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The Economic and Financial Performance of Bahrain's Fisheries Sector

الأداء الاقتصادي والمالي لقطاع الثروة السمكية بمملكة البحرين

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ABSTRACT: This work is based on an extensive socio-economic survey conducted at all Bahrain landing sites in the period July – November, 2002. Based on boat size and the type of fishing gear used, eight fisheries sectors were determined, these included small boats using wire traps, shrimp trawls, gillnets, hooks and lines, and barrier traps. It also included large boats using wire traps, shrimp trawls, and gillnets. The economic and financial performance of these sectors was evaluated. The ratio of net catch flow to total earnings was used to measure the economic performance, while the return over investment was used to measure the financial performance. Higher economic returns (except for gillnet and shrimp trawl fisheries) were found in the case of small boats where smaller investments are found. This indicated that an over-fishing condition exists in Bahrain's fisheries, which is clearly found in the case of the shrimp trawl fishery.

Keywords: *Economic, financial, fisheries performance, fishing gear, Kingdom of Bahrain, Arabian Gulf.*

المستخلص: اعتمدت هذه الورقة على نتائج المسح الاجتماعي الاقتصادي الموسع على الصيادين الذي نفذ في البحرين خلال الفترة من يوليو إلى نوفمبر 2002. بحسب وسيلة الصيد المستخدمة و حجم السفينة تم تصنيف المصايد إلى ثمانية قطاعات رئيسة تشمل السفن الصغيرة التي تعمل بالقراقير وشباك جر الربيان والشباك الخيشومية والخيوط والحظور، كما تشمل السفن الكبيرة التي تعمل بالقراقير وشباك جر الربيان والشباك الخشومية. قيّمت هذه الورقة الأداء المالي والاقتصادي لهذه القطاعات. استخدمت نسبة التدفق الصافي الحالي إلى إجمالي الدخل لقياس الأداء الاقتصادي للمصايد، بينما استخدم العائد من الاستثمار كمؤشر للأداء المالي للمصايد. وجدت الدراسة بأن أعلى أداء اقتصادي كان في حالة السفن الصغيرة ذات الاستثمار الأقل، ويستثنى من ذلك السفن الصغيرة التي تزاول الصيد بشباك جر الربيان والشباك الخيشومية. و يدل هذا على تعرض المصايد البحرينية للصيد الجائر والذي أوضح ما يكون في حالة مصايد جر الربيان.

كلمات مدخلية : *تقييم اقتصادي، مالي، أداء المصايد، وسائل الصيد، مملكة البحرين، الخليج العربي.*

INTRODUCTION

The Kingdom of Bahrain is one of eight countries sharing the coastline of the Arabian Gulf. It is located North between latitudes 25° 32' and 27° 10' and East between longitudes 50° 16' and 51° 07', with a total sea area of 7510 km^2. Average annual fish landings were 11 thousand tons and 9 million Bahraini Dinars (BD; 1 BD=2.645 US$) at first sale value for the years 1999, 2000, and 2001 (Radhi, *et al.* 2002). The average annual fish imports for the same period were 4.2 thousand tonnes with a value of 3 million BD, and average annual exports were 5.1 thousand tonnes with a value of 3 million BD. The Fishing sectors are identified based on

the type of fishing gear used. Fishing gear used in Bahrain's waters can generally be categorized into five groups, namely: wire trap, shrimp trawl, gillnet, Hook and Line, and barrier or fixed trap. These different types of gear are used from a wide size range of motorized fishing boats.

Wire traps target mainly the finfish species, however a new trap fishery has been developed recently, which targets the swimming crab *Portunus pelagicus* (Protunidae, L.). Shrimp trawls target the green tiger shrimp species *Penaues semisulcatus* (Penaeidae, De Haan) mainly in sandy-muddy areas. Several types of gillnets are used which target finfish species, the most important species are the narrow banded Spanish mackerel *Scomberomorus commerson* (Scombridae, L.) and Rabbit fish *Siganus canaliculatus* (Siganidae, Park). Hooks and Lines and barrier traps target several pelagic and benthic finfish species.

Fishing boats are relatively small and are owned by individuals; almost all the boats are motorized. A recent fishery census conducted in 1998 revealed that 2274 boats were used by 6830 fishermen (Radhi, *et al.* 1999). About 60% of the fishermen were using one type of fishing gear, while other fishermen used two, three or four different types of fishing gear (Abdulqader, *et al.* 2004).

Export-aimed fishing started with the shrimp fisheries in 1967. This fishing was discontinued in August 1979 after several declines in the catch rates (Abdulqader, 2001a). Shrimp trawl fishing continued with the use of old steel-hulled, wooden and fiberglass boats. In 1997 all steel-hulled boats were forced to be withdrawn due to a further decline in catch rates and high competition from smaller or what used to be known as artisanal boats. These boats have increased in number and in fishing power, which consequently puts further pressure on shrimp resources. Over-fishing has been documented for shrimp and several key species (Abdulqader, 2001a, b). Despite these drastic changes, little attention was given to the economic consequences (Radhi, *et al.* 1999; Fisheries Statistical Service, 1985; 1990). In 2002, an extensive socio-economic survey was conducted based on interviews with fishermen. Based on this survey data, this paper provides estimates of the economic and financial performance of different fisheries; it also highlights the general characteristics of these fisheries.

MATERIAL AND METHODS

Data used for this work formed part of an extensive socio-economic survey conducted through July to November 2002 at the 33 Bahrain landing sites (Abdulqader, *et al.* 2004). Interviewed fishermen made up 14.7% of the total number of Bahraini fishermen. Boats sampled made up 21.5 and 56.6% of the total number of small and large boats, respectively, based on the 2002 survey of fishermen (Abdulqader, *et al.* 2004).

For the use of this work, earnings and the cost data for fishermen using a single type of fishing gear were sorted and used. Similarly boat, engine, and winch prices data for these fishermen were used in the calculation of depreciation and total investment values. In the case of small boats, depreciation rates of 50%, 10%, and 20% were used for engines, boats, and winches, respectively. In the case of large boats, 25% depreciation was used for engines and winches, and 5% depreciation was used for boats. Fishing boats were categorized into small and large boats based on the engine used; small boats use outboard engines, while large boats use inboard engines.

To obtain up-to-date estimates of investment values, engine prices for engines of less than or equal to two-years of age (based on 2002) were included in the calculation. Similarly, prices for boats, large boat engines, and winches of less than or equal to five-years of age were included in the analysis. Fishing cost elements are diverse and they arise at different time intervals, which can be measured in daily, monthly or annual intervals. Accordingly, cost data was recorded on a daily (fuel, bait in the case of wire trap and hook and line, catch transport, and catering), monthly (labor wages, regular maintenance), or on an annual basis (fees, insurance, fishing gear, and total repair of boat, winch, and engine). To obtain annual estimates of the daily-based cost data, this data was multiplied by the number of working (e.g., fuel) or landing days (e.g., bait, transport, catering) in a year.

To obtain the annual estimates, the monthly-based cost data was multiplied by 12. The annual costs of the fish sale commissions were calculated by multiplying the percentage of fish sale commission into the total annual gross revenue. Annual gross revenue estimates were calculated first by multiplying the daily average catch values into the number of landing days for the respective months, and then by adding all the resultant monthly estimates, the annual gross value per fishing unit was obtained. Earnings and cost data were collected based on fishery conditions and prices for 2001 and 2002. Earnings, investment and cost average estimates for different fisheries (fishing gear) and boat sizes (small, large) were calculated by the direct averaging of the respective values for all fishermen using the respective fishing gear.

The economic and financial performance indicators adopted in this study are based on Lery, *et al.* (1999). The economic performance indicator used is the ratio of net catch flow (NCF) to total earnings (TE). The economic indicator measures the profitability of the investment based on earnings and cost values generated during the sampled year. The financial indicator used in this study is the return over investment (ROI). This indicator is a ratio of NCF to investment (I). The financial indicator is the percentage of the investment that can be returned within the sampled year.

In addition, the study presents the social status of fishermen and describes Bahrain's fishing fleet (boat length, boat age, and engine horse power) based on the 2002 socio-economic survey.

RESULTS

The total number of fishermen estimated by this study was 6601 fishermen, where Bahraini fishermen made up 44.5%. The age of the Bahraini fishermen ranged from 14 to 85 years, with an average of 36.9 years (Standard Deviation, SD 11.33). Fishing experience ranged from 1 to 70 years, with an average of 20.0 years (SD 11.21). The educational level of the Bahraini fishermen ranged from illiterate to university level, with 40.9% of these fishermen possessed secondary school certificates, while illiterate fishermen stood at 7.6%.

Total boat lengths ranged from 4 to 23m. Small boat lengths ranged from 4 to 12m with a peak at 7m, while large boat lengths ranged from 8 to 23m with two peaks at 12 and 18m (Figure 1).

The total number of boats counted by this study was 2587 boats, of which 89.2% were small boats. About 63.8% of these boats were using the global positioning navigator system (GPS), while 4.4, 16.8 and 2.2% of the boats used fish finder, depth finder and radio, respectively.

Boat age ranges were from zero (2002) to 30 years in the case of small boats, with a peak at one year, which indicates that the highest number of new boats entered the fishery in 2001 (Figure 2). The age range for large boats was from zero (2002) to 24-years, with a peak at age-five which indicates that the highest number of new boats entered the fishery in 1997 (Figure 3). Figure 3 shows a decline in the trend in boat numbers from age four to age zero, which indicates that the number of new boats entering the fishery has decreased since 1999.

Engines with a wide power range were used; in the case of small boats it ranged from 4 to 235 horsepower (hp), with peaks at 40, 115, 85, 200, and 75 hp, in order of importance (Figure 4). In the case of large boats it ranged from 74 to 400 hp, with peaks at 240, 250, 165, 270, 290, 160, 230, 350 hp, respectively (Figure 5).

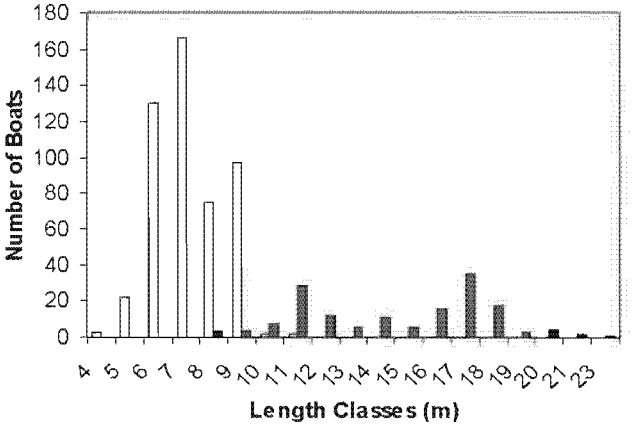

Fig. 1. Boat Total Length Frequency Distribution for Small and Large Boats (dark Bars).

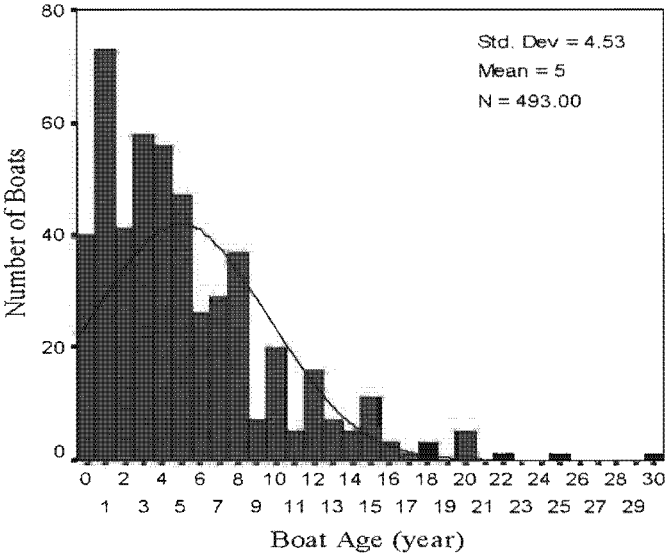

Fig. 2. Boat Age Frequency Distribution for Small Boats (Year 2002 is Year 0).

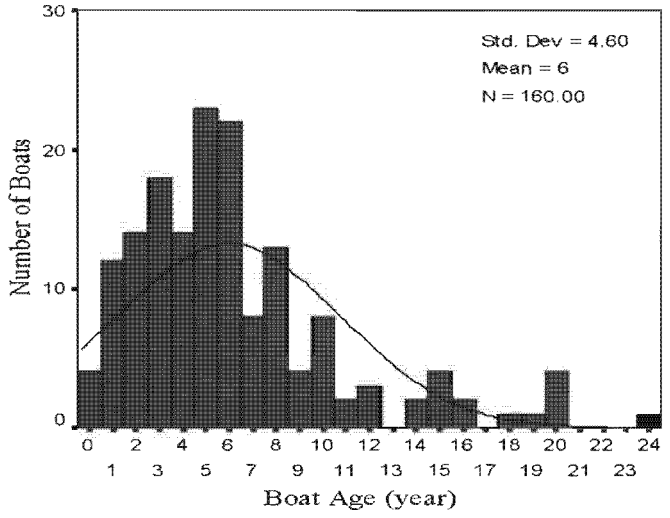

Fig. 3. Boat Age Frequency Distribution for Large Boats (Year 2002 is Year 0).

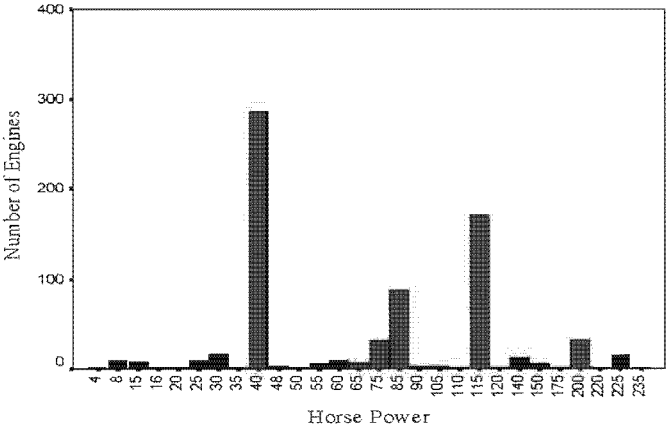

Fig. 4. Engine Power Frequency Distribution for Small Boats.

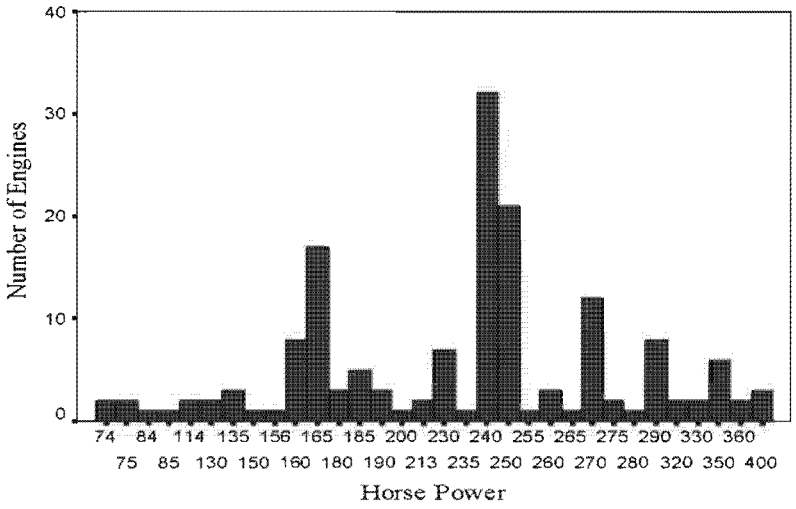

Fig. 5. Engine Power Frequency Distribution for Large Boats.

The average investment in small boats ranged from 1,121 BD (SD 856.2) for boats using hooks and lines to 2,589 BD (SD 2416.1) for boats using wire traps (Table 1). For large boats it ranged from 15,923 BD (SD 11378.1) in the case of shrimp trawlers to 24,515 BD (SD 11398.7) in the case of boats using wire traps. These estimates show high standard deviation values (Table 1).

Average expense estimates for small boats ranged from 2,733 to 19,459 BD in the case of boats using hooks and lines and wire traps (Tables 2 to 5). Bait and fuel are the most important cost items in the case of the wire trap fishery; wages and fuel are the most important in the case of shrimp trawlers, fuel and fishing gear are the most important in the case of gill-netters, and fuel and wages in the case of boats using hooks and lines (Tables 2 to 5).

The total expenses for large boats ranged from 18,982 to 80,059 BD for boats using gillnets and wire traps (Tables 2 to 4). The first two important cost items were fishing gear and bait in the case of boats using wire traps, fuel and wages in the case of shrimp trawlers, and fuel and wages in the case of boats using gillnets (Tables 2 to 4). High standard deviation values were found in the case of most earnings and expenses averages (Tables 2 to 5).

The economic performance indicators for small boats using barrier traps, hooks and lines, and wire traps respectively showed higher values (Table 6). Low and negative economic indicators were found in the case of small boats using gillnets and shrimp trawls, while negative economic indicator values were found in the case of large boats using gillnets and shrimp trawls (Table 6).

Table 1. Total Investment Averages in Fishing Units per Fisheries Sector and Boat Size

Fishing Gear	Small Boats			large Boat		
	Mean	SD	N	Mean	SD	N
Wire Trap	2589	2416.1	75	24515	11398.7	8
Shrimp Trawl	1625	106.1	2	15923	11378.1	46
Gillnet	2218	1684.7	16	17900	5656.9	2
Hook and Line	1121	856.2	46		Not Used	
Barrier Trap	1483	550.1	6		Not Used	

Table 2. Financial and Economic Characteristics per Boat for the Wire Trap Fishery (Categorized for Small and Large Boats).

	Small Boats			large Boat		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**
Total earnings (TE)	**26080**	**35214.5**	**86**	**10366**	**94864.8**	**9**
Fuel	4255	4189.5	86	12739	8204.3	9
Bait	6127	9185.2	86	20238	17333.4	9
Transport	463	714.0	86	1024	892.5	9
Sale commission	1769	3314.6	86	6980	8961.7	9
Labour wages	2724	4050.7	86	11373	8244.7	9
Maintenance	208	197.3	86	965	534.6	9
Repair	509	675.6	86	1184	756.9	9
Fees	83	142.6	86	687	341.4	9
Insurance	1	12.9	86	55	113.0	9
Catering	923	906.9	85	3344	1969.8	9
Fishing gear	2406	3608.7	86	21466	12351.2	9
Total expenses	**19459**	**22453.8**	**86**	**80059.8**	**50698.4**	**9**
Depreciation	775	882.8	82	2764.7	1991.2	9
Interest	118	271.8	28			
Net cash flow (NCF)	**5842**	**20429.5**	**86**	**20827.3**	**48996.0**	**9**

Table 3. Financial and Economic Characteristics per Boat for the Shrimp Trawl Fishery (Categorized for Small and Large Boats).

	Small Boats			large Boats		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**
Total earnings (TE)	**4646**	**2144.6**	**4**	**10811**	**4723.7**	**56**
Fuel	1935	912.6	4	12654	3402.7	56
Bait	0		4	0		56
Transport	0		5	434	148.7	56
Sale commission	131	174.6	4	608.2	324.1	56
Labour wages	2010	861.8	4	4550	2566.2	56
Maintenance	585	811.4	4	1247	594.3	56
Repair	302	186.0	4	1654	925.0	56
Fees	114	122.2	4	679.4	321.6	56
Insurance	7	15.0	4	61	96.9	56
Catering	0		4	1416	783.5	56
Fishing gear	280	97.6	4	776	378.4	56
Total expenses	**5365**	**1340.3**	**4**	**24083**	**5032.8**	**56**
Depreciation	353	220.5	4	2061	1548.1	56
Interest		.		577	993.9	54
Net cash flow (NCF)	**-1073**	**2764.2**	**4**	**-15890**	**8017.6**	**56**

Table 4. Financial and Economic Characteristics per Boat for the Gill Net Fishery (Categorized for Small and Large Boats).

	Small Boats			large Boats		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**
Total earnings (TE)	**17207**	**12058.1**	**19**	**8643**	**4315.1**	**2**
Fuel	5110	5000.3	19	8070	5642.7	2
Bait	0		19	0		2
Transport	369	252.7	19	505	137.9	2
Sale commission	1337	1337.6	19	432	215.8	2
Labour wages	2305	1417.3	19	3300	1272.8	2
Maintenance	243	210.8	19	888	576.9	2
Repair	324	184.2	19	3125	2156.7	2
Fees	250	210.2	19	675	318.2	2
Insurance	9	18.4	19	0		2
Catering	1090	823.7	19	1212	560.0	2
Fishing gear	3975	4249.1	19	775	35.3	2
Total expenses	**15016**	**9849.0**	**19**	**18982**	**10484.9**	2
Depreciation	634	728.9	19	2600	601.0	2
Interest	121	300.2	11	105	148.5	2
Net cash flow (NCF)	**1485**	**8758.3**	**19**	**-13043**	**15252.6**	**2**

Table 5. Financial and Economic Characteristics per Boat for Hook and Line and Barrier Trap Fisheries (Only Small Boats).

	Hook & Line			Barrier Trap		
	Mean	**SD**	**N**	**Mean**	**SD**	**N**
Total earnings (TE)	3973	4086.0	78	8319	5913.2	8
Fuel	1064	1116.1	78	1193	777.2	7
Bait	321	355.1	78	0		8
Transport	99	114.5	78	239	246.5	8
Sale commission	170	278.7	78	510	711.2	8
Labour wages	504	566.0	78	465	861.6	8
Maintenance	116	159.7	78	54	29.2	8
Repair	147	137.8	78	378	296.5	8
Fees	6	21.6	78	41	63.8	8
Insurance	0		78	0		8
Catering	263	342.6	78	428	603.7	8
Fishing gear	38	32.6	78	2565	2276.2	8
Total expenses	2733	1977.2	78	5728	5059.9	8
Depreciation	218	284.0	70	295	222.1	7
Interest	140	137.1	5		.	
Net cash flow (NCF)	1034	3290.7	**78**	2332	3556.4	**8**

Table 6. Economic (NCF/TE) and Financial (ROI) Performance Indices for Different Fishing Sectors (NCF/TE is the ratio of net catch flow to total earnings; ROI is the return over investment, ROI=NCF/I).

Fisheries Sector	NCF/TE		ROI	
	small	large	small	large
Wire trap	22.4	20.1	225.7	85.0
Shrimp trawl	-23.1	-147.0	-26.9	-99.8
Gillnet	8.6	-150.9	67.0	-72.9
Hook and Lines	26.0	Not used	92.2	Not used
Barrier trap	28.0	Not used	157.3	Not used

Except for the shrimp fishery and the large boat gillnet fishery, all fisheries showed high financial indicator values, which ranged from 85% in the case of large boats using wire traps to 225.7% in the case of small boats using wire traps (Table 6).

DISCUSSION

Illiteracy among the Bahraini fishing community was found by this study to be 7.6%, while the general illiteracy rate of the Bahraini population was 7.8% in 2001 (Central Statistics Organization, 2002). This indicates the similarity between fishermen and the total Bahraini population structure. In comparison to other fishing communities in the Gulf, illiteracy among Bahraini fishermen is considered low when compared to the illiteracy rate of fishermen from Al-Batinah (Sultanate of Oman) which was 79.4% (Al-Oufi, *et al.* 2000). This is supported by the lower average age of Bahraini fishermen (36.9 years SD 11.21) compared to Omani fishermen which was 44.4 years SD 8.77 (Al-Oufi, *et al.* 2000).

Bahrain's fishing fleet is made up of fiberglass and wooden boats, and the total length of the boats ranged from 4 to 23m, while 89.2% of these boats were small boats (range from 4 to 12m). Almost all boats were powered by either outboard or inboard engines. Engine power ranged from 4 to 235hp in the case of small boats and from 74 to 400hp for inboard engines. The global positioning navigator system was used by 63.8% of these boats. The present Bahraini fishing fleet used to be defined as an artisanal sector (FAO, 1978). Yet the specifications for the Bahrain fishing fleet are far more advanced than that which was described for the artisanal fisheries of the São Fancisco River and the Negombo Lagoon in Brazil and Sri Lanka (Farnco De Camarco and Petrere JR, 2001, Jayawardane and Perera, 2003). Small-scale was used to describe fisheries such as those found in Bahrain, but there are no distinct lines between small and large-scale fisheries. Furthermore, the term small-scale is used as another expression for artisanal fisheries (Seilert, 2002).

Investment and different cost average values (Tables 1 to 5) showed high standard deviation values. This indicates a wide range in the expenditure of fishermen on similar equipment or to obtain similar services. The open nature of the Bahrain market provides fishermen with a wide selection of different types of boats, engines, winches, and other equipment and materials. Moreover, the personal expenditure attitude varied from one fisherman to another; this might also contribute to the high standard deviation values.

Based on the fishing conditions in 2001 and 2002, good economic returns (NCF/TE > 20%) were found in the case of small boats using wire traps, hooks and lines, barrier traps, and large boats using wire traps (Table 6). On the other hand, losses were found in the case of small and large boats using shrimp trawls, and large boats using gillnets. All large boats using gillnets are targeting the Spanish mackerel fishery. Abdulqader (2001a, b) reported over-fishing in Bahrain's shrimp and Spanish mackerel fisheries.

Figures 2 and 3 suggest a decline in the number of large boats since 1999, while the number of small boats has increased in recent years (2001). This indicates a change towards smaller investments, which is likely to be a

consequence of the over-fishing conditions. It is worth mentioning that Bahrain's fisheries sector has experienced a continuous decline in fishing investment since the mid-1960s (Abdulqader, 2001a). The Return Over Investment (ROI) values are relatively high for all the fisheries sectors with the exception of shrimp and large-boat gillnet fisheries (Table 6). This indicates that the return on the investment can be achieved within a relatively short period, from 5 months to nearly one year for certain fisheries (Table 6). Despite this quick return over investment, the maximum economic performance value was 28.0% in the case of the small boats using barrier trap (Table 6). This indicates that the running costs make a major contribution to fishing expenses.

Fuel is determined by this study as the most important cost item in the case of large boats using shrimp trawls and gillnets, as well as for small boats using hooks and lines (Tables 2 to 5). The Bahrain fishing sector uses petrol and diesel for small and large boats, respectively. Estimates of the total consumption of these two fuel types in quantity and value for 2002 was 5.6 million BD and 70 million liters for petrol, and 3.3 million BD and 48 million liters for diesel (Abdulqader, *et al.* 2004). Fuel costs will always have an influence on the income of fishermen (Wilson, 1999).

CONCLUSION AND RECOMMENDATIONS

Since commercial fishing began in 1967, steel-hauled boats contributed significantly to Bahrain's fishery production. Their role ended in 1997 with the high competition from smaller, or what used to be known as artisanal boats. This study found that better economic and financial performance rates were found in the case of smaller boats in the surviving fishing fleet. Smaller boats are making up to 89.2% of the present fishing fleet, as revealed by this study. This may lead to the conclusion that Bahrain's fishery will become more dependent in the future on small boats. Taking into consideration the present educational level of fishermen, this will empower fishermen to adopt technology and hence will improve the efficiency of their fishing operations. Further declines in catch rates, and more dependence on small boats is expected for Bahrain's fishery. Therefore, the following general recommendations are proposed:

* Develop and implement a fishery management plan which should take in consideration the fundamentals of the FAO code of conduct for sustainable fisheries.
* Monitor the success of the management plan by conducting similar studies every 3 to 5 years, based on the rate of change expected for the fishery.

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