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SOCIOECONOMIC CHARACTERISTICS OF BOTTOM TRAWL FISHERY EXPLOITING DEEP-WATER ROSE SHRIMP AND EUROPEAN HAKE IN NORTH TUNISIA

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by

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Preparation of this document

Within the framework of the FAO MedSudMed project "Assessment and Monitoring of the Fisheries Resources and the ecosystem in the Straits of Sicily" (GCP/RER/010/ITA), several activities were launched since 2001. The aim was to enhance the capacity of the fisheries institutions in the south-central Mediterranean countries to collect and analyse fisheries socioeconomic data, in line with the recommendations of the FAO General Fisheries Commission for the Mediterranean (GFCM). The activities comprised training, support for data collection and follow-up assistance for the assessment of socioeconomic conditions and the economic performance of the fleets. The latter was achieved by direct in-country support and through the organization of regional working groups. Data collected in Tunisia with the support of the project in 2016, 2017 and 2018 were analysed and jointly discussed by national experts on occasion of the MedSudMed Working Groups and ad hoc meetings in 2019. The goals of the analysis were to contribute to an understanding of the main socioeconomic features characterizing the bottom trawl fleet targeting two high value fisheries resources in Tunisia, to support countries in compliance with international requirements in terms of data collection, and to provide national institutions with baseline data to supporting fisheries management. This document outlines the methods adopted and the results of three years of socioeconomic data collection in north Tunisia, including a description of the main socioeconomic drivers of the bottom trawl fishery exploiting deep-water rose shrimp and European hake. The main results presented in this document have been published on Marine Policy (https://doi.org/10.1016/j.marpol.2021.104952).

Abstract

The document summarizes the analysis of the socioeconomic data collection programme for the trawl fleets which target deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) conducted in northern Tunisia in 2016, 2017 and 2018. The programme was carried out within the framework of the FAO MedSudMed Project "Assessment and Monitoring of the Fishery Resources and the Ecosystems in the Straits of Sicily". The data collection was designed on the basis of a standardised methodology developed by FAO that consists of a multivariate sampling survey based on a statistical design where the licensed fishing fleet is stratified into homogenous segments and the sampling unit (fishing vessels) is selected randomly. The steps and methodology followed during the MedSudMed socioeconomic data collection are summarized in this document. Further to this, performance indicators for the northern Tunisia shrimp and hake trawl fleets for the years 2015, 2016 and 2017 are presented. In its last section, the document outlines the main constraints and indications provided by fishers on the future development of the deep-water rose shrimp and European hake fishery in Tunisia. Over 2015, 2016 and 2017 the fishing fleet comprised 589 vessels which operated for 84 500 days and directly generated a total of 6 957 jobs, calculated on a full-time basis. The fishery capture production in the three years of surveys produced a cumulative value of USD 240 million. The study and collected data are envisaged to play a functional role in the planning and informed management of sustainable and profitable fisheries in the area, without jeopardising natural resources, in accordance with the principles of the ecosystem approach to fisheries.

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Acknowledgements

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Abbreviations and acronyms

CU	capacity utilization
DGPA	Direction Générale de la Pêche et d'Aquaculture, Tunisia
FTE	full-time equivalent
GFCM	FAO General Fisheries Commission for the Mediterranean
GSA	geographical subareas
FAO	Food and Agriculture Organization of the United Nations
LOA	length overall
TND	Tunisian Dinar

1. Introduction

The MedSudMed project "Assessment and Monitoring of the Fishery Resources and the Ecosystems in the Straits of Sicily" is a regional project implemented by the Food and Agriculture Organization of the United Nations (FAO) in collaboration with four countries from central-southern Mediterranean: Italy, Tunisia, Libya and Malta.

Funded by the Italian Ministry of Agriculture, Food and Forestry Policies and the European Commission's Directorate-General for Maritime Affairs and Fisheries, the project aims to support scientific communities and participating countries in the establishment of a monitoring system for marine resources and fish ecosystems. Additionally, the project promotes the development of scientific cooperation aimed at the implementation of standardized methodologies in marine fisheries research, which will allow for the reinforcement of both national and regional expertise.

The MedSudMed project focuses its activities in the south-central Mediterranean, one of the most important fishing grounds in the Mediterranean and Black Sea regions (FAO, 2020a). Fishing effort and fishery production are constantly increasing in the region, which has also expanded the utilization of marine ecosystem services. However, data availability for the marine resources, ecosystems and the prevailing socioeconomic conditions of the fisheries is often incomplete (FAO, 2020a).

In this context, a socioeconomic data collection programme for the trawl fleets which target deep-water rose shrimp (*Parapenaeus longirostris*, hereunder referred to as shrimp) and European hake (*Merluccius merluccius*, hereunder referred to as hake) was conducted in northern Tunisia within the framework of MedSudMed objectives. The survey and collected data are envisaged to play a functional role in the planning of management of sustainable and profitable fisheries in the area, without jeopardising natural resources, in accordance with the principles of the ecosystem approach to fisheries.

This report summarizes the steps and methodology followed during the MedSudMed socioeconomic survey. Further to this, performance indicators for the northern Tunisia shrimp and hake trawl fleets for the years 2015, 2016 and 2017 are presented.

The use of indicators allows for ease of communication, transparency, effectiveness and accountability. Indicators are an easy-to-understand tool for the evaluation of the state and trends of marine resources and fishing activities, as well as for the presentation of the assessment of the outcomes of fisheries policies at the global, regional, national and local levels. Indicators are however, not a goal in themselves. Rather, they are an instrument to help clarify the evaluation of and comparisons between different fisheries or, within different years for the same fishery, such as the study presented herein. Indicators also show in simple terms to what extent the sustainable development goals are being achieved.

2. Methods

This work is based on the data collected through ad hoc socioeconomic surveys. The surveys were designed to shed light on both the socioprofessional structure of the selected fisheries in northern Tunisia, as well as the different economic indicators reflecting the state and performance of the shrimp and hake fisheries.

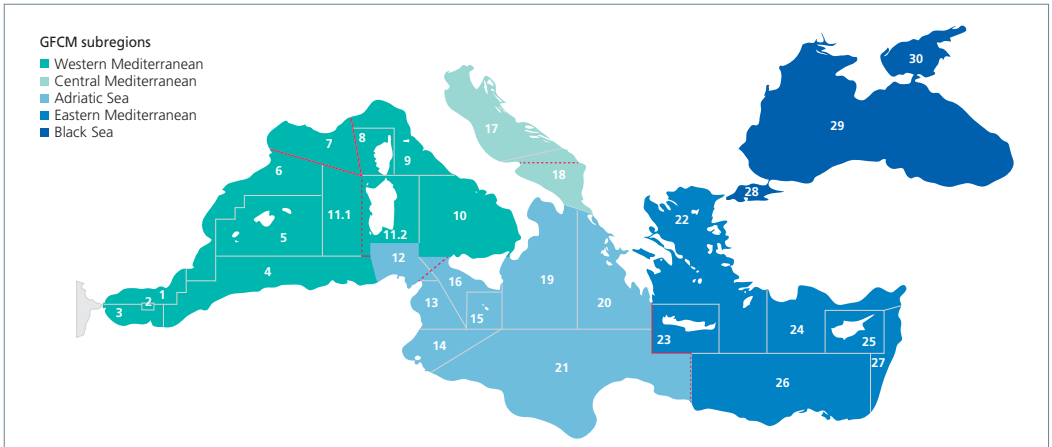
2.1 SURVEY DESCRIPTION

The socioeconomic survey was based on direct interviews with vessel owners or captains, selected randomly within the bottom trawl vessels targeting shrimp and hake in north Tunisia. The interviews were conceptualized, designed and divided into different parts according to an ad hoc developed questionnaire (see Annex 1). The first part of the survey questionnaire was dedicated to general data collection relative to the unit of exploitation and the boat owner. Social data collection, such as age, level of education, experience, complementary economic activities and household size of fishers, was included in the subsequent section (Sabatella, E., and Franquesa, R., 2004). Economic data collection included the costs associated with personnel, commercial activities, fixed costs, investments made, variable costs as well as common costs. The commercial costs included data collection relating to fishing techniques utilized, as well as any revenue sharing system in place in the study area. Lastly, the survey included a section regarding the commercialization of fishery products.

2.2 STUDY AREA

The study area comprises the entire coast of northern Tunisia from Tabarka to Kélibia as per the FAO General Fisheries Commission for the Mediterranean (GFCM) geographical subarea (GSA) 12 (north Tunisia) depicted in Figure 1.

FIGURE 1. Map of the area of application of the FAO General Fisheries Commission for the Mediterranean – geographical sub regions and sub areas



01. Northern Alboran Sea	07. Gulf of Lion	13. Gulf of Hammamet	19. Western Ionian Sea	25. Cyprus
02. Alboran island	08. Corsica	14. Gulf of Gabès	20. Eastern Ionian Sea	26. South Levant
03. Southern Alboran Sea	09. Ligurian Sea and northern Tyrrhenian Sea	15. Malta	21. Southern Ionian Sea	27. Eastern Levant Sea
04. Algeria	10. South and central Tyrrhenian Sea	16. South of Sicily	22. Aegean Sea	28. Marmara Sea
05. Balearic islands	11.1. Sardinia (west) 11.2. Sardinia (east)	17. Northern Adriatic Sea	23. Crete	29. Black Sea
06. Northern Spain	12. Northern Tunisia	18. Southern Adriatic Sea	24. North Levant Sea	30. Azov Sea

Source: GFCM Data collection Reference Framework (DCRF). Version 21.2. Rome. 135pp. (also available at https://www.fao.org/gfcm/data/dcrf/en/).

Data collection focused on the four main fishing ports namely Tabarka, Bizerte, la Goulette and Kélibia (Figure 2). The ports were selected for the purposes of the study because they accommodated the majority of the studied fishing fleet and they were the most important ports with regards to resource exploitation and productivity within the study area.

FIGURE 2. Location of fishing ports

Source: Google map 2020 modified.

2.3 TARGETED VESSELS

This study focused on *Parapenaeus longirostris* and *Merluccius merluccius* fisheries in northern Tunisia.

FIGURE 3. Distribution of fishing fleet segments by length class

Vessel groups			Length classes (LOA)			
			< 6 m	6 - 12 m	12-24 m	> 24 m
Polyvalent	P	Small-scale vessels without engine using passive gear	P-01	P-02	P-03	P-04
			P-13			
		Small-scale vessels with engine using passive gear	P-05	P-06	P-07	P-08
		Polyvalent vessels	P-09	P-10	P-11	P-12
					P-14	
Seiners	S	Purse seiners	S-01	S-02	S-03	S-04
					S-09	
		Tuna seiners	S-05	S-06	S-07	S-08
					S-10	
Dredgers	D	Dredgers	D-01	D-02	D-03	D-04
				D-05		
Trawlers	T	Beam trawlers	T-01	T-02	T-03	T-04
		Pelagic trawlers	T-05	T-06	T-07	T-08
				T-13		
		Trawlers	T-09	T-10	T-11	T-12
Longliners	L	Longliners	L-01	L-02	L-03	L-04
				L-05		

Source: GFCM Data collection Reference Framework (DCRF). Version 21.2. Rome. 135pp. (also available at https://www.fao.org/gfcm/data/dcrf/en/).

Figure 3 describes the groups of trawlers which have been divided into different categories according to the vessel length overall (LOA). The surveyed vessels were from the classes T-11 (12 m to 24 m LOA) and T-12 (>24 m LOA). Since no trawlers with a LOA of less than 12 m were present in the Tunisian fleet, no T-09 and T-10 vessels were included in the survey.

The fishing fleets which operated within the survey area were divided into two groups: the local and the migrant fleets. The landing port for the local fleet was located inside the survey area. The migrant fleet was based in the south and east of Tunisia and would occasionally leave the ordinary fishing grounds located in the area to specifically target shrimp and hake in the northern waters of the country (Table 1). The migrant fleet comprised mainly T-12 vessels (> 24 m LOA).

TABLE 1. Number of operating fishing vessels by fishing segment group

Fleet segment	2015		2016		2017	
	T-11 (≤ 24m)	*T-12 (> 24m)*	*T-11 (≤ 24m)*	*T-12 (> 24m)*	*T-11 (≤ 24m)*	*T-12 (> 24m)*
Local active fleet	31	42	44	45	33	44
Migratory fleet	42	62	56	87	39	65
Total fleet per segment	72	104	100	132	72	109
Total fleet	176		232		181	

Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

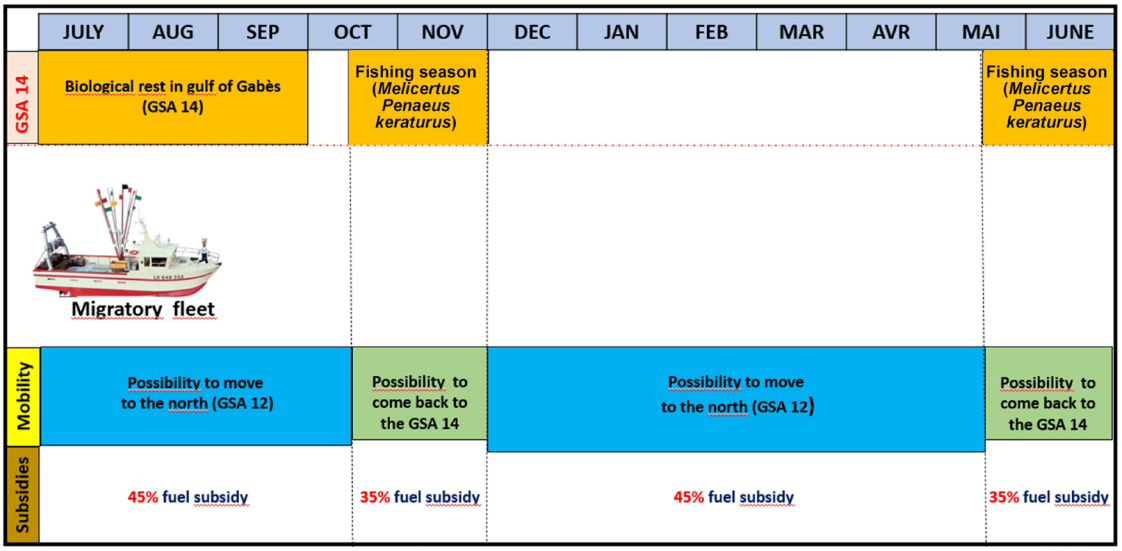
2.4 FLEET MOBILITY

The fleet from the northern part of Tunisia (GSA 12) has the right to migrate southwards towards GSAs 13 and 14, but only during the two fishing campaigns for striped prawn (*Melicertus kerathurus)*. The first campaign lasts from 15 October to 30 November and the second starts on 15 May and ends on 30 June. According to Tunisian legislation, fleets operating in the GSA 12 area receive a fuel subsidy benefit of 45 percent and fleets operating in GSAs 13 and 14 receive a 35 percent fuel subsidy benefit.

In addition, the fleet from GSAs 13 and 14 have free access to the northern waters (GSA 12) throughout the entire year, with the only requirement of maintaining updated administrative papers. The goal of the fleet's migration is to target shrimp and hake but it is not compulsory to target those fish species. Fleet migration begins mainly in July and coincides with an imposed three-month biological rest period in the Gulf of Gabès (southern Tunisia).

Compensation salaries are offered to vessels not moving northwards for the duration of the biological rest period. For most of the fleet that remains in the Gulf of Gabès, this time is used for boat maintenance purposes. The vessels that do migrate would most likely remain in the northern waters throughout the year, only returning to the Gulf of Gabès for the two striped prawn fishing campaigns in October/November and May/June. The two fishing campaigns have the advantage of catching shrimp for lucrative export purposes.

FIGURE 4. Mobility of Tunisian trawlers



2.5 SAMPLING STRATEGY AND DATA COLLECTION

In 2017, FAO reported that when the sample survey and knowledge of the estimated population parameters are not known or not well established (usually in the first two to three years), a "disproportionate allocation" sampling scheme can be applied (Sapsford and Jupp, 2006). Adoption of this approach, allows for the sample to be kept as large as possible (with consideration of budget constraints), so as to ensure a higher coverage rate for the smaller sized segments, while minimizing the variance of each of them (FAO, 2017).

The size of each segment is inversely proportional to the size of the population in the segment, as seen in Table 2. (FAO, 2017) reported that, in general, the larger the sample size, the bigger the sample mean and standard deviation will be – approximately normally distributed about the population mean and population standard deviation (Grafton *et al*., 2006).

TABLE 2. "Disproportionate" allocation of the sample size in the strata

Number of vessels per stratum	Sampling rate
< 50	50%
50–500	25%
500–2 000	10%
> 2 000	5%

Source: FAO. 2017. *Handbook for fisheries socio-economic sample survey: principles and practice*. FAO Fisheries and Aquaculture Technical Paper No. 613. Rome. (also available at https://agris.fao.org/agris-search/search.do?recordID=XF2017003178).

The fleet migration from the southern to the northern regions of Tunisia for the purpose of targeting shrimp and hake, was taken into account during sampling activities. The size of the migrating fleet changed slightly during the survey years of 2015 to 2017. The sampling rate remained unaltered during the three sampling years (Table 3).

TABLE 3. Sample composition per segment

Segment	T-11 (≤ 24m)	T-12 (> 24m)
Number of sampled units per segment	27	39
Total number of sampled units	66	

Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

Data was collected by a team of four people (one person per port). The surveying activities were successfully conducted due to the data collection team's availability, knowledge about the survey area and good communication skills. The data collection process did, however, take more time than expected due to the absence of boat owners, mobility of some trawlers across different ports, the reluctance of a few fishers to answer the questionnaire, and unfavourable weather conditions.

Data collection was accompanied by constant monitoring and inspection by the Tunisian national focal point. This process was found to be of significant benefit for improving coordination and ease of work, and to improve the quality of the final results.

2.6 DATA COUNTING, TREATMENT AND ANALYSIS

All the information collected from the surveys was transferred to an Excel database. To minimize the occurrence of errors, the database was verified, modified and corrected through the data editing procedure described in FAO (2017). Information obtained through the survey was elaborated on to extract different types of indicators, which are summarized in Table 4.

TABLE 4. Description of different types of indicators

Type	Indicator	Description
Demographics	**Age of crew members**	Average age of fishers in the survey area targeting shrimp and hake.
	Literacy level of crew members **Percentage of total population that can read and write.**	
	Household size of crew members	Total number of household members living with the fisher (provides an estimate of the average household size of the target population).
	Professional experience	Level of professional development in the field.
Employment	**Engaged crew (on board)**	Number of jobs on board (including temporary crew and rotational crew).
	Working hours	Any time on board the vessel that the crew is required to work on account of the vessel, including fishing activity, but also any other activities like cleaning, repair and maintenance.
	Total engaged crew	Total number of crew engaged across the whole fleet.
	Engaged crew (full-time employment [FTE] harmonized)	FTE harmonized is based on a threshold of 2 000 hours per FTE.
Activity	**Days at sea**	Standardized fishing time spent actively fishing.
Investments	**Invested capital**	Value of the vessels at the end of the previous calendar year, plus any improvements to existing vessel/gear during the survey period. Unless actually sold during the survey period, the value of the vessel is just an estimate of the value that it would have if sold on the market.
Variable costs	**Personnel costs**	Remuneration of crews, including social security costs.
	Energy costs	Cost of consumed fuel and lubricants for the vessel.
	Commercial costs	All the costs related to selling the production resulting from the activity of the vessel.
	Other operational costs	All the purchased consumable inputs related directly or indirectly to fishing effort. This includes bait, food to be consumed during the fishing trip, costs for delivery of any of these consumables, and components of any assets (gear or vessel) that are not related to maintenance and are consumed within the given year.
	Repair and maintenance costs	Costs for maintenance and repair to the vessel and gears – including both routine and extraordinary maintenance/repairs.
	Fixed costs	Costs not directly connected to operational activities (effort and catch/landings). Fixed costs do not change in relation to the level of activity of the vessel (they remain the same whether there is one trip per year or 200 trips per year).
Economic	Revenues	Value of production measured as the sale of landed fishery products and the income generated from the use of the vessel in other, non-commercial fishing activities.
	Gross cash flow (GCF)	Total amount of cash that the business generates each year. It can be considered as the main indicator for the economic feasibility of fishing companies in the short term.
	Gross value added (GVA)	Net output of a sector after deducting intermediate inputs from all outputs. It is calculated as: revenues – (energy costs + repair and maintenance costs + operational costs + commercial costs + fixed costs).
	Economic profit	Difference between revenues and total (explicit) costs of inputs. It is the primary indicator of economic performance and is often used as a proxy of resource rent in fisheries. It provides an indication of the operating efficiency of the sector and, if expressed as a percentage of revenues, it captures the amount of surplus generated per unit of production. Net economic profit differs from gross profit in that it includes depreciation and the opportunity costs of capital.
	Depreciation cost	Reduction in the value of the capital invested with the passage of time, due in particular to wear and tear.
	Opportunity cost	Implicit cost incurred when an alternative action is forgone but a payment is not made.
Socioeconomic	Remuneration per FTE	Remuneration is among the most important indicators to estimate; it is also the most challenging to estimate. Remuneration per FTE provides the main measure of the contribution to livelihoods for the fishers and, being often paid by crew share proportional to the income, it is also proportional to the overall economic performance.
	Labour productivity (monetary value/FTE)	Measure of productivity as a result of labour inputs that takes into account both the hours worked and the people involved. It is calculated as GVA (measure of output) by FTE employment (unit of labour input). It is expressed in monetary value per FTE, nominal value.
Technical indicators	Capacity utilization (CU)	Degree to which the vessel is fully utilized. From an input-based perspective, this may relate to the ratio of the sea days to the number of days the boat could potentially be at sea under normal working conditions (Ward *et al.*, 2004).

Source: FAO. 2017. *Handbook for fisheries socio-economic sample survey: principles and practice*. FAO Fisheries and Aquaculture Technical Paper No. 613. Rome. (also available at https://agris.fao.org/agris-search/search.do?recordID=XF2017003178).

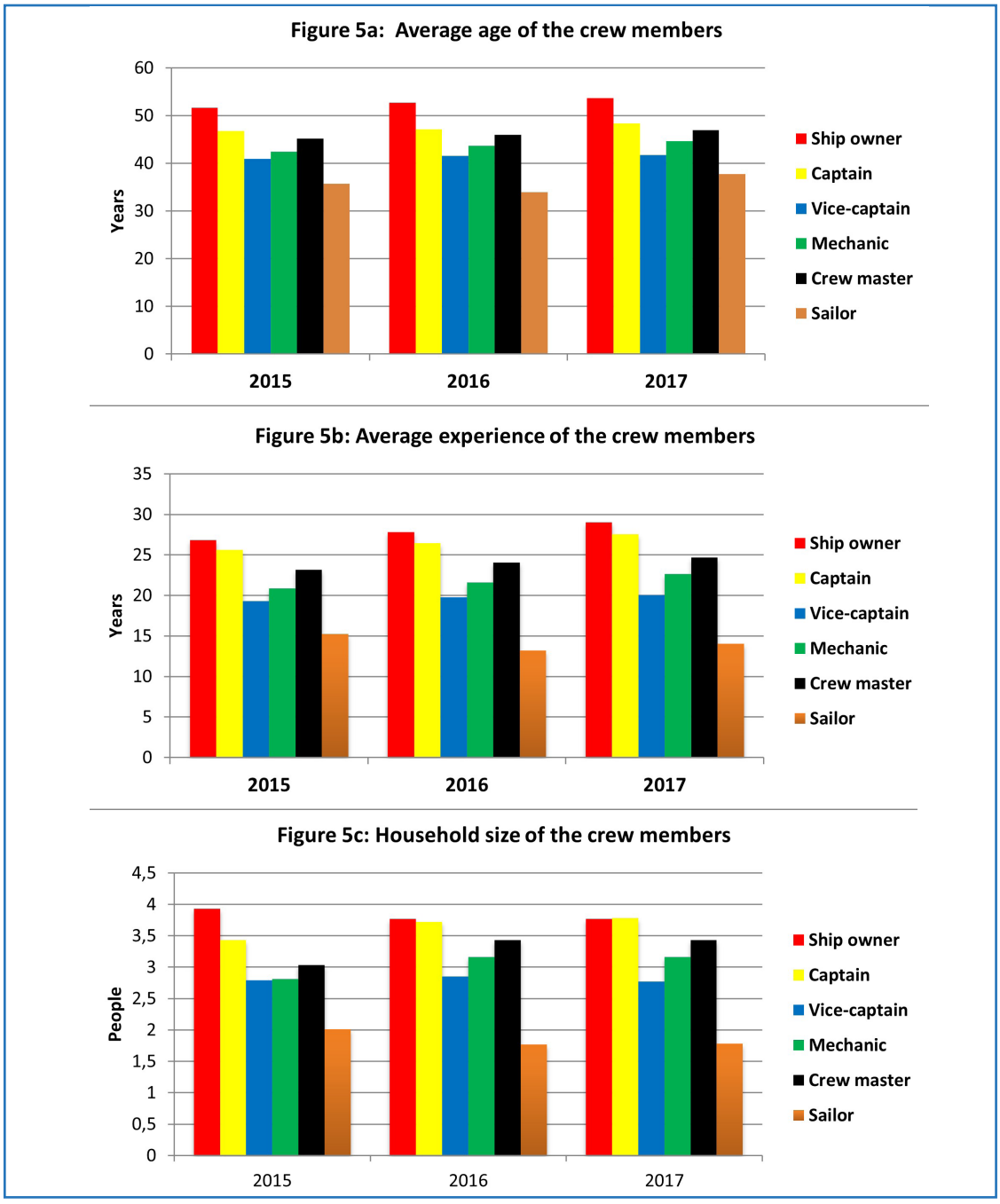
3. Results

Results obtained from the survey are presented below. These are classified according to the group of indicators, namely sociodemographic, economic and technical.

3.1 SOCIODEMOGRAPHIC INDICATORS

Workers employed in the hake and shrimp fishery in northern Tunisia are considered relatively young (mostly between 35 and 45 years of age; Figure 5a). Their level of experience is considered to be high (more than 15 years; Figure 5b) and the size of their families ranges between two and three people (Figure 5c).

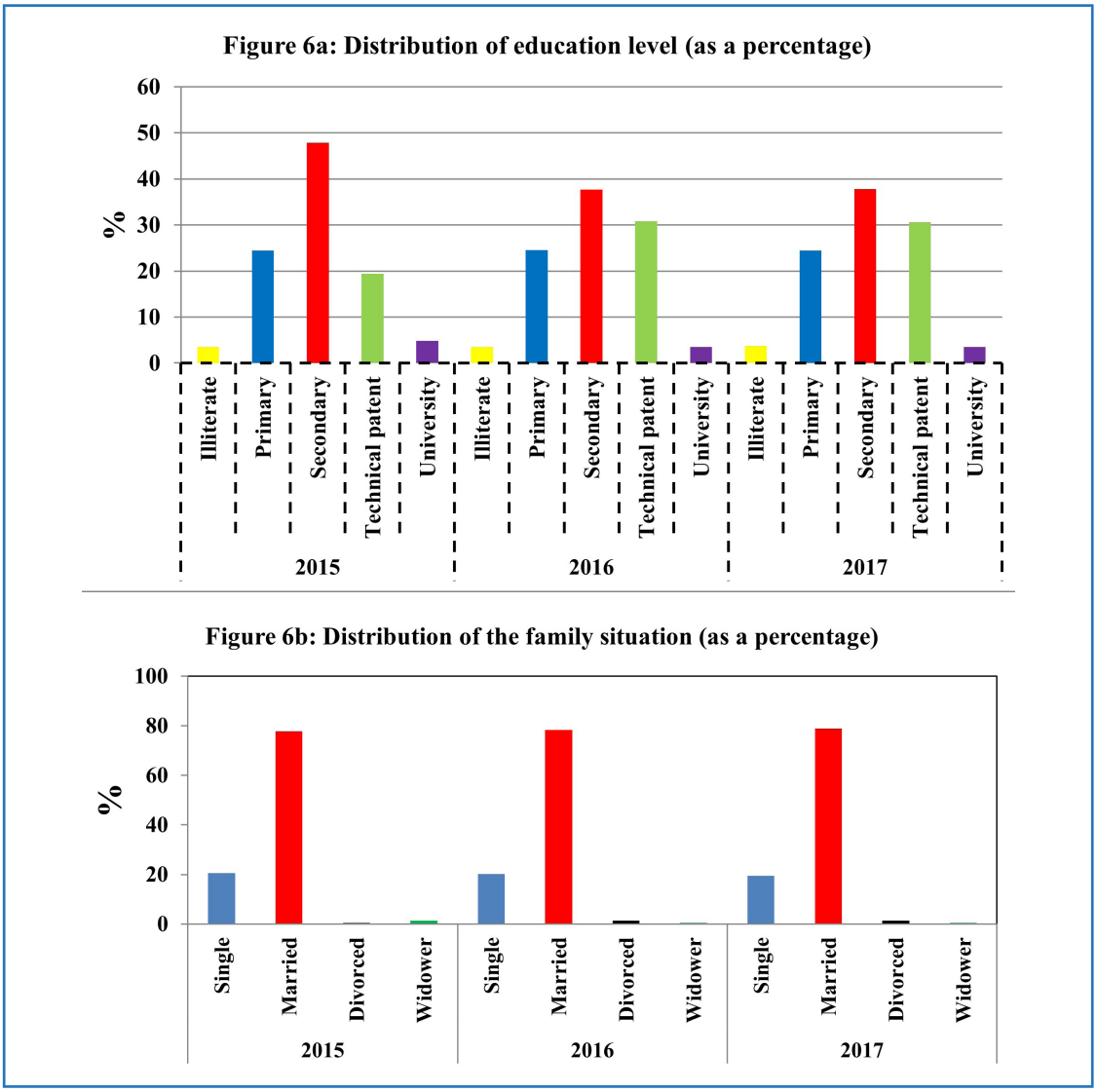
FIGURE 5. Age distribution (5a), work experience (5b), household size (5c).



Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

Almost 40 percent of the population have a secondary level of education, 24 percent have primary level education and more than 25 percent hold a technical diploma (Figure 6a). Only four percent of the workers have a university degree. The majority of the sampled population are married (77 percent; Figure 6b).

FIGURE 6. Distribution of the level of education (6a) and the family situation of the target marine population (6b)



Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

Approximately three and 11 people are respectively employed on land and on board for each vessel. On land, workers are mainly guardians, net repairers and ship operators. In some cases, an accountant and a transporter are also part of the team.

The socioprofessional structure of the fishers is well organized and based on a hierarchy steered from the top, with the captain down to the sailors. Table 5 describes the hierarchy and details the revenue sharing system for all crew members and land workers. Owners have adopted a sharing system based on a percentage of the revenues after fuel, operational and commercial costs are deducted. The owner and crew share the revenue on either a 50/50 split basis or a 52/48 split basis, in favour of the owner. The sharing system may vary from one boat to another and in some cases the owners may even stimulate the productivity of the crew members through additional share percentage incentives of the total revenue.

TABLE 5. Socioprofessional structure and revenue sharing system (Ben Arfa *et al*., 2022)

	Revenue sharing system (average number of parts)
Captain	3.5
Vice-captain	2
Mechanic	2.5
Vice-mechanic	1.5
Specialized sailor	1.5
Crew master	2.25
Sailor	1
Chef	1.25
Guardian	Wage
Net repairer	2.25
Ship operator	Wage
Accountant	Wage
Transporter	wage per trip

Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

The number of sailors employed in the shrimp and hake fisheries in northern Tunisia grew from 1 985 in 2015, to 2 566 in 2016. In 2017, the average number of crew members dropped back to the 2015 employment levels. Both the sharp growth and subsequent decrease were linked to the rise and fall in the number of migrating boats originating from southern and eastern Tunisia.

The average working hours per day for the two trawl fisheries segments were approximately 14 hours in 2015 and increased to more than 15 hours in 2016 and 2017. In each year of the survey, trawlers from the T-11 segment (12 m to 24 m LOA) generally spent less days at sea on average, when compared with the T-12 segment (>24 m LOA) (135 days versus 149 days). The working hours are deemed normal because T-12 trawlers have the ability to travel longer distances and to spend a greater number of days at sea.

Full-time equivalent (FTE) is used as an indicator of employment in the shrimp and hake fisheries. To calculate the FTE, this study referred to the threshold value normally utilized in the primary sector (2 000 hours per year), which can be considered the standard unit of measure of full-time employment. The FTE is calculated as follows:

[(Number of vessels per segment from the fleet register) × (average number of days at sea) × (average number of crew per vessel) × (average number of hours of work per crew member per day at sea)] ÷ (threshold)

TABLE 6. Main indicators of employment and fishing activity

		2015		2016		2017	
		T-11	T-12	T-11	T-12	T-11	T-12
Total number of vessels		72	104	100	132	72	109
Average number of crew per vessel		11.1	11.4	10.6	11.4	10.6	11.3
Total engaged crew	Per segment	797	1 188	1 061	1 505	764	1 232
	Total	1 985		2 566		1 996	
Average working hours per day at sea		13.6	15	15.3	14.8	15	14.8
Average days at sea		134	152.2	141.3	143.5	131.3	151.5
Total days at sea		9 645	15 831	14 134	18 947	9 457	16 510
Total working hours at sea		1 446 754	2 717 253	2 286 917	3 203 265	1 500 986	2 759 305
Engaged crew (FTE harmonized)		723.4	1 358.6	1 143.5	1 601.6	750.5	1 379.7

Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

3.2 ECONOMIC INDICATORS

3.2.1 Revenue

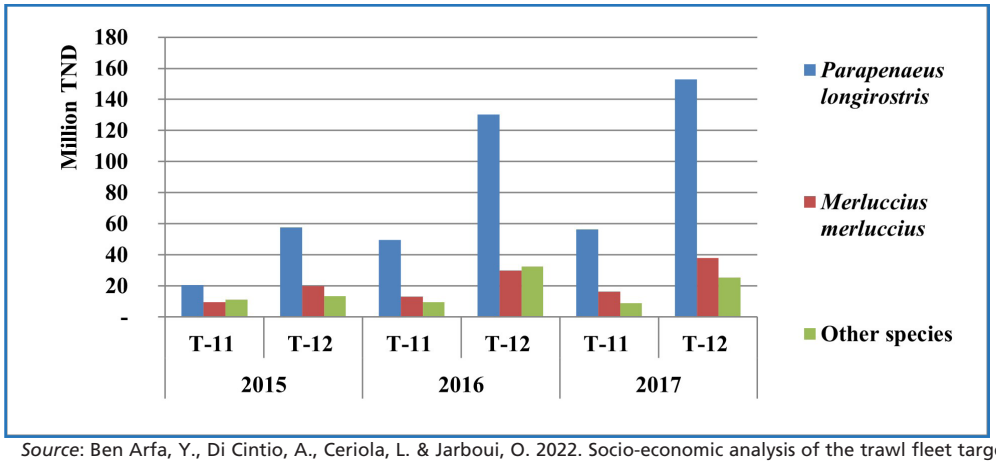
Revenue of the fleets targeting hake and shrimp in northern Tunisia increased in the years 2015 to 2017. The increased revenue was principally related to the sharp increase in shrimp prices experienced at both the national and export levels, with the latter being more lucrative.

TABLE 7. Estimated average revenues (in TND 1 000) per segment (Ben Arfa *et al.*, 2022)

	2015		2016		2017	
	T-11	T-12	T-11	T-12	T-11	T-12
Revenues per segment	41 509	91 080	72 325	192 925	81 640	216 416
Revenues from target species	30 393	77 618	62 619	160 424	72 807	190 870
% of revenues from target species	73.2	85.2	86.6	83.2	89.2	88.2
Total days at sea	9 645	15 831	14 134	18 947	9 457	16 510
Revenues per unit of effort (RPUE)	4.3	5.75	5.11	10.18	8.63	13.1
Total revenues per year	132 589		265 250		298 056	

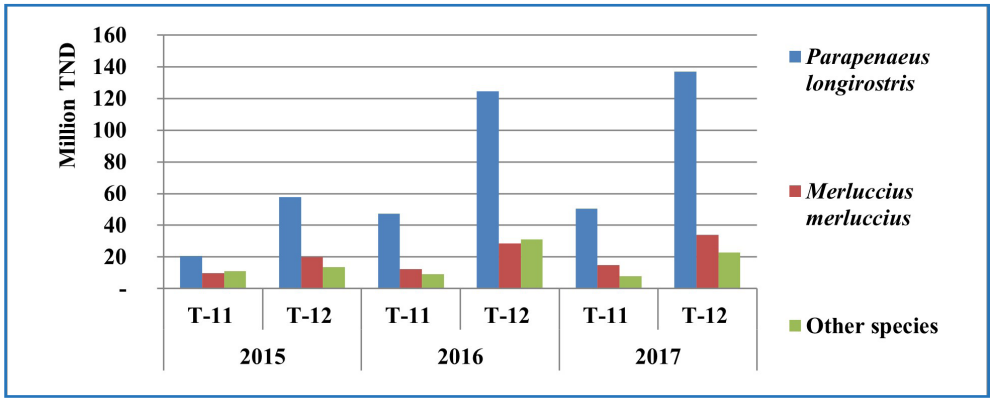
The revenues recorded in Table 7 are expressed in nominal values. Figure 7 and Figure 8 depict the nominal and real values of landings per target species. Shrimp is by far the most lucrative species, mostly due to the constantly increasing international prices received. Hake prices are slightly higher than those achieved for other finfish species.

FIGURE 7. Estimated nominal value of landings per species



Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

FIGURE 8. Estimated real value of landings per species



Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

3.2.2 Average price of target species

Shrimp (*Parapenaeus longirostris*) is in demand in both the national and international markets. Export prices rose constantly between 2015 and 2017 and were also encouraged by a favourable exchange rate, which rose from an average of TND 2.195 for one euro in 2015 to TND 2.905 for one euro in 2017. Processing plants buy shrimp from fishers at a fixed price.

The average price of hake grew by 13.6 percent between 2015 and 2016 and by 16 percent between 2016 and 2017. The increased prices were due to several factors, namely the constant increased rate of inflation (accompanied by a decrease in the purchase power of Tunisian consumers) and increased production costs. These factors caused a general increase in the price of seafood, including hake.

Table 8. Estimated first-sale average price (TND/kg) of target species (Ben Arfa *et al.*, 2022)

	2015		2016		2017	
	National	Export	National	Export	National	Export
Parapenaeus longirostris	8.98	28.8	8.33	35.11	11.11	43.83
Merluccius merluccius	7.14	–	8.11	–	9.42	–

Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

3.2.3 Estimated investments

Invested capital estimated for year 2016 was higher than for the two following years. This was principally related to the increased number of migrating vessels in 2016.

TABLE 9. Estimated invested capital per segment (TND 1 000)

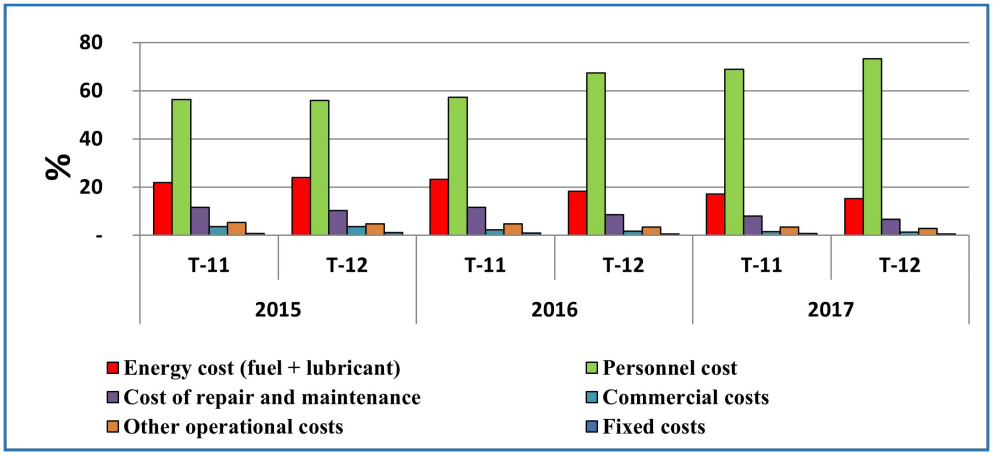
	2015		2016		2017	
	T-11	T-12	T-11	T-12	T-11	T-12
Estimated invested capital	36 867	78 989	63 060	121 875	47 347	101 046
Total estimated invested capital	115 856		184 935		148 393	

Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

3.2.4 Production costs

Production costs were separated into variable and fixed costs. Since fixed costs are generally very low, they were integrated into variable costs (FAO, 2017). Figure 9 shows the composition of variable costs per fleet segment, as well as their progression across the three surveyed years.

FIGURE 9. Distribution and progression of variable costs by segment



Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

Personnel costs (salary and social security) were the highest among all of the production costs. Energy costs (fuel and lubricant) are the second most important. Repair and maintenance costs are the third highest among all variable costs. The ranking of production costs is the same for the two fishing segments across the three years of study.

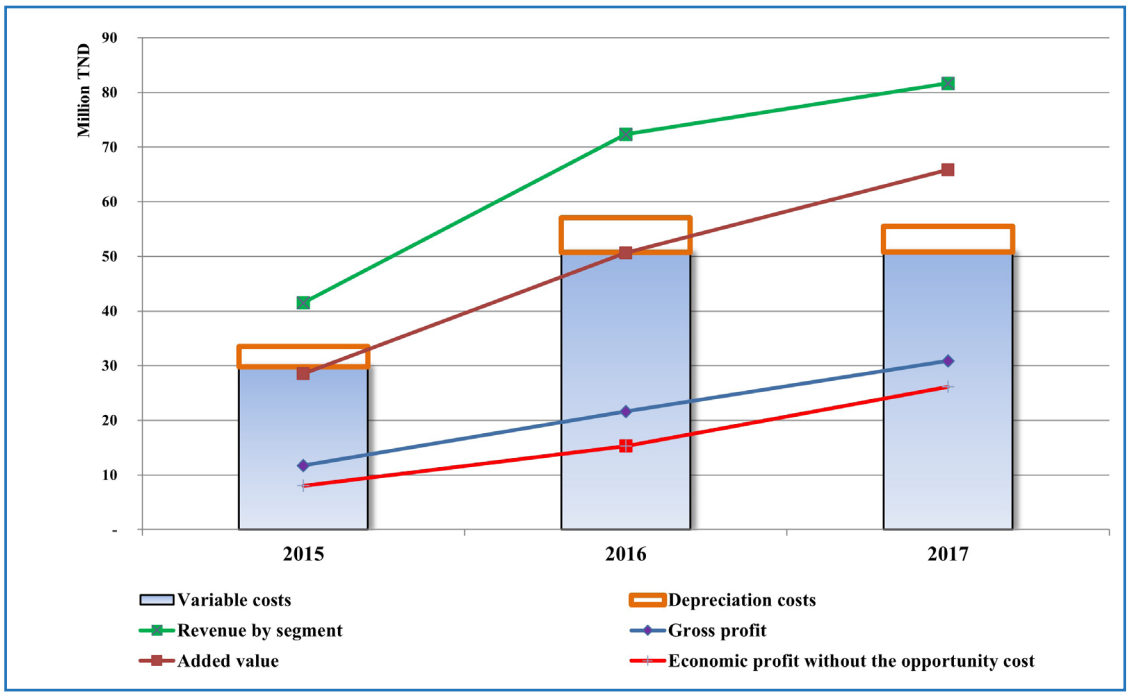
3.2.5 Costs and revenues

Net economic profit is defined as follows:

Net economic profit = gross economic profit – amortization costs – opportunity cost

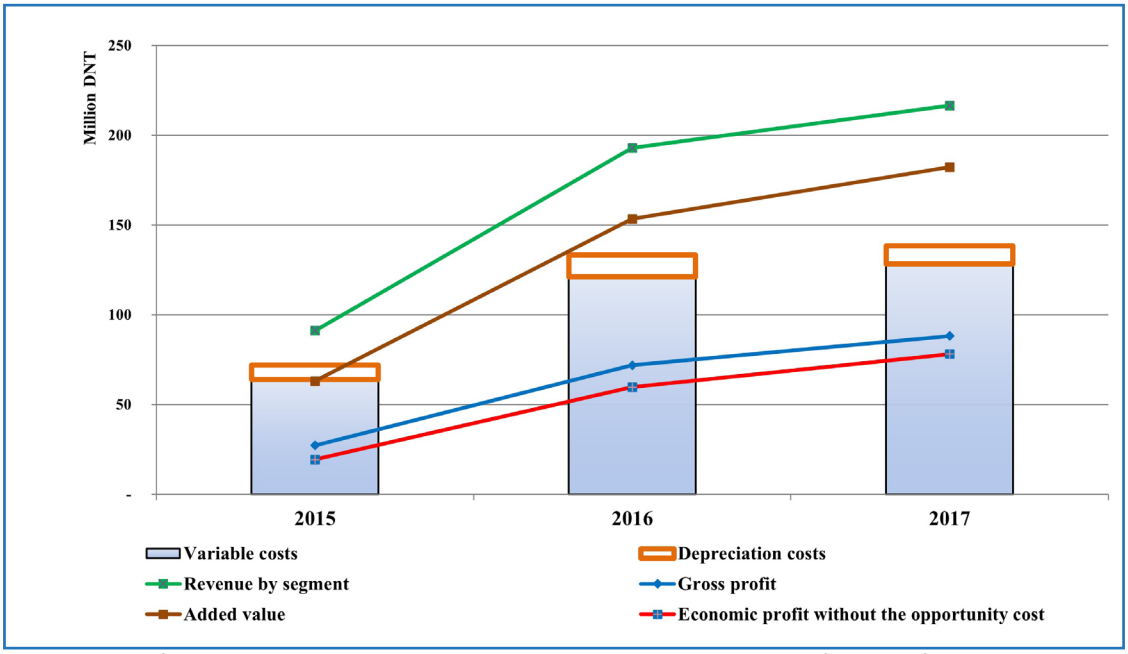
The two fleet segments targeting shrimp and hake experienced positive profits (inclusive of amortization costs). However, due to the incentive schemes currently in place, owners do not pay for the real value of the boat. Therefore, amortization costs are not taken into account. If boat owners were to pay for the real value of the vessel, their enterprises would not be able to show a profit in the medium term from the investment.

FIGURE 10. Evolution of costs and revenues for the T-11 segment



Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

FIGURE 11. Evolution of costs and revenues for the T-12 segment



Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

3.3 TECHNICAL INDICATORS

Capacity utilization (CU) represents the degree to which fishing vessels are fully utilized. From an input based perspective, this may relate to the ratio of the sea days to the number of days the boat could potentially be at sea under normal working conditions (Ward *et al.*, 2004).

The most accurate calculation of CU is implemented through econometric methods e.g. through an analysis of available data. In this study, we recurred to the most practical (but less precise) calculation method, which is based on the number of days at sea, both real and potential. CU is always comprised between zero and one (Garcia and Newton, 1995; Kirkley and Squires, 1999). CU<1 is defined as overcapacity and the overcapacity rate is equal to 1-CU. CU=1 corresponds to full capacity.

In the period 2015 to 2017, all the segments in the fleet were characterized by overcapacity (Table 10). This result reflects the very high number of migrating vessels that moved from the eastern and southern areas of Tunisia towards the north, targeting shrimp and hake. This is also confirmed by the claims and concerns of fishers about the lack of a clear zoning policy (Figure 12).

TABLE 10. Capacity utilization per segment per year

	2015		2016		2017	
	T-11	T-12	T-11	T-12	T-11	T-12
Total active fleet	72	104	100	132	72	109
Average days at sea per boat	134	152	141	144	131	151
Days at sea	9 645	15 831	14 134	18 947	9 456	16 510
Average maximum days at sea(1)	212	221.5	216	235	208	238
Maximum days at sea	15 264	23 036	21 600	31 020	14 976	25 942
Capacity utilization	0.63	0.69	0.65	0.61	0.63	0.64

(1) Based on the average activity of the 10 percent most active vessels in the segment.

Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

3.4 CONSTRAINTS AND CONCERNS

Boat owners and fishers raised several concerns and claims during the survey. These have been ranked to account for the most relevant problems that need to be addressed to improve working conditions and overall fisheries management. Some of the general concerns referred to the entire research area (northern Tunisia), while others were related to specific surveyed ports. The highlighted weaknesses are summarized in Figure 12. The main problems identified were:

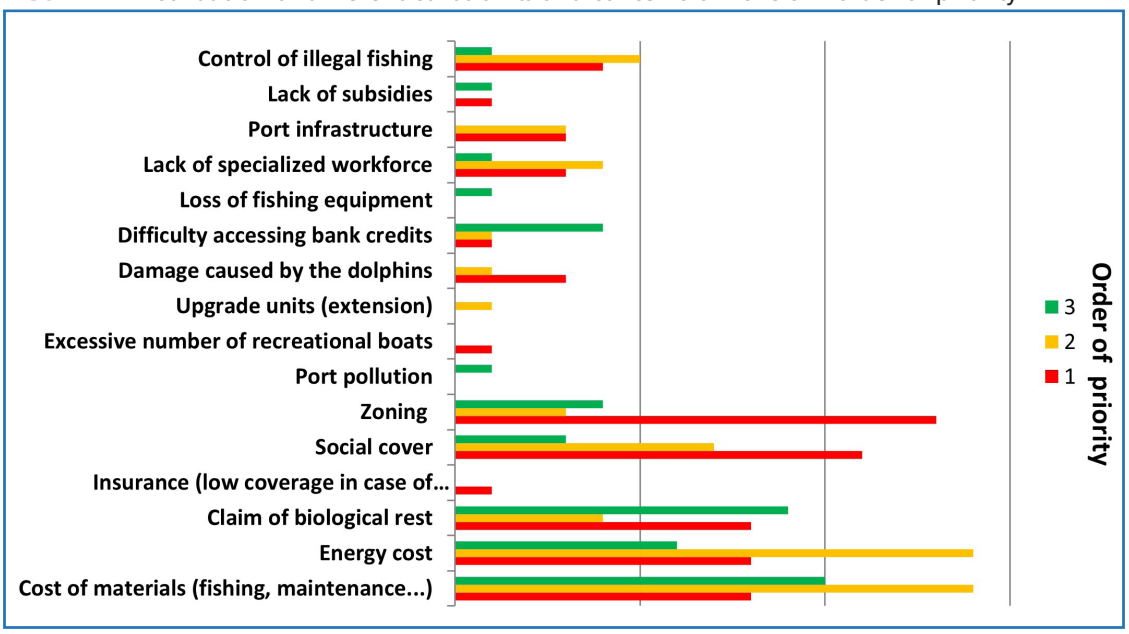
- Zoning issues: this represents a priority issue for the majority of northern Tunisian fishers, who requested a limitation be placed on the migration of vessels from the south to the north of the country. According to the northern fishers, the migrating fleets have caused a distinct decrease in landings. However, the northern fishers have requested that the authorities provide them with access to the southern and eastern fishing grounds to make their activity more profitable, particularly during adverse weather conditions.
- Social security: fishers consider the current social system to be inadequate to support their work activities, especially with regards to drowning or other accidents. Additionally, some owners believe the premium paid each year for social security is too high.
- Biological rest period: the majority of fishers have requested that the biological rest period in northern Tunisia be applied. This is an important indicator reflecting not only their environmental consciousness but also an acknowledgement of the decrease in the availability of marine living resources.
- Fuel and equipment costs: these variable costs reflect mainly energy costs (fuel and lubricants) as well as repair and maintenance costs (charges for purchasing and repairing gears and other vessel equipment). Because of the rise in prices, fuel and equipment are among the main costs for fishers. Unfortunately, this situation will be worsened by the depreciation of the TND.

Other, less stringent, concerns highlighted by the fishers were:

- Control of illegal fishing: fishing with prohibited gear such as lights for fishing for shrimp at night. This issue has been ongoing for decades and the promotion of increased awareness among infringers is pivotal. Illegal fishing will only decrease if control is strengthened and infringers are held accountable.
- Workforce shortage: this phenomenon has been constantly on the increase in the last decade. While a qualified and specialized workforce (mechanics, electronic maintenance, etc.) has increased in size on land, the fishing workforce has decreased in size due to a reluctance from the youth to work in the fishing sector. This trend is explained by the harshness of the work, poor remuneration and the presence of other more attractive employment opportunities.
- Dolphin and other marine vertebrates which cause discards: incidences of marine vertebrate interactions have recently been on the increase, resulting in damage to fishing gear, which necessitates increased costs for repair and maintenance of the vessel and gear. In addition, damaged gear often results in the loss of the catch which reduces the profitability of fishing activities.
- Access to credit (specific to Tabarka area): better access to bank loans in order to finance purchases and repair costs, was claimed in the port of Tabarka.
- Infrastructure limitations (specific to Bizerte area): the improvement of port infrastructure (lifting crane) was requested in the port of Bizerte to enhance security and overall port related operations, e.g. reduction in time for landing the catch and/or boarding material and improved logistics for selling fish.

According to fishers, solutions to these problems are of paramount importance to assist the sector to recover and/or develop further. Addressing the issues would contribute to the enhancement of fisheries sustainability, profitability and overall working conditions, thus making a valuable contribution to local livelihoods and food security. Further to this, inclusion of all these aspects may also contribute towards making fishing more attractive to future generations which may then continue to maintain the traditional heritage related to fisheries, while at the same time benefiting from the full range of goods and services provided by the marine ecosystem.

FIGURE 12. Distribution of different constraints and concerns of fishers in order of priority



4. Concluding remarks

Over the past decades, the Tunisian fishing sector has been characterized by constant changes, marked mainly by a decrease in the availability of marine stocks, coupled with a growth in demand for seafood (FAO, 2020a; FAO, 2020b). The fishing sector constitutes one of the main pillars of the Tunisian economy with respect to foreign currency, wealth, employment, food security and revenues (Anonymous, 2019). Depletion of marine resources, especially hake and shrimp stocks, with an associated reduction of income, may therefore have serious consequences for both fishing communities and the nation as a whole.

High levels of exports from the hake and shrimp fishery of northern Tunisia, ensure an inflow of foreign currency to the country. Through the analysis of different socioeconomic indicators, the present study has highlighted strengths and weakness of the selected fisheries. As part of the concluding remarks, some recommendations provided by fishers are presented (Table 11). These have the goal of giving voice to fishers views, with the aim of pursuing improved fisheries management and sustainable development in the region.

TABLE 11. Main recommendations highlighted from fishers and classified as priority

Recommendations – activity	Priority
Reduce the number of migrating boats targeting hake and shrimp	High
Allow the northern fleet to have access to eastern and southern fishing grounds	High, with precaution
Recommendations – technical measures	Priority
Close some areas to fishing to act as nurseries (spatial zoning)	High
Review the fishing calendar to promote biological rest	High
Recommendations– social aspects	Priority
Review the social protection system	Medium
Recommendations – financial aspects	Priority
Reduce dependency on fuel subsidies	Medium

Source: Ben Arfa, Y., Di Cintio, A., Ceriola, L. & Jarboui, O. 2022. Socio-economic analysis of the trawl fleet targeting deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) in North Tunisia (2015–2017). *Marine Policy* 137, 104952. Doi: https://doi.org/10.1016/j.marpol.2021.104952

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6. Annex 1

Socio-economic survey (reference period January - December)

1	Survey code						Survey date			
2	Interviewer name						Boat registration N.:			
3	Name of interviewee						Port of origin:			
4	Function	Owner □		Captain □	Armament Chief □			Other □		
	Owner									
6	Boat ownership (%)									
7	Do you work on the boat?	Yes □	No □							
8	Do you have other boats?	Yes □	No □							
9	If yes - Type									
10	Number									
11	Value									
	Social data									
	Crew composition	Captain	Vice-capitain	Machinist	Vice-machinist	Specialized sailor	Sailor	Crew master	Chef	Other
12	Number									
	Shore workers	Guardian	Net repairer	Ship operator	Accountant	Transporter	Commissioner/ agent	Other :	Other :	Other : .....
13	Number									
		Ship owner	Captain	Vice-capitain	Mechanic	Vice-mechanic	Specialized sailor	Sailor	Crew master	Chef
14	Age									
15	Level of education									
16	Family status									
17	Household size									
18	Affiliated to social security									
19	Years of work experience									
20	Complementary activity to fishing	Yes □ No □	Yes □ No □	Yes □ No □	Yes □ No □	Yes □ No □	Yes □ No □	Yes □ No □	Yes □ No □	Yes □ No □
21	If yes: Type				**44 What are your main concerns? Prioritize**					
22	If yes: Time spent									
23	If yes: % of revenue				**1.**					
24	Number of children									
25	Children education level									
26	Child 1									
27	Child 2				**2.**					
28	Child 3									
29	Child 4									
30	Child 5									
	Economic data									
31	Employer social costs (TND)/year				**3.**					
	Commercialisation costs									
32	Transport costs (TND)/year									
33	Packing costs (TND)/year									
34	Storage costs (TND)/year									
35	Others				**45 Are you in favor of installing the VMS?**				Yes □ No □	
	Fixed costs									
36	Fishing license (TND)/year									
37	Boat insurance (TND)/year				**46 Observations :**					
38	Port fees (berthing, water, electricity) (TND)/year									
39	Professional organization membership (TND)/year									
40	Police leave									
41	Merchant marine visit									
42	Radio and GPS license									
43	Others									

47	Trawling type		Trawling type		Trawling type	
48	Target species		Target species		Target species	
49	Number of trawl hauls		Number of trawl hauls		Number of trawl hauls	
50	Purchase date		Purchase date		Purchase date	
60	Purchase price		Purchase price		Purchase price	
61	Local assembly of trawl gear?	Yes □ No □	Local assembly of trawl gear?	Yes □ No □	Local assembly of trawl gear?	Yes □ No □
62	If not, country of production		If not, country of production		If not, country of production	
63	Lighting device	Yes □ No □	Lighting device	Yes □ No □	Lighting device	Yes □ No □
64	Length		Length		Length	
65	Codend mesh		Codend mesh		Codend mesh	

	Support to navigation	N	Price
66	GPS		
67	Radar		
68	Sounder		
69	Radio and VHF		
70	Software		
71	Autre		

	Security equipment	N	Price
75	Rescue boat		
76	Buoys		
77	Life vest		
78	Extinguisher		
79	Software		
80	Other		

	Deck equipment	N	Price
72	Trawl reel		
73	Winches		
74	Other		

	Bilge equipment	N	Price
81	Storage room		
82	Freezing room		
83	Ice production		

84 **Have you upgraded/renewed the boat and its equipment?** Yes □ No □

	Date	Upgrade/renewal Detail	Grant amount
85			
86			
87			

88 **Have you received a subsidy for the purchase of equipment?** Yes □ No □

	Date	Equipment purchase detail	Grant amount
89			
90			
91			

	What is the annual cost of maintenance and repairs?	
92	Boat and equipment	Fishing equipment
93		

	Investissement moyens de production	Purchase price	Credit/loan	Annual bank interest
94	Boat		Yes □ No □	
95	Engine and equipment		Yes □ No □	
96	Fishing equipment		Yes □ No □	
97	Other		Yes □ No □	

	Fishing calendar	Minimum	Maximum	Average	Total per reference year
98	Number of fishing trips / month				
99	Number of days at sea / month				
100	Number of trawl hauls / day				
101	Average duration / trawl haul				
	Catch / fishing trip	Minimum	Maximum	Average	Total per reference year
102	Deep-water rose shrimp				
103	European hake				
104	Other species:				
105	Other species:				
106	Other species:				
107	Other species:				
	Price / species / month	Minimum	Maximum	Average per sampled year	
108	Deep-water rose shrimp				
109	European hake				
110	Other species:				
111	Other species:				
112	Other species:				
113	Other species:				
	Revenue sharing system (production costs and workers)				

114 Sharing system: Yes □ No □

115 If yes indicate the % for the crew and for the production costs

116 Boat (Ship owner): ..... %

117 Crew: ..... %

118 Other: ..... % :

		Share	Minimum wage	Maximum wage	Average salary	Bonus and incentives
119	Captain					
120	Vice captain					
121	Mechanic					
122	Assistant mechanic					
123	Specialized sailor					
124	Crew master					
125	Sailor					
126	Chef					
127	Guardian					
128	Net repairer					
129	Armament chief					
130	Accountant					
131	Carrier					

		Common costs	Cost (TND/day)	Cost (TND/month)
132	Fuel	Yes □ No □		
133	Fuel and lubrificant	Yes □ No □		
134	Other operational costs	Yes □ No □		
135	Ice	Yes □ No □		
136	Small equipment	Yes □ No □		
137	Other :	Yes □ No □		
138	Other :	Yes □ No □		
139	Other :	Yes □ No □		
140	Other :	Yes □ No □		
141	Other :	Yes □ No □		

	Sales (as % of total production)	Wholesale market	Port market	Fishmonger	Export company	Direct export	Fish shop	Restaurant	Self-consumption
142	Rose shrimp								
143	European hake								
144	Other species:								
145	Other species:								
146	Other species:								

The FAO MedSudMed project has devoted a great effort to the standardisation of methodologies for collecting fisheries dependent and fisheries independent data in the south-central Mediterranean Sea. One of the main motivations was to have homogeneous data that would allow for regional analyses to be conducted. In this context, a socioeconomic data collection programme for the trawl fleets which target deep-water rose shrimp (*Parapenaeus longirostris*) and European hake (*Merluccius merluccius*) was conducted in northern Tunisia in 2016, 2017 and 2018 with the support by the MedSudMed Project. The data collection design was based on a standardised methodology developed by FAO that consists of a multivariate sampling survey based on a statistical design where the licensed fishing fleet is stratified into homogenous segments and the sampling unit (fishing vessels) is selected randomly. This document summarizes the steps and methodology followed during the MedSudMed socioeconomic data collection. Further to this, performance indicators for the northern Tunisia shrimp and hake trawl fleets for the years 2015, 2016 and 2017 are presented. In its last section, the document outlines the main constraints and indications provided by fishers on the future development of the deep-water rose shrimp and European hake fishery in Tunisia. Over 2015, 2016 and 2017 the fishing fleet comprised 589 vessels which operated for 84 500 days and directly generated a total of 6 957 jobs, calculated on a full-time basis. The fishery capture production in the three years of surveys produced a cumulative value of USD 240 million. The study and collected data are envisaged to play a functional role in the planning and informed management of sustainable and profitable fisheries in the area, without jeopardising natural resources, in accordance with the principles of the ecosystem approach to fisheries.

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