FISHERY COUNTRY PROFILE	Food and Agriculture Organization of the United Nations	FID/CP/SUD
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THE REPUBLIC OF THE SUDAN

Sudan is the largest country in Africa with an area of 2 505 810 km^2, of water constitutes 129 810 km^2, and cultivable land is 34 percent. Sudan has a total land boundary of 7 687 km with 9 border countries, namely Central African Republic (1 165 km), Chad (1 360 km), Democratic Republic of the Congo (628 km), Egypt (1 273 km), Eritrea (605 km), Ethiopia (1 606 km), Kenya (232 km), Libya (383 km) and Uganda (435 km).

This vast country embraces different vegetation patterns reflecting various climatic zones, grading from tropical rain forests in the south through semi-tropical savannah to arid zone in the extreme north, with annual rainfall ranging from 1 600 mm in the south to 25 mm in the north.

The Government of Sudan policies aim at maintaining sustainable economic growth by proceeding with the implementation of reforms in the areas of tax policy and administration, restructuring of financial systems, full liberalization of the economy and abolishment of direct and indirect consumption subsidies.

1. General geographical and economic data

Area	2 505 810 km^2
Water area:	129 810 km^2
Shelf area:	22 300 km^2
Length of continental coastline:	853 km
Population (2006):	37 000 000
GDP at purchaser's value (2006):	US$ 37.6 billion
GNI per head (2006):	US$ 810
Agricultural GDP (2006):	30.8% of GDP

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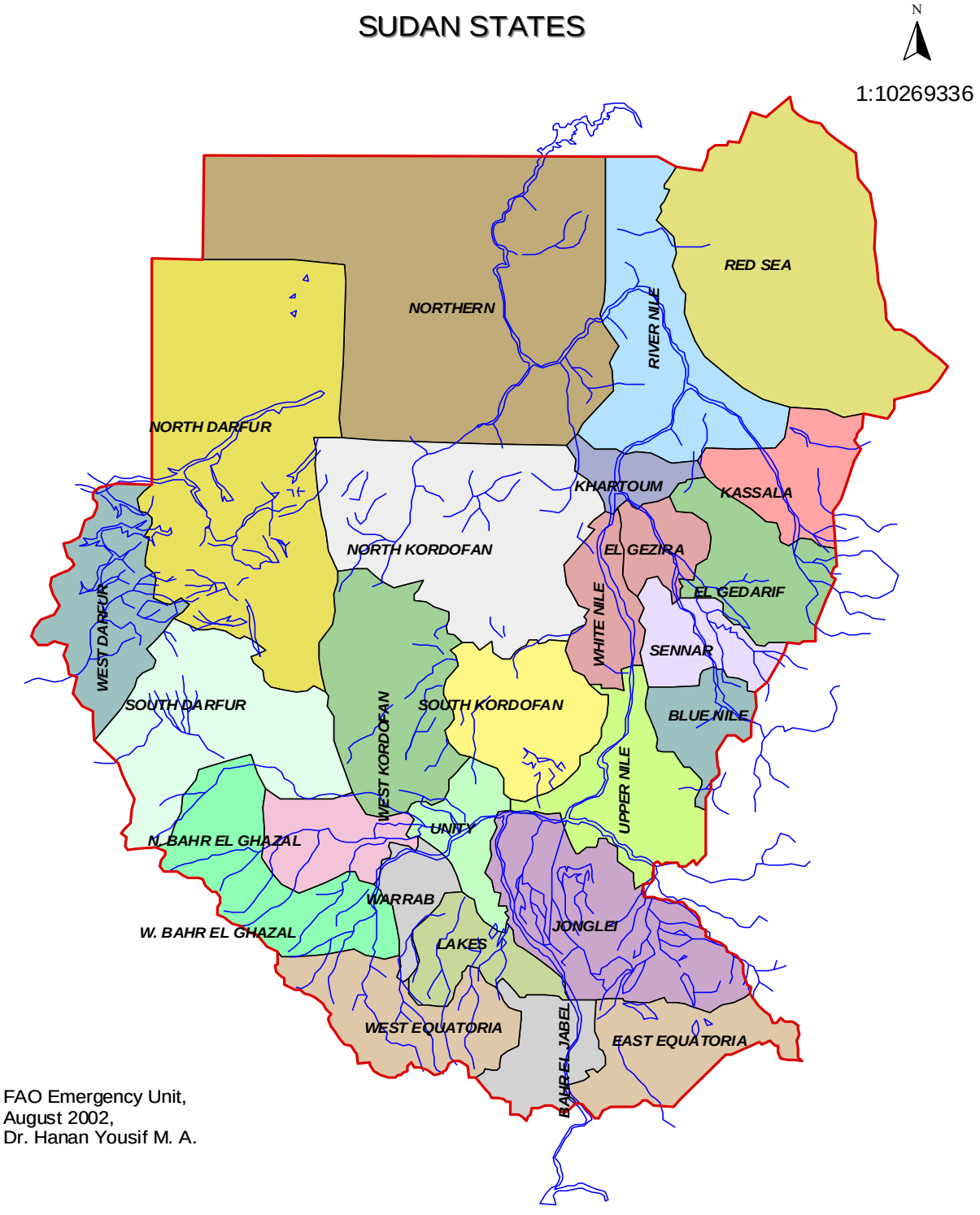

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2. Fisheries data

2003	Production	Imports	Exports	Total Supply	Per Caput Supply
	tonnes live weight				kg/year
Fish for direct human consumption	59 600	249	1 629	58 220	1.7
Fish for animal feed and other purposes	-	-	341 (shell)		

Estimated Employment (2006):	
(i) Primary sector (including aquaculture):	12 900
(ii) Secondary sector:	51 600
Gross value of fisheries output (2006 est):	US$ 1.2 billion
Trade (2005):	
Value of fisheries imports:	US$ 562 000
Value of fisheries exports:	US$ 675 000

3. Fishery sector structure

3.1. Overall fishery sector

Sudan is endowed with diversified surface and underground water resources, and arable lands that are suitable to support to a vigorous capture fisheries and aquaculture industry. Currently, capture fisheries activities are centered around the River Nile and its tributaries, and the territorial waters of Sudan on the Red Sea. Table 1 highlights the data for the various areas: surface area, fish production potential and recent statistics (2006) on fish landings in the main finfish capture.

Table 1. **Overview of fishery areas, resources and exploitation levels**

Location	Surface area (km^2)	Fish potential (t/yr)	Fish landings (t/yr)	Percent Exploitation
Sudd Region & adjacent areas	30 000 (max)	75 000 (min.) 140 000 (max.)	32 000	42
Gebel Aulia Reservoir	1 500 (max)	15 000	13 000	90
Roseires Reservoir	290	1 700	1 600	94
Sennar Reservoir	160 (max)	1 100	1 100	100
Khashm El Girba Reservoir	125 (max)	800	800	100
Lake Nubia	1 144 (max)	5 100	2 000	40
Red Sea	91 600	10 000	5 550	56

Southern Sudan is endowed with tremendous fish potential, particularly in the Sudd region, and this has traditionally been exploited by native Nilotic tribes. However, of an

estimated fish potential of some 75 000 t/yr, reported fish landings do not exceed 32 000 t/yr. Two main factors are responsible for this very low level of fish production. Firstly, the dense macrophytic growth in the Sudd swamps impedes navigation and limits fishing areas, and, secondly, the long-lasting civil war led to social disturbance and insecurity situations, with chronic food shortage. The displaced and vulnerable population, households and small-scale fisheries urgently need community-based projects to improve their nutritional and socio-economic status.

The man-made lakes on the River Nile and its tributaries are major focal points for finfish production potential in the country. The exploitation patterns and trends indicate a high degree of variability. Reservoirs on the Blue Nile (Rosaries and Sennar) and Atbara River (Khashm El Girba) are more-or-less in a state of equilibrium between the fish resource and the level of exploitation. Gebel Aulia reservoir on the White Nile has shown signs of over-fishing, particularly in the northern sector. In contrast, Lake Nubia on the main Nile is under-fished and could be considered virtually untapped. All these require management actions based on the best scientific evidence. Hence, stock assessment studies are needed to update the baseline information for rational utilization, conservation and management of fisheries in these water bodies.

The territorial rights of Sudan on the Red Sea extend to an Exclusive Economic Zone (EEZ) of 91 600 km^2, including a shelf area of 22 300 km^2. Despite the high biodiversity of aquatic life, exploitation emphasis has been historically placed on harvesting wild molluscs and finfish. Both activities are largely of a traditional and subsistence nature. Other high value resources are either untapped or only occasionally fished. Finfish fishing activities are carried out by the artisanal sector using traditional gear, craft and fishing techniques and confined to near-shore areas. Investments in commercial fisheries have been limited, with increases in recent years, using small- and medium-size trawlers and purse seiners.

Aquaculture in Sudan dates from the early 1990s for mariculture, and from 1953 for freshwater culture. The former has focused on culture of the Mother-of-pearl oyster (*Pinctada margaritifera*), and more recently on shrimp culture. For freshwater fish culture, emphasis was placed on extensive and semi-intensive pond culture of the indigenous Nile tilapia (*Oreochromis niloticus*) in monoculture or polyculture systems. Some trials of pen culture were conducted together with seeding of some rainwater impoundments and dams with tilapia species as a form of rural fisheries-based aquaculture.

Table 2. Finfish production by sector

Fishery Sub-sector	Total production (t/yr)
Marine	5 550
Inland	57 000
Aquaculture	2 000
Recreation	—
Total	64 550

3.2 Marine subsector

From its geographical characteristics, the Red Sea is considered more as a tropical water course with a prevailing desert and semi-desert climate. Sudan has a Red Sea coastline of 853 km and an EEZ of 91 600 km^2, with a shelf area of 22 300 km^2.

Sudan's territorial waters are generally characterized by weak currents, lack of upwelling

phenomena, weak tides (30–60 cm), high water temperature (20°C in February and 33°C in August), high salinity (39–45 percent), lack of permanent rivers and freshwater runoff except for the fresh water reaching the sea seasonally from Baraka River, forming the Towker Delta in the south, and rainwater from coastal valleys and ephemeral khors such as Arbaat in the north and Khor Kilab, Khor Moug, Hoshiery Valley and Khor Nawarat south of Port Sudan. These characteristics have a negative impact on productivity and organic production of the Sudanese sector of the Red Sea. These same territorial waters are rich in intensive coral formations in the inner and outer continental shelf. Although these corals represent attractive feeding localities and refuge areas for coralline fish, as well as resorts for tourism activities, they also constitute obstacles to bottom trawl fishing.

3.2.1 Catch profile

Most of the fishing effort in the marine waters is artisanal, targeting finfish, shrimps, molluscs and sea cucumber. Fishing is a year-round activity in inshore coastal areas, lagoons and bays. The small-scale industrial fishery trawlers and highly mechanized vessels operate on a seasonal basis, focusing on pelagic and demersal fish and shrimp resources. Due to poor monitoring and statistical coverage, the actual catch by foreign vessels is not confidently known since the harvest is not landed in Sudan. Estimated production figures are calculated based on the fish quota permits, and rough estimates for 2005 production are shown in Table 3.

Table 3. Breakdown of marine fishery activities in the Red Sea in 2005

Type of marine fishery	percent
Artisanal fin fishery	63
Trawl fin Fishery	25
Wild mollusc fishery	7
Shrimp fishery	4
Shark fishery	0.4
Sea cucumber fishery	0.4
Sardine fishery	0.2

Trawler performance and reported catch for 2000–2005 is given in Table 4.

Table 4. Reported trawler performance and catch in 2000–2005

Year	Number of Fishing Days	Number of trawlers	Total Production (tonne)
2000	179	9	245
2001	195	2	52
2002	168	4	44
2003	638	13	416
2004	934	22	619
2005	1 634	32	1 314

SOURCE: Marine Fisheries Administration.

3.2.2 Landing sites

The fish landing sites and fishing villages along the coast from south to north are indicated in Table 5. For convenience, these localities were divided into South, Central and North Fisheries Administrative Zones. Despite the fact that there are no site-specific daily catch records, the available statistics suggest that the southern and northern zones are more productive than the central zone, each contributing around 40 percent of the catch.

3.2.3 Fishing production means

Fishing operations are mainly conducted by the artisanal sector using traditional gear and craft and fishing methods. There are 1900 registered local fishermen operating 410 fishing craft, including 3–5 m dugout canoes (*Houri*), 5–7 m wooden and steel boats (*Felucca*) and 7–10 m launches (*Sambouk*). The majority of the Houris are propelled by wooden oars or bamboo pole, while the other fishing vessel are fitted with outboard or inboard engines ranging from 10 to 100 horsepower. In addition, there are 30–50 medium-sized wooden boats and steel trawlers of 20–25 GRT, mostly operating on a seasonal basis.

Fishing gear in use by local artisans includes pole-and-line, longline trolling, cast nets, gillnets and beach seines. Trawling is in the hands of a limited number of small-sized, commissioned or contracted, trawlers in confined areas in the southern and northern parts of the Sudanese Red Sea, and operate mainly seasonally, targeting shrimp, lizard fish, goat fish and threadfin bream. The irregular seabed limits trawling operations to an area of 71 000 ha in Delta Toaker (29 500 ha), Gulf of Agieg (6 500 ha), Mersa Mogadam (3 000 ha), Khor Nawarat (2 000 ha) and a few other small areas.

3.2.4 Main resources

Sudan marine finfish fisheries account for about 9 percent of the total fish potential of the country and contributes 8.5 percent of total production.

Table 5. The main marine fishing areas and their character

Fishing Zone	Site	Nature	Average Catch percent
South	Nawarat	Khor (water course)	40
	Khalafia (Ras Abbas)	Fish landing site/Village	
	Ageig	Fish landing site/Village	
	Ras Asees	Fish landing site	
	Trikitat	Fish landing site/Village	
	Ashat	Fish landing site/Village	
	Takrinyay	Fish landing site/Village	
	Sheihk Saad	Fish landing site/Village	
	Sheihk Ibrahim	Fish landing site/Village	
	Haidoub	Khor/Fish landing site	
	Hidi (Houb)	Khor/Fish landing site	
Central	Sawakin/Osman Digna	Port (Passengers/Cargo)	20
	Antabeeb	Fish landing site/Village	
	Damat	Fish landing site/proposed port	

	Ein Harees	Oil export/Free Zone	
	Housheri	Free Zone	
	Kewi	Fish landing site	
	Ata	Fish landing site	
	Ameed	Fish landing site	
	Port Sudan	Main Port/Town	
	Falamengo	Vessel Stopover	
	Haloot	Village	
	Al Ragaba	Tourist Village	
	Darour	Village	
	Arous	Tourist Village	
	Fiega	Fish landing site	
	Arkyay	Village	
	Salak El Sageer	Fish landing site	
	Salak El Kabeer	Fish landing site	
North	Takfial	Fish landing site	40
	Sheihk Accod	Fish landing site	
	Mohammed Goal	Fish Port /Village	
	Dongunab	Bay/Village	
	Dalaw	Fish landing site/Village	
	Shanaab	Bay	
	Ooseif	Port/Village	
	Halaib	Port/Village	
	Abu Ramad	Village	
	Shlatain	Village	

For finfish, fishing activities are primarily artisanal, using traditional gear, craft and fishing techniques and operating close to shore. Investments in commercial fisheries are limited, although increasing, using small- and medium-size trawlers and purse seiners. Some firms are engaged in collecting and marketing fish through different forms of production arrangements with local fishermen.

There are 49 species of cartilaginous fishes in Sudanese waters, belonging to 11 families, of which sharks constitute 57 percent. The most popular species are Thresher shark (*Alopias vulpinus*), Rusty shark (*Ginglymostoma ferruginem* syn. *Nebrius ferrugineus*), *Nebris* □*ouncillor* (Tawy Shark), Tiger shark (*Galeocerda cuvier*), Smoothhound or Smooth dogfish (*Musttellus canis*) and Dog shark (S*coliodon palasorrah* syn. *Rhizoprionodon acutus*).

The reported bony fish fauna includes 280 species, but 60–70 percent of the finfish catch is *Epinephallus aerolatus, Lotijanus bohar, L. gibbus, Lethrinus* spp*., Caranx* spp*., Plectropomus maculatus, Aprion* spp*., Scomberomorus commerson* and *Mugil* spp. Estimates for finfish potential in the Sudanese waters vary, ranging from 6 000 to 35 000 t/yr. However, applying a precautionary approach, a fish potential of 10 000 t/yr has been adopted.

There are several fishing zones in the EEZ:

- *Bays, inlets and merssas,* consisting of single channel, bilobate and trilobate water bodies more or less perpendicular to the coast line and extending inland for 1-5 km with water depth ranging between 15 and 100 fathoms. This zone is famous for Sardine and *Siganus* sp.
- *Coastal boat channels* extending for some half a mile from shore with a depth of approximately 3 fathoms and harbouring mullet, milk fishes and *Lethrinus* spp.
- *The fringing reefs* paralleling the coast at a distance of 1–2 n.mi. with important fishes such as *Cranx* sp*, Litharinus* sp*.* and *Plectropomas* sp.
- *Deep boat channel* with a depth of 40–200 fathoms and famous for *Aprion* spp. and sharks.
- *Outer barrier reefs* within the continental edge where *Lotjanus bohar, L. gibbus, Variola louti* are found.
- *Pelagic zone* of over 300 fathoms. with *Agus* sp*., Cranx* sp, Mackrel, tuna and others.

Crustacean resources have not been adequately studied nor quantified. Small trawlers target shrimps in fishing grounds of the south (e.g. Toker Delta and Agieg) and north of Port Sudan (e.g. Arbat). Eight species of shrimps and prawns have been recorded in the catch, of which *Peneaus semisulcatus, P. latisulcatus* and *Metapeneaus monocerus* form the bulk of the harvest.

Diving in search of wild molluscs is a traditional occupation for the coastal population, targeting Mother-of-Pearl Oysters (*Pinctada margaritifera. Trochus dentatus, Strombus* and *Lambia* spp.), which is exported to Europe as raw material for button manufacture, cosmetics and inlay work.

Crustaceans belonging to the families *Penaedae*, *Palinuridae* and *Potunidae* have been reported in coastal waters.

The coral reef population is a unique and highly regarded national heritage that deserves utmost attention to preserve. This constitutes a potential asset for tourism. The fish resources associated with the coral formations and their vicinity can contribute, apart from food security, to supporting a vigorous ornamental fish industry. There are three types of coral reef: fringing reefs, barrier reefs and atolls. Sanganeb atoll (35 km northeast of Port Sudan) has been an internationally recognized Marine National Park since 1990. Management of this park is the responsibility of the Wildlife Conservation General Administration of the Ministry of the Interior. Two other potential marine reserve areas have been surveyed and identified, namely Makawar Island and Dongonab Bay (approximately 176 km north of Port Sudan). In these areas, the threatened dugong, sea turtles, sharks, manta ray and resident and migratory birds such as osprey, goliath, heron, white-eyed gull, sandpipers and crab plover have been reported.

There are other living marine resources that are either untapped or sporadically fished. These are considered below.

- Sea Cucumber (*Echinoidea*) fishing has increased in recent years. Diving for these is practised by local divers along the coast during April to October. The harvest is mainly for export to the Gulf countries. Although no proper export records are available, some indications of over-fishing have been observed.
- Mammals are represented by *Dugong dugong* and three species of dolphins, namely the common dolphin (*Dolphinus dolphin*), the Bottlenose *(Turspis truncates*) and the humpback (*Sousa plumbea*).
- Of the four species of Sea Turtles that had been reported in the Red Sea region, only the green turtle (*Chelonia mydas*) and the hawksbill (*Eretmochelys imbricates*) have been observed to roam and nest in Sudanese waters, particularly in the Sawakin Archpelago in the south and Makawar Island in the north. A population density of some 3500 individuals was estimated in 1989. No current statistics are available.
- Studies have documented that the mangrove plant (*Avicennia marina*) forms an important ecological system in bays and islands along the Sudanese coast, with well-

established canopies, moderate aggregates, small aggregations or relic thin populations. These ecosystems have suffered from heavy cutting, grazing and blocking of freshwater runoff routes.

- Seaweeds include eight species, of which *Halophila ovalis, H. stipulacea, Halodule uninervis* and *Thalassia hemprichii* are frequent or common.

3.2.5 Management applied to main fisheries

The managerial thrust in marine capture fisheries currently focuses on finfish fisheries, shellfish fisheries, shrimp fisheries, and to some extent on sea cucumber and marine environment conservation.

The goal and objectives are:

- rational utilization and conservation of marine living resources;
- protection of the marine environment from pollution and ecological degradation;
- promotion of investment;
- development of rural communities;
- improvement of fish distribution and marketing; and
- coordination of efforts for integrated coastal management at the national, regional and international levels.

Management Measures — Technical

- *Regulation of access*: licensing local fishermen and fishing craft and issuing special permits for foreign vessels subcontracted to Sudanese counterparts.
- *Mesh regulation*: Standard mesh size for fishing gear is recommended. Checks are performed during routine inspection.
- *Banning of certain fishing methods*: legal prohibition of use of explosives, poisons and spear guns in fishing.
- *Increase of fisher's capacity*: Training, extension, improvement of fishing boats, establishment of boat and engine maintenance workshops, and supply of other services.
- *Closed areas*: Fishing is completely forbidden in Sanganab atoll as a conserved marine park. Dongonab Bay is a closed area for oyster farming and small-scale fishing, and for wild oyster collection by the local inhabitants. Recently, this bay has been declared as a protected national park.
- *Closed seasons*: These apply to shrimp grounds where fishing is not allowed during the period mid-March to mid-August, coinciding with the breeding season.

Management Measures — Input Control

- Vessel and fishing gear registry.
- Import of fishing gear and craft needs initial approval and specifications approval.

Management Measures — Output Control

- Total allowable catch of finfish and shrimps by foreign contracted vessels is specified in the agreement.
- No fish quota arrangements for artisanal craft.

Management Measures — Economic Incentives

- Private sector fishing companies benefit from the privileges specified in the Encouragement of Investment Act.
- On a limited scale, credit schemes with easy repayment terms have been provided to some local fishermen.

3.2.6 Institutional arrangements

The Red Sea Fisheries Research Station of the Fisheries Research Centre and the Red Sea State Marine Fisheries Administration are the two main institutions responsible for fisheries management and development. The Red Sea University contributes through training and research. The Marine Conservation Society assists in public awareness programmes. The Sea Ports Corporation caters for vessel harbouring and catering arrangements.

3.2.7 Fishermen communities

In 2006, 1900 fishermen were registered. These communities are of various ethnicities within the Southern zone (Sawakin to Ageig), Central Sector (Sawakin to Port Sudan Area) and the Northern Sector (Mohammed to Goal). Some of these fishers are enrolled in associations and trade unions. Example include Refuges Cooperative Society (Sawakin), Ausheri Fishers' Union, East Coast Fishermen Union, Red Sea Boat Owners Union for Marine Products, and Mohammed Goal Fishermen Association.

3.3 Inland subsector

Inland capture fisheries area is primarily based on the River Nile and its tributaries. The Sudd swamps and related flood plains in the south, and the five man-made lakes on the White Nile (Gebel Aulia), the Blue Nile (Roseires and Sennar), Atbara River (Khashm EL Girba) and the main River Nile (Lake Nubia) in the north, constitute the major potential production water bodies. This resource base contributes over 90 percent of the estimated production potential of the country, and supplies 70 percent of the total fish landing. Apart from these conventional fishing areas, there are other water bodies, including several thousand kilometres of irrigation canals, non-Nilotic streams (*khors*) and over 1800 large and small rainwater impoundments (*haffirs*) (natural or excavated), particularly in the savannah belt.

Although the inland fisheries are largely artisanal in nature, a steady increase in market-oriented activities has been seen in recent years, particularly in the White Nile and Lake Nubia.

Catch profile

Total inland fish production in 2006 was about 57 000 t. Over 100 species of freshwater fish have been recorded, with marked differences in the population structure in each area. Commercial exploitation is based on only a few species. Table 6 lists the fish families and species numbers.

Table 6. The freshwater fish genera and the number of species

Family	No. of species	Family	No. of species
1. *Protoptridae*	1	12. *Cyprinidae*	25
2. *Polypteeridae*	3	13. *Bagridae*	7
3. *Angullidae*	1	14. *Schilbeidae*	6
4. *Osteoglossidae*	1	15. *Amphillidae*	1
5. *Notopteridae*	1	16. *Clariidae*	8
6. *Mormyridae*	15	17. *Malapteruridae*	1
7. *Gymnarchidae*	1	18. *Mochocidae*	15
8. *Cromeridae*	1	19. *Cyprinodontidae*	3
9. *Characidae*	9	20. *Poeciliidae*	1

10. *Distichodontidae*	7	21. *Clamidae*	1
11. *Citharinidae*	2		

SOURCE: Departmental Reports of the Fisheries Research Centre

Table 7 indicates the contribution of the different fish production sources in total inland fish yield in 2006.

Table 7. Sources of the inland fisheries harvest in 2006

Production source		Yield (tonne)
Sudd swamps, lakes and backwaters		32 000
Man Made Lakes	Gebel Aulia Reservoir	13 000
	Roseries Reservoir	1 600
	Sennar Reservoir	1 100
	Khashm El Girba Reservoir	800
	Lake Nubia	2 000
Dinder, Rahad Rivers and other River Nile Stretches		4 500
Impoundments and irrigation canals		2 000
Inland fisheries total		57 000

SOURCE: Compiled from various Departmental reports and papers

3.3.2 Landing sites

There are 5 man-made lakes within the network of the River Nile and its tributaries, harbouring collectively an estimated fish potential of 23 700 t/yr and contributing 18 500 t in 2006. The basic features of these reservoirs are shown in Table 8.

Table 8. Data on the main man-made lakes in the Nile system

	Gebel Aulia	Lake Nubia	Roseires	Sennar	Khashm El Girba
River basin	White Nile	River Nile	Blue Nile	Blue Nile	Atbara River
Altitude (masl)	377	170–185	–	422	–
Year opened	1937	1964	1966	1925	1964
Surface area (km^2)	600–1 500	830–1 144	290	140-160	125
Total length (km)	629	180	75	–	99
Max. depth	12	25	68	26	10
Fish potential (t/yr)	15 000	5 100	1 700	1 100	800
Fish landings (t/yr)	13 000	2 000	1 600	1 100	800
Number of fish species	56	43	22	22	15
Number of fishers	3 500	313	1 200	800	350

Number of boats	2 000	208	550	450	140

SOURCE: FAO and local departmental reports.

3.3.3 Fishing production means

Local inhabitants along the length of these water bodies and others from inland areas exploit the fish resources in these inland reservoirs, benefiting from the open access management system prevailing in Sudan. Local fishing and marketing companies are also involved, particularly in the White Nile, Blue Nile and Lake Nubia. An estimated 11 000 artisanal fishers of different ethnic groups are active in the inland waters. They are generally characterized by a low socio-economic profile and limited fishing capacity. The majority of the fishing craft are poled dugout canoes. Arab tribes use rowing or motored wooden and steel boats.

Fishing gear includes passive and drifting gillnets, beach seines, trammel nets, baited and unbaited longlines, cast nets and fish traps. Companies and fish brokers transport fish to the market areas by means of insulated trucks or chilled in iceboxes.

3.3.4 Main resources

Sudd Region

Southern Sudan is endowed with tremendous water supply, coming from various catchments (The Nile-Congo catchment; Imatong Mountains Catchment; Lake Victoria-Mobutu Catchment; and Ethiopian Highland Catchment).

The Sudd swamps (between Malakal and Bor) constitute a unique wetland phenomenon. They lie between 6° and 9°30′N, and from 30° to 32°E, with a maximum water surface area in excess of 30 000 km^2 during the rainy season. This milieu has high biodiversity, with floating, submerged and emergent macrophytes, and fisheries resources. It is estimated that 50 percent of the swamp water is lost annually through evaporation. Over 100 species of fish have been reported from this area, of which *Distichodus* spp.*, Gymnachus* spp.*, Hetrotis* spp.*, Citharinus* spp.*, Clarias* spp., *Lates niloticus,* tilapias and catfishes form the bulk of the catches. The fish potential in the Sudd region has been estimated at 75 000 t/yr, while the reported fish landings do not exceed 32 000 t/yr. The locals (Nilotic and other tribes) are well known for their traditional fishing skills. However, their currently low level of fish production is attributed to two factors. Firstly, the high density of macrophytes that impede navigation, and, secondly, the long lasting civil war, with associated social disturbances and insecurity situations. There are 3 500 fishers operating 3 000 unmotorized dugout canoes. The prevailing fishing gear is mainly hook-and-line, long-line, gillnets, seines, cast nets, traps and spear fishing.

Gebel Aulia Reservoir

The reservoir was created as a result of the construction of Gebel Aulia dam on the white Nile in 1937. This lake extends for some 650 km from the site of the dam (45 km south of the capital, Khartoum) to south of Renk town in Upper Nile State.

Studies and actual fish landing have demonstrated that this water body currently has 56 genera of finfish from 13 families. However, a Russian expedition in 1964 reported 100 fish species, a situation that suggests drastic change and decline in fish biodiversity. The common commercial fish species are *Tilapia* spp., *Labeo* spp., *Barbus binny*, *Hydrocynus* spp., *Aleste* spp., *Synodontis* spp., *Bagrus bayad*, *B. docmac, Lates niloticus*, *Distichodus* spp. and *Mormyrus* spp. Based on consumer preference, the first three species are categorized as first-class fish, and rest considered second class.

Fish in this reservoir are characterized by varied spawning seasons. *Barbus binny*, *Hydrocynus* spp. and *Alestes* spp. spawn during March–April (late winter); *Lates niloticus* has a prolonged spawning period; while the other fish species spawn in July–August (autumn).

Roseries Reservoir

The reservoir was formed in 1966 by construction of the dam on the Blue Nile. The carrying capacity of the reservoir was estimated by morpho-edaphic index in 1975 to be of the order of 1700 t/yr fish. The planned heightening of the dam would increase the surface area from the current 300 km^2 to 600 km^2 and is expected to double the fish potential. Current fish production (2006) is estimated at 1600 t.

The lake has 22 fish species, and commercial fish landing statistics show that the first and second class fishes (*Lates niloticus*, *Tilapia* spp.*, Labeo* spp. and *Babus binny*) comprise 50 percent of total fish production, whereas *Hydrocynus* spp. and *Alestes* spp. (excellent for wet salting) constitute 40 percent. The balance is attributed to *Synodontidae* and *Schilbidae* species.

Sennar Reservoir

The reservoir dates back to 1925. It has an area ranging between 140 km^2 and 160 km^2. The fish potential, estimated by indirect methods in 1975, indicated 1100 t/yr, which is identical to the reported production in 2006. The fish population structure (22 fish species) is very similar to Rosaries reservoir. Fishing gear and craft are generally dugout canoes operated by oars or 6 hp engines, in addition to small wooden boats.

Khashm El Girba Reservoir

This reservoir was formed in 1964. It extends for 80 km, with a surface area of 125 km^2, a maximum depth of 50 m and an average depth of 6.6 m. There are 15 fish species, from 9 families: *Lates niloticus*, *Bagrus* spp., *Tilapia* spp., *Labio* spp., *Distichodus* spp. and others. The main problem facing fisheries in this locality is the flushing of the lake in mid-August every year to get rid of silt (40□10^6 m^3/yr) which would otherwise reduce the carrying capacity of the basin.

Lake Nubia

Lake Nubia constitutes the southern end of the Aswan High Dam Reservoir, with a length of 180 km within Sudan. Since its establishment in 1964, the lake has fluctuated between contours 172 and 181 m, with a depth ranging between 3 and 45 m. The lake was estimated to harbour a fish potential of 5100 t/yr, while the largest fish harvest has not exceeded 2000 t (recorded in 2006). Fishing capacity comprises 313 registered fishermen operating 208 steel and fibreglass mechanized fishing boats. The majority of the fishermen are emigrants from other Sudanese fishing communities in the White Nile. The fishing gear is primarily gillnets, trawls and cast nets. Administratively, the lake is divided into Northern, Central and Southern Fishing Zones. The Northern Zone (Argien to Sheick Abdal Gader) contributes some 65 percent of the fish landings, while the Central Zone (Ashkait to Gemei to Sarus) and Southern Zone (Al Beer) contribute 20 percent and 15 percent, respectively. The active fishing season extends from March to October. There are several public and private-sector firms and companies involved in fishing and marketing of whole fish and fish products. The important commercial fish species are *Lates niloticus, Bagrus bayad, B. docmac, Labio* spp. and *Barbus benny.*

3.3.5 Management applied to main fisheries

The inland fisheries management activities centre around the River Nile and its tributaries, with particular emphasis on the Sudd region and man-made lakes. Sporadic attention is paid to monitoring and intervention in fisheries of small waterbodies. The management profile of the major fisheries systems is given below.

Sudd swamps and related flood plain fisheries

Management Goals and Objectives

- To achieve a substantial increase in fish production.
- To improve quality of fish and fish preparations.

- To improve household nutrition and family earnings.
- To improve fish marketing systems.
- To enhance human resources development

Management Measures

Technical measures:

- *Regulation of access*: this is performed through fishermen and fishing camps licences and settlement of displaced people and returnees from war-affected areas.
- *Mesh regulation*: Nets twine number and mesh size are regulated. Control checks are made on an irregular basis.
- *Increase of fisher's capacity*: this is effected through training, demonstration, community-based services, meetings and other interventions.
- *Banning of certain fishing gear and methods*: Fishing with poisonous local material (extracts from *Palanitis aegyptica*) is banned and periodically checked.

Input control:

- Import of fishing gear needs official approval.
- The number of fishing units of commercial firms is specified in the original project approval.

Output control:

- No control measures are in effect at the moment.

Economic incentives:

- Some fishing gear had been distributed free of charge to households and displaced communities.
- No control on fish selling price.

Institutional Arrangements:

The fisheries Departments in Equatoria, Bahr El Gazal and Upper Nile States are the currently established fisheries authorities in Southern Sudan. They perform their responsibilities from their headquarters in Juba, Wao and Malakal towns, respectively. Their fieldwork is coordinated with NGOs, local universities and the federal Fisheries Administration. These fisheries structures are constrained by limited skilled personnel and poor infrastructural facilities that handicap proper monitoring, control and surveillance activities.

Reservoir Fisheries (5 man-made lakes)

Management deals with ecology and fisheries of the 5 man-made lakes on the White Nile (Gebel Aulia), Blue Nile (Roseires and Sennar), Atbara River (Khashm El Girba) and main River Nile (Lake Nubia).

Goals and Objectives:

- To establish and sustain a vigorous fisheries industry.
- To strengthen research capabilities and improve administrative efficiency.
- To control fish resource depletion and environmental degradation.
- To promote rational investment.
- To improve the socio-economic status of fishermen.
- To disseminate information to stakeholders.
- To increase fish production.
- To improve quality of fish and fish products.
- To enhance fish marketing.
- To coordinate efforts with relevant national and international institutions and agencies

Management Measures

Technical measures:

- *Regulation of access*: Full time fishermen and fishing craft must have a licence, renewable annually. Regular monitoring, control and surveillance is carried out by the fisheries conservation task force.
- *Mesh regulation*: Mesh size in the various areas is regulated by the fisheries ordinance, depending on the target species. Checks on fishing gear are carried out on an irregular basis.
- *Banning of certain fishing gear and methods*: Monofilament silk nets are prohibited. Fishing by electricity, dynamites and poisonous substances is completely forbidden. Fishing on dam sluices is not allowed. Some violations do occur in Gebel Aulia Dam.
- *Closed areas*: No closed areas identified.
- *Closed season*: Built-in closed season depending on the availability of fish species or otherwise.
- *Increase of fisher's capacity*: Through training, extension and improvement of fishing gear and motorization of craft.
- *Alternative and new fisheries:* Introduction of cage culture of tilapia on a very limited scale in Gebel Aulia Reservoir. Trials of fish trawling in Lake Nubia.

Input control:

- Control through licensing of the number of fishing craft operating in a particular area.
- Import of fishing twine, fishing nets and craft is encouraged, but requires prior permits and adherence to the relevant specifications.

Output control:

- No strict measures are applied to control allowable catch in the different reservoirs. This has resulted in the observable signs of over fishing in certain localities e.g. the northern zone of Gebel Aulia Reservoir.
- Catch of under sized fish is prohibited by the fisheries legislation. In case of noticed violations the fish is confiscated. If the same person repeats the illegal act, he will be rendered to a more severe punishment.

Economic incentives:

- The *Encouragement of Investment Act* supports development projects through, *inter alia*:
  1. Exemption from the business profit tax for a period of not less than 5 years.
  2. The transfer of profits and the costs of finance, resulting from foreign capital, or loan in the currency in which the capital or loan is imported, at the best declared exchange rate, at the date being due.
  3. Allocating land on favourable terms.
- The repatriation of invested capital, in the case of failure to implement the projector or its liquidation, in the same currency in which it was imported. The machinery, equipment and transport imported on the account of the project may be re-exported.
- Some fishing gear and crafts have been supplied to fishermen under instalment and rental payment arrangements.
- No fish price limits (i.e. open access to supply and demand market forces).
- Banking system loans to some investors.

Institutional arrangements:

- The *Fisheries Research Centre,* through its stations located in the different reservoirs, carries out applied research. The technical committee of this centre (with representatives from the Fisheries Administration, local universities and the private sector) approves the research programmes and endorses subsequent

recommendations. Baseline data and technological packages are channelled to the Fisheries Administration and other stakeholders. Feedback is received to plan for future research.

- The *Federal Fisheries Administration* discharges its mandatory obligations through specialized administration divisions concerned with capture fisheries, aquaculture and conservation. It is the central authority entrusted with the overall monitoring, control and surveillance of the fisheries sector.
- The *State Fisheries Administration* structures are responsible for management and development of fisheries in their respective states, in close cooperation with the Federal Fisheries Administration.
- Close coordination and collaboration is maintained with relevant institutions, agencies and enterprises in the public and private sector through the *Fisheries Council*, the *Advisory Council of the Minister of Animal Resources,* technical committees and other forums of community participation.

3.3.6 Fishermen communities

The fishermen communities in the various localities of the inland waters comprise some 11 000 full-time fishermen, in addition to their households and dependents. These communities comprise a fabric of varied ethnicities, each with their cultural and social background and endogenous knowledge and expertise in fishing. These fishers have poor socio-economic status and are generally constrained by lack of proper organization and poor, if not absent, participation in planning pertaining to the development of the sector, and insufficient support services. However, there are some well organized and efficient fisher societies and unions, particularly in White Nile and Khartoum States.

3.4 Recreational subsector

With respect to fisheries, this subsector has had low priority in the past in terms of development and management as a consequence of the very difficult food security situation. Despite this, some activities of sport fishing in the marine (scuba diving, underwater photography, hunting and sea faring) and inland waters (angling), and some successful business in aquaria ornamental fishes have been developed by some citizens.

However, Sudan's fascinating heritage of aquatic resources and wetlands, with a diverse spectrum of climate and biota forms a multi-dimensional asset, with a wide horizon for development activities of immense economic, environmental, recreational and other values. In the light of this potential, and concerns expressed by the community, considerable effort has been made by the government during the last few years to secure resource sustainability through rational management and use. Wildlife and Fisheries are counterparts of this “man and the biosphere” concept and more coordination and cooperation required among stakeholders for strategic planning and planning the way forward.

The following achievements are examples:

- *Southern Sudan Wetlands* The vast areas of the Sudd swamps, flood plains and rainfed grasslands support a rich biodiversity and form one of the largest tropical wetlands in the world. The Sudd region is formally certified (31 October 2006) as a wetland of international importance under the Ramsar Convention, and included in Ramsar Convention International List of Wetlands.
- *The Sanganeb Atoll Marine National Park* This lies some 23 km from the coast, north-east of Port Sudan, with an enclosed boundary area of some 22 km^2. UNESCO was approached in 2001 to recognize the park as a conservation area and gain World Heritage Status.
- *The Dungonab Bay–Mukawar Island Marine Protected Area* This lies on the north coast of the Sudanese Red Sea coast, about 172 km from Port Sudan. It extends in a straight line

approximately 100 km north to south, and slightly over 40 km east to west at its widest point. PERSGA provided technical and financial support to the development of the marine environment, including ecological and biological studies in Dungunab Bay and Makawar Island, and offered training opportunities to technical staff in the areas of conservation management of marine parks and reserves.

- *Dinder National Park* This became Sudan's first Wetland of International Importance, in January 2005, when the country officially became a Contracting Party to the Ramsar Convention. UNDP and GEF jointly financed a four-year programme (terminated in 2005) to conduct research and survey studies leading to the preparation of a management plan for the park. Within the park, there are several oxbow lakes. A fisheries survey was conducted as a step for using such small waterbodies for food security and rural communities development.
- *Integrated Coastal Zone Management* PERSGA also assisted Sudan in the preparation of the Integrated Coastal Zone Management plan, which was approved by the government in 2005.
- The *Sunut Forest* in Khartoum, adjacent to the White Nile on the East Bank, offers a huge potential for public awareness, environmental education and recreation.
- A National Wetland Committee was established, composed of the following stakeholders:

  Ministry of Environment and Physical Development (Higher Council for Environment and Natural Resources)

  Ministry of Irrigation

  Ministry of Science and Technology (Wildlife Research Centre)

  Ministry of Agriculture and Forestry (*National Forestry Corporation, *Range and Pasture Administration)

  Wildlife Conservation General Administration, Ministry of Interior

  University of Khartoum (Institute of Environmental Studies, Zoology Dept.)

  University of Upper Nile

  Sudanese National Commission of UNESCO

  Sudanese Environmental Conservation Society (SECS)

3.5 Aquaculture subsector

Agriculture activities in Sudan incorporates cultivation of oyster in the marine environment and finfish in freshwater. The former started in 1905, where a pioneer trial farm for the mother-of-pearl oyster (*Pinctada margaritifera*) was established in Dongonab bay, whereas the latter started in 1953 in the research/demonstration farm in Shagara, Khartoum, for pond culture of indigenous finfish, and later testing exotic species.

Based on the successful pioneer work, oyster cultivation started in the form of massive production and family farms based on bottom-culture techniques. The cultivation targeted oyster shell production for export, and some local use in button manufacturing, inlay work and cosmetics. Considerable research emphasis has been devoted to development of oyster cultivation as an activity, which is meant to reduce stress on the natural oyster population, boosting consistent and steady production and improving the socio-economic status of the rural populations. The prolonged research has culminated in the verification and adoption of sound and viable alternative culture technologies based on hanging methods, that paved the way for economically viable expansion of oyster family farms along the coast as well as triggering large investment enterprises in artificial pearl production as a pioneer intervention by the private sector.

Freshwater fish culture is primarily based on pond culture of the indigenous species *Oreochromis niloticus*. Other local species, such as *Lates nilotius, Labio* spp*.,* and *Clarias lazira,* have been tried, but not yet released to farmers. Exotic species have been introduced for experimental culture in combination with *Oreochromis niloticus* (e.g. common carp), or for use as biological control agents for eradication of aquatic weeds

infesting the irrigation canals of large agricultural schemes (grass carp). The culture systems are basically extensive and semi-intensive. As of yet, freshwater fish culture has not developed into a vertically integrated economic activity despite the availability of its prerequisites.

3.5.1 Catch profile

Oyster Family Farm Development Programme has been seriously handicapped by lack of funding and a sharp decline in price—both locally and abroad—which has led to coastal inhabitants abandoning their farms. Family farms established in Dongnab, Mohammed Goal and Arikyay during the period 1994-2001 with support from the Red Sea State governments and the NGOs OXFAM and ACORD amounted to 236 farm with 10 000 oysters each (see Table 9). No new farms have been established since then. Production of pearls by the private sector in Um El-Sheikh Island produced about 16 310 pieces during 1999–2001.

Table 9. Establishment of oyster farms

Support Provider	Year							
	1994	1995	1996	1997	1998	1999	2000	2001
Government	20	36	36	63	-	10	10	10
OXFAM	-	-	8	6	16	6	-	-
ACORD						5	5	5
Total	20	36	44	69	16	21	15	15

SOURCE: Red Sea Fisheries Research Station.

With respect to freshwater fish culture, several state and private sector farms were established around the capital Khartoum and other towns in various states (see Table 10).

Table 10. Establishment of freshwater aquaculture farms

STATE	Total aquaculture area (ha)	As percentage of total
Khartoum	53.9	59.3
Gezira	10.7	11.8
River Nile	10.5	11.6
White Nile	8.6	9.5
Kasala	4.2	4.6
Sennar	2.01	2.3
Greater Darfur	8.8	0.9

SOURCE: Ministry of Agriculture, Animal Resources and Irrigation, Khartoum State

A survey conducted in 2000 showed that 91.7 percent of the fish culture practices in Khartoum State is based on earthen pond systems, 4.17 percent each of floating cages and industrial concrete ponds. Extensive culture of mixed sex *Oreochromis niloticus* dominates these farming systems (95.3 percent), while semi-intensive ranks second. Reluctance of most fish farmers to disclose their actual production makes it difficult to estimate fish production through aquaculture in Sudan with great precision. A round figure of 2000 t/yr of *Oreochromis niloticus* is accepted with some reservation.

3.5.2 Landing sites

Landing sites for oyster culture are concentrated in several localities in the northern sector of the Red Sea, with particular emphasis on Mohammed Goal, Dongonab and Arikyay villages.

Pearl culture production farms are based in Um El-Sheikh Island and the vicinity.

Harvest of fish ponds is either sold at farm gates or landed in Khartoum and other town markets, or delivered to hotels and restaurants.

3.5.3 Fishing production means

Oyster culture is performed by local inhabitant in coastal areas of the northern zone of the Sudanese Red Sea. The culture operation has three stages, *viz*. spat collection, nursery, and rearing to market size. Spat collectors are hired during summer months and the catch is kept in multi-deck hatchery trays covered with galvanized wire mesh for protection, and finally transferred to trays suspended from long lines. The culture cycle takes 3 years to produce market-accepted-size oyster shells.

Freshwater fish culture is predominantly based on earthen or concrete ponds. Pens and cages are rarely used. Extensive or semi-intensive rearing of *Orechromis niloticus* are general among farmers. Integration of fish farming with agriculture and animal production is not common. There are both statal and private sector farms. Fish seed is either collected from the wild or through breeding facilities within the farm.

3.5.4 Main resources

Sudanese marine waters are famous for their high potential for oyster resources. Dongonab bay in the north and Sawakin archipelago are the most famous grounds for spat collection. The breeding of oysters and other molluscan genera occurs during the summer months of June and July.

Several endogenous cultivable fish species are present in the inland and marine waters, such as *Oreochromus niloticus*, *Lates niloticus*, *Bagrus byad*, *Labeo* sp., *Clarias* sp., mullet, milk fish, sea bass and sea Bream are examples. Exotic fish species were introduced to Sudan as early as 1929 for different purposes (see Table 11).

Table 11. Introductions of exotic species

Fish Species	Year	Source	Purpose
Gambusia sp.	1929	Italy	Malaria control
Salmo sp.	1947	Kenya	Sport fishing
Tilapia melanopleura	1953	Congo	Weed control
Cyprinus carpio	1975	India	Polyculture
Ctenopharyngodon idela	1975	India	Weed Control

SOURCE: Arab Organization for Agricultural Development 1995

Other aquaculture production inputs and factors contributing to successful aquaculture are highlighted below.

- The fertile lands and the possible integration of aquaculture in large-scale agricultural schemes.
- The enormous surface and underground water resources.
- Self-sufficiency of the country in agricultural and industrial by-products (oil seed cake, wheat bran, organic fertilizers, molasses, etc.), which are important and comparatively cheap ingredients for fish feed formulation.
- The diversity of climate, ranging from equatorial zones in the south to desert

climate in the extreme north, permitting expansion of cultivation in space and time.
- Reasonable institutional and technical backup support.

3.5.5 Management applied to main fisheries

Mariculture

Bottom and off-bottom oyster culture in shallow coastal zones and some land-based shrimp culture are the only forms of mariculture currently practised. The former is family farm-based, while artificial pearl production forms a new surging semi-large-scale private sector business.

Management goals and objectives:

- To increase oyster production and export.
- To minimize stress on wild oyster populations.
- To improve the socio-economic status of coastal populations.
- To develop and promote sea- and land-based systems of finfish and shellfish culture.

Management measures

Technical measures:

- Establishment of an oyster farming monitoring and extension unit.
- Identification of sites suitable for oyster farming.
- Establishment of oyster demonstration farms.
- Selection and training of oyster family farm beneficiaries.
- Preparation and dissemination of information and technological packages.
- Encouragement of investment.
- Quality control.
- Pilot-testing alternative culture systems and techniques.

Input control:

- Farm location.
- Farmers' control.
- Environmental impact assessment study.

Output control:

- No controls.

Institutional arrangements:

- The Red Sea Fisheries Research Station and the Red Sea State Marine Fisheries Administration are the main authorities concerned with management and development of mariculture. A joint technical unit has been formed and mandated to monitor this activity. The Red Sea University contribute indirectly through research and capacity building.

Freshwater fish culture

Public and private sector pond fish farms primarily culture indigenous fish species.

Management goals and objectives:

- To conduct applied research and transfer appropriate technologies leading to promotion and development of fish farming.
- To augment fish production from capture fisheries.
- To increase productivity through polyculture and proper pond management procedures.
- To produce fish seed for farmers.
- To contribute to food security and national income.

Management measures

Technical measures:

- Development of culture technologies.
- Dissemination of information.
- Training and demonstrations.
- Partial supply of fingerlings.
- Periodic visits to fish farms.

Input control:

- None

Output control:

- None

Economic incentives:

- Privileges under the *Encouragement of Investment Act* apply to fish farmers.
- Free market price.

Institutional arrangements:

- The Aquaculture Research Station of the Fisheries Research Centre supplies approved research recommendation to the Federal Fisheries Administration, which provides extension services through the extension unit and training through the Fisheries Training Institute.

3.5.6 Fishermen communities

Fish farmer categories include:

- Local inhabitants in rural communities, such as oyster farmers, are generally dependant on subsides and financial support from the state government, NGOs or donor funds. They mainly rely on family labour. Many of these farmers are also fishermen and may be enrolled in fisher organizations (e.g. Mohammed Goal area).
- Small-scale fish-farm owners in urban areas around Khartoum and other towns belong generally to comparatively well-off middle class citizens. Some of them self-finance their business, while others obtain bank loans to start or develop their farms. There is no known association for this category except possibly personal membership in the Fisheries Trade Chamber or similar.
- Semi-industrial fish farming in freshwater (e.g. finfish) and marine waters (e.g. shrimp) is practiced by capable investors.

Those in the last two categories hire fishermen, workers and experties for short consultancies or full-time work.

4. Post-harvest use

4.1 Fish utilization

Finfish is marketed and consumed fresh (70 percent), sun dried (25 percent) or wet salted (5 percent). The fresh fish is transported from distant fishing ground to consumption areas in the capital, Khartoum and other towns, either chilled or refrigerated. Sun-dried fish is mostly marketed in rainfed and mechanized agricultural schemes. Wet-salted fish (mainly *Hydrocyon* sp.*, Alestes* sp. and *Mugil* sp.) is for local consumption or export. Insignificant amounts (mainly discards and offal) go into fish and poultry feed production. Some infrastructure for fish handling, preservation, processing and marketing is available.

Shells of the mother-of-pearl oyster and the gastropod *Trochus dentatus* are exported to some European countries. Other shells are harvested and sold locally as source of calcium for poultry feed or as souvenirs. Some part of the catch supports a local cottage industry of handicrafts and cosmetics.

Shrimps and prawns are sold locally as a high-value delicacy food, particularly in high standard hotels.

4.2 Fish markets

The Capital Khartoum receives fish from several fish producing Sudanese States as one of the high-fish-demand markets. With the exception of some shrimp, all landings are of freshwater fish products. Table 12 indicates the amounts of fish marketed in Khartoum and other market destinations as a percentage of the total production of different Sudanese States in 2005.

Table 12. Distribution of catch through markets

State	Total production (t/yr)	Number of fishing units		Percentage of fish marketed	Percentage of illegal fish	Other market places
		Boats	Fishers	in Khartoum		
Gezira	750	400	500	7	1-2	Gadarif
Red Sea	3500	100	700	-	15	Kasala, Medani
Blue Nile	594.6	300	350	80	2	Medani, Sennar
Northern	2004	300	900	95	7	Dongula, Atbara
White Nile	6500	3500	4000	70	7	El Obeid
Sennar	850	604	608	3.5	27	Wad Medani
Kasala	500	240	400	-	60	Gadarif
Khartoum	1400	300	836	100	3-5	—

SOURCE: Ministry of Agriculture, Animal Resources and Irrigation, Khartoum State.

As for marine fisheries and mariculture, Port Sudan forms the principal consumer. Some other towns in Red Sea, Kasala and Gadarif States are also market destinations for marine products. Marine fish landings at Port Sudan Central Market during the period 2001–2006 are shown in Table 13.

Table 13. Landings through Port Sudan market

Year	Landings (tonne)
2001	369 391
2002	373 137
2003	371 329
2004	452 563
2005	506 957
2006	616 931

SOURCE: Marine Fisheries Division.

5. Fishery sector performance

5.1 Economic role of fisheries in the national economy

The contribution of fisheries to Sudanese GDP is currently marginal. The per caput supply is only 1.6 kg/year, which is mostly obtained by capture fish landings. The aquaculture industry is not developed as yet. Because of their basic characteristics, the Sudan inland and marine capture fisheries are of a small-scale and semi-industrial nature. If properly managed, such fisheries could satisfy subsistence requirements and provide a good margin for large investments, particularly in the areas of freshwater fishing, mariculture and off-shore capture fisheries and their related facilities and supplies. The magnitude and trend of fish resource utilization and the level of development of the fisheries sector is handicapped by a number of problems and constraints, as described earlier.

5.2 Demand

Based on the 1993 Census, Sudan's population is growing at an annual rate of 2.63 percent. It is projected to grow from 31.1 million in 2000 to 35.3 million in 2008. The bulk of the population is within the active age group, which was nearly 20 million in 2004, as according to Central Bureau of Statistics data. The population is expected to reach 40 million in 2010, and grow to 50 million in 2020. If the current per caput consumption (1.6 kg/yr) level is to be maintained, the estimated fish production target in 2020 will be 80 000 t. The demand for fish and fish preparations is growing steadily. This is reflected in the increase in chilled, frozen and canned fish imports, and the remarkably high prices, reflecting supply constraints.

5.3 Supply

The current low level of fish supply has limited the available fish protein in the national diet (1.6 kg/yr), and to fill some of the gap, there are growing fish imports. The limited supply is also associated with high prices. This leads the people to compensate by consumption of livestock meat, which is comparatively cheaper.

5.4 Trade

Recent years have witnessed growing levels of fish trade—imports and exports—with neighbouring African and Arab countries. Imports concentrate on chilled *Lates niloticus* and tilapia, mainly from Uganda and Ethiopia, and shrimps from the United Arab Emirates (UAE), Saudi Arabia and Egypt. Canned sardines, mackerels and tuna are imported from different Asian and European countries. Table 15 shows the amount and origin of the monthly imported fish passing through Khartoum markets in 2006.

Table 15. Fish imports through Khartoum markets in 2006

Month	Product type and origin			
	Shrimps	Origin	Nile perch	Origin
January	550	UAE	2 500	Uganda
February	600	UAE/Saudi Arabia	10 100	Uganda/ Ethiopia
March	—	—	1 065	Uganda/ Ethiopia
April	505	Egypt/ UAE	7 500	Ethiopia
May	8 750	Egypt/ Saudi Arabia/UAE	12 500	Uganda/ Ethiopia

June	8 038	Egypt/ UAE	11 002	Ethiopia
July	8 326	Egypt/ Saudi Arabia/UAE	17 704	Uganda
August	—	—	29 810	Uganda
Total	36 759		92 181	

SOURCE: Ministry of Agriculture, Animal Resources and Irrigation, Khartoum State.

Some Sudanese importers of chilled fish from Uganda claim that they faced some obstacles including:

- Lack of a direct air route between Uganda and Sudan makes it necessary to transship fish consignments through intermediate airports. This leads to additional costs and risks of spoilage due to mishandling, preservation and clearance.
- Lack of direct correspondent banking systems between Sudan and fish exporting countries, a situation forcing fish importers to channel their financial transactions through currency exchange agents, with higher change rates.

Fish export, in contrast, focuses on marine fisheries products, including finfish, sea cucumber, shrimps, troches and some wet-salted (mullet) preparations. The main destinations of these exports are Egypt, Saudi Arabia and Europe. Export statistics for marine products during 2001–2006 is summarized in Table 15.

Table 15. Exports of fishery products, 2001 to 2006

Year	Fresh fish	Trawl fish	Sardine	Sea cucumber	Shrimp (*)	Trochus
2001	39 965	31	—	36 700	—	378
2002	70 250	358 895	1 614	44 920	3 946	367
2003	102 400	806 600	717	30 630	12 400	364
2004	153 210	973	1 638	19 000	71 120	336
2005	65 200	782	1 466	20 009	46 220	385
2006	37 700	—	—	9 750	—	341

SOURCE: Marine Fisheries Division

NOTE: * The shrimp products derive from trawling and beach seining in coastal lagoons, and the catch is exported to Egypt.

Cultured shrimps are exported to Saudi Arabia. Exports for 2003 and 2004 amounted to 2 125 t and 4 125 t, respectively. No records are available for 2005 and 2006.

Limited exports of shark fins to Asia, amounting to 180 kg and 400 kg in 2001 and 2002, respectively have since been banned and no license issued in recent years.

5.5 Food security

The animal resources sector (which includes fisheries) contributes 21 percent of Sudan GDP.

Despite the fact that fisheries GDP is extremely low, fish and fish preparations contribute to the food security of a wide sector of the rural and urban communities. Fisheries also provides work opportunities in the form of secondary employment as a source of income that indirectly contributes to household food security.

5.6 Employment

The primary employment in fisheries increased from 12 000 in 2000 to 12 900 full-time registered fishers in 2006—a 7.5 percent increase. Secondary employment in the fisheries sector is estimated by assuming that the average secondary-to-primary employment ratio is 4. Forward and backward activity beneficiaries include fish traders, fishmongers, processors, boat owners, boat builders, gear and craft suppliers and service providers, not forgetting fisher household backyard activities.

5.7 Rural development

Fisheries and aquaculture contribute to the development of a significant sector of rural and urban areas. Indicative examples include:

- Establishment of small-scale family oyster farms along the northern Sudanese coast have contributed to the stability and improvement of the socio-economic status of these multi-ethnic communities, which have very limited alternative income generating opportunities.
- The fisheries sector has successfully mobilized the rural community through providing work opportunities in various activities related to fish production, processing and marketing.
- Stocking of rainwater harvesting impoundments and dams with fish seed has played an important role in food security of fisher households and native fish consumers.
- Organization of fishers into societies, unions and associations resulted in enhancing these communities and increasing their solidarity and political influence.

6. Fishery sector development

6.1 Constraints

The fisheries sector of Sudan is faced by several problems and constraints that need to be addressed and resolved, including:

- Very poor resource databases as a consequence of insufficient monitoring, surveillance and control infrastructure, allocation of resources and limited qualified personnel, a situation that has handicapped proper planning and investment backstopping.
- The civil war disturbances in southern Sudan have jeopardized proper utilization of the huge fish resources, and hampered community development. Some other important fishing grounds are either suffering from overfishing or are virtually untapped. It is anticipated that the Naivasha Peace Agreement and the establishment of a National Unity Government will pave the way for better resource exploitation, management and fisheries industry development.
- Aquaculture still plays a marginal role, despite the availability the basic pre-conditions.
- No attention is paid to the development of the huge number of rainwater bodies within the savannah belt in west, central and eastern Sudan, which would augment fish production and form a basis for rural community development.
- The low finfish production is affected by with high post-harvest losses resulting from improper handling at sea and during distribution.
- Miscellaneous hazards to the aquatic environment include illegal fishing methods, by-catch discard, cutting of mangroves, destruction of coral reef stands, blocking of natural water courses, eutrophication and pollution.
- Weak coordination and cooperation between the research and administration authorities and other stakeholders.
- Fisheries legislation needs considerable revision and amendment to cope with local constitutions and international laws and conventions.
- The poor organization of fishers and their poor socio-economic status has limited their political influence and effective participation in the development process.
- Insufficient credit schemes for fishermen communities and small-scale investors.

- Inadequate extension, with limited transfer of appropriate technologies and innovations, and lack of community participation.
- Inadequate access of fisheries research and management personnel to regional and international forums and foreign training, thus limiting their expertise development.
- Limits in state funding, and limited foreign technical and financial assistance.

6.2 Development prospects and strategies

6.2.1 Prospects

The Sudan has tremendous potential and prospects for capture fishery and aquaculture development. Supportive factors include:

- Mariculture constitutes a potential avenue to augment fish production from capture fisheries for local consumption and export. Emphasis has been historically placed on oyster cultivation targeting production of oyster shells for export as raw material for button manufacturing, cosmetics and inlay work. The well-developed alternative technologies for oyster cultivation need to be further disseminated for expansion of this lucrative business along the Sudanese coast. Over and above, there are other indigenous finfish and crustacean species that have elsewhere proved to be suitable for cultivation in land-based structures (ponds, pens, lagoons) or floating cages in open water. Diversification and intensification of mariculture is a research and development area that deserves high priority in government policies for proper resource utilization for food security and socio-economic enhancement.
- In Equatoria, there is a chronic shortage of meat due to the ravages of tsetse fly, particularly in the Zandi region, where sleeping sickness prevents the population from breeding and rearing livestock. To compensate for this, the people in the area depend on fish for their animal protein intake. As there are no big capture fisheries resources in the vicinity, fish farming becomes the most appealing and effective way of increasing fish protein supply in the diet of the people. There are private governmental artificial ponds and dams distributed in several localities in Equatoria (e.g. Yei, Maridi, Yambio, Nzara, Ezo and Li-YuBu). Rehabilitation of this infrastructure will be the basis and starting point for aquaculture promotion and development there as an alternative community-based occupation.
- The imbalances in animal protein in the everyday diet of rural populations of western, central and eastern Sudan is a serious problem, causing a great deal of ill-health, poor growth, general weakness and susceptibility to many diseases. The irrigation canals of the major agriculture schemes are heavily infested with aquatic macrophytes that harbour the vector snails responsible for spread of schistosomiasis and create favourable environments for mosquito breeding and spread of malaria. Addressing these national problems is of vital importance to the health and stability of these rural communities. A possible and most appealing solution is aquaculture, both for table-fish production and biological control of aquatic weeds. There are over 1 775 rainwater haffirs within the Savannah belt in western, central and eastern Sudan that are used for irrigation of small agricultural areas and provide water for livestock and domestic purposes. Integration of aquaculture in these waterbodies would no doubt contribute to mitigation of the rural population's nutrition and development. Similarly, the tremendous water resources in the canal network in the Gezira Scheme (5 649 km) , Managil Extension (3 958 km), New Halfa (1 331 km), Suki (311 km), Gunied Sugar Estate (304 km) and others provide a good base for aquaculture development for eradication of weeds and supplementing the local diet.
- The fish reaching Khartoum markets from distant fishing localities is affected by high wastage due to improper handling. Low-grade fish, by-catch and fish wastes constitute raw material for fishmeal production. The traditionally-produced fishmeal is of low nutrient value (protein value 38-40 percent, compared to an industrial protein standard of 67–70 percent) and not free from pathogenic agents harmful to livestock and poultry. More research and development is needed in this area to standardize and promote the industry.

- The remoteness of the fishing areas from the marketing centres and improper handling and preservation of the fish catch leads to a high percentage of post-harvest losses and poor product quality. These have a negative impact on fisher's socio-economic status as well as the possible hazards for community health. To improve fisher family nutrition and earnings, and to add value, proper post-harvest treatment and fish utilization are priority areas to be addressed. Women participation will secure more employment opportunities, self-reliance and satisfaction, and improve human resource utilization and involvement.
- Fisheries monitoring, control and surveillance constitute powerful managerial tools. For them to function in an effective and efficient manner in a vast country like the Sudan requires the availability of highly qualified and experienced manpower, effective legislation and legal framework, infrastructural facilities and coordination. Analysis of the current situation indicates a poor performance of the institutions entrusted with this duty. Consequently, building capacity and competence is a priority area for proper fisheries management.
- Institutional and human capacities in marine fisheries suffer from serious setbacks, which lead to low profile resource monitoring and modest output. Acquisition of base-line information on fish resources and levels and trends of fish production and utilization, as well as fisheries forward- and backward-related activities, is considered a prerequisite and powerful tool for responsible fisheries management and development. There is urgent need to improve physical and human capacities for better performance.
- The basic infrastructures in support of forward- and backward-fishing activities are far from being adequate to facilitate a vigorous fisheries industry. There are no proper fishing ports or fish landing and storage facilities. The available ice production plants are of insufficient capacity to satisfy the requirements of the fishing communities. Refrigerated trucks for fish transport are very limited and owned by some fishing firms. Almost all fishing nets and twines are imported and sold on the black market, with prices beyond the capacity of poor fishers. The public and private sectors banks are little involved in fishing credit schemes. These and other factors represent basic constraints to fisheries development. There is urgent need to mobilize, promote and integrate public and private sectors towards investment in capacity building activities.

6.2.2 Vision and strategy

Sudan has launched the Quarter Century Strategy (2002–2027). The guiding values of the fisheries sector strategy call for:

- An enhanced role for fisheries in poverty alleviation, food security, human health and environment.
- Adopting scientific research and technology advancement as vehicles for increasing productivity efficiency.
- Rational utilization, conservation and development of aquatic and fisheries resources through sustainable production management, restocking of depleted fish stocks and pollution control.
- Strengthening economic infrastructure and promoting privatization.
- Strengthening public and private sector institutional setups.
- Securing participation of the fisheries sector beneficiaries in management and development processes.
- Developing and strengthening the competitiveness of fisheries products through improvements in marketing channels, quality control and safety.
- Promoting sustainable development.
- Strengthening and developing information resources and databases.
- Strengthening regional and international cooperation, including agreements, exchange of experiences, joint programmes and scientific forums.
- Institutional and legislative reforms.
- Strengthening coordination mechanisms between the public and private sectors at the

central and state levels within the country.

- Establishing and developing fisher and producer organizations.
- Promoting fish producers and fisheries investors through stimulating easy-term credit systems.

6.2.3 Major elements of the strategy

- Food security and poverty alleviation.
- Environmental sustainability.
- Rational utilization and conservation of resources.
- Investment in and development of aquaculture.
- Development of fisheries-based aquaculture
- Conservation of genetic resources.
- Improvement of quality and safety of fish products.
- Investment in human resources.
- Investment in research and development.
- Strengthening databases and linkages.
- Institutional support.
- Promotion of marketing and trade.
- Regional and international cooperation.

6.3 Research

Applied research and transfer of technology is the mandatory responsibility of the Fisheries Research Centre, Animal Resources Research Corporation of the Ministry of Science and Technology. This centre discharges its responsibilities through specialized stations geographically distributed to cover major marine and inland waters. The centre coordinates its activity through the Technical Research Committee, with representation of public and private sector stakeholders. At the same time, local relevant universities conduct basic and applied research in fisheries and related disciplines through post-graduate studies, sometimes with joint supervision from the two institutions. The regular programmes deal with Capture Fisheries Research, Fish Culture, Fish Industrialization and Technology Transfer, and Capacity Building.

6.4 Education

Sudan has now over 100 universities and colleges that contribute technical, administrative and other support for staff training.

The Fisheries Training Institute delivers short-term training targeting fisheries officers, private fish farmers and fishermen. Local and foreign universities provide training leading to undergraduate and post-graduate degrees. Field training and extension services are periodically provided to fishers and fish farmers through visits and fishermen group discussion.

6.5 Foreign aid

Sudan has received bilateral and humanitarian support in the area of fisheries that has assisted in the development process. These include:

- FAO/UNDP Fisheries Training Project located at Malakal for Southern Sudan — capacity building.
- Chinese People's Republic Project for the development of Lake Nubia fisheries.

- Canada's IDRC funded two projects for development of mariculture (oyster farming) in the Red Sea area, and freshwater fish culture in Khartoum.
- The British ODA executed a project in the Red Sea for development of artisanal fisheries through building and distributing boats and providing fishing gear and storage and transport facilities.
- OPEC/UNDP Project in the Red Sea to assist fisheries cooperatives with fishing gear, storage and transport facilities.
- The Japanese Government provided a grant for the development of White Nile fisheries, which was used to build ice and storage plants in Khartoum and Kosti, and insulated fish transport trucks.
- OXFAM assisted in the establishment of oyster family farms on the Red Sea coast.
- UNICEF Household Food Security Project within the UN Consolidated Appeal for Southern Sudan distributed fishing twines and hooks for displaced people and returnee from war affected areas in and around Juba, Wao and Malakal.
- FAO Technical Cooperation Programme for the establishment of a Fisheries Management Unit.
- FAO missions for evaluation of fisheries and to set up a legal framework for fisheries management.
- The Regional Organization for the Conservation of the Red Sea and Gulf of Aden (PERSGA) commissioned a study for preparation of the Oil Spill Contingency Plan, which was endorsed in 2005.
- FAO relief and rehabilitation assistance programmes in 2005 to meet post-conflict challenges. The direct and indirect programmes addressed areas of agriculture, animal production and health, fisheries, water harvesting, and support to agro-processing and rural communities.
- The European Union Assessment Mission (June-July 2006) to evaluate the Agricultural Research Corporation and the Animal Resources Research Corporation (including Fisheries Research Centre). The mission's terms of reference were to evaluate existing capacities and activities and recommend feasible solutions to overcome problems and constraints, with emphasis on physical infrastructure, human resources, research activities and technology transfer.

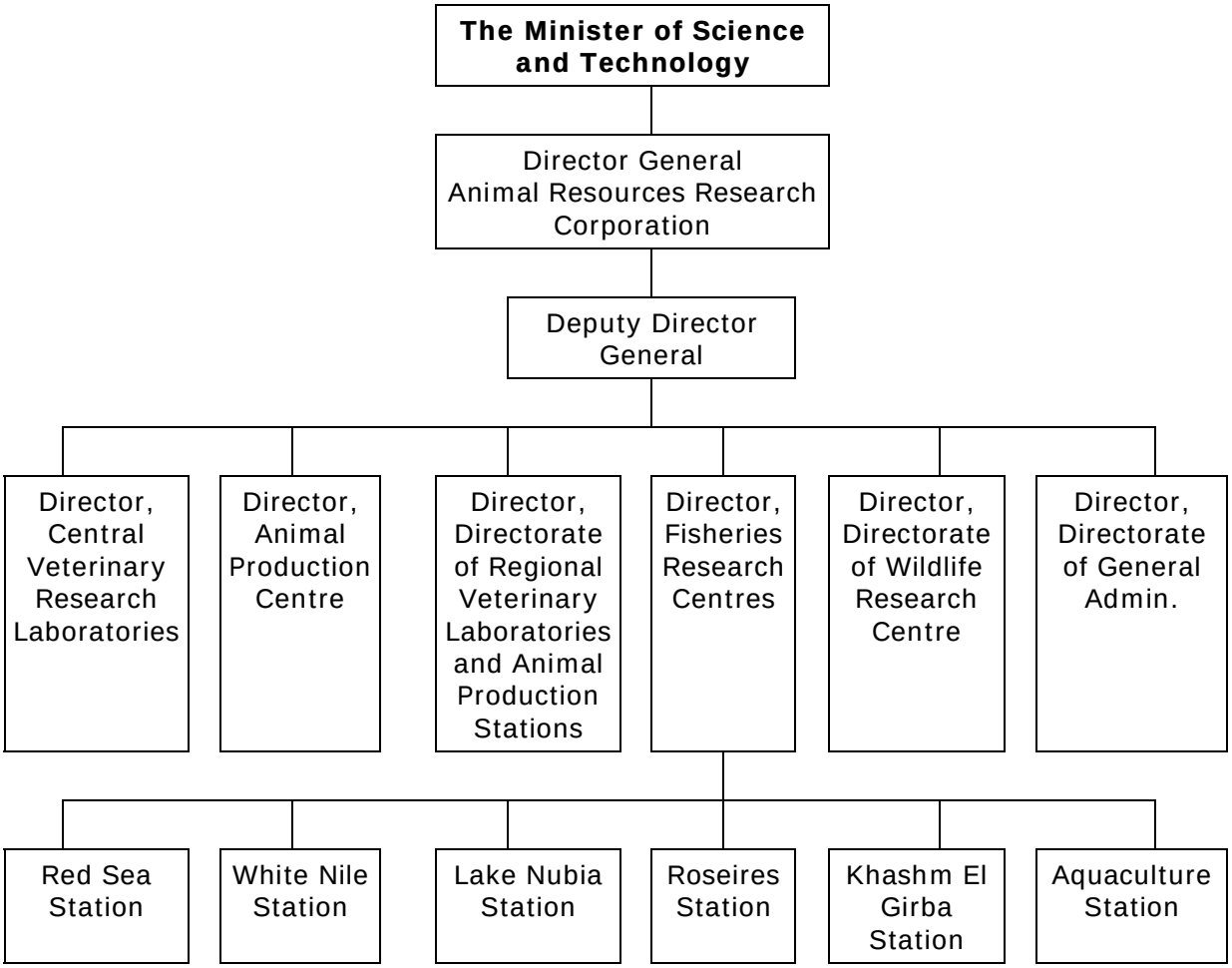
7. Fishery sector institutions

7.1 Fisheries Research Centre

This is a central institution under the umbrella of the Animal Resources Research Corporation, Ministry of Science and Technology. The Fisheries Research Centre performs its mandatory functions through 6 specialized stations geographically positioned to cover the most important inland and marine waters. Their locations are:

- Headquarters — Khartoum
- Red Sea Research Station — Port Sudan
- White Nile Research Station — Kosti
- Lake Nubia Research Station — Wadi Halfa
- Roseires Research Station — El Damazin
- Khashm El Girba Research Station — Half El Gadieda
- Aquaculture Research Station — Khartoum

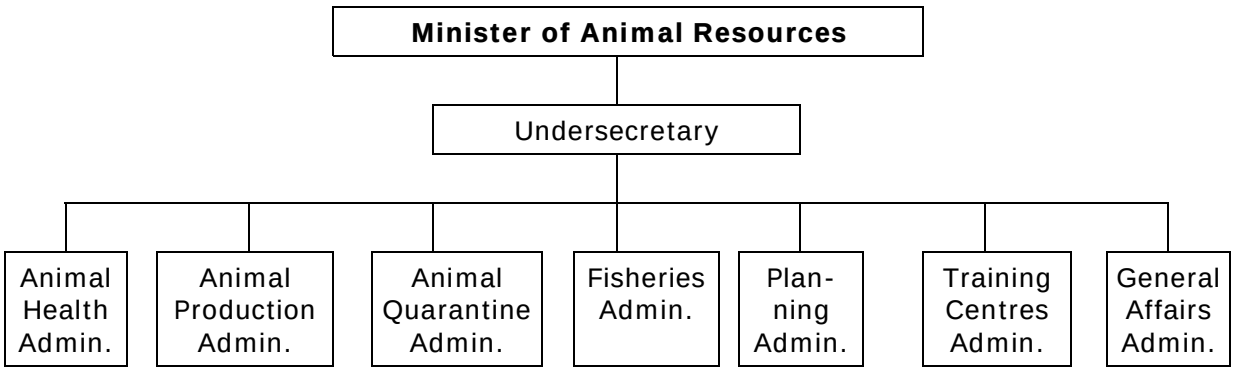
Organizational map of the interrelationships within the Animal Resources Research Corporation

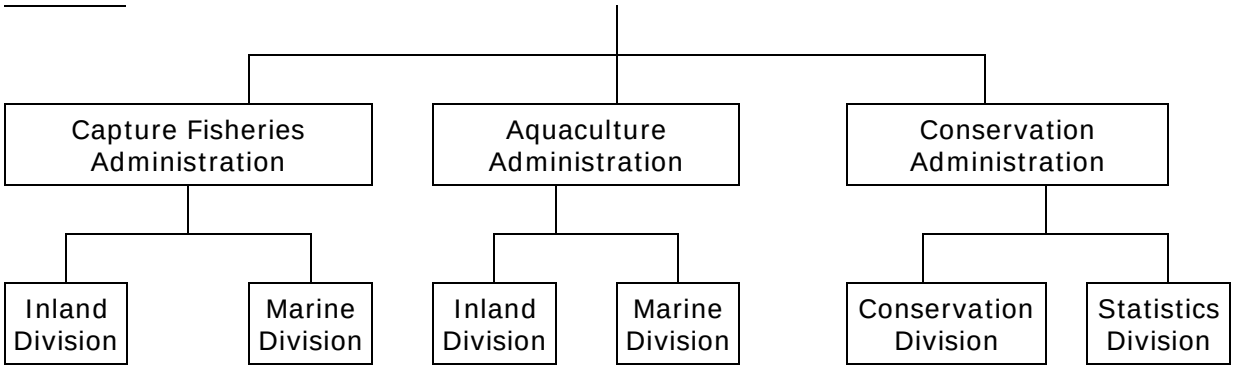


7.2 Fisheries Administration

This is the central fisheries authority within the Ministry of Animal Resources that is responsible for planning, policy formulation, provision of training and extension services, and overall supervision of the fisheries sector. This administration discharges its mandatory obligations from its headquarters and associated structures based in Khartoum, in close coordination with the State Fisheries Departments and relevant public and private sector institutions and agencies.

Organization of Fisheries administration within the Ministry of Animal Resources



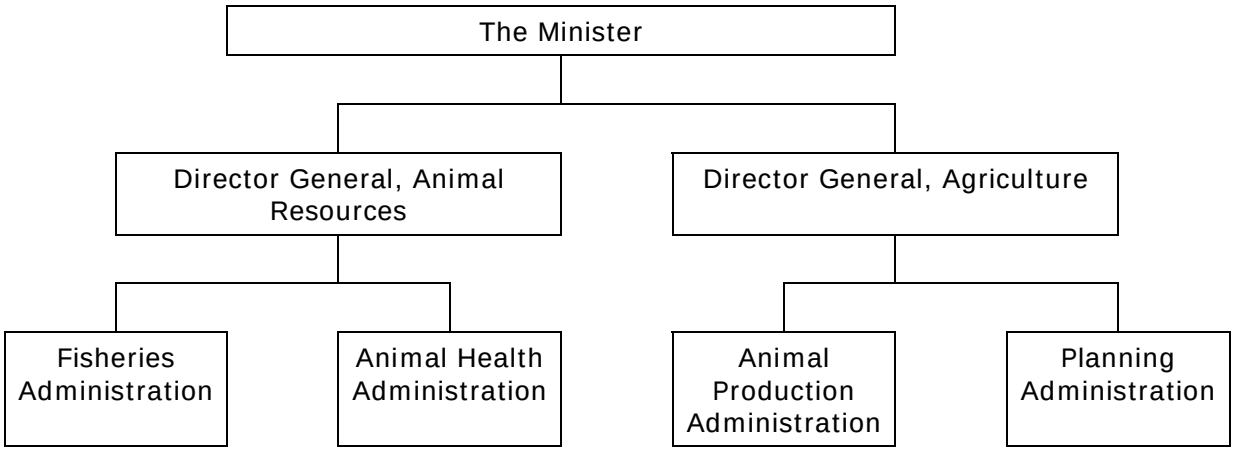


7.2.1 State Fisheries Departments

These are fisheries department within the Ministries of Agriculture and of Animal Resources in various states of the Federal System of the country. The following State Fisheries Departments are operational:

State(= Welaia)	HQ of Fisheries Department
Khartoum	Khartoum
White Nile	Kosti
Blue Nile	El Damazin
Sennar	Sennar
El Gaziera	Wad Medani
Kasala	Khashm El Girba
Red Sea	Port Sudan
Nahr El Niel	Atbara
El Shamalia	Wadi Halfa
Equatoria	Juba
Bahr El Gazal	Wao
Upper Nile	Malakal

The State Ministries of Agriculture and of Animal Resources, to which State Fisheries Department are affiliated, have the following organizational structure:



7.3 Fisheries Training Institute

This is one of the specialized training facilities within the Ministry of Animal Resources. It provides short-term training courses targeting fisheries officers and fishers from the public and private sectors. Arrangements are underway to restructure and upgrade this institution to become an effective managerial tool for capacity building.

7.4 Collaborative Institutions and Supportive Mechanisms

- Local Universities and Higher Learning Institutions
  There are over 100 universities and colleges distributed throughout the Sudan. Quite a number of these universities have colleges that are specifically engaged in fisheries and related disciplines. The fisheries sector benefits from these facilities through education, training, research, participation in technical committees and community development.
- The Fisheries Council
  This is a coordinating structure within the Ministry of Animal Resources and fisheries with representation from the concerned public and private institutions and agencies.
- Fisheries Technical Committee of the Sudanese Standards and Metrology Organization (SSMO)
  This is an advisory committee responsible for drafting fisheries standards and specifications and advise on other matters pertaining to the development of fish products, trade, quality control and consumer safety.
- The Advisory Council of the Ministry of Animal Resources
  This is an advisory, high-ranking technical council representing all fields and activities of the Ministry of Animal Resources. Fisheries Administration, Fisheries Research and private fisheries companies are represented in this consultative body.
- The Higher Council for Environment and Natural Resources
  This is a coordination body within the Ministry of Environment and Physical Development and acting as a national focal point for issues, programmes and conventions of environmental concern.

8. General legal framework

The fisheries sector benefits directly and indirectly from the constitution and local legislation. Some of these are noted below:

- The **Constitution of the Republic of Sudan**, which entered into force on 1 July 1998 to establish public order, specifies, *inter alia*, Federal Powers, State Powers and Concurrent Powers. The following Articles of the Constitution are relevant:
  - **Article 2 Federal State —** Sudan is a Federal Republic governed at its highest level of authority in accordance with a federal system of government based on the Constitution and at the local level it is governed by local councils acting in accordance with the law. The government shall ensure participation, (consultation) shura and mobilization, respect for justice in the division of power and wealth.
  - **Article 8 National Economy —** The State directs the growth of the national economy guided by planning on the basis of work, production and free market to prevent monopoly, usury, cheating, and to ensure national self-sufficiency, abundance, blessings and the aims of justice among states and regions.
  - **Article 9 Natural Resources —** All natural resources under the ground, on its surface or within the territorial waters of Sudan are public property and shall be governed by law. The State shall prepare plans and prompt the appropriate conditions for procuring the financial and human resources necessary to exploit these resources.
  - **Article 12 Science, Arts and Culture —** The State mobilizes its official resources and the popular institutions for combating illiteracy and ignorance, strengthening

educational systems, and promoting science, research, scientific cooperation and facilitating access to education and research. It also encourages all forms of arts and seeks to encourage society to adopt religious values, piety, and activities beneficial to social development.

- The Constitution authorized the **State authorities to issue local orders to regulate in conformity of the Central laws fishing practices within their jusisdiction.**
- **Freshwater Fishing Law** (1954), amended (1960) and (1995)
  This is the current force inland fisheries legislation. FAO commissioned an expert in July–September 1998 to update and complete the missing links. The new version proposed by the expert under the title "The Federal Inland Fisheries Act" is documented in FAO report (TCP/SUD/6611), but not yet put into force.
- **Marine Fisheries Ordinance** (1937):
  This old ordinance aimed at regulating fishing and use of marine resources in territorial waters and was in use until its amendment in 1975, and renamed *Marine Fisheries Regulation*. The major amendment included banning of spear guns in fishing, collection of corals and ornamental fish without permission or dumping of wastes in water, in addition to regulation of marine engineering and coastal development activities.
- **The Encouragement of Investment Act (1999)**

  This Act gives development projects privileges, including:
  - Exemption from the business profit tax for a period not less than 5 years.
  - The transfer of profits and the costing of finance, resulting from foreign capital, or loan in the currency in which the capital or loan is imported, at the best declared exchange rate, at the date being due.
  - Allocating land preferential terms.
  - The repatriation of the invested capital, in the case of failure to implement the projector its liquidation, in the same currency in which it was imported. The machinery, equipment and transport means, which were imported on the account of the project, may be re-exported.

  Other relevant and local legislation include:
  - The Maritime Law (1961)
  - Sudanese Regional Sea and Continental Shelf Act (1970)
  - Quarantine Law (1972)
  - Sea ports Corporation Law (1974)
  - Environmental Health Law (1975)
  - Environment Conservation Law (2001)