

Fisheries Resources of Sudan

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Abstract Sudan is the largest country in Africa with an area of 2,505,810 km², of water constitutes 129,810 km², and cultivable land is 34%. Sudan has a total land boundary of 7,687 km with 9 border countries. 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 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. The demand for fish and fish preparations is growing steadily. The animal resources sector (which includes fisheries) contributes 21% of Sudan GDP. 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. 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 provide work opportunities in the form of secondary employment as a source of income that indirectly contributes to household food security.

Key words : Africa, aquaculture, fisheries, mariculture, Sudan

Introduction

Sudan is the largest country in Africa with an area of 2,505,810 km², of water constitutes 129,810 km², and cultivable land is 34%. 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) (Fig. 1) [3]. 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.

Structure of fisheries sector

Sudan is endowed with diversified surface and under-

ground 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.

However, the recent 5 years total fish productions in Sudan are presented in Table 2. The territorial rights of Sudan on the Red Sea extend to an Exclusive Economic Zone (EEZ) of 91,600 km², including a shelf area of 22,300 km². 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

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

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	16,000	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	916,000	10,000	5,500	56


Fig. 1. Map of Sudan.

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. The finfish production is shown in below (Table 3).

Table 2. Fisheries production in Sudan (thousand tonnes) [1].

Year	capture fishery		Aquaculture		Total
	Marine	Inland	Marine	Inland	
2002	3	57	-	-	60
2003	4	54	-	-	58
2004	5	58	-	-	63
2005	0	36	-	-	36
2006	0	57	-	-	57

Table 3. Finfish production by sector [1].

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

Marine resources

Sudan has a Red Sea coastline of 853 km and an EEZ of 91,600 km², with a shelf area of 22,300 km². Sudan's territorial waters are generally characterized by weak currents. 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.

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 4. Trawler performance and reported catch for 2000–2005 is given in Table 5.

Main production

Sudan marine finfish fisheries account for about 9% of the total fish potential of the country and contributes 8.5% of total production. 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 and 280 bony fish species in Sudanese waters. Estimates for finfish

Table 4. Breakdown of marine fishery activities in the Red Sea in 2005 [1].

Type of marine fishery	Percent
Artisanal fin fishery	63
Trawl fin fishery	25
Wild molluse fishery	7
Shrimp fishery	4
Shark fishery	0.4
Sea cucumber fishery	0.4
Sardine fishery	0.2

Table 5. Reported trawler performance and catch in 2000–2005 [1].

Year	Number of Fishing Days	Number of trawlers	Total Production (ton)
2000	179	9	245
2001	195	2	52
2002	168	4	44
2003	638	13	416
2004	934	22	691
2005	1,634	32	1,314

Source: Marine Fisheries Administration.

potential in the Sudanese waters vary, ranging from 6,000 to 35,000 t/yr.

Inland resources

Inland capture fisheries area is primarily based on the River Nile and its tributaries. It contributes over 90% of the estimated production potential of the country, and supplies 70% 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 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. There are 3,500 fishers operating 3,000 non-motorized dugout canoes. The prevailing fishing gear is mainly hook-and-line, long-line, gillnets, seines, cast nets, traps and spear fishing.

Aquaculture

Agriculture activities in Sudan incorporates cultivation of oyster in the marine environment and finfish in freshwater (Fig. 2). 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 re-

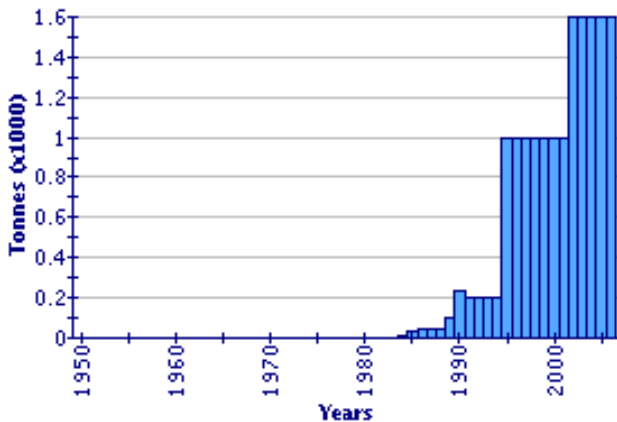


Fig. 2. Aquaculture production of Sudan [2].

search 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.

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. With respect to freshwater fish culture, several state and private sector farms were established around the capital Khartoum and other towns in various states (Table 6).

Table 6. Establishment of freshwater aquaculture farms [1].

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

A survey conducted in 2000 showed that 91.7% of the fish culture practices in Khartoum State is based on earthen pond systems, 4.17% each of floating cages and industrial concrete ponds. Extensive culture of mixed sex *Oreochromis niloticus* dominates these farming systems (95.3%), 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 2,000 t/yr of *Oreochromis niloticus* is accepted with some reservation.

Post-harvest use

Fish utilization

Finfish is marketed and consumed fresh (70%), sun dried (25%) or wet salted (5%). 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. Shrimps and prawns are sold locally as a high-value delicacy food, particularly in high standard hotels.

Fish markets

The Capital Khartoum receives fish from several fish producing Sudanese States as one of the high-fish-demand markets. Figure 3 and Table 7 indicate traditional fish market and the amounts of fish marketed in Khartoum and other market destinations as a percentage of the total production of different Sudanese States in 2005.

As for marine fisheries and mariculture, Port Sudan



Fig. 3. Traditional fish market.

Table 7. Distribution of catch through markets [1].

State	Total production (t/yr)	Number of fishing units		Percentage of fish marketed in Khartoum	Percentage of illegal fish	Other market places
		Boats	Fishers			
Gezira	750	400	500	7	1-2	Gadarif
Red Sea	3,500	100	700	-	15	Kasala, Medani
Blue Nile	594.6	300	350	80	2	Medani, Sennar
Northern	2,004	300	900	95	7	Dongula, Atbara
White Nile	6,500	3,500	4,000	70	7	El Obeid
Sennar	850	604	608	3.5	27	Wad Medani
Kasala	500	240	400	-	60	Gadarif
Khartoum	1,400	300	836	100	3-5	-

Table 8. Landings through Port Sudan market [1].

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

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 8.

Fishery sector performance

The contribution of fisheries to Sudanese GDP is cur-

rently marginal. The per caput supply is only 1.6 kg/year, which is mostly obtained by capture fish landings. Based on the 1993 Census, Sudan's population is growing at an annual rate of 2.63%. It is projected to grow from 31.1 million in 2000 to 35.3 million in 2008. 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 [1]. 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.

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. 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 9.

Cultured shrimps are exported to Saudi Arabia. Exports for 2003 and 2004 amounted to 2,125 t and

Table 9. Exports of fishery products, 2001 to 2006 [1].

Year	Fiersh 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

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

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.

Employment

The primary employment in fisheries increased from 12,000 in 2000 to 12,900 full-time registered fishers in 2006—a 7.5% 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.

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.
- 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

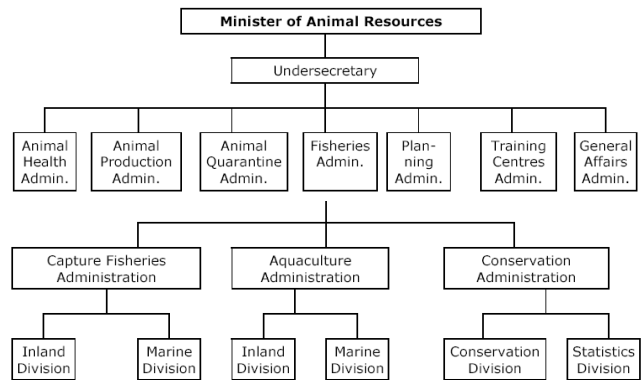


Fig. 4. Organization of Fisheries administration within the Ministry of Animal Resources [1].

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 is shown in Figure 4.

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