

# Socio-Economic Characteristics of Three Artisanal Fisheries Communities in the Northern Sudanese Red Sea Coast

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## Abstract

Socio-economic characteristics related to fishing gears and boats from three selected small-scale fishers' communities (Oseif, Dunganab and Mohammed Qol) in the northern part of the Sudanese Red Sea coast were studied. The study was designed to provide base line data and information on the current socio-economic situation, factors that determine the use of fishing gear, types of boats and fishing equipment, challenges facing fishers and the extent to which fishing gear and boats are related with the socio-economic characteristics of the fishers community in the study sites. Fieldwork was carried out during 2016. The study methods included a series of interviews based on questionnaires, field observations and focus group discussions. The results of the study showed that the most common fishing gears are handlines, cast nets and gillnets. The two types of boats used at the study sites are motorized fiberglass and *hour*i (motorized and paddled) with a V-shaped hull. Boat ownership varies among fishers. Each fisher can have several types of gears in different numbers. Target fish species, season, efficiency of gear and fishing location were the main factors determining the use of fishing gear at study sites, respectively. All fishers are men and most have families of at least four people. The majority of fishers are between 21 and 50 years old and work mainly in fishing. They inherited fishing knowledge within the family, and most of them have been working in artisanal fishing for more than 10 years. Fishers have relatively good net incomes compared to other government employers in the study sites. Most fishers work full time in fishing. A small number of fishers work part-time with the possibility of undertaking other income-generating activities such as animal husbandry and seasonal agriculture. The main challenges identified by fishers at the study sites were fish prices, sea surface roughness and high cost of fishing materials, respectively. Most fishers perceived a recent decline in both catch size and abundance.

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## Keywords

Red Sea of Sudan, Gears, Boats, Small Scale Fishers, Socio-Economic

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### 1. Introduction

Sudan's coastline is about 853 km long along the western coast of the Red Sea. The Red Sea coastal zone of the Sudan has several unique marine habitats, including marshes (sabkhas), wetlands, sandy shores, rocky shores, mangroves, seagrass beds, shallow bays, and coral reefs. The Sudanese coast has the highest diversity of coral reefs in the Red Sea, providing structure for many species to hide and live in as well as crevices for spawning. Therefore, coral reefs provide food and a nursery ground for raising young. There are many landing sites and fishing villages along the Sudanese coast. The northern Sudanese Red Sea coast offers unique (fantastic) fishing opportunities to many fishing households (food and income) and contributes about 40% of the national marine catch.

Fishing and fisheries play an important role in the economics of the developing countries and contribute to intake of the animal protein, the generation of employment and the household income [1]. The artisanal fisheries are more important for the incomes and food safety of the local people in the developing countries [2]. The small-scale fisheries are based on the traditional fishing methods [3] [4]. In the developing countries, fishing in small-scale fisheries is often part of a complex set of livelihood activities, which may include farming and other part-time occupations [5]. The small-scale fisheries deal about 50% of the global fisheries export [6]. According to [7] the artisanal fisheries employ over 12 million people worldwide.

Sudanese marine fisheries are small-scale artisanal. Sudan's artisanal fisheries use small amounts of capital and energy for fishing operations because they frequent the shallow waters close to the shore areas. The fishers usually fish in limited areas near their villages [8]. Along the Sudanese Red Sea coast, fishers use part of their catch for their self-consumption, while the bulk of the total catch is for sale.

The fishers in the Sudanese coast typically use the hooks and lines for the reef fish and gillnets for the bottom fish [8] [9]. The handlines fishing can be very beneficial [10].

The fishers in the Sudan use different types of boats, generally dugout canoes of two to three meters in length, which take one to two fishers using paddles (or sometimes sail) to fish in inlets and behind the fringing reef. The other common types boat are *houries* of three to five meters in length and are mainly used for handlining along the fringing reefs and in the deeper water just off the reefs. They can take two to three fishers and usually have a sail and paddles. The bigger than the *houries* there are the rare *felukas* (wooden oars or bamboo poles) of five to seven meters in length. Which, unlike the *houries*, the *felukas*

are fitted with a transom stern and usually have a sail. Both the *houries* and the *felukas* are sometimes equipped with outboard engine of three to eight hp (*houries*) and 10 to 12 hp (*felukas*). The biggest types of the boats use by the Sudanese fishers are the launches (*sambouk*), which range from seven to 11 meters in length and are usually fitted with an inboard engine of 30 to 100 hp. They are used for handlining further offshore [9]. In addition, there are relatively few large wooden or steel-hulled fishing vessels, which are engaged in limited seasonal activities.

The fishers select their fishing gears depending on the types of water bodies, the season, the safety of the area of operation, the depth of water, and the availability of fish to be caught. The seasonal variation in species composition and abundance may also specify the use of the specific fishing gear and boats at the particular fishing location during a given period. The fishing boats may also change over time from using small wooden boats to fiberglass boats. The duration of fishing trips ranges between one and seven days for the long trip, while for the launches it may reach 21 days [11].

Sudanese marine fisheries are not of great economic importance, with total catch being only about 300 tonnes per year, and the prospects for large scale development do not look very bright. With gradual improvements in equipment and the introduction of mechanized boats, production is likely to increase within a few years. With the increase of the population, especially in the city of Port Sudan, fisheries will play an increasingly important role in providing food of high nutritional value and employing more local people in the fishing industry [10].

The main economic activity of the villagers at the northern Sudanese Red Sea coast is fishing. There is also animal husbandry, an important income-generating activity, with camel milk sold in local markets and restaurants. There are also some farming activities centered on the seasonal riverbeds in the areas close to the villages. All these activities are small scale and mainly for subsistence purposes [12]. Besides the subsistence activities, there are also private oyster farms at the edge of Dungonab village, which was provided in the past considerable employment opportunities for the local men. As a result of the massive loss of production in 2001 due to undetermined mass mortality and later for administrative reasons, the farm is currently operating at one-fifth of its full capacity and employs only 5 locals. The local women do not have any experience in doing any work related to fisheries or aquaculture and the farm management is currently seeking to find an effective role for them in this [12]. The women's association was recently established in Mohammed Qol with the support of the United Nations Industrial Development Organization (UNIDO) to involve women in project activities and create alternative livelihoods for them.

The fisheries in the northern Red Sea coast region of Sudan are typical coral reef fisheries in that they are extremely polyspecific, although there are favoured or highly valued species, which are preferentially targeted. Most commercially

important coral species, which are the target of artisanal fisheries, are found in the barrier reef area. The Artisanal fishing targets species such as *Mugil* spp., *Epinephelus areolatus* (areolate grouper), *Lutjanus bohar*, *L. gibbus* and *Scomberomorus commerson*, which they are considered the most important marine fish in the region. The fish that are commonly caught are groupers (Serranidae), snappers (Lutjanidae), emperors (Lethrinidae), jacks (Carangidae), and sharks (Elasmobranchii). Mullet (*Mugilidae*) is salted in barrels, locally called *fasikh* and exported to Egypt, but recently, it is consumed locally [13].

A variety of studies and reports have examined fisheries sectors and fishing communities in Sudan's coastal area and the Red Sea region [8] [14]-[26]. However, most Sudan-specific studies do not show a clear link between fishing gear and boats and the socioeconomic characteristics of fisheries in the Sudanese Red Sea coast. The present study aims to provide base line data and information on the current socio-economic situation of the fishers community, recognize factors that determine the use of fishing gear, identify the types of boats and fishing equipment used in the study area, classify the most important challenges facing fishers in the study area and identify the extent to which fishing gear and boats are related with the socio-economic characteristics of the fishers community. The findings of the current study may will enhance, improve and add some information within the framework of planning, managing and developing fisheries in the Sudanese Red Sea coast.

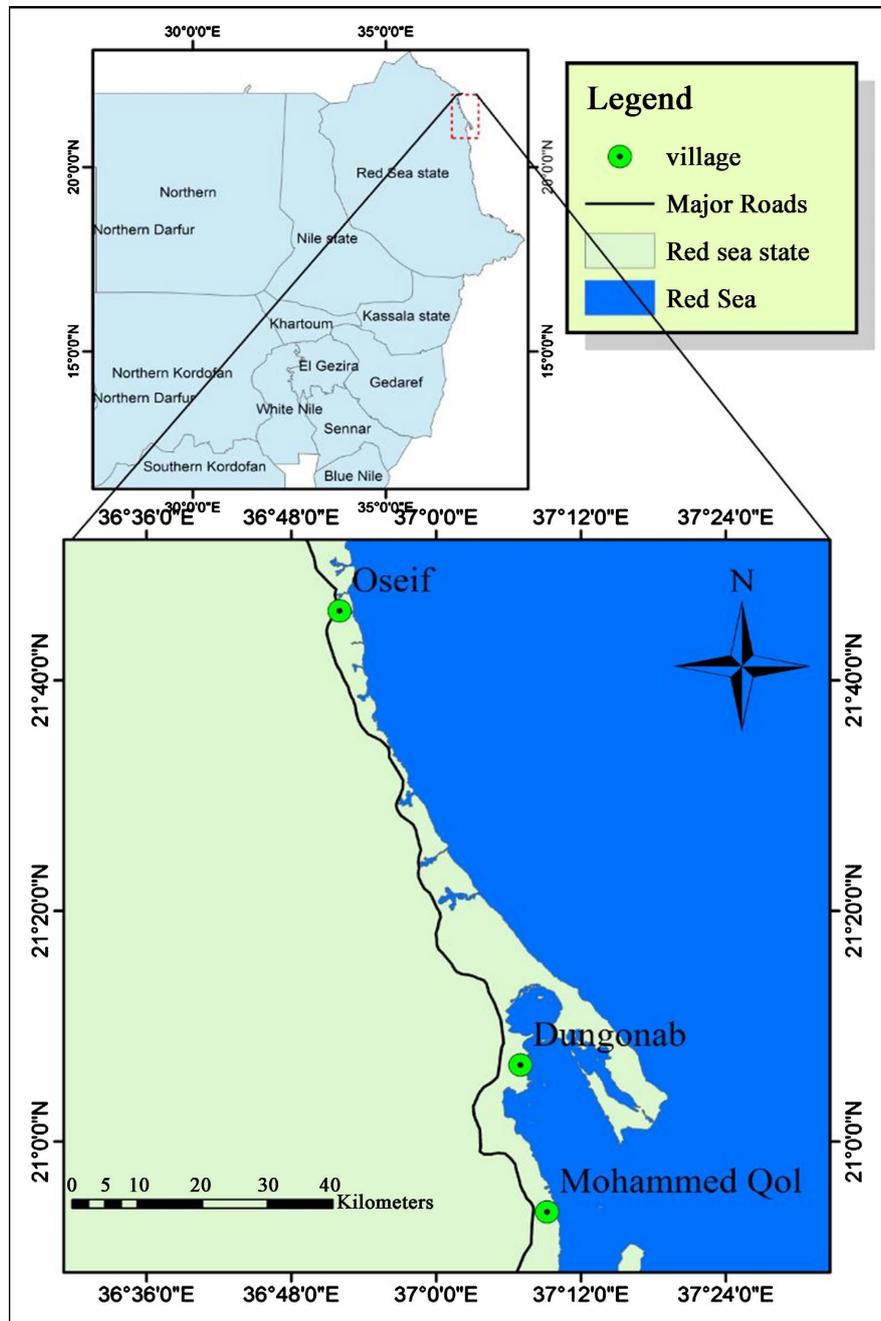
## 2. Materials and Methods

### 2.1. Study Area

In the study area there are many landing sites and fishing villages. Among these sites, three sites were selected for this study (**Figure 1**). Oseif (latitude 21°45'31"N, longitude 36°52'15"E), Dungonab (latitude 21°06'15"N, longitude 37°07'18"E) and Mohammed Qol, about 13 kilometers from Dungonab (latitude 20°54'11"N, longitude 37°09'32"E). These sites were selected basis on accessibility to fish and operation of fishing gear.

### 2.2. Data Collection

The study used three different methods to collect data. These methods are included a series of semi-structured interviews based on questionnaires, focus group discussions [26] [27] and field observations. Three focus groups discussions and fifty questionnaire-based interviews were conducted. Observations of some employees of the Marine Fisheries Department (Red Sea State) and NGOs were recorded. Information was obtained on the socio-economic characteristics of the sampled fishing villages, and the equipment and boats used for fishing. Specifically, information was obtained about the age-sex composition of fishers, marital status, educational level, fishing experience, family size, general perception of fishers about marine resources, income from artisanal fishing, and sources of funding for artisanal fishing.



**Figure 1.** Map showing the location of the study sites.

### 2.3. Data Analysis

The data and information achieved from the survey were collected, clustered, and interpreted based on the objectives of the study with the relevant parameters. Some data contain numerical values, while some are summarized according to evidence. The data obtained were analyzed based on descriptive statistics using the frequency and percentage distributions to analyze the socio-economic characteristics of the fishers regarding fishing gears and boats. The data were then presented in graphs or tabular forms. Statistical analyzes were performed

using Microsoft Office Excel 2007.

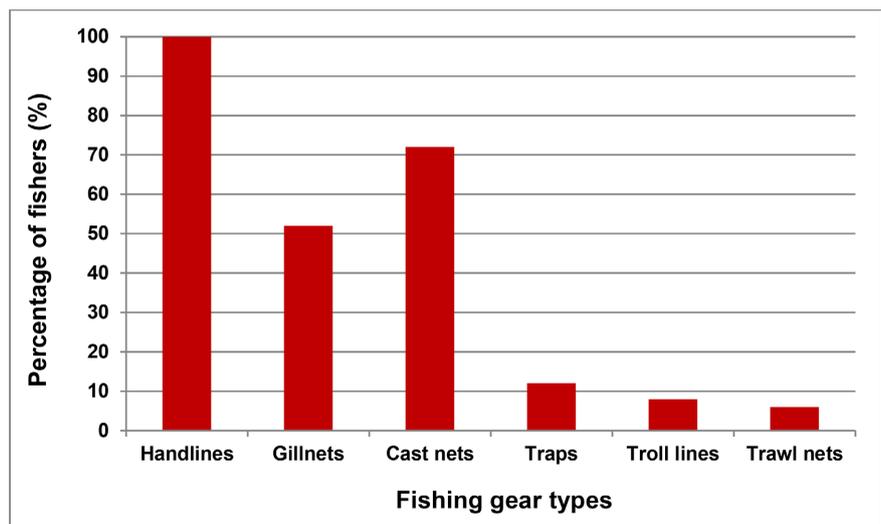
### 3. Results

#### 3.1. Fishing Gears and Boats

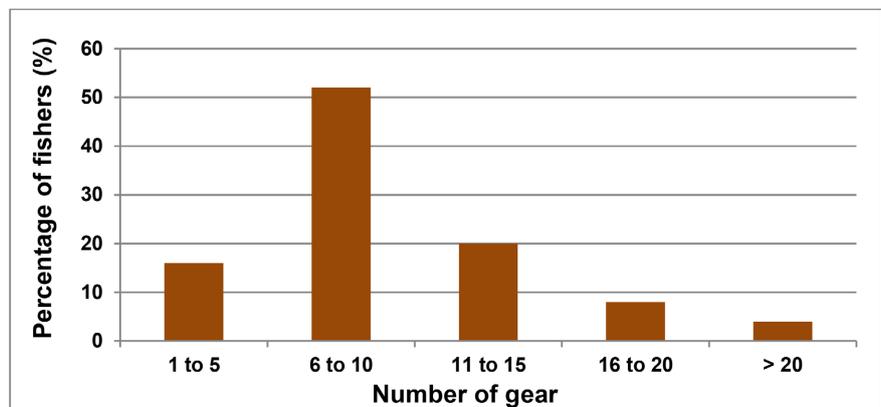
Six types of fishing gears were used for fishing in the study sites (**Figure 2**). Main types of fishing gear included handlines, cast nets, and gillnets, respectively. Most notable were handlines, the main fishing gear, they were used by 100% of fishers at the study sites. The cast nets (*Shaya*) were used by 72% of fishers. Gillnets (*shuwar*) were used by 52% of fishers. Traps (*shaqwa*), troll lines (*majror*) and trawl nets (*jarf*) were only used by few fishers.

The majority of fishers (82%) indicated that the handlines are more efficient, followed by gillnets and cast nets. The gillnets and cast nets had quite similar trends among the fishers, in approximately equal proportions.

Most fishers own more than one gear. More than 50% of the fishers had between 6 and 10 gears of different types (**Figure 3**). Only 4% of the fishers owned more than 20 gears. Overall, the average number of gears per fisher was 6.1. As



**Figure 2.** Different types of gears used in fishing.



**Figure 3.** The number of fishing gear per fisher.

for the source of fishing gears, most fishers purchased the fishing gear themselves.

As shown in **Table 1**, there were some factors that determined the use of fishing gear. The percentage of these factors ranged between 19.2% for the target fish species and 2.8% for other factors such as depth and weather.

Two types of fishing boats were used: small fiberglass boats and wooden boats. Fiberglass boats are seven meters long, and they constitute 70% of fishing boats. It is equipped with a 40 hp diesel engine and a 200 kg ice box. Wooden boats (*houries*) were between 4 and 8 meters long and were equipped with outboard motors and small ice boxes, and only a few have been found with paddles or sails. Among fishers, 92% had motorized boats and only 8% had paddle boats. Most of these boats (about 55%) were owned by local fishers and were provided to them by the government or the Islamic *Zakat* Office on credit. But there were many boats owned by fish traders who would provide ice, fuel, charcoal and food for the fishing trip with the agreement to sell the catch to them later. All boats at the study sites were V-shaped.

### 3.2. Socio-Economic Features of the Fishers

All fishers (100%) participating in artisanal fishing operations at the study sites were male. The average age was 36 years, and the age was mostly 30 years. Most fishers (58%) were married. Although 54% of fishers studied up to primary school, only 14% of them did not receive any type of education. Most fishermen (54%) had between 4 and 6 members within their household, while 30% had more than 7 members within their household. Only 16% have between 1 and 3 members in their family. Overall, 84% of artisanal fishing households in the study sites had at least four members residing within the household. Most fishers (86%) was full-time fishers and relied heavily on fishing because they did not have access to other productive resources. The other fishers (14%) had alternative livelihoods such as animal husbandry and agriculture. About 70% of fishers

**Table 1.** Factors determining the use of fishing gear at study sites.

Factor	Frequency	Percentage	Rank
Target fish species	41	19.2	1 <sup>st</sup>
Season	36	16.9	2 <sup>nd</sup>
Efficiency of gear	31	14.6	3 <sup>rd</sup>
Fishing location	30	14.1	4 <sup>th</sup>
Freshness of catch	29	13.6	5 <sup>th</sup>
Safety at operation	21	9.9	6 <sup>th</sup>
Cost of gear	19	8.9	7 <sup>th</sup>
Other	6	2.8	8 <sup>th</sup>
<b>Total</b>	<b>213</b>	<b>100</b>	<b>8</b>

have been working in artisanal fishing for more than 10 years, while about 20% have less than 5 years of fishing experience (**Table 2**).

Fishers belong to various fishers' associations. Most fishers (58%) were not members of any fishers' cooperatives due to the absence of government support. About 36% of the fishermen were members of Mohammad Qol Fishers' Association. Only 4% and 2% of fishers were members of the Dungonab and Red Sea Fishers' Union, respectively. However, fishers work individually and make

**Table 2.** Socio-economic characteristics of the fishers and their relationship to the use of gears and boats in the study sites.

Variable	Characteristic	%	Handline	Gill Net	Cast Net	Trap	Troll line	Trawl net	Motor Boats	Paddle Boats
Sex	Male	100	327	63	41	11	10	3	54	4
	Female	0	0	0	0	0	0	0	0	0
Age	≤20	12	37	6	6	0	0	0	7	1
	21 - 30	30	91	12	8	1	2	1	9	2
	31 - 40	24	105	29	9	8	0	2	13	0
	41 - 50	18	47	8	9	0	2	0	12	0
	51 - 60	12	41	13	8	2	6	0	8	0
	>60	4	6	4	1	0	0	0	5	1
Marital status	Married	58	196	41	24	10	6	1	31	1
	Single	42	131	22	17	1	4	2	23	3
Education level	Uneducated	14	43	5	4	4	0	0	8	1
	Qur'an education	6	17	8	3	0	2	0	7	0
	Primary education	54	195	29	22	3	4	2	23	3
	Secondary education	18	39	7	10	2	2	1	11	0
	Vocational education	2	8	0	0	0	0	0	1	0
	Tertiary education	6	25	14	2	2	2	0	4	0
Number of households	1 - 3	16	60	3	3	4	0	0	7	2
	4 - 6	54	185	44	27	6	8	2	25	2
	>7	30	85	16	11	1	2	1	22	0
Status of work	Fulltime	86	287	43	35	9	10	3	47	1
	Part-time	14	40	20	6	2	0	0	7	3
Fishing experience	1 - 5 years	20	54	13	10	0	2	0	6	2
	6 - 10	10	31	6	3	0	0	0	4	1
	11 - 15	14	42	2	5	4	0	1	13	0
	>15	56	200	42	23	7	8	2	31	1
Cooperative Membership	Member	42	135	34	16	4	6	1	19	0
	Non-member	58	192	29	25	7	4	2	35	4
Residence status	Local	78	256	48	33	11	4	1	43	4
	Migratory	22	68	15	8	0	6	2	11	0

individual arrangements with the fish traders who buy their catch.

### 3.3. Favorite Species among Fishers

Fishers characterized fish species according to three criteria: 1) those that are caught frequently/consistently (even if in low quantities); 2) those that are abundant in the catch; 3) their favorite catch. Trevally (*Caranx* species), was the most frequently caught species, followed by Grass emperor (*Lethrinus laticaudis*), Areolate grouper (*Epinephelus areolatus*), Parrot fishes (Scaridae spp.), Lyretail grouper (*Variola louti*) and Coral trout (*Plectropomus maculatus*), respectively (Figure 4). In terms of abundance, Parrot fishes are reported to be the most abundant in number, followed by Trevally. Coral trout was the favorite catch among fishers, followed by Lyretail grouper and Areolate grouper in order.

### 3.4. Fishing Effort, Selling and Income

There were significant differences in the effort devoted to catching fish among fishers. The majority of fishers (85%) spend between 4 and 6 days per week. Only 15% of fishers fish during the day, spending between 6 and 8 hours a day, 7 days a week. Fishing trips consist of a crew of two per *houri* or fiberglass. The crew used an average of 6 - 10 gears, including gillnets with varying mesh sizes, varying lengths of handlines, and approximately 1 - 2 cast nets per boat. Fishing is practiced throughout the year except for Friday and Saturday, when fishers rest and prepare for the next trip. The days of stopping fishing are due to the rough sea and poor catches in the previous days. Fishers fish about 24 days a month during the fishing season (May–August) and 15 days a month during the off-season (September–January).

The majority of fishers (94%) sell their catch directly to fish traders as fresh.

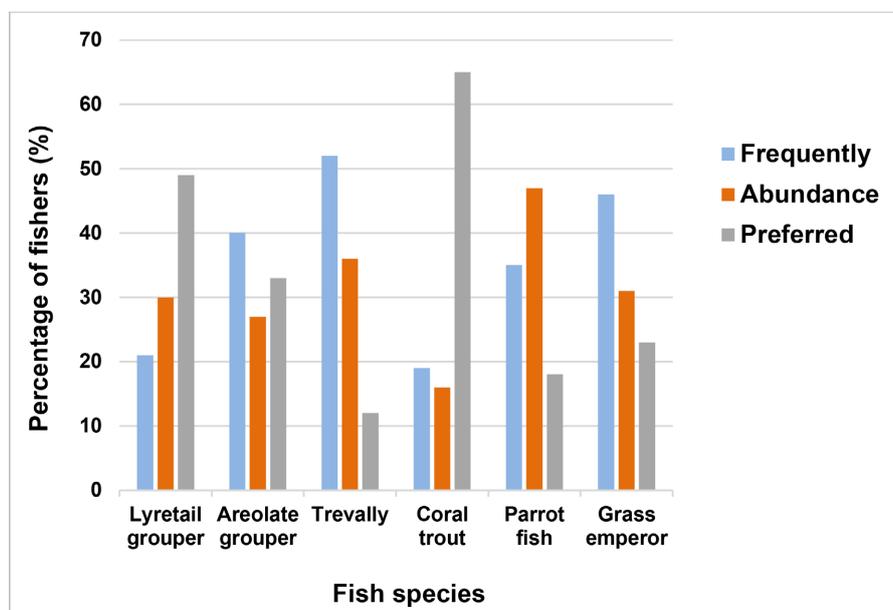


Figure 4. Criteria for characterizing fishers towards some caught fish species.

Only 6% of them sell their catch to fish traders and sometimes they prefer to sell to the main market in Port Sudan, which offers a diverse range of customers and better profits due to higher prices. Fish traders visit different landing sites twice a week to buy fish. After purchasing the fish from the fishers, the traders bring the fish to the main market in Port Sudan by truck.

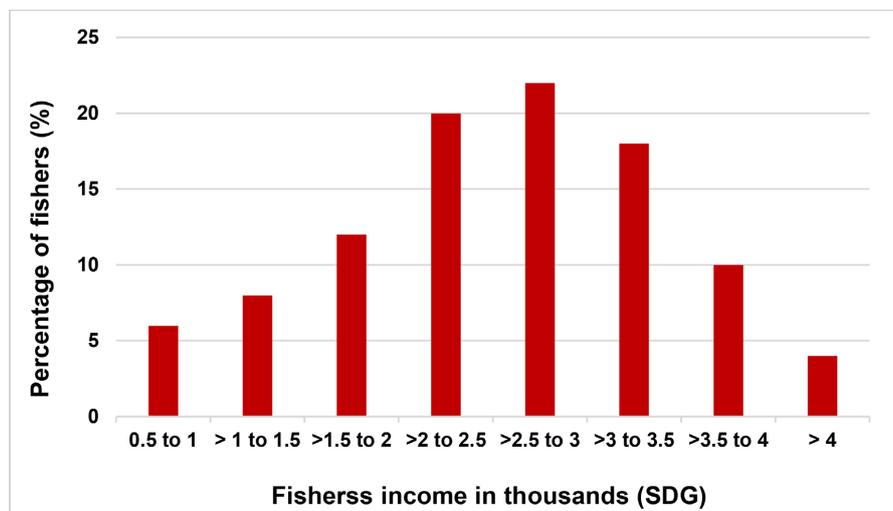
**Figure 5** shows the distribution of weekly income among fishers. Fishers use a percentage sharing system after selling the catch. As for the money remaining after removing expenses such as ice, fuel, coal, etc., it was considered income and was divided in proportions of 28%, 38%, and 34% between the boat owner, the fishers plus driver, and the fishers, respectively. More than 60% of fishers in the study sites earned a weekly income between 1000 and 3000 Sudanese pounds (SDG), and only 4% earned more than 4000 SDG.

### 3.5. Challenges Identified by Fishers

Fishers usually face many challenges related to their profession. The vast majority (19%) faced the challenges of low fish prices, followed by sea surface roughness, high costs of fishing materials, and declining of fish stocks, respectively (**Table 3**).

### 3.6. Fishers' Perception and Environmental Awareness

A larger percentage of fishers have noted a recent decline in both catch size and abundance. There was no overwhelming answer from fishers about potential reasons for the change in fish resources. The reasons given by fishers included an increase in the number of fishers. Another reason stated that the fish moved to deeper waters. Additional responses from fishers included overfishing and weather. The fishers were highly aware and knowledgeable about local fisheries management laws such as prohibited fishing practices. The opinions regarding the future of fishing expressed by the fishers were not positive. Most of the fishers' group leaders stated that the future of the fishery is not promising because of



**Figure 5.** Weekly income distribution among fishers.

**Table 3.** Challenges identified by fishers at the study sites.

Factor	Frequency	Percentage	Rank
Fish prices	44	19	1 <sup>st</sup>
Sea surface roughness	41	17.7	2 <sup>nd</sup>
High cost of fishing materials	39	16.9	3 <sup>rd</sup>
Declining of fish stocks	32	13.9	4 <sup>th</sup>
Credit facilities cannot be accessed	28	12.1	5 <sup>th</sup>
Inability to repair boat and gear	18	7.8	6 <sup>th</sup>
Poor durability of gear material	13	5.6	7 <sup>th</sup>
Decreased ability to catch fish with gear	8	3.5	8 <sup>th</sup>
Other	5	2.2	9 <sup>th</sup>
Fish spoilage	3	1.3	10 <sup>th</sup>
<b>Total</b>	<b>231</b>	<b>100</b>	<b>10</b>

unsustainable fishing practices due to the entry of large fishing vessels into these areas.

#### 4. Discussion

All fishing gears reported during the current study were acknowledged by Reed [10] and Mishrigi [9]. Fishing handlines are classified as the most important and most widely used fishing tools among fishers. The dominance of handlines followed by cast nets and gillnets can be traced back to the mid-60s as previously mentioned by [10]. Gillnets are widely used in artisanal fisheries in developing countries because they are efficient, relatively inexpensive, and capable of catching larger quantities of economically valuable fish than other artisanal gear [28]. Although handlines and gillnets are acceptable in the northern Sudanese coast, fishers change their gear during fishing activities. As stated by [10], different gears are used to target fish due to habitat changes. The current study provided a consistent description of fishers' dependence on fish species and seasonal variability as the main reasons for changing fishing gear.

There is variation in the efficiency of fishing gear used by fishers; this difference in efficiency may be affected by the length and size of the hook and the mesh size of the net, which may always have a greater impact on the size of the species caught. This may be due to the behavioral pattern of the gear itself (passive or active) and even related to the materials used in the manufacture of fishing gear.

Almost all fishers have handlines. Other commonly used fishing gears are gillnets and cast nets, which constitute approximately 60% of fishers' use at the study sites. However, handlines of different thickness and length are the most commonly used active gears. It can be operated from shallow depth to great depth. Gillnets and most cast nets can be used for pelagic fishing, especially for

sardine schools, which are of great importance in local fisheries, as they are the most commonly used bait. Handlines are used to catch a wide range of fish species. Hence, the majority of fishers believe that they are more efficient (powerful) and allow them to target their favorite species.

All boats sampled during the study were built of either wood panels or fiberglass. Wooden boats are made locally, and fiberglass boats are often imported from Saudi Arabia. Many fishers use motorized fiberglass boats, and this is achieved through the framework of [12] in the northern coast of Sudan. Most fishers only have one boat; this may be due to the low level of income and perhaps to the size of the family. However, some fishers do not own boats, so they fish using boats owned by fish traders.

The results of the current study showed that there were a few types of boats used in the study sites. In previous studies, [9] identified four types of fishing boats in Sudanese coastal waters: the dugout, the *huries*, the *felukas* and the launch boats. Fiberglass boats are more widely accepted by fishers than wooden boats. The reason for using fiberglass boats may be due to the ease of crossing deep waters or avoiding coral reefs, in addition to fishers claiming that they are always comfortable and safe on them. In the current survey, all the boats found were V-shaped. The reason for the V-shaped boat is probably the surface's ability to be exposed to water movements.

The boats used by fishers in the northern Sudanese Red Sea coast are mainly equipped with motors, and a small number of fishers use paddle boats due to their financial inability and due to the high prices of boats and outboard motors. Fishers believe that motorized boats make it easier for fishers to reach fishing grounds farther and deeper from shore, and perhaps other landing sites. Aside from the simplicity of fiberglass boats, they are also durable and can last for more than 15 years.

Fishers reveal that motorboats (outboard motors) are larger, but more expensive, while paddle boats are very small and affordable. The observed trend of boat thrust indicates that boat cost and boat size may be determining factors in choosing to use a boat for fishing activities. The following three factors always determine the choice of the right boat: efficiency, fishing mileage, and lack of maintenance.

It was noted that the main determinants responsible for selecting fishing gear are the suitability of the gear to catch the target fish, followed by the fishing season and the efficiency of the equipment. The effectiveness of fishing gear can be expressed in terms of the number of fish caught by the fishing gear per unit time. Equipment efficiency is directly related to the likelihood of encountering and catching a fish in the equipment. According to [29], fishing efficiency varies with gear types. In general, the fishing gear used to catch fish may have an estimated impact on catches and thus on income.

Generally, the results of the current study showed that there is no sufficient relationship between the social-economic characteristics of the fishers and the

use of both fishing equipment and boats.

Fishing is the main source of employment and income in the study sites and contributes to fishers' survival in terms of food supplies and occupations. Fishers earn a relatively good weekly income, with about 50% of them earning between 1000 and 3000 SDG. Fishers' income is unequal, and disparities are often very large, especially between poorly equipped fishers and fishers with motorized boats. Due to the seasonality of fishing, income is not distributed evenly throughout the year. The income of fishers' communities in the study area is generally low, especially during the non-fishing period. From August to September, there are no fishing activities, they simply cannot catch enough fish to run a living, and this leads to more indebtedness. This unequal reproduction in androids between hunting and non-hunting leads to indebtedness. During the non-fishing period, fishers' resort to collecting shells otherwise they can enjoy income generating economy such as agricultural and animal rearing. A number of family members may be able to improve income to support livelihoods through more extractive fishing [2].

In this study, the marketing channel is considered traditional and remains in the hands of private sector traders, and the government has no role in this area. Therefore, fish prices are usually set by the traders' union. Fishers are obligated to sell their fish to traders because they receive *Zuwadah* from them, but few fishers sell their catch through fish traders or directly in the Port Sudan market. Fishers usually sell fish by the kilogram. However, only a few species are sold in large quantities. Fishers and fish traders use personal agreements to sell catches that are based on species and body weight. Every fisher has a stable and permanent trader who buys his fish. The market price of fish is not always constant, for example, when the supply of fish is high, the price of fish falls, and when the supply of fish is low, the price rises. The fish distribution channel starts from fishers to fish traders and finally to consumers.

There is a claim by some fishers that fishing is declining. It is likely that it is in the catch as a result of fishing pressure. However, this may be due to another factor such as seasonal variation. It may also have a negative impact on coral bleaching in the area. [30] noted that there were signs of overfishing on certain groups such as the large Serranids, in particular the Nagil (*Plectropomus*), the Kokian (*Trochus*) and the beach-de-mer (sea cucumber). These observations are supported by accounts of changes in catch received from fishing communities across the current study sites. Of particular concern is reported information about heavy fishing at spawning and hatchery sites in Nagil and other fishery groups. This occurs in several places, most notably on the southern tip of Mukkawwar Island. If this practice continues this path, it may result in the loss of some of the most important fish species from all or part of the current study sites.

Therefore, awareness efforts should focus on the younger generation of fishers. Regulations to ban certain species in the breeding season or set quotas for

certain species will not be well received by local communities unless combined with alternative livelihood options to generate income.

## 5. Conclusions

The fishers considered that the problem facing the administration was the lack of monitoring of fishing by the government. The area's fisheries will not be sustainable in the long term. Previously, there was support for cooperation through the establishment of a specialized department to grant credit and technical support to these cooperatives. Currently, there are no political decisions to support cooperation. In addition, there seems to be no effective joint action and real cooperation between fishers and government towards the use of fishing gear, diversity of fish species, income level of fishers, operation of fish market and fisheries management in general.

The head of the fishers' group (*Rais*) indicated that they noticed a continuous increase in the number of fishers in their fisheries due to the lack of work, which forced them to resort to fishing. Most of them use animal husbandry and agriculture as an alternative for their livelihood. Fishers often combine all three activities (fishing, animal husbandry and agriculture).

However, the challenges facing fishers in the Sudanese Red Sea northern coast are not new but are common to other artisanal fisheries in the country and other developing countries of the world. This indicates that these are the main problems faced by artisanal fishers in most parts of Sudan. Governments and non-governmental organizations have pledged to solve some of these challenges, but they lack continuity, and the lack of access to credit facilities to purchase fishing inputs is a problem often raised by fishers in the region.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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