Comparative analysis of carp farming costs in Iran, in 1996 and 2001

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Abstract

Carp is one of the most widely cultivated warm water fish, which has been introduced into many countries. It is essential for the manager of a carp farm to know the production costs and their evolution, showing the main inputs on which the cost reduction is worth effort. In Iran, carp farming is mainly based on common carp, silver carp, grass carp, and bighead carp, which were often reared in poly culture. Carp farming production reached a peak in 2006 with production of more than 77,000 tones. The characteristics of the carp farming industry in the main fish farming provinces, (overall more than 90% of total carp production) are considerably different. In years 1996 and 2001, a study of yield production, factor costs and profitability of farmed carp was carried out to help clarify carp production costs and their difference between the provinces. 153 farms in 1996 and 101 farms in 2001, overall, a total of 254 farms from the main carp farming provinces, including; Guilan, Mazandaran and Khuzestan were randomly selected, classified and studied. Results showed that the various producer provinces have different cost structures. Overall, feed and fertilizer with the highest level of variation accounted for 45% of total costs in 1996, declined to 23% in 2001. However, on average, cost of seed and labor increased from 7% and 10% to 23% and 17% of total costs over the 1996 and 2001, respectively. On average, benefit-cost ratio and the rate of farm income were closely related to location suggesting that farmers practiced more efficiently and have better conditions in Guilan in 1996, resulting in higher farm income per ha and per kg, changing to better conditions and more efficient by Mazandaran province in 2001. Overall, in the three main provinces, rate of farm income from an average of 20% in 1996, declined to 12% in 2001.

Keywords: Carp, Farm, Production, Cost, Benefit, Iran

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Introduction

Iran covers an area of about 1.6 million square kilometers, and had a population of about 70 million in 2006. The Iranian Planning and Development Department (PDD) of the Iranian Fisheries Organization, estimated a per capita fish consumption of more than 7 kg per capita per year in 2006, the same for Africa and South America, but less than the global average and the average for developed and developing countries. The carp is one of the most widely cultivated warm-water fish, and has been introduced into some 81 countries (Welcomme, 1988; Holcik, 1991; Csavas, 1993 & 1994 and Michaels, 1994), particularly in developing countries, where, the various species are grown in fertilized ponds or with low-level of supplementary feeding. Common, Chinese and Indian major carps are cultured wherever traditional markets exist. It is essential for a manager of a carp farm to know the production costs and their evolution, showing the main inputs on which the cost reduction is worth effort. It also helps the manager in decision-making and in adjusting to changes. It also gives the price level under which the product cannot be sold without losses. Basically the production cost comprises all the expenses incurred during the production process, which subtracted from the turnover (sales), determines the income before taxes (Bailly *et al*., 1990). Interest on working capital and interest plus depreciation on the

invested capital must also be considered. Many variables influence production costs for farmed carp. As noted by (Shang, 1981, 1990; Smith, 1981; Salehi, 1999, 2003), the collection and analysis of data on costs and earning based on farm records provide essential information to determine the relative profitability of various production systems, or climatic conditions, to compare the productivity of major inputs, and to improve the efficiency of the farm operation.

Details of output records such as species harvested (with its amount and its unit prices), and the disposition of the products needs to be considered. According to Shang (1990) profitability of a farm is dependent on three major factors including level of yield, cost of production, and price of products sold.

In Iran, it has undoubtedly seen great success for carp farming sector over the last decade, overall, carp production rising from less than 12,000 t in 1986 to more than 68,000 t in 2002 and 77,000 t by 2006 according to annual reports of the Iranian Aquaculture Department and The Iranian Planning and Development Department in 1997, 2003 and 2007). Though, the potential of carp culture to expand may be apparent, it may be constrained by market demand and producer profitability. The marketing channels for carp farming products are also differ between the provinces, in Guilan and Mazandaran

harvesting starts in September, but in Khuzestan it may be two or three months later. The standard marketable size for carp is about 1kg in weight, and some farmers may delay their harvesting up to November, or even December to achieve larger sizes and potentially better prices. However, this delay is constrained by additional cost, and most farmers, except a few with large farms and high capital investments, are unable to do so. Over the last 3 years the new market for carp farming products have been also established in Iraq and this market have influenced carp farming sector and its profitability in Iran. Carp market building up in September, increasing in December, and peaking in March, with almost 90% supplied over October-March and 10% over the August to September (Fig. 1; Salehi, 2006).

However, the limited supply from marine capture fisheries is unlikely to meet growing demand for fish and fishery products and the farmed carp is the predominant species in aquaculture in Iran (more than 60% of production in 2006), the paper will analysis current and changing the production factor costs of farmed carp, specially in the main producer provinces over the 1996 and 2001. Overall, the specific objectives of the present study were to determine the costs and returns to farmers, to find the cost contribution of the main input factors, to determine the profitability of carp farming, to determine the benefit-costs differences of carp culture with the provinces, and to determine the differences in the contribution of main input costs for carp farming, over the year 1996 and 2001 in Iran.
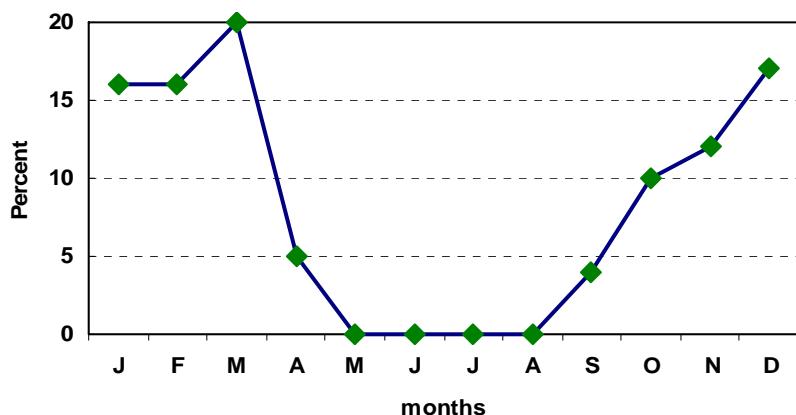

Figure 1: Seasonal purchase of cultured carps in Iran
(**Source: Salehi, 2006**)

Materials and methods

A study of yield production, costs and profitability for carp farming was carried out to help clarify carp production costs and their differences in different provinces over the years 1996 and 2001 in Iran. Key production cost indicators are not only useful for fish farmers but also for economics and policy making (Shang 1981, 1990; Cunningham *et al.,* 1985; Jolly & Clonts, 1993; Salehi, 1999).

The present study was developed to indicate the following elements:

(I) The characteristics of carp farms in three main provinces of Guilan, Mazandaran and Khuzestan,

(II) Costs: including fixed costs, such as permanent labor, maintenance, interest, and depreciation, which are usually independent of the level of production and variable costs, such as seed, feed, fertilizer, chemical and drugs, temporary labor, water and energy, harvesting and post-harvest, and miscellaneous costs, which vary with the level of output,

(III) Income: Total production, total cost of production, total revenue, net return, benefit-cost ratio (total revenue divided by total cost), cost of input per unit of output (kg), value of unit of output (kg), amount of output (kg) per unit of land (ha), and costs of production per unit of land (ha), (IV) Assessment of key factors affecting production costs for carp farming sector and its profitability.

The present study covered the three main carp culture provinces, Guilan, Mazandaran, and Khuzestan. Data collection, classification, and analysis cover the years 1996 and 2001. The farms for questionnaire in each province were selected by stratified random sampling. Based on the experience from 1995 census, Guilan province divided by three sections (west, center and east), Mazandaran divided by two sections (east and center) and Khuzestan divided by two sections (north and center). Two sources of data were used, primary data was obtained through personal interviews of fish farmers, which were conducted to obtain information on resources used and the quantity of output. Wherever core data was not sufficient, additional surveys, through other related experts, and other available data was used to ensure a representative perspective on the sector. Overall, 254 farms including; 153 farms in 1996 and 101 farms in 2001 from the three main provinces, were randomly selected, classified and analyzed. Of the 153 farms in 1996, 81 farms from the province of Guilan, 48 farms from the Mazandaran and 24 farms were selected from Khuzestan and of the 101 farms in 2001, 60 farms from the Guilan, 26 farms from Mazandaran and 15 farms from Khuzestan. Data on pond structure, used species, labor, fertilization, feeding, water and energy, transportation, maintenance, facilities on farm, surface area, harvesting time, individual production of species, sale

price of species, various fish production activities, market channels, and miscellaneous were recorded. Data were entered into a Microsoft Office Excel 2003 for Windows and methods for classification, summarizing, averaging, and other functions according to (Lee, 1981; Shang 1981, 1990; Cunningham *et al.,* 1985; Jolly & Clonts, 1993; Salehi, 1999) were used for analysis.

Results

There is a significant difference in average area of farms. The area of farms averaged almost 6.7ha, in 1996, varying from less than 3.4ha in Guilan to 6.7ha in Mazandaran and 19ha in Khuzestan, and averaged, 7.8ha, in 2001, varying from 4.5ha in Guilan to 10ha in Mazandaran and 18.5ha in Khuzestan (Table 1). The average yield was changed from 2,873 kg ha^{-1} in 1996 to 4,380 kg ha^{-1} in 2001, and there was a marked difference in the provinces. In 1996, farmers in Mazandaran and Guilan produced an average 2,159 and 2,543kg ha^{-1}, respectively, but farmers in Khuzestan produced 3,572kg ha^{-1}, though, in Khuzestan, production (kg ha^{-1}) is higher than the

average (+24%), but in Mazandaran is less than the average (-25%). In 2001, per ha of production in all provinces were improved, but there is a significant growth in Mazandaran (46% higher than the average).

In 1996, total costs per ha were 150% greater in Khuzestan than that in Mazandaran and 79% more than that in Guilan (Table 2). Costs in Guilan were 40% more than that in Mazandaran. However, in 2001, total costs for ha were 21% greater in Mazandaran than that in Khuzestan and 56% more than that in Guilan. Costs in Khuzestan were 29% more than that in Guilan.

As Table 2 shows, in 1996, total costs for ha were 150% greater in Khuzestan than that in Mazandaran and 79% more than that in Guilan. Costs in Guilan were 40% more than that in Mazandaran. However, in 2001, total costs for ha were 21% greater in Mazandaran than that in Khuzestan and 56% more than that in Guilan. Costs in Khuzestan were 29% more than that in Guilan.

Table 1: Comparison of the number of sample farms, average area and production of farms for the years 1996 and 2001 in Iran

Factor / Province	Guilan	Mazandaran	Khuzestan	Total
Number of selected farms in 1996 2001	81,60	48,26	24,15	153,101
Average area in 1996 (ha)	3.35	6.72	19	6.86
Average area in 2001 (ha)	4.5	10	18.5	7.8
Average production in 1996 (kg ha^{-1})	2543	2159	3572	2873
Average production in 2001 (kg ha^{-1})	3575	6400	4100	4380
Production differences (kg ha^{-1}) between 1996 and 2001	**1032**	**4241**	**528**	**1507**

In 1996, variable costs averaged 75% of total costs, from 63% in Mazandaran to 75% in Guilan and 78% in Khuzestan. In 1996, among the variable costs, feed and fertilizer dominated all other costs averaging 45% of total cost, varying from 28% in Mazandaran to 43% in Guilan and 52% in Khuzestan, changing to 33%, 22% and 23% in 2001, respectively, (Fig. 2; Tables 2 and 3). Though, in 2001, the share of feed and fertilizer were also dominated all other costs averaging 23% of total costs, comparing with 1996, increasing 17% in Mazandaran, and decreasing 49% and 56% in Guilan and Khuzestan respectively.

Table 2: Inputs costs ha⁻¹ of sample farms and their contributions in selected provinces in 1996

Province	Guilan		Mazandaran		Khuzestan		All	
Factor	IRR. 1000	% of total costs	IRR. 1000	% of total costs	IRR. 1000	% of total costs	IRR. 1000, Mean*	R. 1000, SD
Seed	153	5	301	14	336	6	278	97
Feed	947	31	443	20	2075	39	1283	836
Chemical fertilizer	147	5	98	5	142	3	130	27
Animal fertilizer	217	7	59	3	518	9.6	299	233
Chemical and Drugs	84	3	19	1	56	1	52	32
Fuel	28	1	35	2	54	1	42	13
Water and electricity	261	9	131	6	288	5	233	84
Harvesting & post harvest	264	9	132	6	511	9.5	331	192
Labor	312	10.9	298	14	477	9	382	224
Miscellaneous	58	1.9	50	2	79	1	65	15
Maintenance	36	1	89	4	267	5	153	121
Interest	19	0.6	10	0	43	0.9	27	17
Depreciation	469	15.6	482	22	483	9	479	8
Insurance	0	0	17	1	44	1	25	22
TC	3006	100	2164	100	5373	100	3779	1663

* : To Accounted the mean, the area of farms were also affected. SD: Standard deviation, TC: Total cost, IRR = Iranian Rials.

Table 3: Inputs costs per ha of sample farms and their contributions in selected provinces in 2001

Province	Guilan		Mazandaran		Khuzestan		All	
Factor	% of total costs	IRR. 1000	% of total costs	IRR. 1000	% of total costs	IRR. 1000	IRR. 1000, Mean*	R. 1000, SD
Seed	13	2402	15	4307	24	5712	4835	1661
Feed	12	2217	20	5754	11	2619	3514	1937
Chemical fertilizer	3	554	6	1728	3	714	999	637
Animal fertilizer	4	740	5	1440	5	1191	1205	355
Chemical and Drugs	1	186	1	288	0	118	179	86
Fuel	2	368	2	717	2	477	535	179
Water and electricity	10	1848	7	2016	6	1428	1663	303
Harvesting & post harvest	8	1480	7	2016	9	2142	2014	352
labor	22	4065	12	3450	20	4761	4269	656
Miscellaneous	5	926	8	2445	2	359	1068	1079
Maintenance	6	1108	9	2592	8	1905	2005	743
Depreciation	9	1662	5	1440	7	1664	1596	129
Interest	5	926	2	576	3	714	701	176
TC	100	18483	100	28768	100	23805	24583	5144

*- To Accounted the mean, the area of farms were also affected. SD: Standard deviation, TC: Total cost

Table 4: Percentage of total costs per ha by major groups of input and as a percentage of average in selected provinces for the years 1996 and 2001

Factor/Province	Guilan		Mazandaran		Khuzestan		Average	
year	1996	2001	1996	2001	1996	2001	1996	2001
Feed and Fertilizer	43	19	28	31	52	20	45	23
Seed	5	13	14	15	6	24	7	20
Labor	11	22	14	12	9	20	10	18
Water and Energy	10	10	8	7	6	6	7	9
Harvesting and post harvest	9	8	6	7	10	/9	9	8
Maintenance	1	6	4	9	5	8	4	8
Depreciation	16	9	22	5	9	7	13	7

In 1996, average cost of seed are 7% of total costs, varying from 5% in Guilan to 6% in Khuzestan and 14% in Mazandaran, but in 2001, it was averaging 20% of total cost, increasing to 13%, 24% and 15%, respectively. The other main cost is the cost of labor that was averaged 10% and 18% of total costs over the 1996 and 2001 respectively. The cost of 'harvesting and post harvest' and 'water and energy' were also averaging 8% and 9% of total costs, respectively. As Table 4 shows, in 1996, farmers in Khuzestan paid 60% more than the average for feed and fertilizer, while their counterparts in Mazandaran paid almost one-third the average. In Mazandaran and Khuzestan, farmers paid 8% and 21% more than the average for seed respectively, but their counterparts in Guilan paid 45% less than the average. Cost for labor and salary is also 25% higher than the average in Khuzestan. While cost for harvesting and post harvest in Mazandaran

and Guilan, respectively averaged 60% and 20% less than the average, in Khuzestan is 50% more than the average. On average, comparing costs per ha over the 1996-2001, the share of the cost of feed and fertilizer declined, while for seed and labor increased. As Table 5 Shows, the cost per kg of carp production in Khuzestan is higher than that in the two other provinces, at R 1,505 and 5,435kg^{-1} followed by Guilan with R 1,183 and 5,170kg^{-1}, and only R 1,001 and 4,495kg^{-1} in Mazandaran over the 1996 and 2001, respectively. Over the 1996 and 2001, of these costs, feed and fertilizer averaged R 766 and 1,023kg^{-1} in Khuzestan, R 516 and 982kg^{-1} in Guilan and R 277 and 1,394kg^{-1} in Mazandaran, while in contrast seed costs, respectively, amounted to R 139 and 673kg^{-1} in Mazandaran followed by Khuzestan and Guilan R 94 and 1,304kg^{-1} and 60 and 672kg^{-1}, respectively.
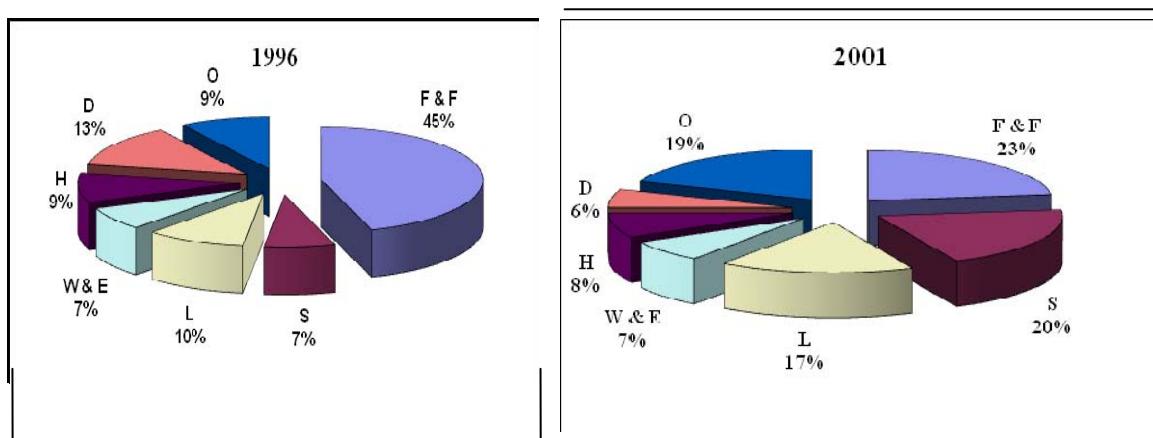

Figure 2: Percentage of total costs per ha by major groups of input for the years 1996 and 2001.
F & F: Feed & Fertilizer; S: Seed; 3. L: Labor; W & E: Water and Energy; H: Harvesting & post harvest; D: Depreciation; O: Other costs

There was a low difference in costs per kg of labor and salary in 1996 in provinces, were increased in 2001. As showed in Table 4, other major inputs costs were 'water and energy' and 'harvesting and post harvest'. Per kg of carp production in Khuzestan, feed and fertilizer and harvesting and post harvest was much higher than the average, while this was the case only for seed in Mazandaran and water and energy in Guilan in 1996, while, changed to seed, animal fertilizer, harvesting and post harvest' and "labor and salary" in Khuzestan, feed, 'water and energy', "labor " and depreciation in Guilan, and feed and chemical fertilizer in Mazandaran in 2001 (Tables 5 and 6). Though, in 1996 variability of feed was higher than other operation costs, followed by fertilizer, 'harvesting and post harvest' and seed respectively, were changed to seed, "labor and salary" and feed respectively in 2001. Table 7 summarizes the profitability of carp culture farming per ha in the provinces, as defined by following measures: net return, defined as total revenue minus total costs; benefit-cost ratio, defined as total revenue divided by total costs; rate of farm income[1], defined as net return divided by gross revenue, times 100.

In 1996, despite a higher cost per ha, the net return per unit of land is higher in Guilan; at R^2 1,446,000 ha^{-1} compared

with R 885,000 ha^{-1} in Mazandaran and R 683,000 ha^{-1} in Khuzestan. As Table 8 shows, the benefit-cost ratio in Guilan is also higher than elsewhere; at 1.48 compared with 1.41 and 1.13 in Mazandaran and Khuzestan, respectively. The average rate of farm income for carp averaging 20%; 32% for Guilan, 29% for Mazandaran and only 11% for Khuzestan. Per ha variability of total costs within the Khuzestan is higher than other areas, showing differences in use of major inputs per ha, particularly feed and fertilizer, and cost of harvesting and post harvest. On average, over the 1996-2001, total costs per ha increased 6.5 times, compared with gross revenue 5.9 times and net return only 3.6 times.

As Table 9 shows, in 1996, profitability per kg of carp culture in Guilan was also higher, followed by Mazandaran, farmers in Guilan and Mazandaran, respectively having benefit-cost ratio of 92% and 64% more than the average, in Khuzestan having almost half the average. Total costs' variability per kg production within farms in Mazandaran is higher than other areas. In 2001, in Guilan, benefit-cost ration declined more than 3 times, compared with 2.5 times in Mazandaran and no difference in Khuzestan. Benefit-cost ratio changed from 1.25 in 1996 to 1.13 in 2001 and rate of farm income declined from 20% to 12%, respectively.

1- The rate of farm income is also an indicator of production efficiency, based on rate of farm income, we can see that the larger the rate of farm income, the greater the production efficiency (Lee, 1981).

2- US$ 1 = IRR 3,000 and IRR 8,000 at 1996 and 2001 rates.

Table 5: Main factor cost (IRR kg⁻¹) of carp production in selected provinces for the years 1996 and 2001 in Iran

Factor / Province	Mazandaran		Khuzestan		Guilan		Mean	SD
Year	1996	2001	1996	2001	1996	2001	1996 - 2001	1996-2001
Seed	139	673	94	1304	60	672	97-1027	40–365
Feed	205	899	581	598	373	620	447-692	188–168
Chemical fertilizer	45	270	40	163	58	155	45-194	9–64
Animal fertilizer	27	225	145	/272	85	207	104–249	59–34
Chemical and Drugs	9	45	16	27	33	52	18–36	12–13
Fuel	16	112	15	109	11	103	15–109	3–5
Water and electricity	61	315	81	326	103	517	81–349	21–114
Harvesting & post harvest	61	315	143	489	104	414	115–426	41–87
Labor	138	539	134	1087	127	1137	133–928	6–332
Miscellaneous	23	382	22	82	23	259	23–197	1–151
Maintenance	41	405	75	435	14	310	53–409	31–65
Interest	5	90	12	163	8	259	9–154	4–85
Depreciation	223	225	135	380	184	465	16-/345	44–122
Tax	0	0	0	0	0	0	0–0	0–0
Insurance	8	NA	12	NA	0	NA	9–NA	6–NA
TC	1001	4495	1505	5435	1183	5170	1316-5114	254-485

SD: Standard deviation, NA: Not available.

Table 6: Major costs (IRR kg⁻¹) of carp production in selected provinces for the years 1996 and 2001 in Iran

Factor / Province	Guilan		Mazandaran		Khuzestan	
year	1996	2001	1996	2001	1996	2001
Seed	60	672	139	673	94	1304
Feed and fertilizer	516	982	277	1394	766	1023
Water and energy	114	620	77	427	96	435
Harvesting & post harvest	104	414	61	315	143	489
Labor	127	1137	138	539	134	1,087
Maintenance	41	405	75	435	14	310
Depreciation	184	465	223	225	135	380

Table 7: Production costs and returns per ha of farms in the provinces for the years 1996 and 2001 in Iran

Factor / Province	Guilan		Mazandaran		Khuzestan		Average		SD	
Year	1996	2001	1996	2001	1996	2001	1996	2001	1996	2001
Total costs (IRR 1000)	3006	18483	2164	28768	5373	23805	3779	24583	1663	5144
Total revenue (IRR 1000)	4452	21060	3049	33318	6056	26736	4719	27957	1505	6135
Net return (IRR 1000)	1446	2578	885	4550	683	2930	940	3373	395	1052

SD: Standard deviation

Table 8: Costs and returns per kg of carp production in selected provinces for the years 1996 and 2001 in Iran

Factor/ Province	Guilan		Mazandaran		Khuzestan		Average	
Year	1996	2001	1996	2001	1996	2001	1996	2001
Total costs (IRR)	1183	5170	1001	4495	1505	5435	1316	5114
Total revenue (IRR)	1751	5891	1412	5206	1695	6104	1643	5803
Net return[a] (IRR)	568	721	411	711	190	669	327	689
Benefit-cost ratio[b]	1.48	1.14	1.41	1.16	1.13	1.12	1.25	1.13
Rate of farm income[c] (%)	32	12	29	14	11	11	20	12

a) total revenue minus total costs, b) total revenue divided by total costs, and c) net return divided by total revenue times 100.

Discussion

Over the last two decades demand for carp products is initially increasing as a result of a relative decline of Caspian bony fish and increasing in urbanization, population and economic growth in Iran (Salehi, 1999, 2006 and 2007). Nash (1997) noted expansion of bony fish production appears to be leveling off and according to (FAO, 1992, 2006; Shehadeh, 1996; Nash, 1997; Salehi, 1999, 2006) aquaculture is a key factor in the national strategy for increasing fish production in Iran. The result from data obtained from the three main provinces clearly demonstrate that carp farming was a profitable activity with an average of 20% rate of farm income in 1996, declined to 12% in 2001. The results of the survey showed that the various producer provinces have different cost structures, depending on availability and quality of inputs, farm management, climate, area of farms and other related factors. In 1996, the cost of inputs in Khuzestan (per ha and per kg) were higher than elsewhere, apparently due to higher also usage, cost of feed and fertilizer. Thus, in Khuzestan use of animal fertilizer ponds was five times higher than that in Mazandaran. Apart from the absence

of a well defined fertilization program, in summer, the farmers in Khuzestan flush water through their ponds and as a consequence additional feed and particularly animal fertilizer, has to be applied to complete for cases, this was noted by FAO, 1992 and Salehi, 1999 & 2003. In Guilan, where carp culture is older, and farmers have smaller farms and may manage ponds on an ad hoc basis, they usually use agricultural wastes as feed and fertilizer, but in Mazandaran the price of feed and fertilizer was higher than elsewhere, where they use concentrated feed, consequence 50 percent production more than the average per ha. in 2001. Feed and fertilizer productivity is usually considered as important indicator of the level of efficiency of carp farming production. Feed and fertilizer productivity of farms in the Caspian area is higher than that in Khuzestan (for feed two times higher and for fertilizer almost four times). This suggests that, the productivity of carp farming in different locations is closely related to feed and fertilizer productivity, followed by seed. In Khuzestan, seed prices are much higher as most fry/fingerling

come from Guilan hatcheries and thus include transport cost, as well as allowing for higher mortality combined with high stocking rate, thus increases the cost in 2001. In 1996, the relative higher cost of seed in Mazandaran is due to the use of larger size seed, mainly coming from Guilan. However, it is expected, that increased hatchery production in Mazandaran and Khuzestan will reduce the cost of seed. In 1996 and 2001, increased cost of harvesting and post harvest in Khuzestan is likely to be due to the greater distance to markets. However, additional costs and reduced revenue per kg (due to single harvesting and supplying large quantity of product in markets over short time period) reduced the profitability. Development objectives of farmed production depends on its profitability, and increases in yield, reduction in costs and increases in price of product were the major means of increasing profit (Cunningham *et al.* 1985; Bjorndal, 1987, 1988 & 1990; Pillay, 1990 & 1994; Hatch & Kinnucan, 1993; Jolly & Clonts, 1993; Muir 1994; Muir, *et al.*, 1995; Nash, 1995; Salehi, 1999 & 2003; Jia, *et al.*, 2001). Though, reduction in major variable costs, such as feed and fertilizer, seed, labor and harvesting and post harvest, as well as main fixed cost (construction[3]), increased production per unit of land, associated with increased stocking rate, survival rate, good pond management, growth rate, and increased price per quantity of fish by aiming at higher valued production may all increase carp farm profit. Despite higher

production per unit of land, the present profitability of carp farming in Khuzestan followed by Guilan and Mazandaran may not be acceptable in the longer term.

However, many researchers explained that economies of scale will confer the benefits of lower-cost production on the large farm, (e.g., Shang 1981, 1990; Cunningham *et al.* 1985; Shaw, 1988; Jolly & Clonts 1993; Muir, 1995), in Iran, small farms mainly those located in the Caspian zone with longer history (Azari Takami, 1994), integrated with other agricultural activities and experience with large farms, or those in Khuzestan province, due to their use of agricultural wastes, had smaller costs per unit of land and per quantity of fish.

Future production vary widely and will be to a large extent dependent on the ability of producers to reduce production costs and on the potential for markets to be developed, as has been the case for carp products export to Iraq recently and has also been the case elsewhere, where development has arisen through on acceptable of market opportunities and technical feasibility (Roberts & Muir, 1994; Muir, 1995; Muir, *et al.*, 1995; Salehi, 2007, 2008; Fisheries of Iran, 2008). However, recently the significant expansion and increasing intensification in aquaculture raises questions concerning the industry's future viability in the condition of increasingly limited resources (such as water, area and feed) and great concern for sustainable development which noted by (New, 1991; De Saram & Singh, 1992; Pillay, 1992; Bagarinao & Flores, 1995; Chamberlain & Rosenthal, 1995, Muir, 1995; Reinersen & Haaland, 1995; Salehi, 1999, 2003; Hasan, 2001; Smith & Phillips,

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3- Investment required to establish a carp farm increased from R 5 million ($US 2,900) in 1992 to R 1.5-1.8 million (5,000-6,000) in 1996 and R 5.5-6.5 million (6,800-8,100) in 2001.

2001; Subasinghe, *et al*., 2001). Regarding the government policy toward carp farms, the government should assist farmers, especially those in Khuzestan province and larger farms in Guilan and Mazandaran, with high operating costs, particularly feed and fertilizer costs, seed and labor, insufficient knowledge and inadequate management. Appropriate short-term credit schemes, applied research, an effective extension services related to the problems of share of each species for production, size and amount of seed per unit area, methods of rearing, feed and fertilizer use, farm preparation, diseases control, water management and poly culture of carp and other species such as Indian major carps and other market accepted of local species such as other bony fishes from the Caspian Sea and sturgeon in north of Iran and barbus speices such as (*Barbus sharpyei* and *Barbus grypus*) in Khuzestan are initially necessary.

It is expected that production of carp in Caspian area will become more intensive and will increase in the next few years, particularly in areas, where there is a good demand for carp products, farm profitability is higher than elsewhere, and there is a limitation for land to expand carp farms. Other areas are also likely to commence production, but production growth in Khuzestan will depends on productivity growth of feed and fertilizer, seed and better farm management. The availability of natural resources in Khuzestan are most attractive for future expansion, and a development strategy may be focused there, as well as poly culture with other market accepted of local species as noted, the main constraint being the higher cost of

production, poor harvesting and post-harvest facilities and low profitability of farms. If the cost of feed and fertilizer and seed can be reduced through improved quality of these inputs and farm management, Khuzestan and the largest farms in Guilan may become more attractive. With moderate natural resources, quality of used feed and seed, farm management and profitability, development is more suitable in Mazandaran.

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