

The roles of bony fish catch with emphasis Kutum, *Rutilus frisii kutum* in fisherman's income in fishing season 2008-09 from the southern Caspian Sea

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ABSTRACT: This study was carried out in the southern part of Caspian Sea with the purpose of studying the economic and social analysis of Kutum catch in fishermen's income in fishing season 2008-2009. Fish catch were collected using beach seines. Overall, the catch of all bony fish by beach seine cooperatives was 13000 metric tonnes and Kutum accounted 10138 metric tonnes. Kutum contributed about 76% of total sell bony fish in south of the Caspian Sea and total income of Kutum sell are estimated US\$ 30,415,998. The income of fishermen through selling of *R. f. kutum* from total bony fish income was 74% for Guilan, 85.8% for Mazandaran, and 26% for Golestan provinces. The catch per unit effort (CPUE) of whole bony fish was 182.5 ± 78.3 for Guilan, 355.6 ± 242.8 for Mazandaran, and 207.2 ± 66.9 for Golestan, while dependent on fish catch, fishing effort, manpower, skilfulness, management and ecologic conditions of areas. The average break-even point (Q) catch of *R. f. kutum* estimated in Mazandaran zone was more than that others areas. Consequently, *R. f. kutum* plays a significant role in fishermen's income in southern coasts of the Caspian Sea.

Keywords: Bony fish, catch, *Rutilus frisii kutum*, income, Caspian Sea.

INTRODUCTION

Economics is the social science that studies the production, distribution, and consumption of goods and services (Clark, 1998). In 2004, the total nominal value of reported global fish production was estimated at \$148 billion, of which capture fisheries was \$85 billion and aquaculture was \$63 billion. The total estimated value of the reported marine catch of 85.7 million tons was \$78.8 billion (FAO, 2007). Grafton, (2007) reported that about 25% of the world's fisheries are depleted such that their current biomass (B_{CUR}) is less than the biomass that maximizes the sustained yield (B_{MSY}).

The Caspian Sea has provided enormous economic facilities for the people living in its coasts. The major type of fishing in recent years has been the capture of various types of bony fishes carried out by the fishermen gathered in beach seine cooperatives. These cooperatives play a considerable role in providing protein resources, food security and even national incomes of countries of the region (Pourhosein, 2002). Utilizing reserves of the Caspian Sea is a production process, and fishing, as the ultimate stage of this process, happens as the combination of fish reserves with the labor force and capital. Due to various factors, including natural causes such as temperature of water and air, salinity, precipitation, water level, winds, nutritive organisms and aggressive creatures, and using improper fishing tools and machinery, the amount of fishing and resources fluctuate (Salehi, 2007).

Ghorbani, (2009) noted that the economic study of beach seine fishing technique focused on the labour force, fishing tools and machinery, experienced fishermen, efficient management, skilfulness, proper storage, and recreational facilities. The location of fishing cooperatives in the seaside could be affected on the improvement of the economic situation of fishermen. According to Meimandi (1992) in recent decades the fishery biologists and

economists have begun an intensive effort to discover the amount of utilizable marine products, without imposing a loss on the sea reserves, from an economic standpoint. The main objective is the utilization of marine stocks in a profitable mode. According to Forth Development Plan of Fisheries (NFDP, 2005), FAO (1992), Nash (1997), and Salehi (2004) Iran has tremendous opportunities to increase the product of fisheries through development of aquaculture.

Despite its commercial importance, no studies have been carried out on economical and social analysis of *R. f. kutum* by beach seine fishing cooperative in southern Caspian Sea especially in the Guilan, Mazandaran and Golestan provinces. Therefore, it is important to improve knowledge of this target species as a tool for stock management. The present study was carried out to investigate the economical and social analysis of Kutum in the southern Caspian Sea. The main objectives of the study were to describe net profit, cost, and break-even point for Pare fishing cooperatives in Guilan, Mazandaran and Golestan provinces.

MATERIALS AND METHODS

Economic survey of the beach seine fishing is practiced by 131 fishing cooperatives in three provinces located on the southern coasts of the Caspian Sea that included Guilan (58), Mazandaran (53) and Golestan (20) provinces. An overall number of 10773 fishermen 4480 in Guilan, 4800 in Mazandaran and 1493 in Golestan are involved. Besides providing job and livelihood for the fishermen, this is a source of protein (white meat) in the country. Therefore, improving economic aspects of the cooperatives and helping them employ skilled manpower and more efficient fishing tools and machinery, bringing about a balance between expenditure and the number of fishermen, familiarity with more scientific fishing techniques in order to protect the marine and fishing stocks for succeeding generations and economizing these activities are necessary.

Data collection

Regarding the project schedule, the research was carried out in three stages. The first stage included studying related references and literature, providing economic studies forms, consulting directors of fishing cooperatives and fishery experts and economists. In the second stage, interview to responsible fishery administration of Guilan, Mazandaran and Golestan provinces for gathering the data collection related to fish catch, and the third stage comprise to data analysis. The operational expenses of Pare fishing cooperatives comprised to infrastructure, equipment, accessory, personality, and current costs.

Cost

The cost of each fishing effort based on mentioned cases after met by an expert fishery group for the cooperatives taken into account in less than 200 was about \$80, for 201-499 it was about \$280, and for more than 500 times fishing effort was \$350. The average cost of each time of fishing effort in southern coasts of the Caspian Sea estimated $\$241.5 \pm 84.7$. In order to estimate the cost of fishing effort, factors such as the time of seine laying in the sea, amount of gasoline and gas oil used, manpower, number of boats, seine and machinery depreciation were taken into account. Price estimation was based on the Fishery's reports for Kutum (*R. f. Kutum*), Mugil (*Liza auratus*), common carp (*Cyprinus carpio*), and other fish (*Alosa* spp., *Sander lucioperca*, *Vimba vimba*, *R. rutilus*, *Neogobius* spp., *Aspius aspius*, *Liza saliens*, *Barbus* spp., *Esox luscious*, *Salmo trutta caspicus*) that were evaluated \$3, \$3.2, \$4.5 and \$2, respectively.

Estimate of break-even point

In economic theories, break-even point is a production level on which the profit is zero, or when total income is counterbalanced by total expenditure (Anderson and Clancy, 1991).

TC = Total fixed and variable cost, (TC=TFC+TVC)

TFC = Total fixed cost that is irrelevant to production level (its increase or decrease does not affect production level).

TVC = Total variable cost that is related to the production level and an increase or decrease in it will affect the production level.

AFC = Average fixed cost that consists of total fixed expenses divided by the production amount where the average fixed expenses change with the production level.

AVC = Average variable cost that is the total variable cost divided by production

- 1) $AFC = TFC/Q$ where AFC = Average fixed cost, TFC = Total fixed cost and Q = quantity of production
- 2) $AVC = TVC/Q$
- 3) $\pi = TR - TC$

- 4) If $\pi = 0$ therefore $TR = TC$ then $TR = TVC + TFC$
- 5) The formula of the break-even point is $Q = TFC / (P - AVC)$

The CPUE were obtained by dividing the Pare net annual catch by the annual number of fishing effort.

Data analysis

The data were analyzed by ANOVA test based on SPSS version 11.5 and Excel software.

RESULTS AND DISCUSSION

Results

Relationship between fishing effort and catch ratio of Kutum

According to the information collected, totally 41,786 times of fishing effort with a mean 360.7 ± 111.8 were carried out by 131 Pare fishing cooperatives in southern coasts of the Caspian Sea (Table 1). Overall, the catch ratio of all bony fish was 13000 metric tons whereas Kutum comprised 10138 metric tons. There is a significant relationship between catch ratio and number of fishing effort (ANOVA, $p < 0.05$).

Table 1. Mean of catch ratio of bony fish and Kutum based on fishing effort in varies areas of the southern Caspian Sea during fishing season 2008-09. (Note: a is not the significant and b is significant between catch and fishing effort in varies areas based on Duncan's Post Hoc Test with significant level 0.05 in each column)

Province	N.	Catch(tonne)		
		Bony fish	Kutum	Fishing effort
Guilan	58	71373.5±4451.9 ^a	52873.1±43633.1 ^a	368.1±102.7 ^b
Mazandaran	53	148683.5±120249.6 ^b	127797.0±116993.4 ^b	401.2±106.2 ^b
Golestan	20	49017.5±19908.9 ^a	14939.1±11004.5 ^a	232.2±29.5 ^a
Total	131	99238.9±91879.1	77394.4±90727.7	360.7±111.8

Fishermen's income in Guilan province and CPUE

Overall, numbers of 58 Pare fishing cooperatives are authorized to engage in fishing along the west coastal strip of the Caspian Sea. The numbers of 4480 members who are engaged in 21345 sets of fishing effort with mean 368 ± 102.7 sets for each fishing cooperative. In these efforts, 4140 tonnes of bony fish were captured and Kutum's share of this figure was 3067 tonnes, which constituted 74% of the bony fishes captured. The total income of the fishermen amounted to \$12,432,527 and the expenses in each fishing effort estimated to be \$279.3±52.8 in average that totalled \$5,961,879 (Table 2). Each fisherman share's of this income in a fishing season was \$1,444, which the net profit of Kutum was \$1069 (Table 3). Therefore, Kutum had the highest allotment (\$9,199,923) and common carp (*Cyprinus carpio*) the lowest (\$52,313) in terms of the income earned through selling various fish species in Guilan province. Mihanparast fishing cooperative obtained the highest catch and income with 199.1 tonnes (185.5 tonnes belong to Kutum) and \$594.550 (\$556.542for Kutum), which each fisherman obtained the net profit of \$6147. The lowest catch and income related to Daryakenar fishing cooperative with a production of 10 tonnes (6.6 tonnes for Kutum) with an income of \$29663 (\$19902 for Kutum), which produced the net profit of \$193 for each fisherman. The catch per unit effort (CPUE) of whole bony fish was 182.5 ± 78.3 , while Kutum contributed to 128.8 ± 80.9 kg/set.

Table 2. Income ratio and frequency percent based on sell various fish species in Guilan province from the southern Caspian Sea

Species	Mean price/kg (\$)	Sum income (\$)	Sell (%)
R.frisii kutum	3	9199923	74
L. auratus	3.2	2819690	22.7
C. carpio	4.5	52313	0.4
Others	2	360602	2.9
Total		12432527	100

Table 3. Net profit and monthly income of each fisherman in Guilan province from the southern Caspian Sea

	Toman (Iran)	Dollars (\$) in US
Total Income	12432527100	12432527
Total cost	5961879000	5961879
Net profit	6470684000	6470648
Income per person	1444341	1444
Income per month	241056	241

Fishermen’s income in Mazandaran province and CPUE

Fifty three Pare fishing cooperatives engage in Mazandaran province that carried out 21,263 sets of fishing effort with mean 401.2±106.2 per cooperative. Generally, fish catch of 7,880,228 kg bony fish were captured, while Kutum’s share of this weight was 6,773,243 kg or 85.8% of the whole bony fishes catch. The total income of the fishing cooperatives amounted to \$23,785,117 (Table 4). The expenses with respect to each fishing effort estimated to be \$295.8±29.576 in the mean. Therefore, the total cost of fishing cooperatives was estimated to be \$6,293,848.

Consequently, in terms of incomes of selling fishes in Mazandaran province, Kutum has had the highest share of fishing (\$20,319,729) and common carp has had the lowest share (\$205,408). This brought an income of about \$3,644 for each fisherman, which the net profit of Kutum was \$3126 (Table 5). The highest fish catch belonged to Shahid Beheshti fishing cooperative (in central Mazandaran) with a production of 469,393 kg (with Kutum’s share of 441,662 kg) and total income of \$1,413,547 (\$1,324,986 for Kutum) that produced the net profit of \$14,345 for each fisherman. The lowest fishing and income belonged to Shahid Razaghi fishing cooperative with a production 16,781 kg (11,950 kg for Kutum) with an income of \$49,059 (\$35,850 for Kutum). This cooperative made a loss of \$18,421 that is attributed to the manpower, skilfulness, management and ecologic conditions. The catch per unit effort (CPUE) of whole bony fish was 355.6±242.8, while Kutum contributed to 300.7±238.3 kg/set.

Table 4. Income ratio and frequency percent based on sell various fish species in Mazandaran province from the southern Caspian Sea

Species	Mean price/kg (\$)	Sum income (\$)	Sell (%)
R. frisii kutum	3	20319729	85.8
L. auratus	3.2	3034288	12.8
C. carpio	4.5	205408	0.9
Others	2	113346	0.5
Total		23785117	100.0

Table 5. Net profit and monthly income of each fisherman in Mazandaran province from the southern Caspian Sea

	Toman (Iran)	Dollar (\$) in US
Total Income	23785117321	23785117
Total cost	23785117321	6293848
Net profit	17491269203	17491269
Income per person	3644256	3644
Income per month	606333	607

Fishermen’s income in Golestan province and CPUE

Twenty seine fishing cooperatives are working in Golestan province that engaged in 4,643 fishing effort with mean 232.2±29.5 sets per each cooperative. Totally, 980,340 kg of various types of bony fishes were caught, while the Kutum’s share of this figure was 298,782 kg and 26% of the bony fishes. Overall, fishermen’s income amounted to \$3,506,122 (Table 6). The total cost of seining operations, where the cost of each seining catch is approximately \$260±61.6, was estimated \$1,207,180 (Table 7). Consequently, each fisherman made an income of about \$1540 in Golestan province, which the net profit of Kutum was \$400. In Golestan province, as sales figures are considered, common Carp and Kutum ranked as first and third of \$1,546,587 and \$896,346, respectively. These could be due to the geographical conditions in the Gorgan Bay as the natural feeding area for common carp, high temperature and shallowness of waters in this region. The Gomishan Pare fishing cooperative (in east Golestan) ranked first in terms of production and income with 99,409 kg (7,958 kg for Kutum) and \$413,154 income (\$23,874 for Kutum). Each member of the cooperatives earned \$4,580 in mean. The Makhtumgholi Pare fishing cooperative (west Golestan) made the lowest amount 259,994 kg (11,864 kg for Kutum), \$81,922 income (\$35,592 for Kutum) and each fisherman earned \$890. The catch per unit effort (CPUE) of whole bony fish was 207.2±66.9, while Kutum contributed to 66.3±47.5 kg/set.

Table 6. Income ratio and frequency percent based on sell various fish species in Golestan province from the southern Caspian Sea

Species	Mean price/kg (\$)	Sum income (\$)	Sell (%)
R. frisii kutum	3	896346	26
L. auratus	3.2	1033139	29
C. carpio	4.5	1546587	44
Others	2	30050	1
Total		3506122	100

Table 7. Net profit and monthly income of each fisherman in Golestan province from the southern Caspian Sea

	Toman (Iran)	Dollar (\$) in US
Total Income	3506122200	3506122
Total cost	1207180000	1207180
Net profit	2298942200	2298942
Income per person	1539813	1540
Income per month	256635	256

Classifying cooperatives regarding income and cost

Catching bony fishes, mainly the Kutum, by Pare fishing cooperative in southern coasts of the Caspian Sea has fluctuations (Tables 8 and 9). The highest frequency catch of bony fishes in Guilan (24.1%) and Golestan (50%) was in the range 20-40 metric tonnes while in Mazandaran the highest fish catch (50.9%) occurred in the range of above 100 metric tonnes. This could be due to released fries of Kutum, the existence of rivers and sufficient water flowing, availability of nutrients, and ecological conditions. In Guilan this could be due to improper living conditions in the lagoons and obstacles in rivers at the migration season. There is a significant difference between the fish catch ratio and the number of Pare fishing cooperatives in the coastal provinces ($P < 0.05$).

Table 8. Number of Pare cooperative society in each range of catch of bony fish from the southern Caspian Sea. Note: PFC is the Pare fishing cooperative

Range of catch (tonne)	<20	20-40	40-60	60-80	80-100	>100	Number PFC
Guilan	3	14	13	9	6	13	58
Mazandaran	1	2	9	9	5	27	53
Golestan	0	10	5	4	1	0	20
Total	4	26	27	22	12	40	131

The catch ratio of Kutum by Pare fishing cooperatives in various provinces was the highest notable fluctuation. The highest catch ratio in Guilan (25.9%) occurred within the range of 20-40 metric tonnes and the highest catch in Mazandaran (39.6%) was in the range above 100 metric tonnes, whereas, the highest catch of Kutum (75%) was ranged below 20 tonnes in Golestan. This could be due to factors such as the high temperature, lack of the movement of Kutum in large schools, releasing small number of Kutum fries, insufficient rivers for reproduction migrations, the small number of Pare fishing cooperative (fishing effort) are operative, fishing owing to topographic conditions of the region.

Table 9. Number of Pare fishing cooperative in each range of catch of R. f. kutum from the southern Caspian Sea Note: PFC is the Pare fishing cooperative

Range of catch (tonne)	<20	20-40	40-60	60-80	80-100	>100	Number of PFC
Guilan	13	15	13	4	2	11	58
Mazandaran	1	11	9	7	4	21	53
Golestan	15	5	0	0	0	0	20
Total	29	31	22	11	6	32	131

Break-even point of Kutum in different provinces

The calculate break-even point of Kutum obtained Average Variable Cost (AVC) and price minus AVC for the three provinces. The average variable cost of Kutum takes into account \$0.863 for Guilan, \$0.479 for Mazandaran, and \$0.738 for Golestan provinces. The price minus average variable cost obtained were \$2.136, \$2.520, and \$2.261 for Guilan, Mazandaran and Golestan provinces, respectively (Table 10).

Table 10. Information and calculate relate to estimate Break-even point of R. f. kutum in different areas in southern part of the Caspian Sea

Guilan province								
Species	TVC (\$)	TFC (\$)	Yield (kg)	Price (\$)	Sell(\$)	AVC (\$)	P-AVC (\$)	% Sell
Kutum	3573153	2382102	3066641	3	9199923	0.863	2.136	0.740
Mugil			881153	3.2	2819689	0.863	2.336	0.227
Carp			11625	4.5	52312	0.863	3.636	0.004
Others			180301	2	360602	0.863	1.136	0.029
Total	5955255		4139719		13965847			1.000
Mazandaran province								
Kutum	3776308.8	2517539	6773243	3	20319729	0.479	2.520	0.854
Mugil			948215	3.2	3034288	0.479	2.720	0.127
Carp			45424	4.5	204408	0.479	4.020	0.008
Others			113346	2	226692	0.479	1.520	0.009
Total	6293848		7880228		23785117			1.000
Golestan province								
Kutum	724308	482872	298782	3	896346	0.738	2.261	0.255
Mugil			322856	3.2	1033139	0.738	2.461	0.294
carp			343686	4.5	1546587	0.738	3.761	0.441
Others			15025	2	30050	0.738	1.261	0.008
Total	1207180		980349		3506122			1.000

The break-even point of Kutum obtained with mean (\pm SD) 19220 \pm 5364.5 for Guilan, 18843 \pm 4989.2 for Mazandaran, and 10677 \pm 1358.2 for Golestan province, which correlated with the fishing effort, catch ratio, number of fishing cooperatives, number of labor. The analysis between break-even point, catch, and cost ratio of R. f. kutum in the south part of the Caspian Sea shows that there is significant difference between break-even point, catch, and cost ratio in Mazandaran province (ANOVA, P<0.05 (Table 11). There is no significant difference between cost and catch of Kutum in the Golestan and Guilan provinces but significant difference between the cost and break-even points in Guilan province.

Table 11. Analysis between the Break-even point, catch, and cost ratio of R. f. kutum in different provinces from the southern Caspian Sea. Note: a is not significant and b is the significant. N. is number of fishing cooperatives society.

Province		Q (kg)	Catch (kg)	Cost (\$)
Golestan	Mean	10677 ^a	14939 ^a	60359 ^b
	N.	20	20	20
	Std. Deviation	1358	11004	7679
Mazandaran	Mean	18843 ^b	127797 ^b	118751 ^b
	N.	53	53	53
	Std. Deviation	4989	116993	31442
Guilan	Mean	19220 ^b	52873 ^a	102676 ^b
	N.	58	58	58
	Std. Deviation	5364	43633	28657
Total	Mean	17763	77394	102719
	N.	131	131	131
	Std. Deviation	5656	90727	33838

Discussion

The growth of population, the expansion of urban lifestyle and the development of industrial, agricultural, services and infrastructures can change supply and demand for fishery products (Salehi, 2007). Since it is almost impossible to supply aquatic food from the seas and because of the increase in the demand for aquatic animals, therefore this demand should be met by the aquaculture (FAO, 2003). Unfortunately, the Iranian Fishery Organization (IFO) has not yet made serious measures for Kutum culture, through physiological and ecological conditions of the Kutum in seas is different from the conditions for culturing this fish in aquatic farms.

Shilat (2008) reported that the catch ratio of R. f. kutum comprised more than 10000 tonnes in the southern Caspian Sea annually, which the average annual catches of Kutum in Azerbaijan amounted to 2500 tonnes in 1931-1935 and reached 1900- 5000 tonnes, and 3800 tonnes (www.caspianenvironment.org). Unfortunately, there is no new data about the catch ratio of Kutum in Azerbaijan territory. In recent years no Black Sea roaches have been caught in Kazakstan. The reasons for the population decline include commercial over-fishing and changes in the basic hydrology of the sea itself. According to Alexander (1996) R. f. kutum is a red list species in Kazakestan territory. This could be due to not having artificial breeding plans in these countries which still harbour ample populations of Kutum for the enhancement of the species.

Southern coast of the Caspian Sea has a length of 900 km, and more than 10,000 fishermen work in Guilan, Mazandaran and Golestan provinces. According to a ranking based on the income of fishermen, the highest profit

is earned by Mazandaran province through most fishing efforts occurred in Guilan province. The results showed that the average income of a fisherman in Mazandaran was \$3644, while this amount was \$1444 for Guilan and \$1540 for Golestan provinces. The fishing areas, number of fishing effort, number of pure fishing cooperatives and region ecological conditions are the factors that may play a crucial role in this situation.

In this study, the highest profit was earned by the Shahid Beheshti fishing cooperative in Mazandaran with 90 members and amounted to \$1,324,986 that the per capita income for each fisherman was \$14,722. The lowest profit was made by the Shahid Razaghi fishing cooperative that brought a per capita income of \$398 and a total income of \$18,421 and has made a loss as in comparison to other fishing cooperatives. This is attributed to the number of fishing effort, management, manpower, skillfulness of members and ecological conditions of the region because most fishermen working in these cooperatives are seasonal workers instead of permanent members.

Pourhosein,(2002) reported that Eslami fishing cooperative in Mazandaran has made the highest profit \$84,600 and highest income of \$171,700. The lowest profit made by the Pasand Taleghani fishing cooperative, and the Kolahtuz fishing cooperative made the highest loss. The average income of fishing cooperatives in various regions was different and the highest incomes were made by fishing cooperatives in the central part, east and west, respectively.

Ghorbani,(2009) reported that 75 fishing cooperatives in Guilan province with 5,877 members were authorized to capture bony fishes in the coastal strip; however, because of some factors, including the lack of fishing area (increase of the Caspian Sea water level), financial problems, and labor force deficit, 17 fishing cooperatives with 1,397 members were inactive. According to Ghorbani,(2004) the cost of each Pure fishing cooperative in Guilan was \$66,000 while provision of fishing tools, service and maintenance and insurance constituted 60% of the expenses.

In this study, the results show that each Pure fishing cooperative in Guilan experiences an average cost of \$102,782. The highest cost was borne by the Ghalam Godeh fishing cooperative with \$162,552 and the Moje Gol fishing cooperative with \$54,936 tolerated the lowest. The highest income was made by the Mihanparast fishing cooperative that consisted of 77 members who each received \$7,721, which Kutum sales constituted about 93.6% of the fishermen's income. Ghorbani et al., (2004) reported that each fisherman in Guilan made an average income of \$432 but profit was different depending on the region. The highest per capita profit was made by fishermen of a fishing cooperative in Roodsar with \$2,770 and the lowest profit was earned by the Shohada-ye Talesh fishing cooperative that made a loss of approximately \$447.

According to Ghorbani,(2004) every fishing cooperative in Guilan province during the fishing season of 2002-2003 captured 52 tonnes of fish in average percentage of each fish was 32% of Kutum, 55% of Mugil and 13% of other species. Each Pure fishing cooperative in Guilan obtained 71.3 tonnes, which the Kutum's comprised about 74%. Therefore, the main cause of the increase in fishermen's income as compared to the previous studies may be the increase in catch of Kutum, weather situation, water temperature, suitability of the river conditions especially in spawning migration time since this specie is an anadromous.

Pourhoseien (2002) reported that Shahid Eslami fishing cooperative made the highest income amounting to \$1,795,651 and the total cost was \$878,039, while Shahid Razaghi fishing cooperative made a lowest income. In contrast, Shahid Motahari fishing cooperative had an income of \$786,675 through selling bony fishes (including Kutum) and experienced a cost of \$893,684 in the fishing season of 1999-2000 that resulted in a loss of \$107,008 (Pourhosein, 2002). In this study, the net profit through selling bony fishes made by the Shahid Motahari fishing cooperative with 89 members was \$98,437 and each member received an income of \$1,106. The Shahid Eslami fishing cooperative obtained the second rank based on catch ratio and income. The net profit earned through selling Kutum amounted to \$1,178,418 and each member of the cooperative received \$14,371. The net profit of selling Kutum constituted about 84% of the fishermen's income. The results show that the net profit earned by the Shahid Eslami and Shahid Motahari fishing cooperatives began to grow after a decade. This could be due to quality released fries of Kutum into the sea, using high-quality fishing tools, water temperature, suitable rivers and the number of seine fishing.

Regarding the topographic conditions of Golestan as in comparison to those of the other two provinces, fewer seine-fishing cooperatives are working in Golestan and consequently, the catch ratio of bony fishes is lower than the two other provinces. This may be attributed to narrower coastal strip and problems with fishing sites. Unlike the two other provinces, catch of Kutum ranks third in the list of bony fishes and this may result from the absence of suitable rivers for artificial breeding and release of fries of Kutum. Therefore, in Golestan R. f. kutum constitute about 26% of bony fishes, while this percentage is 85.8% and 74% in Mazandaran and Guilan provinces, respectively.

At the present study, the results show that the Nemuneh experienced the highest catch (55.8%) and income through selling Kutum in Golestan province fishing cooperative in the eastern zone of the province. Thus, the net

profit through selling Kutum obtained 41% of the whole sale of bony fishes. The lowest income was earned by the Azimgol fishing cooperative for which the profit through selling Kutum was 5.7% of the whole sale. Fishing Kutum in this part depends on the abundance of fish.

Classifying fishing cooperatives based on the amount of bony fish catch showed that 22.4% Pare fishing cooperatives in Guilan and 50.9% in Mazanadaran had ranged over catch above 100 tonnes, while none of Pare fishing cooperatives in Golestan reached this range. Pare fishing cooperatives in Guilan and Golestan harvested in the range of 20-40 tonnes with 24.1% and 50%, respectively. Abdolmaleki and Ghaninejad (2007) reported that fishing cooperatives in Guilan and Mazandaran harvested range above 100 tonnes with 1.3% and 30.3% in the fishing season of 2004-2005, while in Golestan this percentage reached about 80%. Furthermore, the highest amount of fishing (38.3%) fell within the range of 20-40 tonnes. Abdolmaleki and Ghaninejad, (2007) reported that Pare fishing cooperatives in Guilan, Mazandaran and Golestan obtained in harvests range above 100 tonnes with 13.1%, 54.7% and 15%, respectively. This could be due to the abundance of Kutum and increase in fishing and climatic conditions suitable for fishing Kutum in Guilan and Mazanadaran, and catch of common carp and Mugil in Golestan.

According to Grafton,(2007) revisiting the economics of overexploitation provides both a target and a framework to help overcome a key cause of overharvesting: fisher opposition to lower catches associated with stock rebuilding. For fast-growing species, rebuilding to B_{MEY} may only take a short time, but for very slow-growing fish it may take decades. In addition, classifying fishing cooperatives based on the amount of Kutum harvested in southern coasts of the Caspian Sea showed that 24.4% of the Pare fishing cooperatives had harvested above 100 tonnes. About 18.9% and 39.6% of the Pare fishing cooperative in Guilan and Mazandaran, respectively, harvested in the range above 100 tonnes while in Golestan, the range fell below 40 tonnes. This could be due to Kutum is a fast-growing species and Iranian fishery organization (IFO) release fries of Kutum in the Caspian Sea annually. In Golestan zone, this could be attributed that absence of schooling move of *R. f. kutum* in the eastern coast and consequently the absence of mass fishing by the fishing cooperatives. However, most Pare fishing cooperatives in Mazanadan can be placed in the range of above 100 tonnes. The presence of proper rivers, the movement of Kutum schools in the reproduction season towards rivers to engage in natural reproduction, available manpower and good management of cooperatives may be reasons for this success.

Based on Mackinson,(1997) incorporating some basic economic features relating to cost of harvesting, price of catch and investment incentives greatly accelerates the rate of stock depletion predict by the constant CPUE. When fishers fail to cooperate or are subsidised, the constant CPUE model predicts that profits accrue so quickly to fishers that they continue to invest in fishing even when a stock collapse is imminent. In this study, we calculated cost of each cooperative based on fishing efforts, which the effects on the CPUE. Therefore, the highest CPUE earned in Mazandaran and the lowest was in Golestan zones that coincided to fish catch and fishing effort. Furthermore, if Iranian fishery organizations taken into account a constant CPUE for fisheries this could be help fish conservation and prevent fish collapse in the Caspian Sea, and fishermen can be continued fishing without endurance more lost. Similarity the results were found by Mackinson et al., (1997). Parente (2004) reported that the higher values of CPUE are also expected for high powered vessels since they spend less time encircling the fish shoals, therefore reducing the fish escaping probability. Maynou et al., (2003) noted that the contribution of the individual vessel was important (18.6% of deviance explained), suggesting that the fishing skills of the individual fishermen or other factors not captured by the technical characteristics, such as investment in technology, are important in this fishery. In contrast, in this study the fishing skills, individual fishermen, hale tractors are important in this fishery.

The results show that break-even point of *R. f. kutum* was ranged from 9087 to 30396 with average 19220 ± 5364 kg for Guilan, from 10803 to 28933 with a mean 18843 ± 4989 kg for Mazandaran and from 8693 to 13062 with a mean 10677 ± 1358 kg for Golestan. Emami , (2002) reported that break-even point of bony fish obtained 21367 kg in Mazandaran province. According to Ghorbani et al., (2004) the break-even point of Kutum was ranged from 3029 to 34459 with average 13190 ± 11135 kg in Guilan province.

In conclusion, the results show that *R. f. kutum* constituted about 78% of bony fish harvest and about 76.6% of the whole income of fishermen in the southern coasts of the Caspian Sea. The income of fishermen through selling Kutum in Guilan and Mazandaran provinces made 74% and 85.8% of the fishermen's income, respectively, while these was 26% in Golestan. The net profit earned of selling the Kutum for each member of Pare fishing cooperatives in Guilan and Mazandaran provinces was \$1069 and \$3126, respectively. While this profit was \$400 in Golestan province. Therefore, Kutum plays a significant role in fishermen's income in southern coasts of the Caspian Sea which coincided to release of Kutum fries, the presence of proper rivers and lagoons for reproductive migration in the spawning seasons, and artificial breeding of the fish can be highly important in protecting and enhancement stocks in this area.

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