Research Article

Socio-economic analysis of kilka fisheries in the southern waters of the Caspian Sea (Iranian waters)

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Abstract

Socio-economic data of kilka fisheries in the south part of the Caspian Sea were collected using questionnaire form, which consisted of different variables related to the fishing activity to evaluate its socio-economic performance. The cost , livelihoods, employment and profitability, level of investments, debts, subsidies, activity levels, demographic and ownership structures data were employed and assessed. The result of the analysis showed that 80% of the vessel owners were active in fishing operations in Mazandaran Province. This figure was 90% for the segment 12-18 LOA and 40% for the segment 18-24 LOA of Gilan Province. The survey also showed lower revenue and higher costs for the vessels that owner present onboard of the vessel during fishing operation.

According to the analysis, 377.4 crew were engaged onboard of all the vessel segments in both Provinces. Mean number of crew engaged on the board of each fishing vessel was 5.1 individuals. The number of different individuals engaged on kilka fisheries in both Provinces were calculated 480 .The average working hours per crew for the kilka fleets in the southern Caspian Sea were calculated 1212.1 hours per year. The activity level (days at sea) for Mazandaran fleet was estimated 5485.8 days, which were higher than Gilan fleets. Daily duration of fishing trip for whole kilka fisheries was calculated 16.5 hours per day. Total yearly duration of fishing trip for whole fleets under study (2017) was 144108 hours. Personel costs were contributed 64% of total variable costs of kilka fleets, the lowest portion of the operational costs were belonged to energy cost . Whole kilka fleet in the Caspian Sea consumed total of 2.6 Million liters of fuel and oil in 2017. Each $US in 2017= 3885 Tomans (each Toman=10 Rials, Iranian currency).

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Introduction

Fishing is playing a major role to improve the socio-economic condition of coastal communities of Iran in both south (Persian Gulf and Gulf of Oman) and north (Caspian Sea), through providing employment, livelihood and food (Taghavimotlagh, 2018). In Iran, the development of fisheries began in 1982, when the Iranian Fisheries Company joined the former Ministry of Jihad. From this period, with the development of necessary infrastructure, including fishing ports, construction of related factories, refrigeration units, canning factories, fish and shrimp processing plants, boat building and fishing gear facilities. There has been ongoing and continuous work conducted train fishers to improve safety and fishing practices in complement to the development of infrastructure. In fact, this period could be considered as the beginning of the rapid development of fisheries in Iran (Taghavimotlagh *et al.*, 2006).

The fishery management strategy is the sum of all actions, which have to be taken to achieve the biological, ecological, social and economic aspects of the fishery (Cochrane, 2002). It is necessary to have solid scientific research in the field of fishery biology and economic (Kar and Chakraborty, 2011), control catch and fishing effort of the fishery for sustainable fisheries. According to FAO , the economic efficiency of the fishing industry has dropped all over the world and the contribution of marine fish stocks within sustainable levels declined from 90% (1974) to 68.6% (2013) because most of the marine fish stock are either fully fished or overfished (Kar and Chakraborty, 2011; FAO, 2020).

History of kilka fishery in Iran (south Caspian Sea, Iranian waters)

Prior to the period of government-directed fisheries development, the kilka fishery in Iran started in Gilan Province (Anzali port) in 1971 with six vessels, which were most likely imported from the former Soviet Union vessels with 12-24 LOA (length overall) equipped with funnel net and underwater electronic light were used to attract and catch kilka.

The amount of kilka catch was less than 3000 t until 1986 (Razavisayad, 1993). From this time, the Iran Fisheries Organization started the development of the kilka fishery and gave permission for increasing the number of kilka vessels in both Mazandaran and Gilan Provinces. The number of vessels started to increase from 1989 and already by 1999, there were more than 200 vessels and the catches of kilka reached more than 95 000 t. However, after this year the catches of kilka started to decline and decreased to 15 500 tons in 2003. The decreasing trend of kilka catch was occurred in Iranian and all coastal areas of the Caspian Sea (Karpyuk *et al.*, 2004).

The composition of kilka species in the Caspian Sea:

Anchovy kilka, *Clupeonella engrauliformis* (Borodin, 1904)

Common kilka, *Clupeonella cultriventris* (Nordmann, 1840),
Big eye kilka, *Clupeonella grimmi*, (Kessler, 1877)

More than 90% of the catches of kilka were comprised of Anchovy species until 1990, but as the total catches declined, the share of the anchovy in the catch gradually started to decrease to near 2-3 percent. From 2003, Common kilka (C. *cultriventris*) catch was increased. Big eye has been very low from beginning. After the collapse of anchovy species, the government decided to balance the number of vessels using the buyback method in 2000. Through this, the government spent huge amount of money, and bought out more than 126 vessels from the kilka fishing fleet. Nowadays, the number of fishing kilka vessels is 74, of which 30 are operating in Gilan Province (Anzali port) and the rest (44 vessels) are operating in Mazandaran Province. In Mazandaran, 10 vessels focus their fishing effort in the eastern of Mazandaran waters (Amirabad port) and the rest (34 vessels) in western of Mazandaran Province waters (Babolsar port).

The aim of this study was to collect the socio-economic data of kilka fisheries in the south part of the Caspian Sea based on a questionnaire form, which consisted of different variables related to the fishing activity to allow for an analysis and estimation of the socio-economic indicators of this fishery. In general, socio-economic data collection was done to assess the economic performance, cost structure, livelihood , employment, profitability, level of investments, debts and subsidies, activity levels, demographics and ownership structures (Pinello *et al*., 2017).

Materials and methods
Socio-economic data
The target population of the survey was kilka fishing vessels in the southern part of the Caspian Sea. The survey period to collect the socio-economic data (variables) was one calendar year (2017). For calculation of socio-economic indicators, like costs and revenue, for each vessel segments, stratified random probability sampling strategy was proposed (Pinello *et al*., 2017). When the sample survey and the knowledge of the estimation of the population parameters are not known or not well established (generally in the first two to three years), it is possible to apply a "disproportionate allocation" sampling scheme (Sapsford and Jupp, 2006). This strategy allows for keeping the sample as large as possible (within the threshold set by the budget) in order to have higher coverage rate for the smaller –sized segments, while trying to minimize as much as possible the variance of each stratum (Pinello *et al*., 2017). In the other words, the size of the sample in each stratum is inversely proportional to the stratum's population size. For instance, if the numbers of vessels per stratum are less than 50, sampling rate will be 50% of total population in stratum. As the number of kilka vessels in each stratum are less than 50, therefore 50% of total

population were chosen in each vessels segment as samples.

The questionnaires were used for collecting the socio-economic data of the kilka fisheries in the southern part of the Caspian Sea. The total numbers of kilka vessels in Gilan Province are 30, with two segments based on overall length (20 vessels with a LOA of 12-18 m and 10 vessels with a LOA of 18-24 m). Ten vessels from segment one and five vessels from segment 2 were selected and interviewed, so the Questionnaire forms were filled out. The total numbers of Mazandaran Province kilka vessels are 44, all with the same LOA (12-18 m), of which 22 were selected as samples .As the socio-economic survey is data-collected based and the quality of the data is largely reliant on the quality of work done by the people in the field, therefore, before starting the survey, training course was held for data collectors, including lectures, training, and practice with trial field-questionnaires. To facilitate this understanding, the general questionnaires were presented in detail with practical examples provided, as required. The questionnaire contained 76 variables, including economic variables like cost, income, commercial ,investment and demographic information like the size of fishermen household, age and literacy level. Each vessel owner was interviewed by data collector to fill out the questionnaire . The excel software was used to analyse the economic data of kilka fisheries. Total costs included fixed, variable, and opportunity costs.

Fixed costs including, bookkeeping, vessel insurance, legal expense, bank costs, and fishing licence renewal which do not vary with the changes in the quantity of fishing operations, while variable costs which vary with the changes in the number of fishing operations are (personnel, fuel, bait, food and beverages, repair and maintenance, commercial and other operational costs). Opportunity costs are the loss of other alternatives when one alternative is chosen. *i.e.*, other regional fisheries, capital investment or alternative employment must be integrated in cost estimations (Cochrane, 2002).

Results

The cost, revenue, demographic data and information of kilka fisheries in the southern Caspian Sea were collected using questionnaire forms through interviews which were done face to face, mostly with owners of the vessels in 2017. Interviewers did the data entries in the same day as the interviews were done. The financial indicators were shown in Toman, and percentage. The exchange rate of 1 US$ was equal to 3885 Tomans in 2017. The data used to calculate socio-economic indicators were as follows:

Engagements of owner on vessel fishing operation

According to data in Mazandaran Province out of 20 sample vessels, the owners of 16 vessels were presented on board during fishing operations, this indicator for Gilan Province was 9 (9

from 10 vessels) for 12-18 LOA segment and 2 for the segment 18-24. Eighty percent (80%) of the vessel owners were active in fishing operations in Mazandaran Province. This figure was 90% for the 12-18 segment and 40% for 18-24 segment for Gilan Province. The amount of revenue and variable costs (fuel, operational, repair , maintenance and commercial costs) for the vessels with owners onboard and owners which were not present in the fishing operations were compared (Tables 1 and 2) . The results showed that for all the vessel segments (both Provinces), which owners were present on the board, the revenue was

lower in comparison with the vessels that owners were not active on the board. The costs and revenue data analysis of Mazandaran Province (12-18 LOA), showed 16% lower revenue with higher costs (22%) for the vessels with owners present on board. These figures for Gilan Province vessels, for the segment 12-18 LOA, were 2% (lower revenue) and 10% (higher costs). For the segment of 18-24 LOA, showed 4% lower revenue and slightly higher costs (0.02%). In general, the data showed lower revenue and higher costs for vessels which owner participated in fishing operations.

Table 1: Comparison between mean revenue (Tomans) of different vessel segments with owner engaged and owner not engaged onboard.

Revenue	Kilka			Total
	Mazandaran 12-18	Gilan 12-18	Gilan18-24	
Owner engaged	338,970,470	209,289,140	154,775,625	282,099,297
Owner not engaged	394,300,750	214,019,830	160,998,660	284,277,351
Differences in revenue (%)	-16%	-2%	-4%	-1%

Table 2: Mean variable costs (Tomans) of different vessel segments with owner engaged and owner not engaged in fishing operations.

Variable	Kilka			Total
	Mazandaran 12-18	Gilan 12-18	Gilan18-24	
Ownership engaged	87,577,375	48,155,656	62,018,787	72,543,573
Ownership not engaged	72,016,750	53,790,900	62,031,200	65,993,938
Differences in variable costs (%)	22%	10%	0.02%	10%

Engaged crew (on board)

The engaged crew equals the number of jobs on board of the vessels. This includes temporary crew as well as rotational crew. According to the analysis, 377.4 crew were engaged on the board of all the vessel segments in

both Provinces. This figure was 5.1 per each vessel. This indicator, for vessel segments with 12-18 LOA in Mazandaran, 12-18 LOA segments in Gilan, and for the 18-24 segment in Gilan, were 5.4, 4.8 and 4.6 crew per vessel, respectively (Table 3).

Table 3: Average engaged crew on board of each vessel segment.

Variable	Kilka			Total
	Mazandaran 12-18	Gilan 12-18	Gilan18-24	
Total engaged crew (on board)	235.4	96	46	377.4
Number of vessels	44	20	10	74
Engaged crew (per vessel)	5.4	4.8	4.6	5.1

Total engaged crew
The number of total engaged in kilka fisheries were 480 individuals in both Provinces. These figures were 312.4 individuals for Mazandaran segment (12-18 LOA), 115.6 for 12-18 LOA, and 52.0 for 18-24 LOA for Gilan segments. The mean different individuals per each vessel segments were, 7.1, 5.8, and 5.2, for 12-18 LOA (Mazandaran), 12-18 LOA (Gilan), and 18-24 LOA (Gilan), respectively (Table 4).

Table 4: Total number of different individuals ever engaged in Kilka fisheries during 2017.

Variable	Kilka			Total
	Mazandaran 12-18	Gilan 12-18	Gilan18-24	
Total number of individuals	312.4	115.6	52.0	480.0
Fleet (Numbers)	44	20	10	74
Average number of different individuals Per vessel	7.1	5.8	5.2	6.5

Average working hours per crewmember
The average working hours per crew for the kilka fleets in the southern Caspian Sea calculated 1212.1 hours. This index for different vessel segments, 12-18 LOA Mazandaran, 12-18 Guilan and 18-24 LOA were 1230.8, 1182.7, and 1221.0 per individual, respectively. Comparing this index for the same vessel segments in Mazandaran and Gilan, showed 48 hours higher for Mazandarn fleet segment.

Working hours
This index refers to any time that the crew is required to work onboard of the vessel, including fishing activity, but also any other activities like cleaning, repair and maintenance. In 2017, the total working hours for all kilka fleet were 4437.3 hours in both Provinces. The figure for Mazandaran was 1633.4 hours and for Gilan segments (12-18 and 18-24) were 1423.6 and 1380.3 hours. The working hours for Mazandaran were 6% higher than Gilan Province.

Engaged crew-FTE
The FTE, which equals the ratio between the working hours and the country reference level, was calculated. The index of FTE for each crewmember based on national metrics were calculated as 0.62, 0.60 0.71 and 0.77, for Mazandaran (12-18 LOA), Gilan (12-18 LOA), Gilan (18-24 LOA) and

for whole fleets respectively. The index of FTE based on international metrics (2000 hours per year) was estimated 0.82, 0.71, 0.69, and 0.77 as above mentioned, respectively.

Days at sea
The fishing days for the whole fleet were 8733.8 days at sea in 2017. This index for Mazandaran fleet was 5485.8 days which was higher than Gilan fleet. Fig. 1 shows the number of days at sea for different fleet segments.
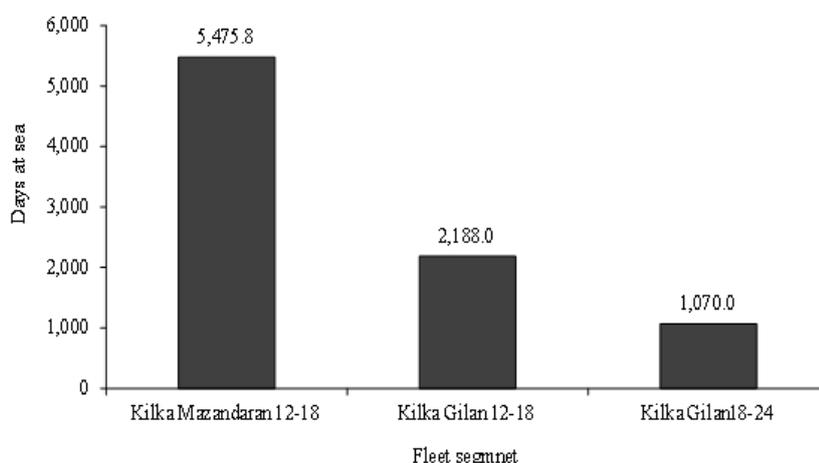
Figure 1: Days at sea for different fleet segments (south part of the Caspian Sea)

Duration of fishing trip
This indicator for whole kilka fisheries was calculated 16.5 hours per day. Total duration of fishing trips for whole fleet in the year under study (2017) was 144108 hours; from which 90351 hours

were belonged to Mazandaran fleet (12-18 LOA) with higher fishing trip (63%). In Table 5 duration of fishing trip for kilka fleets in south part of the Caspian Sea was presented.

Table 5: Duration of Kilka fleet fishing trips in southern part of the Caspian Sea (2017).

Variable	Kilka			
	Mazandaran 12-18	Gilan 12-18	Gilan18-24	Total
Number of Fleet segments	44	20	10	74
Average duration of vessel fishing trip (Hours per year)	2053.4	1805.1	1765.5	1947.4
Duration of vessel fishing trips (Hours per year)	90,351	36,102	17,655	144,108
Precent	63%	25%	12%	100%

Volume of fish landings
Total kilka catch was estimated 20135.5 t in south part of the Caspian Sea, which 70% was belonged to Mazandaran Province fleet (12-18

LOA). The volume of catch for Gilan Province was 5959.1 t, which 4325 t was belonged to 12-18 LOA fleet and 1634.1 t for 18-24 LOA fleet.

Self-consumption

Quantity of kilka landings per trip not sold but used by the fishers for their own consumption or their families' consumption were less than 1% of total catches.

Variable costs

Variable costs of fishing vessels are different and include personnel, Energy, operational, commercial, repair, and maintenance costs. The results of variable costs presented below.

Personnel costs

Personnel costs mostly include remuneration of crews. There are different methods of payment to crews. The results of kilka fisheries analysis show that the owners of kilka vessels in Mazandaran Province pay fixed renumeration to their crew. The remuneration fees are different based on job categories on board. The renumeration per month for Capitan, motorist and fishers were 1700000, 1500000, and 1400000 Tomans, respectively. These figures are slightly different for each vessel segments. In addition, the owners pay 50000 Tomans to all personnel per each ton catch. This amount equally divided between all personnels. In addition, at the end of each fishing year, one extra month renumeration has been paid to all crewmembers. The owners pay fixed renumeration to all crewmembers even during closed season (kilka spawning) in Mazandaran Province.

The renumeration of the crew is paid in the form of catch share in Gilan Province. The Capitan, Motorist, and fishers received, 80000, 60000, and 50000 Tomans per 1000 Kg of catch, respectively. As fishermen were paid the remuneration in the form of catch share, therefore, the payment to the personnel is done only during fishing season. For instance, during closed season, even during repairing time the crew has no remuneration. Personnel costs were included health insurance and social services as well. According to present survey, the amount of payment for health insurance was based on the least renumeration payment, which was 278300 Tomans per year for each personnel. Total personnel costs for the year under study (2017) including, remuneration, incentives, and insurance for all crewmembers for all fleet segments are demonstrated in Table 6. These figures include the owners who engaged on board of vessels and are active in fishing operation. According to analysis the total personnel costs for the year under survey was 9.3 Billion Tomans, which 7.2 Billion Tomans (77%) of this cost was belonged to Mazandaran fleet. The reason for higher personnel costs for Mazandaran fleet attributed to both higher remuneration and higher personnel.

Table 6: Total personnel costs including remuneration, incentives and insurance for crewmembers for all fleet segments in 2017.

Variable	Kilka			Total
	Mazandaran 12-18	Gilan 12-18	Gilan18-24	
Total engaged crew	235.4	96.0	46.0	377.4
Personnel costs (Tomans)	7,179,928,360	1,534,960,660	577,517,020	9,292,406,040

Energy costs

Total costs for fuel and oil of kilka vessels were 1.5 Billion Tomans which 71% of this amount was belonged to Mazandaran fleet (12-18 LOA). The figure for Gilan fleet segments, 12-18 LOA and 18-24 were 19% and 10%, respectively. Total energy costs were 24.5, 14.4, and 15.3 Million Tomans for each vessel in different segments, 12-18 LOA Mazandaran, 12-18 LOA Gilan, and 18-24 LOA Gilan respectively. Higher energy costs for Mazandaran fleet attributed to the higher number of fleet and higher distance from landing place to fishing ground.

Energy consumption

Whole kilka fleets in the Caspian Sea consumed total of 2.6 Million liters of fuel and oil in 2017, which 75% of this amount was belonged to Mazandaran fleet segments. Mean amount of fuel and oil consumption per each vessel of Mazandaran fleet was estimated 44262 liters, this figure was 21471 and 23159 liters for the 12-18 LOA (Gilan) and 18-24 LOA (Gilan) segments, respectively. Higher energy consumption rate for Mazandaran fleet attributed to the higher number of fleets and higher distance from landing place to fishing ground.

Other operational costs

This index represents the costs of other purchased consumable inputs related directly or indirectly to fishing operation included the bait for fishing and crewmember food during fishing trip, costs for delivery of any of these consumables, and components of any assets (gear or vessel) that are not related to maintenance were 1.5 Billion Tomans which 80% of this amount was belonged to Mazandaran fleet due to higher numbers of fishing fleets and higher fishing days effort.

Commercial costs

Total costs of kilka commercial including boxes, bags and transportation to market were calculated 182.6 Million Tomans, of which 80% (146 Million Tomans were belonged to Mazandaran fleet (12-18 LOA), and 16% and 4% were belonged to fleet segments 12-18 and 18-24 in Gilan Province, respectively.

Repair and maintenance costs

Maintenance and repair costs of the vessel and gear of kilka fisheries including both routine and extraordinary ones were estimated more than 2 Billion Tomans, of which 61% were belonged to Mazandaran fleet (12-18 LOA), and 22% and 17% were

belonged to fleet segments, 12-18 LOA and 18-24 LOA Gilan.

Comparison between variable costs of different vessel segments

Total variable costs included personnel, energy, and other operational, commercial, repair and maintenance for the whole fleet of kilka fisheries during 2017 were estimated to be 14.6 Billion Tomans, which higher portion (64%) were belonged to personnel costs and lower portion (1%) to commercial costs. Other operational and energy costs have equal share, each with 10% of total costs. Fig. 2 presents the share of each variable costs in kilka fisheries for 2017. The share of personnel costs (percent) for 12-18 LOA Mazandaran, 12-18 LOA Gilan and 18-24 LOA Gilan were estimated 66%, 61%, and 48%, respectively.
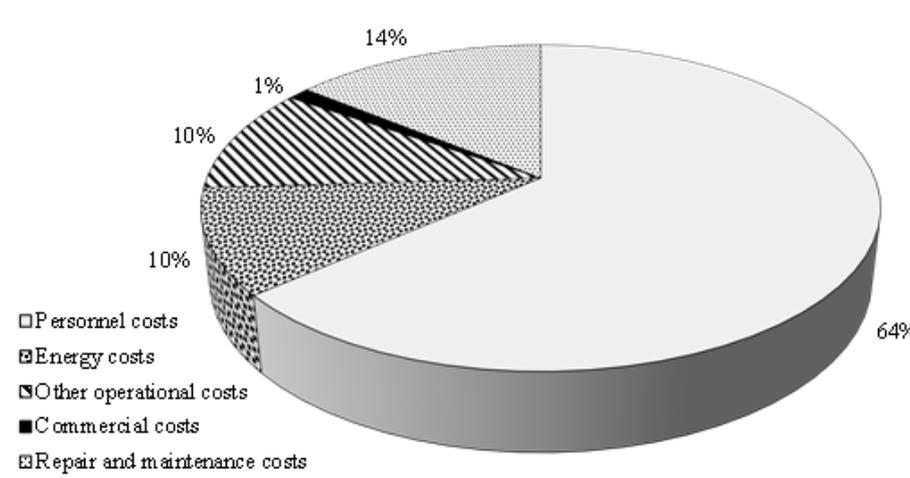
Figure 2: Contribution of each variable cost for whole Kilka fisheries in 2017.

Fixed costs

Fixed costs were estimated 1.6 Billion Tomans which were not directly connected with operational activities for kilka fisheries in 2017. The share of fixed costs for Mazandaran and Gilan fleet were estimated 53% and 47% respectively (Table 7).

Investments

This indicator is the value of the vessels at the end of the previous calendar year, plus any improvements to existing vessel/gear during the survey period. The value of kilka fleet in both Mazandaran and Gilan Provinces (74 vessels) were estimated to be 80 Billion Tomans, which 65.7% of this value was estimated to belong to Mazandaran fishing fleet and the rest belong to Gilan fleet. Mean value for each Mazandaran vessel estimated to be 1.2, Billion Tomans, for Gilan Fleet, was 900 Million Tomans.

Table 7: Fixed costs (Tomans) for Kilka vessel segments in south part of the Caspian Sea 2017.

Variable	Kilka			Total
	Mazandaran 12-18	**Gilan 12-18**	**Gilan 18-24**	
Fixed costs	860,882,000	663,900,000	90,453,520	1,615,235,520

Economic performance of Kilka Fisheries in south part of the Caspian Sea

Revenue indicator

Value of kilka production measured as the sale of landed catches and income generated from the use of the vessel in other non-commercial fishing activities. According to survey, all the vessels except two vessels from segment 18-24 Gilan Province, which had other activities rather than kilka fishing, all others engaged only in fishing activity. Total revenue of kilka fishing fleets were estimated 21.3 Billion Tomans, in 2017, which 15.4 Billion (72%) Tomans was belonged to Mazandaran fleet (12-18 LOA). Mean revenue for each vessel of Mazandaran fleet (12-18 LOA) were estimated 350 Million Tomans, this figure for Gilan were 210 and 175 Million Tomans for 12-18 LOA and 18-24 LOA, respectively (Table 8).

Table 8: The revenue of each fleet segment in southern Caspian Sea, 2017.

Variable	Kilka			Total
	Mazandaran 12-18	**Gilan 12-18**	**Gilan 18-24**	
Volume of landings (t)	14,176.4	4,325.0	1,634.1	20,135.5
Revenue (Tomans)	15,401,607,144	4,195,244,180	1,749,094,460	21,345,945,784

Gross cash flow

For kilka fisheries in 2017, gross cash flow, were estimated as 5 Billion Tomans, which 3.6 Billion Tomans, was belonged to Mazandaran fleet (12-18 LOA), 1.0 Billion and 297 Million Tomans were belong to 12-18 LOA and 18-24 LOA Gilan, respectively. Mean gross cash flow, for each vessel in Mazandaran Province fleet segment were 83 Million Tomans, 51, and 30 Million Tomans, for Gilan fleet segments, 12-18 LOA and 18-24 LOA, respectively.

Gross value added

This index for kilka fisheries in south Caspian Sea for the year 2017 were estimated as 14.43 Billion Tomans.

The share of Mazandaran fleet segment (12-18 LOA) was 10.8 Billion Tomans (76%), for Gilan fleet segment the share of gross value added, were 2.6 and 0.9 Billion Tomans for 12-18 LOA and 18-24 LOA, respectively. Mean gross value added, for each vessel in different segments were 246 Million, 127.8 Million and 87.4 Million Tomans, for 12-18 LOA (Mazandaran), 12-18 LOA and 18-24 LOA Gilan, respectively.

Profit based on operational and fixed costs

Based on operational and fixed costs, this index was calculated 5 Billion Tomans for whole kilka fisheries in south part of the Caspian Sea (2017). For Mazandaran fleet (12-18 LOA)

was, 3.6 Billion Tomans, for Gilan fleets (12-18 LOA) were, 1 Billion Tomans and 297 Million Tomans for the fleet of 18-24 LOA. Amount of profit for each fishing vessel, were estimated as, 82.8 Million Tomans for Mazandaran 12-18 LOA, 51.1 Million Tomans for Gilan 12-18 LOA and 29.7 Million Tomans for Gilan 18-24 (Table 9).

Table 9: Profit of fishing fleets based on operational and fixed costs in south part of the Caspian Sea.

Variable	Kilka			Total
	Mazandaran 12-18	**Gilan 12-18**	**Gilan 18-24**	
Profit (Tomans)	3,644,325,784	1,021,999,918	296,861,573	4,963,187, 275
Profit per vessel (Tomans)	82,825,586	51,099,996	29,686,157	67,070,098

Depreciation costs
This figure for kilka fleet assumed to be 5% per year, which estimated 3.9 Billion Tomans for whole fleet in the south part of the Caspian Sea. This index was estimated 2.6 Billion Tomans for Mazandaran fleet, 875 and 465 Million Tomans for 2 different segments of the Gilan fleet. Depreciation costs for each vessel of different segments were estimated 59 Million Tomans/vessel of Mazandaran fleet, 43.8 and 46.5 Million Tomans/vessel of Gilan fleet.

Opportunity costs
The inflation rate was so high in Iran in recent years and it is more than bank interest rate, therefore opportunity costs for kilka fleet is negative.

Subsidies to GVA (Gross Value Added)
There is no any direct monetary payment as subsidies, which fishers rely on indirect payment of fuel subsidies payed by government to kilka fleet in south part of the Caspian Sea.

Socio-economic indicator
Remuneration per FTE
Total personnel remuneration based on national and international full time equivalent were estimated 33.9 and 31.7 Million Tomans per vessel for whole kilka fleet in south part of the Caspian Sea in 2017. For Mazandaran fleet (12-18 LOA) these figures for each vessel were 39.6 and 37.1 Million Tomans, respectively. For Gilan fleet segments, personnel remuneration was estimated 24.1 and 22.6 Million Tomans for 12-18 LOA, and 19.8 and 18.5 Million Tomans for 18-24 LOA, respectively.

Labor productivity
Labor productivity per unit of labor was calculated 59.6 Million Tomans based on national FTE and 55.9 Million Tomans based on international FTE for kilka fishery in Mazandaran. For Gilan, labor productivity, the figures were calculated 40.1 (national) and 37.7 Million Tomans (international) for 12-18 LOA, 29.9, and 28.1 Million Tomans on national and international FTE, respectively.

Demographics
Age of crewmembers
The mean age of all crewmembers for kilka fisheries in south part of the Caspian Sea was 47.7 years, the mean age of personnel in Mazandaran fleet was 45.1 years, and for Gilan fleet were 51.2 years and 55.7 years, for fleet segments, 12-18 LOA and 18-24 LOA, respectively. Comparing mean ages of the all-fleet segments showed that the personnel of Mazandaran fleet were younger than Gillan fleet.

Literacy level of crewmembers
Crewmembers literacy level of fleet segments of Gilan was higher than Mazandaran fleet. In Gilan fleet segments (12-18 and 18-24 LOA), more than 90% of the crewmembers have diploma and higher literacy level, this figure for Mazandaran fleet were 33 percent.

Household size of crewmembers
The numbers of household depended on kilka fisheries were 1604 in the southern Caspian Sea. This figure was 1044 For Mazandaran fleet, for Gilan, 386 and 174 individuals for the segments, 12-18 LOA and 18-24 LOA, respectively.

Number of household members engaged in fishing
Total number of fisher's family engaged in kilka fishery were 76.7 individuals, which 46.7 individuals were belonged to Mazandaran fleet and for Gilan fleet segments were 20 and 10 individuals for the 12-18 LOA and 18-

24 LOA , respectively. The data shows that only the head of family involve on fishing vessels in all Gilan fleet segments but in 6 % of Mazandaran vessels in addition to the head of family, other members of the family also engaged in fishing.

Number of family members engaged in onshore activities
This indicator represents the number of fisher's family member active in onshore fishing activity of kilka fisheries. According to survey, in Gilan fleet none of the family members engaged on fishing activities on onshore, for Mazandaran fleet only 2% of fisher's families were engaged in fishing onshore activities.

Proportion of total household income from fishing activity
This indicator provided the amount of household income from kilka fishing activity. According to survey, 92% of kilka income household family came from the kilka fishing. This index was 98% for Mazandaran fleet (12-18 LOA), 88% were belonged to 12-18 LOA Gilan fleet segment and 57% for 18-24 LOA Gilan fleet segment.

Technical indicators
Capacity utilization
This index shows how much the capacity of kilka fleets were employed in fishing activities. According to survey, capacity utilization for whole kilka fleet was 83% in 2017, for Mazandaran fleet this indicator was 88%, for Gilan fleet segments, were

78% for 12-18 LOA and 76% for 18-24 LOA.

Environmental indicators
Fuel efficiency of seafood landings
This indicator represents landings of kilka per ton of fuel consumed, that for whole fleet segments in 2017, was 20135.5 tons of landings for 2218.1 tons of fuel consumption. This indicator shows that 110 liters (0.110 tons) fuel were consumed per one ton catch of kilka, it means the efficiency of fuel consumption for kilka fleet in south Caspian Sea was 11.02%, in 2017. Fuel efficiency for Mazandaran fleet (12-18 LOA) estimated 11.7%, which means

116.8-liters fuels were consumed to catch 1- ton kilka. For Gilan fleet segments, these figures were 8.4% and 12.1% for 12-18 LOA and 18-24 LOA, respectively which imply that, segment 12-18, for each one ton of kilka catch consumed 84.4-liters fuel and segment 18-24 LOA consumed 120.5 liters of fuel. Comparison of fuel efficiency for fleet segments 12-18 LOA of two provinces showed that Mazandaran fleet segment, consumed 38% more fuel to catch one ton of kilka than Gilan segment (Table 10).

Table 10: Fuel efficiency of kilka fisheries in south part of the Caspian Sea, 2017.

Variable	Kilka			Total
	Mazandaran 12-18	Gilan 12-18	Gilan 18-24	
Volume of landings (ton)	14176.4	4325.0	1634.1	20135.5
Energy consumption (ton)	1656.0	365.1	196.9	2218.1
Fuel efficiency of seafood landing	0.117	0.084	0.121	0.110

Discussion
Socio-economic analysis of fisheries data used to support the conservation and management of fisheries industries (FAO, 2001). The results of an economic analysis could contribute to the design of fisheries policies and management plans that ensure adequate wealth for the fishers, profitability of the activities and maintenance of stocks at sustainable levels. Socio-economic data are collected with the aim of assessing, economic performance and cost structure, livelihoods and employment, profitability level of investments, debts and subsidies,

activity levels, demographics and ownership structures (Pinello *et al*., 2017).

This study is the first analysis of socio-economic of kilka fisheries through Questionnaire forms in the southern part of the Caspian Sea

Fishing statistics of kilka in south Caspian Sea (Iranian waters)
Figure 3 shows the catch statistics of kilka in the south part of the Caspian Sea from 1971 to 2017. As it is clear from the figure, the increasing trend began in 1990, reached its maximum in 1999 and then the decreasing trend of

the catches began. Some scientists believe that the decline has been the result of the invasion and bloom of comb jelly (*Mnemiopsis leidyi*) in the Caspian Sea, while other scientists believe that the decline has been the consequence of both the comb jelly invasion and overfishing. CPUE (catch

per vessel night) in this study was 2.6 and 1.8 tons per vessel night for Mazandaran and Gilan fleet respectively. This indicator for 2012 and 2013 were 2.8 and 3.0 tons per vessel night for Mazandaran, while 2.6 and 2.2 tons per vessel night for Gilan fleets (Janbaz, 2016).
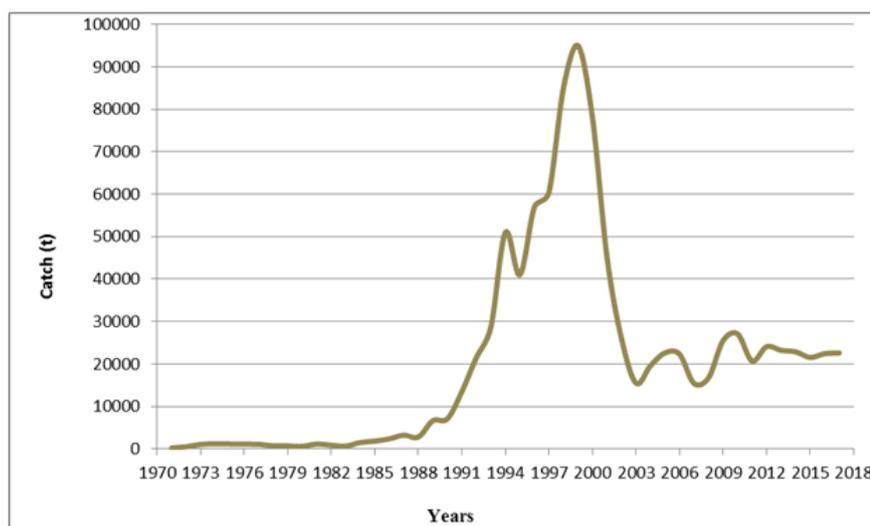

Figure 3: Kilka landings in tons from 1971-2017, in south part of the Caspian Sea.

Ownership index estimated for kilka fisheries showed that in Mazandaran Province 80% of the vessel owners were active in fishing operation. For Gilan Province, this figure was 90% for the 12-18 segment and 40 % for 18-24 segment. The survey revealed that, revenue was lower and the variable costs were higher for vessels with owner engaged in fishing operation. The fishermen were received incentive for each ton of catches in Mazandaran, in addition to fixed remuneration for crew, while the remuneration of crewmembers based on catch share in Gilan Province. The higher revenue and lower variable costs for the vessels that owners do not engage in fishing

operation might be related to these two reasons. Some fisheries socio-economic surveys showed that the revenues of some fishing fleets which the owners were active on the board of vessels were higher than the fleet which the owners were not on the board of vessels, also variable costs were lower too, which is not in conformity with the results of kilka fisheries in south Caspian Sea (Pinello *et al.,* 2017).

According to 84th session of the ILO (International Labor Organization) in 1996, the mean maximum working hours per day for seamen has to be 14 hours and maximum working hours per week should be 72 hours. The results of present survey showed mean working

hours per day for kilka fleet was 10 hours, which were 4 hours lower than ILO convention.

The number of fixed job opportunities created by kilka fisheries were estimated 5.1 individuals per vessel in 2017. Total job opportunities including fixed, temporary, and rotated job, created by each vessel of kilka fleet in southern Caspian Sea were 6.5 individuals. The mean number of job opportunity created by each kilka vessel in 1999 was 12 individuals (Ghorbani and Zare, 2001). The number of kilka fleets was 90 vessels in 1999 and total landings were 55900 tons. One of the reasons of higher revenues for kilka vessels was the higher mean number of crew per each vessel in 1999. Extraordinary increasing costs in recent years in comparison with 1999 could be other reasons for decreasing the number of crew per vessels in 2017.

Personnel costs were contributed 64% of total variable costs of the kilka fleets in south part of the Caspian Sea in 2017. The share of personnel costs for Mazandaran fleet (12-18 LOA) were 66% of the total variable costs, which is higher than both kilka fleets (12-18 and 18-24 LOA) in Gilan Province.

The share of fuel, other operational, commercial, repair, and maintenance costs were, 10%, 10%, 1%, and 14% respectively. The share of personnel costs for kilka fleet in 1995 was 38% of total costs (Zand, 1997). According to Ghorbani and Zare (2001), the share of personnel costs in 1999 for Gilan fleet were 55% of total costs, the share of fuel costs was 5% which increased

twice for 2017 (10%). The share of repair and maintenance cost for 1999, were 10%, which increased to 14% in 2017.

Total revenue for kilka fisheries in south part of the Caspian Sea were estimated 21.2 Billion Tomans (1028 Tomans/kg). This index was 15.4 Billion Tomans for Mazandaran fleet (1086 Tomans/ kg) and 5.8 Billion Tomans for Gilan fleets (970 Tomans/kg) in 2017. Mean revenue for each vessel in Mazandaran (12-18 LOA) was 350 Million Tomans, for Gilan fleets were 210 (12-18 LOA) and 175 Million Tomans (18-24 LOA). The results of survey showed that the amount of fish landed and revenue for Mazandaran fleet were 1.5 and 3.7 times higher than Gilan fleets, which could be attributed to higher price and higher density of kilka in Mazandaran fishing grounds. These two factors might be the reasons for higher revenue in Mazandaran fleet.

According to Ghorbani and Zare (2001), landings of kilka were 55900 tons in Gilan in 1999, which made 2.544 Billion Tomans as revenue (63.4 Tomans/kg for fishermen) . Mean catch and revenue per each vessel of Gilan fleets were 621 tons and 39.4 Million Tomans in 1999. Landings of kilka per vessel in Gilan decreased to one-third (198.6 tons per vessel) in 2017 in comparison with 1999.

Capital productivity for whole kilka fleets estimated 1.3% in 2017. Capital productivity was 2% for Mazandaran fleet while this figure estimated as 0.8% (12-18 LOA) and -1.8% (18-24 LOA)

for Gilan fleets. The results showed higher capital productivity for Mazandaran fleet in comparison with Gilan fleets. The lower capital productivity for Gilan fleets could be attributed to higher costs and lower revenue in 2017. Mean revenue for Gilan fleet were 158.5 Million Tomans with 128.8 Million Tomans costs for 18-24 LOA, these figures for Mazandaran fleet were 350 Million Tomans revenue and 267.2 Million Tomans costs, which show high differences. If the costs of fishing gears, equipment and navigation instruments added to the costs of Gilan fishing fleet (18-24 LOA), negative capital productivity is expected. It would be concluded that fleet capital productivity was desirable based on costs and revenue analysis of kilka fleets in Mazandaran in 2017.

According to the National Supreme Labor Council Resolution, the basic monthly wage for workers (30 days of work) was set 930000 Tomans (Supreme Labor Council, 2016) in 2016. In the present study the mean remuneration plus incentives and health insurance was 2,541,748 Tomans for Mazandaran fleet (12-18 LOA), for Gilan vessel segments were 1,332,431 Tomans for 12-18 LOA and 1,046226 Tomans for 18-24 LOA. The amount of payments was higher than national Supreme Labor Council Resolution in 2017. The higher payments to Mazandaran crewmembers were attributed to twelve months fixed payments and one-month incentive even when there is no fishing activity.

remuneration of crew was three times higher than the National Supreme Labor Council Resolution in 1999.

Fuel efficiency for kilka fleet 12-18 LOA in Gilan was estimated 84.4 liter of fuel per 1 ton catch, this figure for Mazandaran fleet 12-18 LOA was 116.8 liters of fuel per 1 ton catch, which is attributed to longer distance of fishing grounds from the Mazandaran ports in comparison with Gilan port distance from fishing grounds. Fuel efficiency for Gilan fleet 18-24 LOA was calculated 120.5 liters of fuel per 1-ton catch, implying lower fuel efficiency of these fleets, which could be attributed to higher hp of this fleet in comparison with 12-18 LOA (232.2 hp for 12-18 LOA and 306.5 hp for 18-24 LOA).

The share of operational costs (including variable and fixed costs) was estimated 9.35%, 12.85%, 9.42%, 1.13%, 9.96% and 57.29% for energy, maintenance, other operational, commercial, fixed and crew share (renumeration), respectively. According to results, more than 50% of the operational costs of kilka fisheries were belonged to crew share (renumeration) and the lowest portion of the operational costs were belonged to energy. The reason for low energy costs could be attributed to low price of fuel in Iran, which is subsidized for all kind of vessels.

In conclusion, kilka fishery in south part of the Caspian Sea created economic opportunity, job, and livelihood for some of the households in the southern part of Caspian Sea.

Due to participation of the fishermen in Fisheries Management Committees of kilka fishing during past ten years, the stock of common kilka has been stable, consequently, the opportunities created by this fishery are also stable. It is necessary to continue this kind of studies to reveal profoundly all the socio-economic parameters of kilka fishery in south part of the Caspian Sea.

Acknowledgement

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