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Final Project 2003

THE ECONOMICS OF SHRIMP CULTURE IN IRAN AND FUTURE STRATEGIES

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EXECUTIVE SUMMARY

A cost-benefit analysis (CBA) was conducted in this case study to determine the most economically efficient way of production in the shrimp culture in Iran. The goals of this analysis are to provide a tool that can founded profits. And uses for efficient policy making are to shrimp culture strategies for the future. This paper is including:

When the looking at the analysis results, we can understand average shrimp production increases in 1998-2002. Average revenues increases in the 30 farms. But average total costs increases rapidly. Therefore Average profit in the 30 farms was in 1998 to 1999 increased, but decreased and go to the big lost in 2002. To increase profits the costs must be lowered and a decrease in the three largest factors, feed, labour, and post larvae, would matter the most. .In 2002 the industry operated at severally unprofitable levels. Industry losses in 2002.

Feed cost is one of the important costs in the shrimp farming. In fact productivity increased and cost per unit decreased during 1998 to 2002. In the future if the technology increased FCR come down, shrimp culture farms have possibility to decreases feed costs in the future.

Labour costs are one items important cost in the operating shrimp costs. In fact labour costs increased during 1998 to 2002. But if using new methods in the farm should be can decreased labour costs in the future.

Generally in this case study need for reduction capital costs like interest rate or depreciation reduce costs. If rate of interest for shrimp activity decreased, therefore decreases cost. For this work need to cooperation important between the public and private sectors also. Depreciation cost decreased just.

It was realizes that the economic success of shrimp culture and profitability was largely dependent upon the cost of production. Various discuss have relatively between the non profitability. By estimates can understand the can decreases cost the future. Conditions can increase production and revenues increase and also have better profitability.

Sensitivity analysis of costs show that some productions are more sensitive .If productivity changes in fact profits can change. Result of sensitivity can show that production in the shrimp farms is so sensitive to profitability the results can show that price and production are so sensitive after feed cost, labour cost and post larvae cost more sensitively. Other costs have less sensitivity to profits.

Break even analysis can show that if the price is 2 US$, variable costs are not covered and increasing shrimp production simply leads to more losses .But When if the price is 3 US$, variable costs are covered and break-even occurs at production. This shows that a shrimp price of 3 US$ per kg is not sufficient for this industry to break-even. When the price is 4 US$, Thus, this price will make the industry profitable.

Comparison can show that production per hectare is so far and productivity is weak.

Finally one of the reasons for unpredictability is low productivity in the shrimp farms.

One is situation for world market prices and if these factors increased, in fact prices for shrimp farms increase. But other prices like transportation or processing are opposition. In fact if price for middle man increased prices for shrimp farm decreased.

When looking the future we can understand the prices for shrimp markets not so increases, so if we need to profitability, just have possibility to decreasing other prices like transportation for shrimp or decreasing the prices for processing or decreasing the prices middle man. In fact the decreases the prices for middle man is practical than others.

We consider three strategies for the shrimp culture. The first involves ending the shrimp culture program. The second and third continue the shrimp culture but include different actions to make this economically feasible for the operators based on the analysis. To end the shrimp culture no particular government action is needed. Due to the heavy losses, the industry will soon collapse by itself the collapse of the shrimp culture industry; however, will have repercussions that may require some action. First, a number of people will lose their jobs. Second, a number of people and firms, including suppliers and lenders, will suffer losses of assets. Third, the regional economies will suffer partly directly due to the bankruptcies and partly indirectly due to linkages and multiplier effects. All of these effects will lead to social and political problems as well which may evolve into serious unrest with possibly additional economic losses.

Moreover, the price of the most important material in the feed. However, feed costs can be reduced if the FCR (food conversion ratio) can be increased. That may be possible by improved farming technology. The post-larvae cost is perhaps the item that has most room for a reduction.

However, by improved product development, reduced transportation and marketing costs and better marketing it may be possible to increase the price to the farms (ex farm price) even when global shrimp prices remain constant. Moreover, production per unit of pool surface, the FCR and average shrimp size can clearly be improved substantially.

Some of the inputs such as post-larvae shrimp are supplied with the support of by government facilities. It can arrange for lower interests on loans or provide longer term loans. It can reduce the price of power and help to reduce post larvae prices for shrimp farmer and or feed costs.

However, is the strategy of providing subsidies is selected it is almost certainly preferable to subsidize production .Thus, it may well be that to maintain zero profitability for the average firm; the annual subsidy may have to be considerably.

Strategy 1, letting the industry collapse, implies a significant loss of human capital and possibly infrastructure. In addition it is probably not politically and socially feasible. Strategy 2 is good as far as it goes, but is unlikely to return the industry to profitability, at least within a relatively short span of time (2-3 years). Therefore, if the

industry is to survive, it may be necessary to resort to Strategy 3 at least in part. To the extent that Strategy 3 is employed it should consist of output price supports, which are almost certainly less distorted than input subsidies.

I conclude that the most promising strategy is to use Strategy 2 and 3 in combinations for the next few years in order to maintain the industry and thus both avoid social losses due to irreversibility and provide time for a deeper analysis of its problems and opportunities on which a better informed long term strategy can be built.

1 INTRODUCTION

Shrimp culture in Iran is a rather new industry. It began with feasibility studies in 1989 and the shrimp farms started production in 1992. Shrimp culture is important to the four southern provinces of Iran since it is a major source of employment and a factor in the local economies. No study has been done before on the economics of the shrimp culture sector in Iran.

The general objective of this study is to determine the optimal cost-benefit for efficient shrimp production. This was done by determining whether shrimp production in Iran could be profitable. The second objective is then to form strategies to make the industry profitable if they do not show profits today or increase profitability.

The specific objectives are then defined:

Objective 1: Determine possibility to profitable shrimp production in Iran.

I. Determine current profitability and potential improvement.

Objective 2: Development of strategies to make the industry profitable or increase profits.

I. Including false price, multiplier, economic growth effects, and linkages.
II. Improvement industry profitable.

To reach these objectives a questionnaire was sent to the Institute of Research for Shrimp in Boushehr province in Iran requesting economic information about shrimp culture in the area from the beginning.

2 Background

World capture fisheries production decreased from 95.4 million tons in 2000 to 92.4 million tons in 2001. Major fluctuations in capture production in recent years were mainly due to variations in catches of Peruvian anchovy which are environmentally driven.

2.1 Aquaculture production in the world

Aquaculture production, excluding aquatic plants, reached 37.9 million tons by weight (US$ 55.7 billion by value) in 2001, from 35.5 million tons (US$ 52.1 billion) in 2000. Aquaculture production reported by China the largest producer in 2001 showed a 6.0% increase by volume and an 8.8% growth by value compared with 2000, reaching 26.1 million tones (US$ 26.2 billion) (NACA 2002).

For world excluding China, aquaculture production was 11.8 million tons (US$ 29.4 billion) in 2001, representing an 8.2% growth in volume and a 5.0% increase in value compared with 2000. Other major producing countries in 2001 were India (2.2 million tons), Indonesia (864 000 tons), Japan (802 000 tons) and Thailand 724 000 tons. (Rossenbery 2002).

Figure 1 shows the total fishery production (excl. aquatic plants) in 1970-2001. The total fishery production was reported to be 130.2 million tons in 2001, of which 37.9 million tons from aquaculture. In fact, China was the leading producing country with 16.5 million tons, representing a decrease of 2.7% compared to 2000. China was followed by Peru (8.0 million tons), the USA (4.9 million tons), Japan (4.7 million tons) and Indonesia 4.2 million tons (FAO 2002).

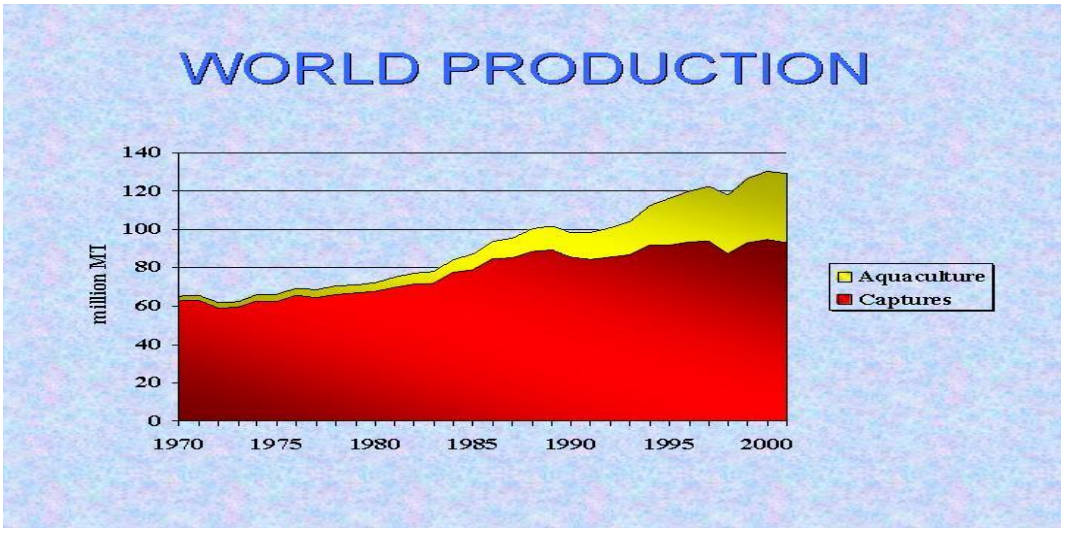

Figure 1: Aquaculture and Capture Production in the world, 1970- 2001.

The promoters of global trade maintain that trade is neutral with respect to the environment, society, sustainable management and economic efficiency. Export-oriented industrial shrimp farming has already proven to be socially and environmentally unsustainable (Rosenberry 2002).

According to reports, shrimp farming has been become increasingly significant due to their superior taste, high nutritious value and excellent market (Rosenberry 1998). By far, the greatest productions of shrimp farms crustacean are marine and brackish water *penaeid* shrimp (FAO 1999).

2.2 Shrimp production in the world

First shrimp farm was established in Southeast Asia during 1900, people used inter tidal zones to culture shrimp (Rosenberry, 1998). But the modern shrimp culture started from 1930s with successful breeding of shrimp by Professor Motosaka Fujinaga In 1954. He managed to build first shrimp farm in Japan. After wards, in the US laboratories in Galveston-Texas, shrimp culture was successfully carried out with newer techniques in 1958 **(**FAO, statistics, 2002).

Noting the importance of hard currencies earned by exporting cultured shrimp, it is necessary to improve the economic situation so that this industry can actively participate in global markets.

Shrimp consumption is quite expanded in the US, Europe and in some Asian countries. The landings of wild shrimp from "capture" fisheries have between 2 to 3 million tons a year. For some developing countries, the trade in seafood products is greater than that of coffee, tea and banana combined. Figure 2 shows the total shrimp production in the world, both from capture fisheries and shrimp culture.

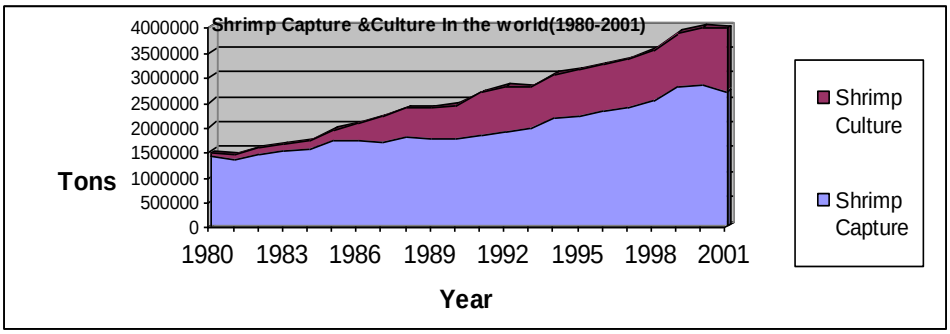

Figure 2: Shrimp statistics capture, culture and total Shrimp productions in the world. (1980-2001).

2.3 Shrimp culture in the world

There are more than 380 species of shrimp living in tropical, sub-tropical and cold water areas around the world. Penaeid shrimp members of the family Penaeidae, are the most commercially important species, which include some 60% of shrimp catch and 90% of farm annual raised shrimp. (FAO1999).

The technology now exists to bring selected adult shrimp (called *brood stock*) into reproductive readiness within on-shore tanks. This process is called *maturation***.** The result of successful maturation is controlled spawning of eggs which quickly hatch into microscopic *nauplii***.**

Hatchery technology allows more than 60% of farm raised nauplii to reach *post-larvae* status (compared to fractions of 1% in the wild).

Post-larvae can be sold and transported to separate farm facilities. These facilities can take the form of tanks, raceways or earthen ponds, some as large as 40 acres each. Shrimp farming is now practiced in many countries around the world.

There are just under an estimated 376,000 farms world wide covering about 3 million acres. Most of these are in tropical, developing countries where climate, land values and labour costs make the business more economically feasible.

The original vision of ocean farming was to mass produce inexpensive seafood to help feed the world's growing population, especially in developing countries. The modern reality of shrimp culture is to mass produce profits, promising jobs and an improved economy for the farming country. During 1999 an estimated 814,250 metric tons (nearly 1.8 billion pounds) of shrimp were cultured (World Shrimp Farming 1999).

The industry still needs more investors with more good ideas on how to raise more shrimp, larger and faster with less land, less impact on the natural environment and more benefit to the producing countries. (FAO 2003) (Appendix 4, Table 26).

The growth of the shrimp culture has provided new perspectives and horizons in economics of the areas. Intensive exported shrimp farming with a short term, high rate of return on investment and cheap supply at the expense of degraded environment, displaced communities, loss of traditional livelihoods.

Shrimp, once regarded as a luxury food by most people, has become more affordable and available as demand for it steadily rises in the major consuming markets on Japan, the United States, and various European countries. Much of the shrimp is sold in restaurants and supermarkets today. Shrimp exports count for 19% of total fisheries exports in the world in 2001 (Figure 3).

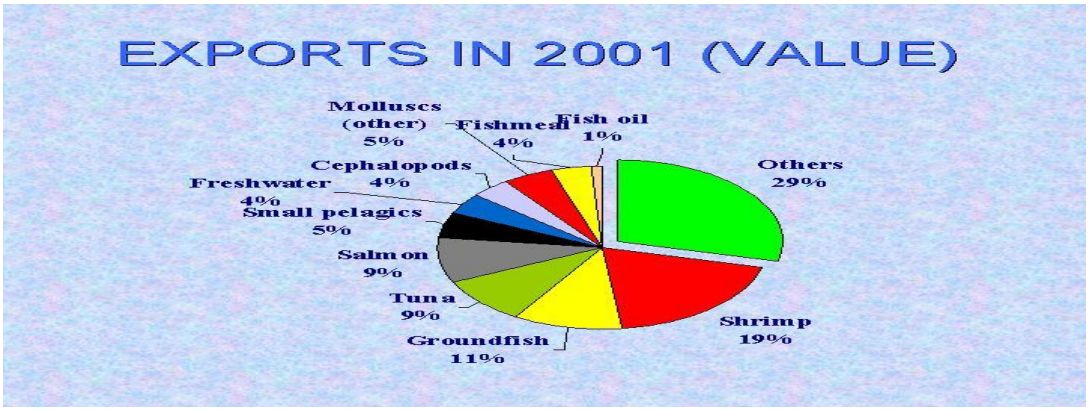

Figure 3: Fisheries value exports in 2001 (FAO 2003).

2.4 Main species in the world

The commercial shrimp and prawns species in the world have some unique character and different names are given or known for the same species such as:

Penaeid shrimps

This shrimps are commonly named as *penaeid* shrimps or prawn (English), *Crevettes*, *crevettes charmois* or *crevettes* royals (French), *Camarones peneides*, *gambas* (Spanish).The size of this species range from a maximum of more than 30 cm in total length, but most species are much smaller in size. Prawns are caught using various kinds of seines, stake net and cast nets, used in shallow water, and trawlers in offshore waters.

Black Tiger Shrimp or monodon (*Penaeus monodon*)

Penaeus monodon Fabricius, 1798, Synonms: Penaeus bubulus Kubo, 1949 Loc. names: Kalri (Sind), Tiger madak (BAL), Tiger shrimp (En) En-Giant tiger shrimp, Fr-Crevette geante Tigre, Sp-camaron tiger gigante. Size, 27 cm (male) and 37 cm (female) maximum total, traps, etc. The *monodon* has been the main cultured species in Southeast Asia although many countries in the region are shifting to *vennamei* (NACA 2002).

Western white shrimp (*Penaeus vennamei*)

It is native of Central and South American coastal areas (from Peru to Mexico) and it also known as the main cultured specie in Latin America. Total length is 230 mm. It can be reared better than *monodon* but it is not as good as Japanese and Chinese species.

Chinese white shrimp

It is called eastern species as well and is native of Korean Peninsula and Chinese coastal areas. It has better growth under 16.c Temperature in contrast with *P. monodon* and *P. vennamei*. It can easily tolerate very low salinity and muddy sediment and perhaps it is the only species that can easily live and spawn in ponds but, needs a protein rich feeding regime (between 40 to 60 percent). It is small in size (max, length 183 and mostly consumed in china but it has been exported to other countries, too.

Japanese shrimp (Kuruma)

Penaeus (*marsupenaeus)* japonicus Bate, 1888, Loc. names: Kalri (Sind), Kalri, Patti (kalmat areas) (Bal), En-Kuruma shrimps, Fr-Crevette Kuruma .Ps-*camaron kuruma*, Size: 20 cm (male)

Penaeus Fenneropeaneus marguiensis

Jaira (Sind), Jaira (Bal), En-Banana shrimp, Fr- crevette banana .Sp-camaron banana, Size: 20 cm (male) and 24 (female) maximum total lengths.

Penaeus semisulcatus

Local names, Kalri(sind), Jaira(Bal), En-green tiger prawn, Fr-crevette tigree verte , Sp-camaron tigre verde. Size: 18 cm (male) and 23 cm (female) maximum total length.

Indian White shrimp *Penaeus indicus*

Penaeus fenneropenaus indicus (H.Milne Edwards, 1837). Loc. names, Jaira (sind), Jira(Bal), En-Indian white shrimp, Fr- crevette royale blanche (des indes), Sp-camaron blanco de la India. Size: 18 cm (male) and 23 cm (female) maximum total length.

Indian White Shrimp *P. indicus* is raised throughout Southeast Asia, and it is widely cultured in India, the Middle East and eastern Africa. This is also the species cultured in Iran. Native to the Indian Ocean from southern Africa to northern Australia and to all of Southeast Asia, *P.indicus* is one of the major species in the region's commercial fishery.

The world production in farm raised shrimp 1990-2001 is shown in Figure 4, both total production and according to species of shrimp.

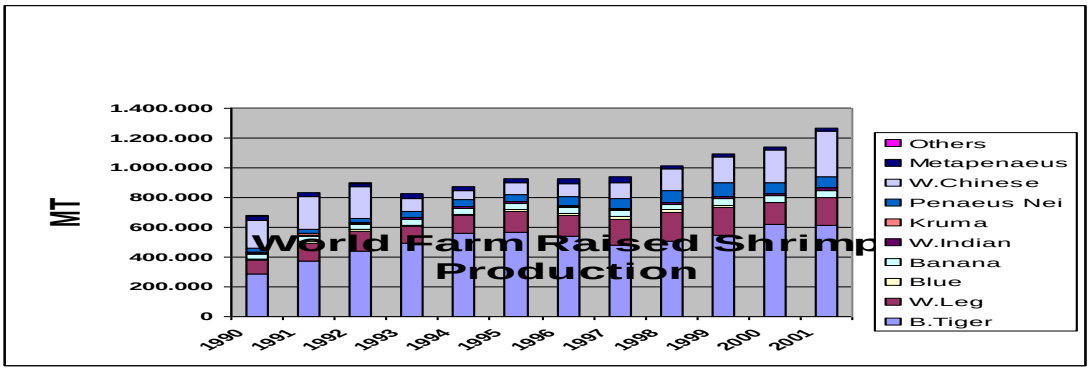

Figure 4: World shrimp farm production in the famous species, 1990-2001 (FAO 2002).

2.5 Shrimp prices in the world

Shrimp prices vary with size, source, species and time of the year. The frozen product in particular behaves like a commodity with price fluctuations weekly or even daily depending on interplay of factors that affect global supply and demand.

EU shrimp prices are generally lower than the ones in Japan or in the USA. While in the past Japanese prices exceeded the ones paid in the USA, in recent years, this situation reversed. The main reason was the economic crisis in Japan which led to

less demand for shrimp in this country. On the other hand, demand for shrimp stayed good in the US market, and prices paid there were generally higher than the ones in Japan.

2.5.1 Shrimp prices before 1999

Shrimp prices increased during the 1989-1994 period, dropping suddenly in the course of 1995. This drop in prices was caused by less demand in Japan. In 1996, the situation in Japan normalized and prices started to climb up again. (Info fish 2000)

The economic crisis in Japan and other Asian countries which started in late 1997, led to a second fall in world shrimp prices. The EU market does not play a dominant role in fixing tropical shrimp prices, rather following the price trend set by Japan. For coldwater shrimp, on the other hand, the EU is price setting, taking some 90% of the total supply of this type of shrimp on the world market (Globe fish 2001).

2.5.2 Shrimp prices after 1999

Shrimp prices in Japan, US, Europe had came down from early end of 1999, The Japanese crisis led to bleak demand for shrimp in the country and prices declined sharply. In mid 2000, the situation changed suddenly, as cold storage holdings were very low, and there were indication of a recovery of the Japanese economy (Rosenberry 2002). Figure 5 shows the changes in international shrimp culture prices in 1984 to 2001.

Figure 5: International shrimp culture prices, 1984 – 2001.

2.5.3 Reason probability

The three main markets for shrimp are Japan, USA and EU. Until late 1999 the demand for shrimp in these markets was high and prices were high especially after 1997. However, the demand for shrimp was less after 1999 due to various reasons and thus the prices declined.

Generally the Japanese price exceeds the one paid in the USA. Only recently the Japanese price fell below the US price levels, again as a result of the Japanese economic crisis. However, one can notice that the two prices will be equal, or the Japanese price will exceed the US one. French black tiger prices follow the world price trend. The high price levels in the end 1999, prices declined to bottom out in 2000. Only recently there has been a certain tendency for price increases.

2.5.4 Economic construction

The main shrimp importing countries have always been Japan, EU and USA, with the US taking over in recent years. In 1998, Japanese shrimp imports declined, while US trade grew further. In 2001, in fact Japan imported only 240,000 MT, while US shrimp imports reached 315,000 MT.

The shift from Japan as main importer to the USA created substantial problems for the main exporters to the Japanese market, mainly from Asia. Shrimp imports into Europe continue to grow, with Spain as the main market, followed by France and UK. The Danish shrimp imports are mainly re-exported (Globe Fish 2002).

Indian white prawn or *P.indicus* mostly culture by some countries like this Cyprus, India, Oman, Saudi Arabia, South Africa, United Arab Emirate, Viet Nam and Iran. Oman and the Emirates have just started to culture shrimp and will probably increase production in the future (FAO 2001). The production of the main countries culturing Indian White shrimp are shown in Table 1.

Table 1: Indian White Prawn shrimp culture statistics in main producer countries in the world 1990-2001 in tons (FAO 2002).

Country	Species	1990	1991	1992	1993	1994	1995
Cyprus	*Indian White Prawn*	0	0	0	1	2	6
India	*Indian White Prawn*	5100	5700	5700	7500	8600	6000
Oman	*Indian White Prawn*	0	0	0	0	0	0
Saudi Arabia	*Indian White Prawn*	0	0	0	0	0	20
South Africa	*Indian White Prawn*	0	0	0	9	40	75
United Arab Emirates	*Indian White Prawn*	0	0	0	0	0	0
Viet Nam	*Indian White Prawn*	1636	1785	1870	1972	2228	2766
Iran(I.R)	*Indian White Prawn*	0	0	31	15	56	136
Total	*Indian White Prawn*	6736	7485	7601	9497	10926	9003
Country	**Species**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Cyprus	*Indian White Prawn*	12	22	25	43	65	75
India	*Indian White Prawn*	6000	5943	5734	4870	5740	5830
Oman	*Indian White Prawn*	0	0	1	1	1	1
Saudi Arabia	*Indian White Prawn*	100	830	1681	1868	1961	4150
South Africa	*Indian White Prawn*	85	69	85	100	100	120
United Arab Emirates	*Indian White Prawn*	0	1	1	1	1	1
Viet Nam	*Indian White Prawn*	2489	2468	2743	2873	3473	3500
Iran (I.R)	*Indian White Prawn*	163	524	869	1800	4050	7607
Total	*Indian White Prawn*	8849	9857	11139	11556	15391	21284

2.6 An overview of fisheries in Iran

Iran with a coastline of more than 1800 km along Persian Gulf and Oman Sea and 900 km along the Caspian Sea as well as many rivers and lakes enjoys a significant potential for harvesting aquatics (Figure 6). Fisheries do not play an important role in the national economy (Shilat 2003). The total production of the fisheries sector of Iran is shown in Table 2.

Figure 6: A map of Iran.

The major species harvested by the Iranian vessels in the Caspian Sea are sturgeon fish, bony fish including white fish (Rutihus frisil kutum) and mullets, and finally Kilka which are caught by gill net, beach seine and lift net respectively.

Some 168 vessels are engaged in Kilka fishery, and about 139 beach seine fishery cooperatives operate bony fish fishery. However, gillnets are mainly used in the Oman Sea and just few purse-seiners and long liners. The small pelagic, mostly sardines, distributed in the Persian Gulf and Oman Sea with a high annual fluctuation. The fishermen catch them by bag beach-seines. The Fisheries Department of Islamic Republic of Iran, Shilat, is now promoting sardine purse seining operated by small boats. Some about 2739 dhows and 6463 small boasts catch pelagic and demersal species in the Persian Gulf and Oman Sea using mainly Gillnet and traps (Table 3). Some of them operate bottom trawls during the shrimp season in Bushehr and Hormozgan provinces.

Table 2: Fisheries Production in Iran 1992-2002 (Shilat 2003).

Fisheries Production in Iran, 1998-2002. (Thousand Tons/Year)				
Region/ Year	**Persian Gulf & Oman Sea**	**Caspian Sea**	**Inland Water**	**Total**
1992	271	41	42	354
1993	272	53	44	369
1994	235	69	45	349
1995	265	58	59	382
1996	260	74	65	399
1997	259	76	65	400
1998	226	101	72	399
1999	234	110	67	411
2000	260	98	66	424
2001	262	62	73	397
2002	265	55	84	404

Table 3: Type and number of different vessels operating in the Persian Gulf and Oman Sea (Shilat 2003).

Type	**No**	**Operational zone**
Industrial	**80**	Oman Sea, beyond 7 n.mil, Bottom Trawler, Purse Seiners, Long liners
Boat	**6463**	Persian Gulf & Oman Sea Mostly Coastal Fishery using Gillnet & Shrimp Trawl
Dhow	**2732**	Persian Gulf & Oman Sea, Gillnet, Trap (Gargoor), Shrimp Trawl

There are four provinces in south Iran which boarder the Persian Gulf and Oman Sea, Khozestan, Bushehr, Hormozgan and Sistan Blochestan. In northern Iran two provinces boarder the Caspian Sea, Gilan and Mazandaran. Table 4 shows the number of landings sites and number of vessels.

Table 4: Place and numbers of fishing ports and fish landing in different provinces.

Province	Coast length (km)	Landing Centre	Ports	No. Vessels
Khozestan	**220**	**5**	**5**	**2094**
Bushehr	**625**	**38**	**15**	**2662**
Hormozgan	**735**	**58**	**14**	**3156**
Sistan Blochestan	**300**	**10**	**8**	**1765**
Gilan	**350**	**-**	**3**	**100**
Mazandaran	**600**	**-**	**2**	**68**

2.7 Aquaculture in Iran

Aquaculture activity has been started in Iran with Sturgeon breeding and rainbow trout in 1923 and 1956, respectively. (Fish culture in the world magazine, 2000)

In order to ensure national food security and to compensate the regulatory limitations in fish catch, Iranian Fisheries Cooperative has tried to increase the production of commercially valuable species. Concentrated efforts to develop aquaculture throughout the country were initiated in the 1980's. Inland waters production and fish farming including:

- Warm water fish farming
- Cold water fish farming
- Catch in inland water
- Shrimp culture

The initial efforts, in the 1970's, were directed towards developments of hatchery techniques for fingerling production of the valuable Caspian Sea species, such as Sturgeon (*Beluga Huso huso),* Russian Sturgeon Acipenser guldenstadti Iranian Sturgeon *A. persicus,* and *Sevruga, A. Stellatus.* Other fishes (*Kutum Rutilus frisil kutum,* Mullets *Mugil auratus* and *M. Saliens,* Carp *Cuprinus carpio,* Bream *Abramis brama,* Pilke-perch *Lucioperaca lucioperca , Roach Rutilus rutilus* and Salmon *salmo trutta caspius*) and other indigenous species, rainbow trout and Chinese carp. The last two species have become the major species for freshwater aquaculture.

In general it is supposed that chondrosteans as a group originated in the freshwater basin of northern Asia in early Triassic from ancient ancestors belonging to the *paleoniscoid* fishes (Berg 1948, Schaeffer 1973, Yakovelev 1997) and acipenserids became widespread in the Northern Hemisphere in the late cretaceous era (Grande and *bemis,* 1991). *Acipenseriformes* are divided into three families:

- Family *Scaphirhynchidae* that includes the genus paddlefish with 2 species.

- Family *Acipenseridae* that includes two genera: Acipenser (18 species) and *Huso* (2 species).

- Family *Polydontidae* that includes two genera: *Scaphirhynchus* (2 species) and *Pseudoscaphyrhynchus.* (3 species)

Six of the above mentioned species are in the Caspian Sea and rivers leading to it and provide 90% of the world's caviar. These species include:

- Beluga, *Husu huso*
- Stellate Sturgeon, *Acipenser stellatus*
- Persian Sturgeon, *Acipenser persicus*
- Russian Sturgeon, *Acipenser gueldenstaedtii*
- Ship Sturgeon, *Acipenser nudiventris*
- Starlet Sturgeon, *Acipenser ruthenus*

At present the valuable stocks of sturgeon in the Caspian Sea have been severely affected by the irrational interventions of man. This difference is mainly due to the abundance of Persian Sturgeon (*A. persicus*) that is found more abundant in the southern basin and Iranian shores of the Caspian Sea as a result of rehabilitation of stocks of this species in the recent years.

2.7.1 Natural and Semi-Natural Water Resource

So far 133 species of fishes have been identified from these resources, among which only 15 species are of economic importance. Total area of inland water bodies, including lakes reservoirs, rivers, pools, etc, is estimated to be about 1.5 million hectares. To exploit the potential of these waters serious measures have been taken to enrich them by means of releasing seeds of rainbow trout and carps of various species (Shilat, 2002).

2.7.2 Fish Farms

A considerable part of fish production through aquaculture comes from fish farms. These farms are scattered throughout the country and generally classified as warm-water and cold-water farms. Warm-water fish ponds are found all over the country, but majority of them are located in Gilan and Mazandaran provinces in the north and Khozestan province in the south. Cold-water farms are distributed in the eight provinces of west Azerbaijan, Fars, Tehran, Lorestan, Mazandaran, Zanjan, Kohkiloyeh- Boir Ahmad and Chaharamaha Bakhtiari. Trout production has started in 1959 and total production was 280 ton in 1978 and its increasing ration in 12000 tons was 2001. This product in 2002 was near 19000 tons (Shilat 2003).

2.7.3 Marine Fish

Although many scattered studies about reproduction and breeding of marine fish have been accomplished by IFRTO and/or fisheries reproduction and breeding deputy in recent years, but it can be said that the programmed and codified activities have started in mid 1992 about reproduction and breeding of Grouper. This project is being carried out in Khuzestan province, and the experts could collect 60 parents and keep them in the caged located in the branches of Khor- Musa during the first year of their activity (IFRTO 2002).

2.7.4 Marine Molluscs

Since pearl is one of the valuable resources of the Persian Gulf, and before exploration and extraction of oil in the district has been one of the main aspects of economic activities, Iranian fisheries has started some activities to revive the traditional catch and pearl culture since 1984. In this regards, the project of cultured pearl production from Black lip oyster (*P. morgaritifera*) has been executed in Kish Island (IFRTO 2002).

2.7.5 Marine Plants

No significant research activity has been accomplished about reproduction and breeding of marine plants yet, because on the good potentials of this aquatics in the coasts of Oman Sea (Sistan and Baluchestan province), a research project has been designed to breed marine plants and will be executed in near future. The algae *Gracilaria, Ulva*, and *Sargassum* have been chosen for experimented breeding (IFRTO 2002).

2.7.6 Artemia Cyst Production for Hatchery

For propose of cyst production for hatchery a joint study project carried out with Genet University in two year in Urmia lack which is located in Northwest of Iran. The area is 6000 km and the average depth is 6 m. The salinity was 220 ppt in 1992, 140 ppt in 1994 and 180 ppt in 1995. A pilot established for cyst processing beside the Urmia Lake (IFRTO 2000).

Now the Artemia cyst from the Urmia lake produces about 100 tons annually. Artemia culture has expanded to saline waters and in 2000 the production of *Artemia Sanfernsicana* in Kerman province was 15 tons.

2.8 Shrimp Culture in Iran

Shrimp farms in Iran are located in coastal areas in the southern part of the country. Iran has an almost 2000 km coastline along the Persian Gulf and Oman Sea. The 900 km coastline of the Caspian Sea may be used for shrimp farming in the future.

Near the Oman Sea and the Persian Gulf, the quality of soil is classified in third and fourth class. There can be no other agriculture activity due to soil quality and scarcity of fresh water. Hence, shrimp farming is viewed as the only profitable and economic activity in these areas (PDOFI 2002).

It plays a key role in the economy of the area and its people with extended social impacts on their life. Before the emergence of this industry, rural people of these areas migrated to large cities but this procedure was stopped by shrimp farming activities. With respect to various problems of Iranian shrimp farmers due to high production costs and low global prices of shrimp, it is necessary to evaluate their problems and think about the solutions.

2.8.1 History of Shrimp Culture in Iran

The first steps to set up shrimp culture in Iran emerged in Boushehr Province in 1976. In this regard site selection activities started (France Research Co. 1976). In 1982, two Iranian experts were dispatched to Japan to participate in a shrimp culture training course. Then, in 1985, a group of Chinese experts visited southern provinces of Iran and in 1987, the first shrimp farm established in Hormuzgan Province with the help of Bangladeshi expert.

In 1990, feasibility studies regarding shrimp culture started with cooperation of France Aquaculture Company (Abzigostar 2000). In 1990, Agriculture Section of Iran requested a skilled expert of shrimp culture and this regard with the collaboration, FAO and UNDP Office in Tehran, Mr. Yapp; a Filipino expert was dispatched to Iran to deliver required training and other assistance needed for Iranian shrimp culture section.

Construction began in 1991 on a National Shrimp Culture Development Centre in south of Iran (Shilat 1996). Preliminary studies were conducted on banana shrimp (P. *merguiensis)*, the Tiger green prawn (*P.semisulcatus)* and the Indian white shrimp (*P. indicus)* at Kolahi Fisheries Station (Shilat 1991).As a results, and shrimp culture is practiced from April to October in Iran. During the rest of the year, night temperatures are too low and cause stress in the shrimp, stopping their growth.

Fundamentally, fishing in Iran has a long history. We have just some parts information got too much background in shrimp reproduction except a few research projects were preformed in Iran. (I.FRTO, 2002).

At the present Giant tiger shrimp (*P.monodon*) in eastern hemisphere and (*P.vannamei*) and Blue shrimp (*P.Stylirostris*) are major species for pond culture. These shrimp do not exists in Iranian water of the Indian Ocean (Oman Sea) and Persian Gulf, so shrimp culture industry in Iran is founded on the basis of an endemic species i.e. Indian White Shrimp (*P. indicus*).

2.8.2 Shrimp Culture Methods

There are three different methods of shrimp culture, namely non-intensive, with production yield between 500 and 2000 Kg in per hectare. The semi-intensive is the method of production chosen. The production yield is on average 2.2 ton/ha. There is a possibility of increasing it to 3 ton/ha, which means that if one prepares expertise and appropriate conditions, can increase production by 800 kg per hectare.

Semi-intensive shrimp culture with 2000 to 3000 production yield per ha and intensive culture with 3000 to 5000 Kg/ha in each crop. Intensive system, almost have production yield more than 5000 Kg/ha in each crop. Particularly, Iranian shrimp processing system have HACCP certificate for shrimp exports.

2.8.3 Shrimp culture area

Boushehr is a province in south of Iran and corner Persian Gulf. Boushehr is also the name of a city in this province and there are also other small cities in this province. The fundamental economic activities in Boushehr are trading. Existence of high evaporation plus arid and desert condition in this province has results in comparatively poor fauna. During the summer season there is no precipitation and the length of this is nearly seven months but there is continuous rain during the wintertime.

2.8.4 Air Temperature

The Persian Gulf with its special characteristics is located between Iran and the Saudi Arabian Plateau, which means that during winter this region in under impact of a weather front originated from the Mediterranean Sea. This area is under direct impact of high pressure system of tropical areas and hence it has a very hot and dry weather (Boushehr Geographical Information centre 2002).

2.8.5 Water Temperature

Boushehr province has two different elevations. Most of the area in this province is mountainous and small amount of it is pathogenesis. Since this area is located near the Persian Gulf it is mostly affected by its climate. The warmest months is August and the coldest is January (the highest degree 36°C and lowest is 14.3°C). So, it rarely freezes in Boushehr. High temperature of the province affected by elevation has caused some adjustment in different parts of it. The average precipitation in Boushehr province is 220 mm and therefore the agriculture activities are carried out without irrigation. The highest level of raining occurs in December, January, February and lowest level is recorded in summertime.

2.8.6 Wind

Winds directions have a great impact on climatic status of the province. West winds in cold months of the year change the weather of this province like any other area of this country. These winds, by moving over the Persian Gulf, absorb great amounts of humidity and increase the level of rainfall in Boushehr province.

2.8.7 Salinity

Marine water near the coastline has high salinity. Normal variation in salinity ranges between 30 and 38 ppt. The quality of subterranean water in this province is not satisfactory at all and only the subterranean waters near limestone layers are of good quality.

2.8.8 Trade (Socio-Economic)

Other economic activities of this province include ship building factories and shipyards, trade and administrative services.

Borazdjan, Genaweh, Khourmodje, Kaki, Ahram, Daier, Kangan are important cities of Boushehr province.

The coastline in the south of Iran is 2000 km and about 110,000 ha of land along it are suitable for shrimp culture. This area is being developed with road building, electricity etc.

Main produced species of shrimp is *Panaeus indicus* that is domestic in Iran and its production was 2.2 tons per ha. The culture method chosen was semi-intensive since intensive methods have been shown to be problematic in other countries.

2.8.9 Policy Trusts

Shilat (Iranian fisheries government division) determines the policy and planning of shrimp culture in Iran. In the second and third development programs of Iran, sections of fisheries have strategies for shrimp development in south of Iran (Figure 7).

Shilat supported each shrimp farmer for the necessary infrastructure for the farm such as roads, electricity, canals etc. Shilat carry this out using bank loans with low interest and credit banking to shrimp farmers. The policies of Iranian fisheries aim toward growth and development of shrimp farming in Iran during years 2000 until 2004 (PDOFI, 2003).

Figure 7: Map of Persian Gulf.

2.8.10 Species selected for shrimp culture

Persian Gulf and Oman Sea have shrimps more than 10 shrimp species are known in Southern waters of Iran, which are as follows:

1 Plesiopenaeus award sianus	**2-** ***Metapenaeus affinis***
3- ***Parapenaeopsis stylifera***	**4-** ***P. indicus***
5- ***P. Japonicus***	**6-** ***P. latisulcatus***
7- ***P. merguiensis***	**8-** ***P. Penicillatus***
9- ***P. Semisulcatus***	**10-** ***Trachypenaeus curvirostris***

Native species of the Persian Gulf and Oman Sea which have significant economic value and have been selected for culture are:

I. ***P. indicus***

This species is distributed in waters of Hormozgan province of the Oman Sea. This specie has been considered best for culture due to its adaptability to different conditions. It is now cultured in all four provinces along the coast of both the Oman Sea and the Persian Gulf.

II. ***P. Semisulcatus***

This species is mostly distributed and abundant in the Persian Gulf and its main habitats are in coastal waters of Bushehr province, but its resources in Khouzestan and Hormozgan provinces are also important. This species bas been chosen to be cultured in Bushehr and Khouzestan provinces.

III. ***P. Merguiensis***

This species is mostly distributed in waters of Hormozgan province. Although this species has also been considered to be cultured, because of the existing problems in providing brood stock and larvae production and reproduction, it is no longer being considered.

2.8.11 Post Larvae Production

Intense production of shrimp post – larvae period started in Iran since 1992, and had many difficulties during 1992 to 1994, but since then a good quality product was obtained (Post Larvae). The post–larvae produced in 1992, were released in the sea, and some of them were cultured in Kolahi hatchery farm in Hormozgan province.

The imported post-larvae of the species *P.monodon* were cultured in preparative and training hatchery in Iranian province. Finally, Iran selected *P.indicus* for shrimp culture in the farms (Appendix 2, Table 24).

2.8.12 Shrimp Culture Production

Following shrimp experimental preparative training hatchery in 1992 in Khouzestan and Hormozgan provinces, and possibility for the expansion of this industry in south of the country, a large number of approvals for establishment of shrimp culture farms in southern provinces have been issued for the private sector. (Appendix 2, Table 24).

2.8.13 Problems and Constraints

I. Lack of knowledge of shrimp farmers is the most important problem and a high potential risk for the future. Another possible weakness point could be shortage of post larvae. *P. indicus* is the main and also the only commercial species. Selecting only one species has many risks e.g. disease could destroy the sector. The source of wild spawn is limiting for almost all shrimp producer. Fisheries of Iran have an extension plan to introduce techniques of rearing Spawn in captivity. Demonstration farm are in operation at the present time (Appendix 2, Table24).

II. Iran has big plans for shrimp development and is seeking ways to make this industry sustainable. In addition, there is no study about the economics of shrimp in Iran and as a result the importance of this project becomes obvious (Shilat 2002b).

2.8.14 Some research activities

Among shrimp producing countries, Thailand has carried out more economic surveys in the world because with highest production of cultured shrimp, has the largest export of shrimp in the world (NACA 2001, FAO 2001).

Table 5 is a comparison of the percentage of variable costs for shrimp production such as feed, larvae, power, labour, and other costs in selected countries, which are large producers of cultured shrimp. From the Table it is obvious that the various factors of shrimp farming affect the cost of production differently in each country. For example, the cost of feed is almost half of the total production cost in Iran while it is only 23% in Vietnam. Another example is the cost of labour, which is extremely low in India (only 2.4%) but almost 12% for Iran.

Feed cost is one of the significant variable costs. The main reason for differences in cost is the method chosen, dry feed (Philippine, India, Iran and Malaysia) vs. a combination of dry and live feed ,Indonesia and Vietnam (NACA 2001, FAO 2001).

Post larvae costs concern new techniques in the shrimp countries producers. Some countries have good techniques and good natural conditions for the reproduction and should have lower prices for post-larvae because have more supply.

This basically means that Iran, Vietnam, and Indonesia have high costs for post-larvae but Philippine, Malaysia and mainly, India have lower prices for post-larvae. For power and labour most shrimp producers have less than 10% but the cost is more than 10% for Iran in both instances (PDOFI, 2003).

Table 5: Status of variable costs required for production of each kg of cultured shrimp in selected countries in 2001.

Status/Country	Indonesia	Philippine	Malaysia	Vietnam	India	Iran
Percentage of Variable Costs in Production Per Kg	78,2	91,6	71	66,8	72,9	70,1
Percentage of Feed Costs in Production Per Kg	39,3	55,2	43,3	23,1	45,5	45
Percentage Of Post Larvae in Production Per Kg	21,6	17,5	10,8	31,7	18,1	28,2
Power	2,4	6,9	7	0,5	4,2	12
Labour	8,6	10,7	4,7	4,6	2,4	11,8
Percentage of Other Costs in Production Per Kg	6,3	1,2	5,2	6,8	2,6	3

2.8.15 Shrimp Investment system in Iran

Iranian banking investment board has given its facilities for an Iranian private shrimp company to creation shrimp farms. In fact banks have business by investment to shrimp company. The rate of bank credit business is 13% of its shares. During time for return loan and rate of profit loan are 8 years and also bank have guaranty for pay credit maximum 60% of value of shrimp farms and 40% of shrimp farm value recompense by private company .

2.9 Biology of Indian White Shrimp

2.9.1 Distribution

P. indicus is a marine, warm water species living from 40N to 40S latitudes, inhabiting soft, muddy bottom areas from the southern part of Australia to east and southeast Africa, including the coastal water of Oman Sea, Pakistan to Jask area in Iran.

2.9.2 Morphology

Average body weight and length of females in wild population are 30-35 g and 15 cm respectively. Males are smaller than females. Whole body is covered by a hard exoskeleton, protecting the animals from the physical and some biological damages. Coloration of the animals varies depending on environmental conditions from dark olive green to light, yellowish green.

2.9.3 Life Cycle

Indian white shrimp lives for 2 to 2.5 years. Maturation age strongly depends on feeding and temperature. It is typically 5 months for male and more than 7 month for female. Mature animals are usually found offshore in depth of 20 m. Fertilization of eggs takes place outside of the body. Number of eggs per spawn varies from 200,000 to more than 300,000 in larger animals.

2.9.4 Growth

Indian white shrimp is a Eury- haline species. The animal lives in a wide range of salinity, from less than 10 ppt to more than 50 ppt. However, successful reproduction takes place in salinities between 30 to 40 ppt. In low salinity, less than 30 ppt, mature shrimp may spawns but the eggs do not hatch to larvae. Optimal range of temperature for growth and reproduction is 27°C to 31°C. Out of this range the growth would be retarded. *P. indicus* grows well in the temperature range between 16°C and 33°C.

2.9.5 Feeding

P.indicus is omnivorous; feeding on all levels of trophy. It preferably preys and feeds on worms, small crustaceans, mollusc, fish larvae, etc. In starvation period or stressful condition it shows cannibalistic behaviour. In the hatcheries zoea larvae feed on phytoplankton like skeletonema and chaetocerous. They will feed with zooplanktons in Mysis stage. From late post larvae stage it is able to prey on adult *Artemia* (Appendix 2, Table 24).

3 Data collection

3.1 Shrimp culture information in Iran

The potential of shrimp culture was first realized by Shilat in Iran in the mid 1980's (1984-1986). Consequently in 1989, the first feasibility study and development project, funded jointly by United Nations Development (UNDP) and Shilat, was carried out with the help of Asian experts contracted through the Food and Agriculture Organization (FAO). Establishment of shrimp farms was slow in the beginning but increased dramatically in 1999 and there are now 280 farms in the province (Figure 8).

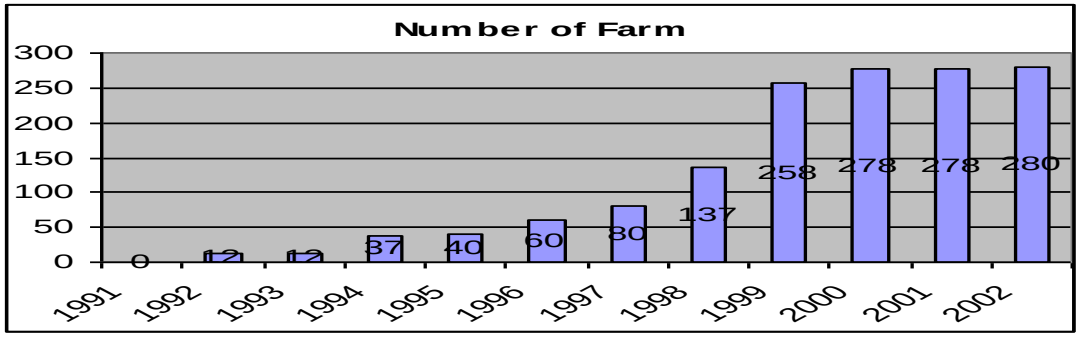

Figure 8: Number of Shrimp Farms in Iran, 2003 (Aquaculture Dept. Iran 2003).

3.2 Data collection in shrimp culture, 1998- 2002.

From the establishment of shrimp culture in Boushehr province until 1998 there were few farms, poor technology and conditions for production were not good. After 1998 the farms were in better condition and information about the culture was more readily available.

The number of shrimp farms in Boushehr province is much greater than in the other southern provinces, which is why this project focuses on Boushehr (Figure 9). The Iranian government established sites where infrastructure such as electricity, canals and roads were laid, to make the establishment of farms possible. Therefore, many farms are within one site, although each farm is a separate unit.

Helleh site is one of the oldest sites in Boushehr established for shrimp farming in 1992. Helleh site was chosen for this project since these farms were among the oldest and there were also many farms in the site (52 farms in 1998) (Aquaculture Dept. Iran 2003).

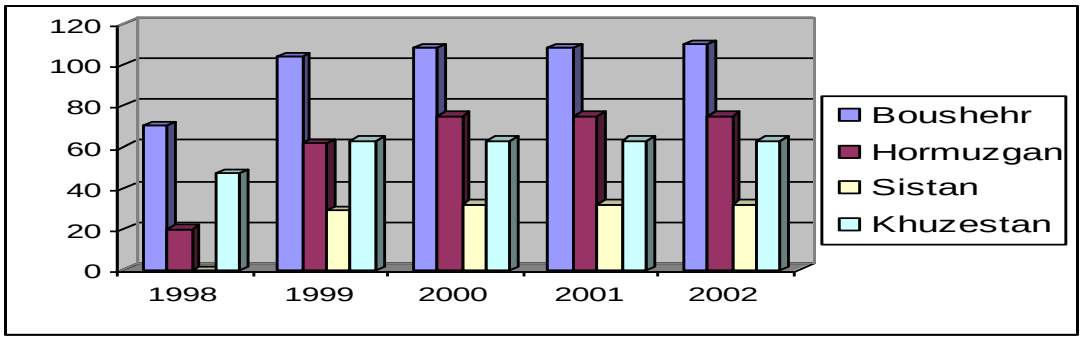

Figure 9: Number of shrimp farms in four provinces In Iran 1998-2002 (Aquaculture Dept. Iran 2003).

3.3 Data reference

Data for this project was received from PDOFI (Planning and Development Office of Fisheries, Tehran). It was collected by the Shrimp Research Institute Centre in Boushehr.

3.3.1 Period of data collection on Bousherhr

The Shrimp Research Institute Centre in Boushehr gathers information from every farm in the province during the culture process. This information is then sent to PDOFI in Tehran for further analysis and future planning in the sector. Information for this project was requested from both organizations. The data used is from the period 1998-2002.

3.3.2 Shrimp farms in Boushehr province

Boushehr province has less than half of shrimp farms in Iran. Boushehr province has a number of shrimp sites such as Helleh, Mond, Delvar, and Rood Shour. Helleh is not only the biggest site in Boushehr, but also the biggest site in Iran. This site has 52 shrimp farms, which are all very similar in structure. Helleh is one of the oldest sites in Boushehr and therefore, data have been collected form this site for a longer period of time than in other sites. In Table 6 compares the different sites in Boushehr.

Table 6: Shrimp sites in Boushehr province, south of Iran, 2002.

Name of Site	Number Of shrimp Farms	Number of Pools	Total Surface (ha)	Production (Ton)
Helleh	52	677	1040	1510
Mond	24	312	480	610
Delvar	33	429	665	820
Rood shour	1	14	21	32
Total	110	1432	2206	2972

Table 7 compares different aspects of shrimp farming in the four southern provinces of Iran and shows that conditions in Boushehr are better than in the other three provinces.

Table 7: Shrimp Culture in Four Provinces in South of Iran (PDOFI, 2002).

Comparison between shrimp culture in four provinces in south of Iran.					
Condition / Province		**Boushehr**	**Khuzestan**	**Hormuzgan**	**Sistan**
Air & Water	Good	*		*	*
	Normal				
	Weak		*		
Supply of Post- Larvae	Good	*		*	*
	Normal				
	Weak		*		
Security Shrimp Farms	Good	*	*	*	
	Normal				
	Weak				*
Pollution & Environment	Good				*
	Normal	*		*	
	Weak		*		
Shrimp Management Farms	Good	*			
	Normal			*	
	Weak		*		*
Shrimp Health	Good	*		*	*
	Normal				
	Weak		*		
Accuracy of Data	Good	*			
	Normal		*	*	*
	Weak				
Total	Good	6	1	4	4
	Normal	1	1	3	1
	Weak	0	5	0	2

3.4 Data selection process

In order to reach a reliable conclusion one must first go through the information available and decide how reliable it is. One must also decide upon which province, site and farms will provide the best information for the period chosen.

The selection of the Boushehr province is obvious since it has the most shrimp farms, the oldest farms and the best conditions of all the provinces in southern Iran, although they all have active shrimp farming. The selection of Helleh site is also obvious since it is the oldest site for shrimp farming in Iran and in 1998 there were 52 active farms.
Further selection is done in the following manner:

- Of the 52 active farms in Helleh site, 12 were new, so they did not have sufficient data for this study.

- Of the remaining 40 shrimp farms, 10 farms had incomplete data. The information was unclear due to mortality in some of the pools or other problems in the production. Thus, data from these farms could not be used in this project.

- Finally, just 30 farms have complete data.

- Mostly, every farm has approximately 13 pools and every pool is 1 hectare. Thus, every farm has approximately 13 hectares useful for shrimp culture. The total area of the shrimp farms is approximately 20 hectares. Since there are 30 farms used in the project and each farm has 13 pools, there are approximately 390 hectares to be considered.

- In this case variable factors including post-larvae stock, feeding, labour and other variable factors are useful.

- Every farm has a different manager and management systems in farms are also probably different. Therefore, results can be expected to differ between farms.

- The data used is from a five-year period, 1998-2002. The data from the years before 1998 isn't clear; there are fewer farms, and some start-up problems.

- Shrimp cultures have working time between 5 to 6.5 months in Iran. The farming is only active once every year from April until October and therefore, there is only one shrimp crop per year. Therefore, there is just culture for one time in the year.

- During the winter months shrimp farming is not possible due to cooler night temperatures. The cooler temperatures put stress on the shrimp, growth stops, and sometimes shrimp dies.

- Fundamentally, some data needs to be prepared and estimated like stocking, FCR, survival, duration, weight, fertilizers and some important variable factors.

Both biological and economical information is need as well as estimated data like feed cost, fertilizer cost, power cost, transport cost, some data after calculations like depreciations, fixed capital, working capital, or other costs, production, interest rate and other items need to be calculated.

In this case study, the broad approach adopted for the identification and estimation of benefits is given below citing the framework within which the benefits are

classified and analyzed according to the present data.

3.5 Data Reliability

The accuracy of the data from shrimp farming must be determined. To do this the process of data collection in Boushehr must be checked and then the long term control and monitoring of the data in Tehran. This means all data is double checked before use in this analysis.

In Iran, each farmer is expected to fill forms on the various aspects of the farming operation. This information is then gathered by the Shrimp Research Institute for further analysis and monitoring of the shrimp farming. The data is also sent to the PDOFI in Tehran for economic analysis of the industry as well as to several other government agencies. The data is made available through yearbooks.

The generating and gathering of information in the shrimp culture sector is as follows:

I. Biological and economical records about shrimp culture are kept by the shrimp farmers.

II. Controlling and monitoring of biological data by shrimp section of the fisheries director in Boushehr province.

III. Controlling of biological data by Shrimp Research Institute Centre in Boushehr.

IV. Controlling of economic data by PDOFI.

V. Controlling of data by Shrimp office, Fisheries department of Tehran, Iran.

VI. Controlling of biological and economic data by Statistics division, Agriculture Organization, Tehran, Iran.

VII. Controlling of data by Statistics Organization, Tehran, Iran.

VIII. Controlling of data by Planning and Budget Organization, Tehran, Iran.

3.6 Data Controlling

In this study many formulae are used to check the validity of the data. These formulae are:

- **Post Larvae costs (US$) =** Stocking Post Larvae (bits) * Price (US$) **(1)**
- **Post Larvae cost for one farm (US$/Kg) =** Stocking (bits) * Price (US$) * useful Surface (Pool/ ha) **(2)**
- **Feed Costs (US$)** = Production (kg) * FCR (%) * Feed Price (US $ /kg) **(3)**
- **Feed Cost for One Farm (Price/Kg) =** Total Productions in the Farm (kg) *Total FCR in the Farm (%) * Feed Prices (US $ /kg) **(4)**
- **Fertilizer & Lime costs (US$/Kg) =** Fertilizer consumer in the farm (kg) * Price (US $) + Lime consumer in the farm (kg) * Price (US $) **(5)**
- **Labour Costs (US $)** = Number of workers * Working Times (Days) * Salary (US $ /Day) + over time costs (US $) **(6)**
- **Power Costs (US $)** = Electricity cost (US $) +Fuel cost (US$) **(7)**
- **Transports costs (US $) =** Feed Transport cost (US $) +Post Larvae Transport Cost (US $) + Labour Transport Cost (US $) + Other Transport cost (US $) **(8)**
- **Total Operating costs (US $)** = Post Larvae cost (US $) +Feed cost (US $) + Fertilizer cost (US $) + Labour cost (US $) +Power Cost (US $) + Transport cost (US $) **(9)**
- **Interest (US $) =** Fixed Capital (US $) + working capital (US $) **(10)**
- **Total capital costs (US $) =** Depreciation (US $) + interest (US $) **(11)**
- **Total costs (US $) =** Operating cost (US $) +Capital cost (US $) **(12)**
- **Revenues (US $) =** Price (US $/kg) * shrimp production (kg) **(13)**
- **Cost –Benefit (US$) =** Benefit (US$) – Cost (US$) **(14)**

4 Data Analysis

4.1 Profitability Assessment

The main objective of this study is to determine the profitability of shrimp farming in Iran. In this chapter the data for the 30 farms in the Helleh site chosen is analysed and then the 10 best farms are chosen for further study.

4.1.1. Sample of 30 Farms

In Table 8 the average production, revenues, total costs and profit are estimated. Average revenues in the 30 farms went from 89446 US$ in 1998 to 64707 US$ in 2002. Average total costs in the 30 farms was 16667US$ in 1998 but had increased to 11733US$ in 2002. Average profit in the 30 farms was 10407 US$ in 1998 but decreased to -25828 US$ in 2002.

Table 8: Data for the 10 best shrimp farms 1998-2002

Average of 30 farms					
No of farm: Average / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	22361	25154	28359	30476	32354
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	89446	100615	85076	91427	64707
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	15700	16554	17140	17601	18036
1.2.Feed Cost	26203	27833	29783	29958	30624
1.3.Fertilizer-Lime	1130	1239	1396	1449	1601
1.4.Labour	15704	17359	18883	20579	22103
1.5.Power Cost	2907	3514	4033	4626	5294
1.6.Transport Cost	728	840	934	1025	1144
II. Total operating cost	62372	67339	72170	75238	78802
2. Capital costs:					
2.1 Depreciation					
Fixed capital	16667	15434	14200	12967	11733
Liquid capital	5647	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	5667	5167	4667	4167	3667
III. Total capital costs	16667	15434	14200	12967	11733
IV.Total costs:	79039	82773	86370	88205	90535
Contribution to fixed costs (I-II):	27074	33276	12906	16189	-14095
Profits (I-IV):	10407	17842	-1294	3223	-25828

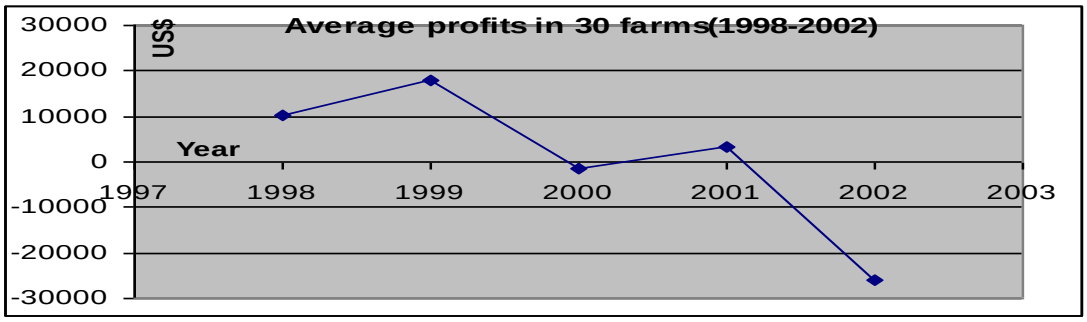

Figure 10: Average Profits for 30 Farms (1998-2002).

Figure 11 shows the average shrimp production of the 30 farms in 1998-2002. Shrimp production increases every year. Average shrimp production in the farms increased gradually from 22,361 kg in 1998, in 1999 25,154 kg, in 2000 28,336 kg, in 2001 30,467 kg and 32,354 kg in 2002.

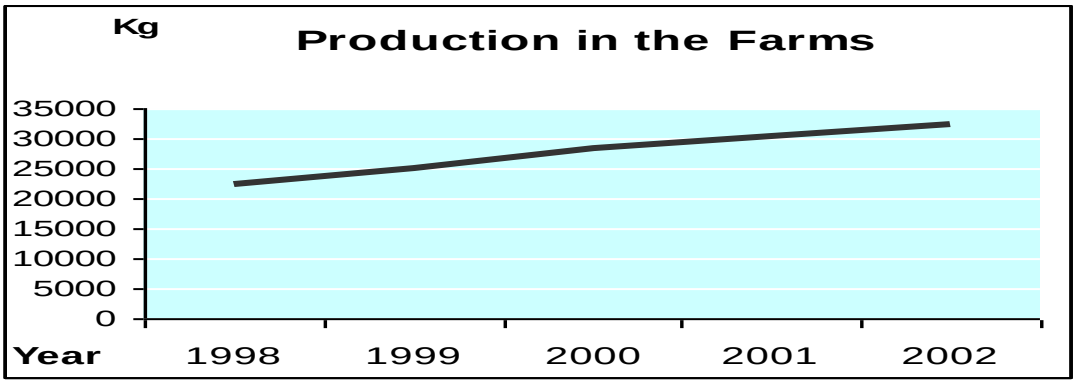

Figure 11: Average shrimp production on the 30 farms 1998-2002.

In Figure 12 the production and revenues from 1998 to 2002 are compared. Shrimp production increased from 1998 to 2002. Average revenues for the 30 farms is 89,446 US$ in 1998 and 100,615 US$ in 1999. In 2000 average revenues reduced to approximately 85,076 US$ and in 2001 increased again to 91,427US$ and then decrease once more to 64,707 US$ in 2002 (Figure 12).

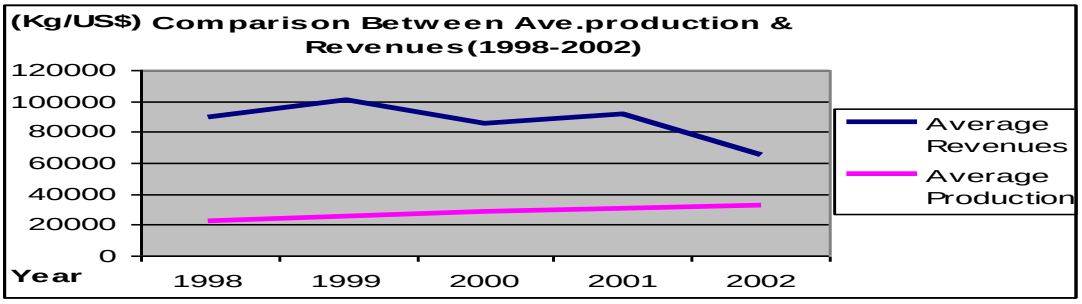

Figure 12: Comparison between Average Production & Revenues in Shrimp Farms (1998-2002).

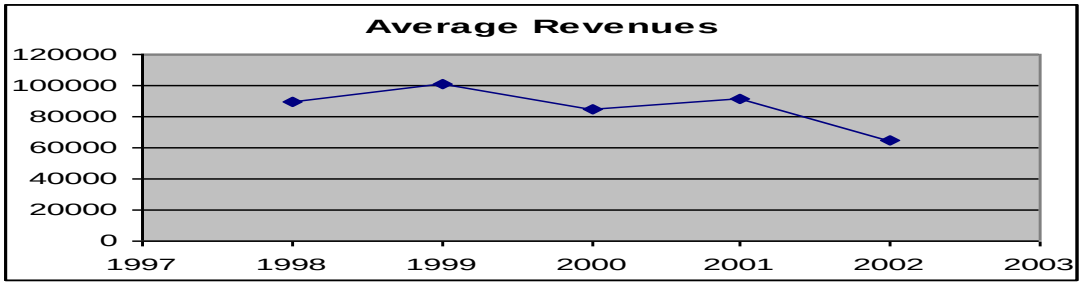

Figure 13: Average Revenues in the Farms (1998-2002).

The distribution for the revenue of the 30 farms was 14% in 1998. In 1999 distribution was 12%. Distribution was 16% in 2002.

Figure 14 shows the average total costs of the shrimp farm in 1998-2002.

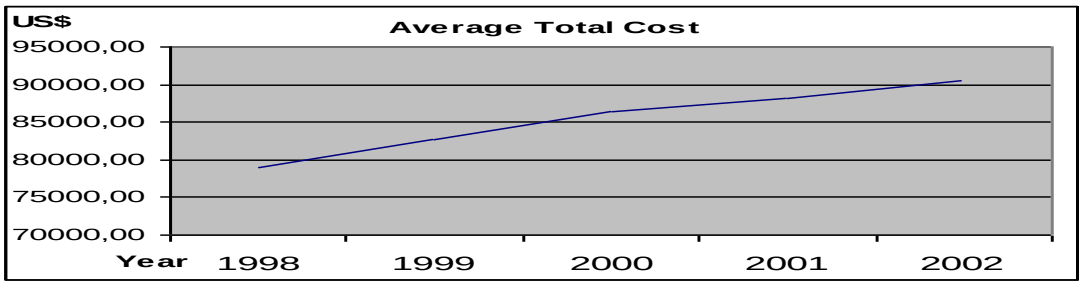

Figure 14 : Average Total Costs in the Shrimp Farms, 1998-2002.

4.1.2. Sample of the 10 best farms

The main objective of this study is to determine the profitability of shrimp farming in Iran. In this chapter the 10 best farms form the 30 farms in the Helleh site are chosen for further study.

In Table 9 the average production, revenues, total costs and profit are estimated. Average revenues in the 10 farms went from 87,247 US$ in 1998 to 65,218 US$ in 2002. Average total costs in the 10 farms was 75,311 US$ in 1998 but had increased to 86,436 US$ in 2002. Average profit in the 10 farms was 11,937 US$ in 1998 but decreased to -21,218 US$ in 2002.

Table 9: Data for the 10 best shrimp farms 1998-2002.

Average of 10 most profitable farms					
No of farm: Average /Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	22361	25154	28359	30476	32354
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	89446	100615	85076	91427	64707
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	15732	16559	17133	17591	18012
1.2.Feed Cost	26203	27833	29783	29958	30624
1.3.Fertilizer-Lime	1130	1239	1396	1449	1601
1.4.Labour	15704	17359	18883	20579	22103
1.5.Power Cost	2907	3514	4033	4626	5294
1.6.Transport Cost	738	848	944	1038	1158
II. Total operating cost	62414	67352	72172	75240	78793
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	79414	83119	86705	88540	90859
Contribution to fixed costs (I-II):	27032	33262	12904	16187	-14085
Profits (I-IV):	10032	17495	-1629	2887	-26152

Figure 15 shows the average profits for the 10 best farms in 1998-2002. The average profits for 10 farms are 11,937 US$ in 1998 but were -21,218 US$ in 2002. In this period costs increased in shrimp farming and revenues decreased so that by 2002 every farm was showing a loss.

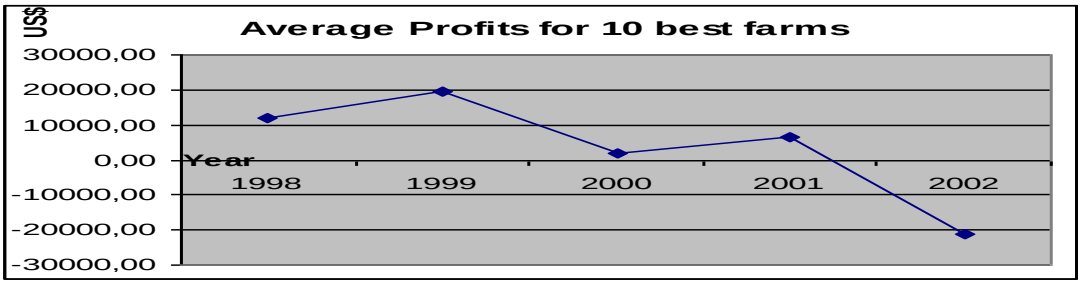

Figure 15: Average Profits in 10 Best Farms 1998-2002.

Figure 16 shows the average total costs for the 10 best shrimp farms in 1998-2002. The average total cost increased steadily from 75,310 US$ in 1998 to 86,436 US$ in 2002.

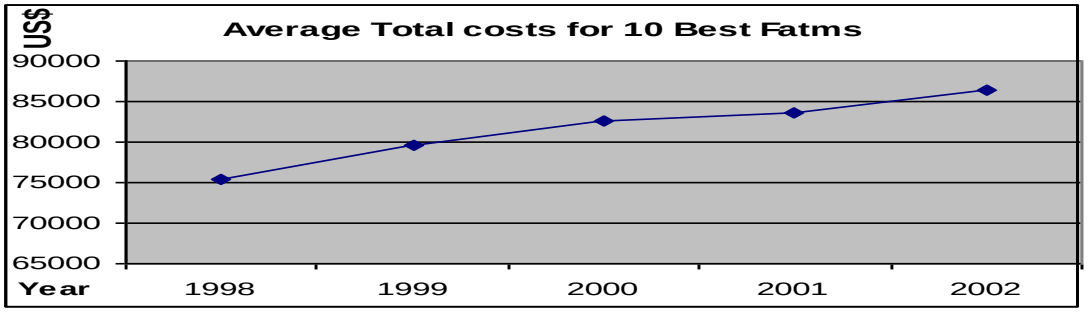

Figure 16: Average total costs in the 10 best farms 1998-2002.

Figure 17 shows the average production for the 10 best farms in 1998-2002. The average production went up from 27,675 kg in 1998 to 31,448 kg in 2002. The greatest production was 37,809 kg (upper limit), minimum production was 27,409 kg (lower limit) and distribution between 10 farms was 16% in 2002.

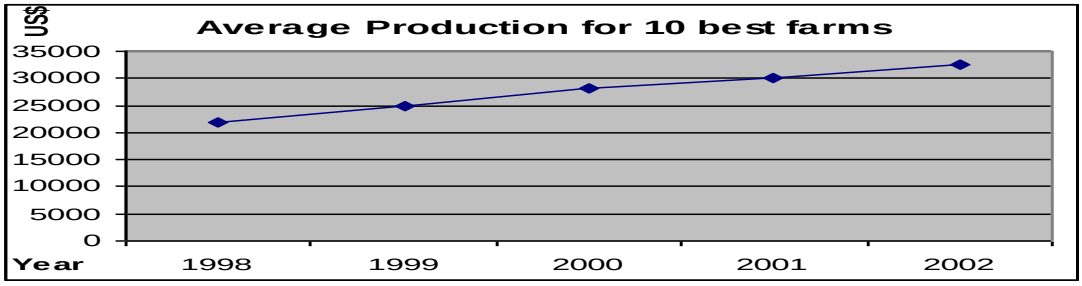

Figure 17: Average production of the 10 best farms in 1998-2002.

Figure 18 shows the average revenues for 10 best shrimp farms 1998-2002. The average revenues for 10 farms are 87,247 US$ in 1998. In 2002 average revenues in the 10 farms had decreased to 65,217 US$.

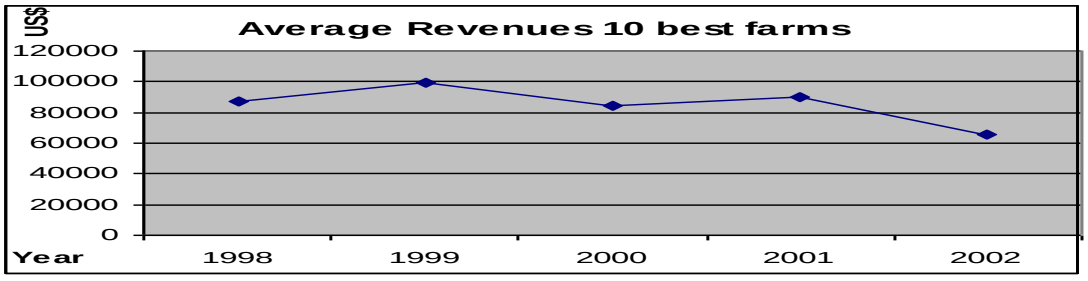

Figure 18: Average revenues in 10 best farms 1998-2002.

In Figure 19 the average revenue for 1998-2002 is compared to the average profits in the same period.

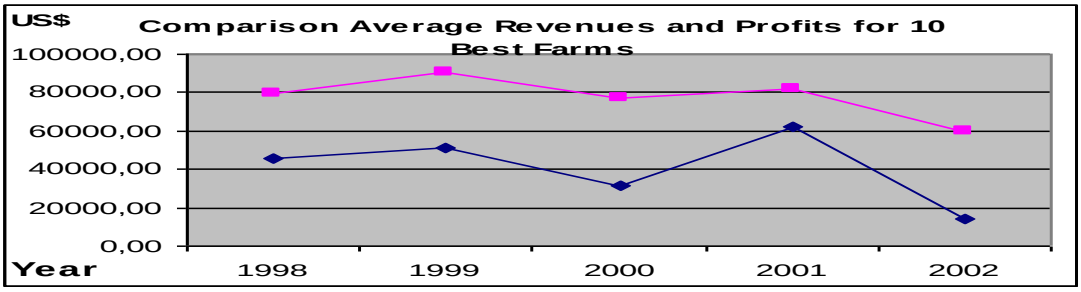

Figure 19: Comparison of average revenues and profits in 10 Best Farms 1998-2002.

4.2 Dispersion

Looking at the data it is obvious that there is a lot of variability in profitability between the firms. This suggests that the firms are not equally efficient. It also suggests the performance of the industry would be enhanced if all the firms were as efficient as the best third (10 farms).

Table 10 provides information about the dispersion and range of the data for certain key variables in the sample of 30 farms.

Table 10: Calculating Results about Shrimp Culture in 30 Farms, 2002.

Item	Average(US$)	SD	Coefficient of Deviation (%)	Maximum	Minimum
Production (kg)	32354	5017	16	37371	8459
Profits US$	-25818	4556	18	-21261	-30375
Total Costs US$	90525	11266	12	101792	79259
Operating Cost US$	78792	10870	14	89663	67921

As can be read from table10, average production for the 30 farms was 32,354 US$ and the coefficient of deviation was 16%. Maximum production was 37,371 kg and minimum production was 8,459 kg. Average profits for these 30 farms was -25,818 US$ with a coefficient of deviation 18%. The coefficients of deviation for average total costs and operating costs were 12% and 14%, respectively. The following two diagrams provide a visual representation of this dispersion for production and profits (Figure 20 and 21).

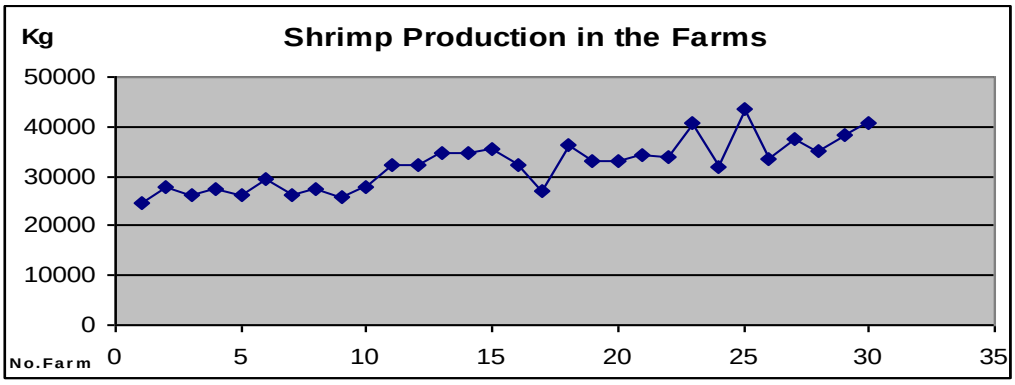

Figure 20: Distribution shrimp production in 30 farms, 2002.

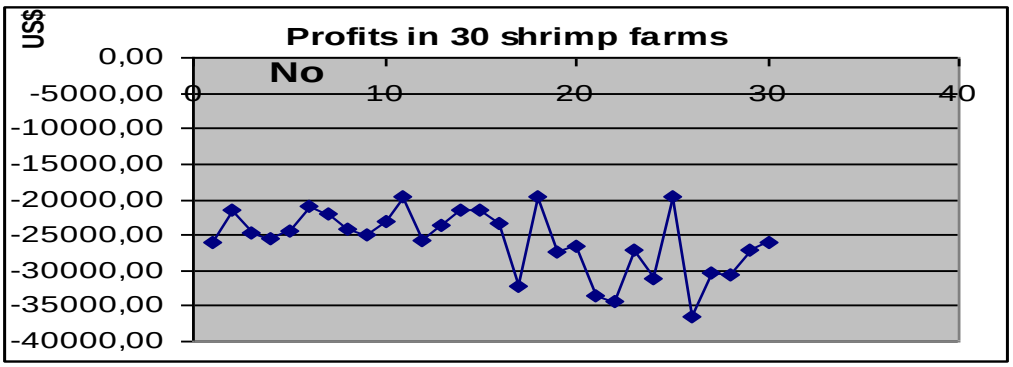

Figure 21: Distribution Profits in 30 shrimp farms, 2002.

Now some of this dispersion in profits may be due to differences in scale of production. Plotting profits in 2002 as a function of output yields Figure 22.

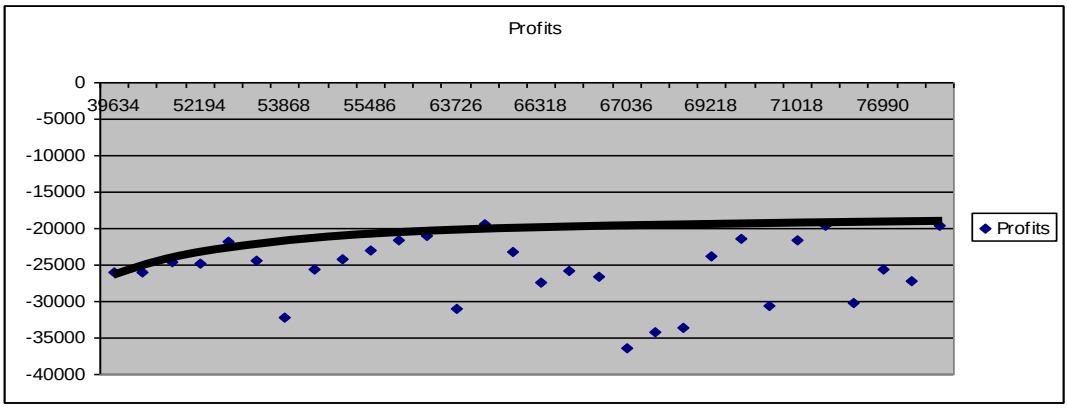

Figure 22 : Distribution between profits 30 shrimp farms, 2002.

As can be clearly seen from this diagram, many of the farms are a good distance away from the efficient frontier (drawn as a bold curve through the sample). Only about half the sample is reasonably close to it (within 20% away). Although, stochastic effects can explain some deviations in any given year, it seems clear from

these data that of the sample consists of farms that are substantially less efficient than others. Hence, since these farms all come from the same area, it seems from this that there is a considerable room for increased efficiency.

We can obtain a better picture of this dispersion by looking at revenue and cost variable per unit output. This is summarized in Table 11 for the year 2002.

Table 11: Average values per unit output US$/kg 30 farms in 2002.

	Average	Standard deviation	Coefficient of deviation	Minimum	Maximum
Revenues	2.00	0.31	0.16	0.52	2.31
Operating costs	2.44	0.34	0.14	2.10	2.77
Post larvae	0.56	0.04	0.07	0.52	0.59
Feed	0.95	0.10	0.11	0.84	1.05
Fertilizer-lime	0.05	0.01	0.25	0.04	0.06
Labour	0.68	0.13	0.19	0.56	0.81
Power	0.16	0.12	0.73	0.04	0.28
Transport	0.04	0.01	0.27	0.03	0.04
Capital costs	0.36	0.01	0.04	0.35	0.38
Depreciation	0.25	0.00	0.00	0.25	0.25
Interest	0.11	0.01	0.13	0.10	0.13
Total costs	2.80	0.35	0.12	2.45	3.15
Profits	-0.80	0.14	0.18	- 1.93	-0.84

From Table 11 is it clear that average revenues for one kg shrimp product are 2 US$ and the total cost is more (2.80 US$) so the profit is -0.80 US$. The biggest factors of the total operating costs are feed, labour, and post larvae costs. The maximum and minimum value for each factor is given in the table. The coefficient of deviation for profits was 18% but distribution in total costs was 12%. The coefficient of deviation in revenues was 16%. To increase profits the costs must be lowered and a decrease in the three largest factors, feed, labour, and post larvae, would matter the most.

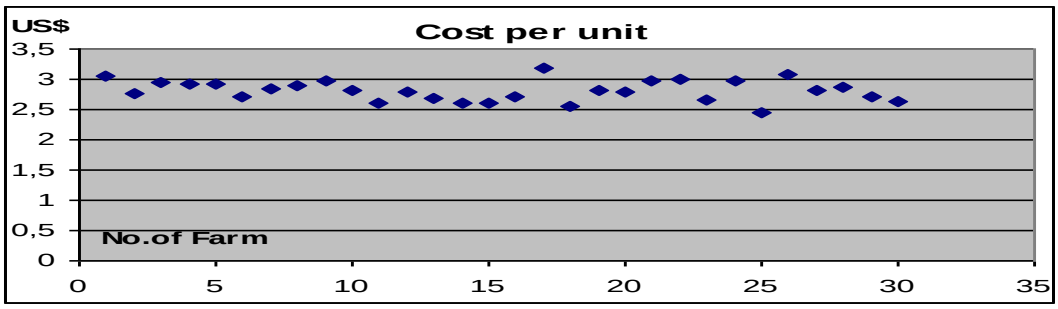

Figure 23: Distribution of cost per unit in 30 shrimp farms.

Figure 24 show that about ability profits per unit (per one kg shrimp) in one crop per year for shrimp culture in Iran. All farms in this study showed negative profits or losses. Average profits per unit in 30 farms was -0.81 US$ and standard deviation is 0.14 US$. Maximum profits was 2.99 US$ (upper limit) and minimum profits was -0.64 US$ (lower limit) and distributions was 21% between 30 farms in 2002.

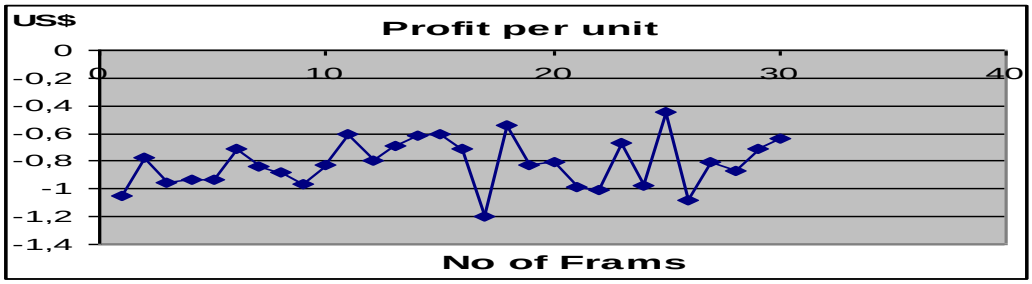

Figure 24: Distribution of profits per unit in 30 Shrimp Farms.

4.3 Returns to Scale

In any industry the returns to scale are among the most important aspects of the production technology. Scale economies are traditionally divided into three categories; increasing returns to scale (IRS), constant returns to scale (CRS) and decreasing returns to scale (DRS). These three cases are illustrated in Figure 25.

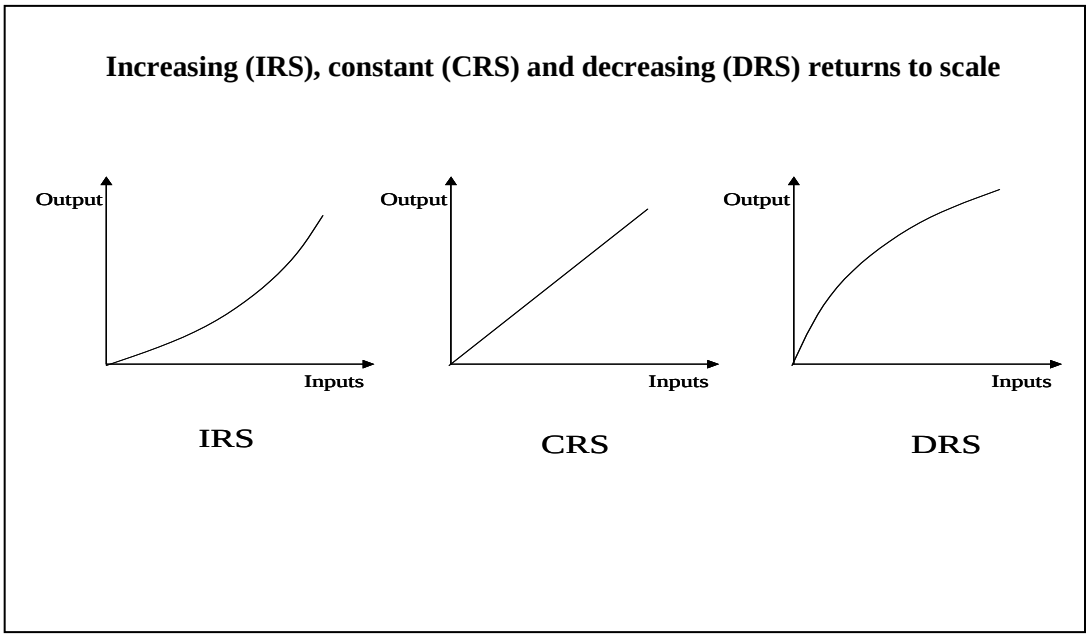

Figure 25 : Return to scale in three different manners.

Increasing returns to scale imply that profits per unit of production, i.e. average profits, can be increased by increasing the scale of the operation. Constant returns to scale indicates that these average profits do not change with the scale of operations and decreasing returns to scale indicate that average profits cost per unit of production increase with increased production (Varian 1992). It follows that knowledge about returns to scale provides information about whether profitability (in the sense of profits per unit of output) can be increased by altering the scale of production.

The data set assembled in this study indirectly provides information about returns to scale in the Iranian, or more precisely Boushehr, shrimp culture. The data set

including both the level of production and profitability can be used to calculate average profits per unit of production. These data are plotted in Figure 26 as a function of output for all 30 farms in 2002.

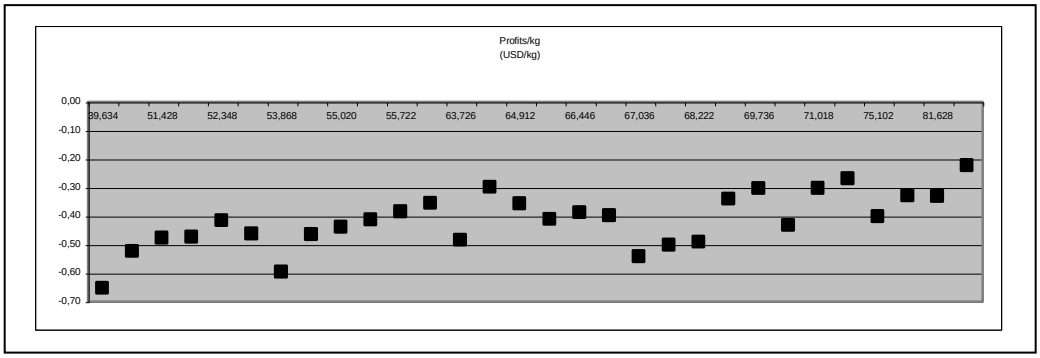

Figure 26: Profits per unit of output as a function of output (30 farms 2002).

A visual inspection of Figure 26 suggests that average profits (profits per kg. of output) are increasing with the scale of the operation (horizontal axis in the Figure). This impression is confirmed by a simple linear regression of profits per unit output on the level of output.

More precisely the following regression line was fitted to the data:

$$y = a + b \cdot q,$$

Where y represents profit per unit output and q the level of output. a and b are parameters. Now, returns to scale are estimated by the parameter b in this regression equation. If a is statistically significantly greater than zero, there is increasing returns to scale. If a is statistically significantly less than zero, there is decreasing returns to scale. And *an* indistinguishable from zero suggests constant returns to scale.

The equation was estimated by OLS (ordinary least squares) using observations on all 30 farms in 2002. The most salient results are as follows:

Goodness of fit: R^2=0.5
Estimate of b: b=0.0065
Student t-statistic for b: 5.3
95% confidence interval for b: b = 0.0065±0.0025

We thus conclude that this sample shows clear and statistically significant evidence of increasing returns to scale. Moreover we can calculate that at sample means the elasticity of average profits with respect to output volume is approximately unity. In other words: Profits per unit output increase by approximately 1% when the output level is increased by 1%.

4.4 Sensitivity Analysis

Accurate data on the various income and cost items of shrimp culture are difficult to obtain. Also the various income and cost items may alter in the future. It may therefore be helpful to consider the sensitivity of profits to such changes. We do this by increasing and decreasing the various variables making up profits from some benchmark values. In this case the benchmark values are taken to be the sample averages in 2002. The following table gives these values.

Table 12: Calculation for average 30 farms, 2002.

Sensitivity Analysis For Average30 Farms	
No of farm: Averages 30 farms	**2002**
Revenues	
Production(Kg)	32432
Price (US$/Kg)	2
I. Total revenues:	64864
Costs	
1.Operating Costs:	
1.1.Post Larvae Cost	18012
1.2.Feed Cost	30624
1.3.Fertilizer-Lime	1601
1.4.Labour	22103
1.5.Power Cost	5294
1.6.Transport Cost	1158
II. Total operating cost	78793
2. Capital costs:	
2.1 Depreciation	
Fixed capital	5647
Liquid capital	2420
Total depreciation	8067
2.2 Interest payments	3667
III. Total capital costs	11733
IV. Total costs:	90526
Contribution to fixed costs (I-II):	-13929
Profits (I-IV):	-25662

The sensitivity of profits to variations in the variables making up profits is calculated in Table 13.

Table 13: Estimating sensitivity analysis (profits) in 30 farms, 2002.

	Base case (Thousand USD)						
Profit	**-30%**	**-10%**	**0%**	**10%**	**30%**	**50%**	**100%**
Production	-43,2	-30,1	-23,6	-17,1	-4,1	9,0	41,6
Price	-43,2	-30,1	-23,6	-17,1	-4,1	9,0	41,6
Larvae cost	-18,3	-21,8	-23,6	-25,4	-29,0	-32,6	-41,5
Labour cost	-17,6	-21,6	-23,6	-25,6	-29,7	-33,7	-43,8
Power cost	-22,6	-23,3	-23,6	-24,0	-24,6	-25,3	-26,9
Feed Cost	-14,3	-20,5	-23,6	-26,7	-33,0	-39,1	-54,7
Depreciation	-21,2	-22,8	-23,6	-24,4	-26,0	-27,7	-31,7
Interest	-21,8	-23,0	-23,6	-24,2	-25,4	-26,6	-29,6

From the Table 13 we can see that profits are most sensitive to changes in production levels (for given inputs), output price, feed costs, labour costs, and larvae costs. It is less sensitive to changes in capital costs, i.e. depreciation and interest and power costs. This is further illustrated in Figure 27.

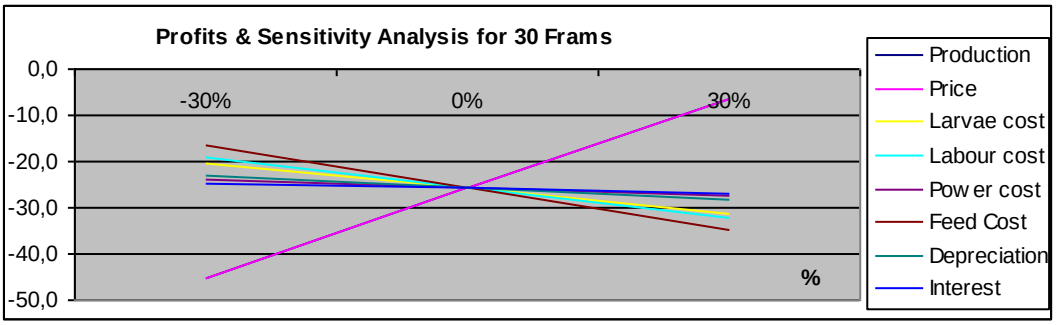

Figure 27: Profits and Sensitivity analysis for 30 Farms, 2002.

The following table does a corresponding calculation for contribution to fixed costs (instead of profits).

Table 14: Estimating sensitivity analysis (contribution to fixed cost in 30 farms, 2002).

	Contribution to Fixed Cost			Base case (Thousand USD)			
Contribution to Fixed Cost	**-30%**	**-10%**	**0%**	**10%**	**30%**	**50%**	**100%**
Production	-29,1	-16,1	-9,6	-3,0	10,0	23,1	55,7
Price	-29,1	-16,1	9,6	-3,0	10,0	23,1	55,7
Larvae cost	-4,2	-7,7	-9,6	-11,4	-14,9	-18,5	-27,4
Labour cost	-3,5	-7,5	-9,6	-11,6	-15,6	-19,6	-29,7
Power cost	-8,6	-9,2	-9,6	-9,9	-10,5	-11,2	-12,8
Feed Cost	-0,3	-6,5	-9,6	-12,7	-18,9	-25,1	-40,6

This table essentially repeats the sensitivity information of table 14 Contribution to

fixed costs is most sensitive to production levels and output price as well as feed costs, labour costs and larvae costs. This is further illustrated in the sensitivity diagram in Figure 28.

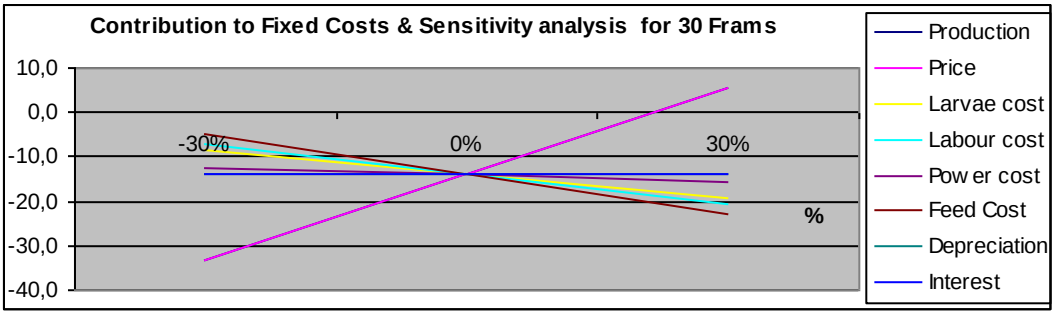

Figure 28: Sensitivity analysis between contributions to fixed costs and some factors (30 Farms).

Similar analysis may be carried out for the sub-sample of the 10 most efficient farms in the sample. The benchmark values are given in the following table.

Table 15: Averages 10 best shrimp farms, 2002.

Sensitivity Analysis For Average 10 best Farms	
No of farm: / Year	**2002**
Revenues	
Production(Kg)	32609
Price (US$/Kg)	2,00
I. Total revenues:	65218
Costs	
1.Operating Costs:	
1.1.Post Larvae Cost	17875
1.2.Feed Cost	31000
1.3.Fertilizer-Lime	1475
1.4.Labour	20184
1.5.Power Cost	3265
1.6.Transport Cost	970
II. Total operating cost	74769
2. Capital costs:	
2.1 Depreciation	
Fixed capital	5647
Liquid capital	2420
Total depreciation	8067
2.2 Interest payments	6000
III. Total capital costs	14067
IV. Total costs:	88836
Contribution to fixed costs (I-II):	-9551
Profits (I-IV):	-23618

The sensitivity of profits to the various components of profits is given in Table 16.

Table 16: Estimating sensitivity analysis (profits) in 10 farms, 2002.

	Base case (Thousand USD)						
Profit	**-30%**	**-10%**	**0%**	**10%**	**30%**	**50%**	**100%**
Production	-45,1	-32,1	-25,7	-19,2	-6,5	6,8	39,2
Price	-45,1	-32,1	-25,7	-19,2	-6,2	6,8	39,2
Larvae cost	-20,3	-23,9	-25,7	-27,5	-31,1	-34,7	-43,7
Labour cost	-19,0	-23,5	-25,7	-27,9	-32,3	-36,7	-47,8
Power cost	-24,1	-25,1	-25,7	-26,2	-27,3	-28,3	-31,0
Feed Cost	-16,5	-22,6	-25,7	-28,7	-34,8	-40,9	-56,2
Depreciation	-23,2	-24,9	-25,7	-26,5	-28,1	-29,7	-33,7
Interest	-24,6	-25,3	-25,7	-26,0	-26,8	-27,5	-29,4

Comparison of this table to table 16 for the total sample shows that the sensitivity in the sub-sample is very similar to that of the total sample. The sensitivity diagram is drawn in Figure 29.

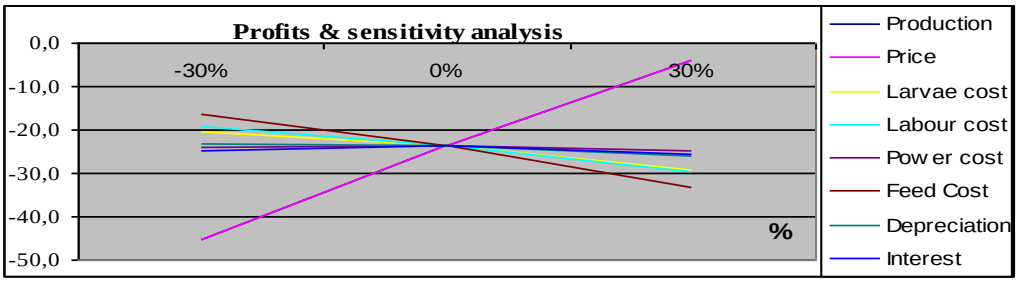

Figure 29: Sensitivity analysis between some factors in the farms (10 farms).

4.5 Break-even analysis

Break-even refers to a position where revenues equal costs, i.e. the firm "breaks even". Break-even analysis is used to find the levels of certain variables that correspond to break even. The variables in question may be output quantity, output price and various cost items.

To explain further, it may be useful to consider the following formulation. Consider the variables:

Fc = fixed costs
Vc = variable costs
p = price
q = quantity
Π = profits

Then profits are defined by:

$\Pi = p.q - (Vc/q).q - Fc$

Break-even occurs at:

$\Pi = p.q - (Vc/q).q - Fc = 0$

Or

$q = Fc / (p - Vc/q)$.

For our sample (see Table16) in 2002 the average values of the variables are

$Vc/q = 74{,}769/32{,}609 = 2, 90$
$p = 2,$
$Fc = 14067.$

Thus profits are given by the equation:

$\Pi = 2*q - 2, 90*q - 14067$

And the break-even quantity is defined by:

$\Pi = 2*q - 2, 90*q - 14067 = 0$

Or,

$q = 14067/-0, 90.$

This is a negative number meaning that there can be no break-even at a positive quantity. The reason is that variable profits, $[p - (Vc/q)].q$ is negative. Revenue does not cover variable costs let alone fixed costs.

Table 17 calculates break-even points as well as profits at various production levels for different prices.

Table 17: Estimating Break-even

quantity	Price a	FC	VC	Profit a
10000	2	14067	29000	-23067
20000	2	14067	58000	-32067
30000	2	14067	87000	-41067
40000	2	14067	116000	-50067
-15630	2	14067	-45327	0
quantity	**Price b**	**FC**	**VC**	**Profit b**
10000	3	14067	29000	-13067
20000	3	14067	58000	-12067
30000	3	14067	87000	-11067
40000	3	14067	116000	-10067
140670	3	14067	407943	0
quantity	**Price c**	**FC**	**VC**	**Profit c**
10000	4	14067	29000	-3067
20000	4	14067	58000	7933
30000	4	14067	87000	18933
40000	4	14067	116000	29933
12788	4	14067	37085	0

The above table basically gives three break–even points, one for each output prices:

- When the price is 2 US$, variable costs are not covered and increasing shrimp production simply leads to more losses. The only break-even level is for negative production, which, of course, is not feasible.

- When the price is 3 US$, variable costs are covered and break-even occurs at production level 14067 kg, which is much higher than any of the farms in the sample. This shows that a shrimp price of 3 US$ per kg is not sufficient for this industry to break-even.

- When the price is 4 US$, however, the industry can break-even at a fairly low production level, 12788 kg, which is comparable to the farms in our sample. Thus, this price will make the industry profitable.

The following diagram draws the profitability lines for the three cases calculated in Table 17 Break-even occurs where these lines cross the horizontal axis.

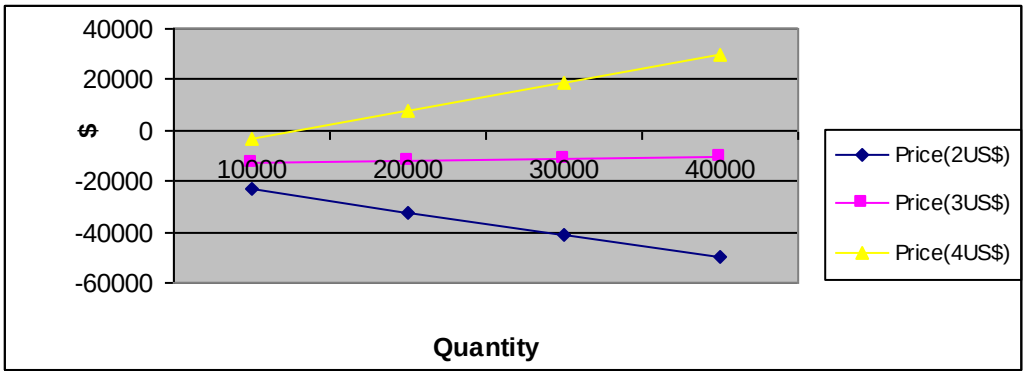

Figure 30: Estimating break-even.

5 The outlook

5.1 Outlook for the future

As discussed in chapter 4, profitability in Iran shrimp culture has exhibited a declining trend since 2000. In 2002 the industry operated at severally unprofitable levels. According to the sample of firms examined in chapter 4, industry losses in 2002 appear to have been – 40 % of revenues. This may be compared to estimated profits of some 11 % of revenues in 1998. Given that the sample of farms considered in chapter 4, probably represents the best part of the Iranian shrimp culture industry, it may be assumed that overall industry profitability is considerably inferior to these numbers. Clearly, losses of the magnitude experienced in 2002 cannot be sustained by the industry for many years.

In this section we speculate about the outlook for the industry in coming years. In so doing we will focus on the key variables determining profitability; (i) output prices, (ii) certain important cost items, (iii) productivity in the sense of production per unit of pool surface and (iv) altered access to markets.

5.2 Output price

Global shrimp markets have experienced a substantial decline in prices of farmed shrimp since 2000. These weak prices have continued to this day. This price development is broadly a result of a strong increase in the supply farmed shrimp combined with somewhat weakened demand in the shrimp markets.

The decline has been due to a variety of factors. Demand has contracted because of the economic slowdown in the western world, particularly the USA, since 2000. The events of September 11 and the continued economic sluggishness in Japan, a major importer of shrimp, have also played a role in this. At the same time increased shrimp aquaculture production partly due to the entry of new major producers such as Vietnam, China and Brazil (See relevant table or figure in Chapters 2 or 4).

There are few signs of a significant pickup in shrimp prices in the near future. The global economic recession seems to be ending which will push up demand. However, at the same time there are little indications of a slowdown in the growth of supply. In fact, the recent entry of Vietnam and China and other nations into the shrimp culture business suggests a continued rapid growth in supply, even if the more traditional suppliers such as Thailand will not expand further. Perhaps, more seriously, the entry of low-wage, centralized economies like China and Vietnam into the shrimp farming business is likely to lead to even less flexibility and more persistence of shrimp supply in the face of price declines.

Thus, it seems very unlikely that world market shrimp prices will improve markedly in coming years. It is possible that due to the economic pick-up there may be a temporary strengthening in shrimp prices during the next 2 years or so. The price increase, however, is unlikely to be substantial (i.e. in excess of 25%) and permanent. Moreover, as new facilities come on line it and prices strengthen

slightly, supply is very likely to expand rapidly again, reducing prices again to current levels or less.

Given the relative accessibility of shrimp culture technology and ease of production, it seems likely that in the longer run shrimp world prices will be determined primarily by cost of production; more precisely the cost of production by the most efficient producer. Although, this is not at all clear, it seems that some producers, e.g. Thailand, China and Vietnam may be able to break-even in their production of shrimp at prices not much different to current world prices. If that is the case, the long term outlook for shrimp prices is for little or no improvement from current prices.

5.3 Important cost items

One of the ways to increase profitability is decreasing the costs in the shrimp farms. Consequently, if cost decreases, the gaps between revenues and cost will increase and also should be increased profit.

The results in the chapter can 4 shows that the feed labour and post larvae costs are most important costs in the operating costs shrimp farms. Thus, when wondering about future profitability is necessary to consider these cost items.

(i) Feed costs

When the looking at the analysis results in chapter four, we can understand feed cost is one of the important cost in the shrimp farming. In fact, in 1998 feed cost in the farm was approximately 42 % operating costs, while in the 2002, feed costs was approximately 38,9 % of the all operating cost. In the sensitivity analysis feed costs is one factors sensitive to changes profit. For example when the feed cost 100 % increased, profits changes to – 55 %, therefore feed costs for profitability is sensitively.

Average feed cost per unit was 1, 17 US$/kg in 1998, and in 2002, that was 0, 95 US$/kg. In fact productivity increased and cost per unit decreased during 1998 to 2002. In the future if the technology increased FCR come down, shrimp culture farms have possibility to decreases feed costs in the future.

(ii) Labour costs

Labour costs is one items important costs in the operating shrimp costs .Approximately 28 % total operating costs was labour cost.

Labour cost per unit was 0, 70 US$ in 1998 and in 2002, was 0, 68 US$ .Therefore cost per unit had not more changes. In fact labour costs increased during 1998 to 2002 by approximately 40 %. In fact production in the farms increased and also increased labour costs and finally gets not more changes.

Shrimp farmer interested to special manager from other countries like India and Philippines. Regularly, pay for foreign shrimp specialist is more than domestic specialist. More things are the number labour in the shrimp farms are more because

the systems haven't new technology. But if using new methods in the farm should be can decreased labour costs in the future.

(iii) Post larvae costs

All the shrimp farms in the starts stocking post larvae in the pool. Post larvae costs per unit 0, 70 US$ in 1998 and decreased after that to 0, 56 US$ in 2002. When looking to sensitivity analysis, we can see after feed cost and labour cost, post larvae cost is sensitive. For example if post larvae cost 100% increased, profits changes to - 41%. This calculates show that the post larvae cost is so sensitive. In fact after feed costs and labour cost, post larvae cost have more costs in operating shrimp costs. If technology increased, productivity shrimp increased and when the supply post larvae increased prices come down and labour costs decreased.

(iv) Capital costs

Generally in this case study need for reduction capital costs like interest rate or depreciation reduce costs. If rate of interest for shrimp activity decreased, therefore decreases cost. For this work need to cooperation important between the public and private sectors also.

Depreciation cost decreased just. By protect and better controlled and maintenance some tools in the farms. Therefore some tools working for the long time and do not needed to pay more for depreciation thus can redact costs.

It was realizes that the economic success of shrimp culture and profitability was largely dependent upon the cost of production. Various discuss have relatively between the non profitability. By estimates can understand the can decreases cost the future.

5.4 Productivity per unit of pool

There are three different methods of shrimp culture, namely non-intensive, with production yield between 500 and 1500 Kg in per hectare. The semi-intensive is the method of production chosen. In Iran the production yield is 2.2 ton/ha. But, there is a possibility of increasing it to 3 ton/ha, which means that if expertise and appropriate conditions can increase production can be by 800 kg per hectare. And increase 800 kg per hectare should be revenues increase and also has better profitability.

Shrimp culture is semi-intensive system in Iran. Shrimp culture productions by this system have at least 2, 5 to 3 tons per crops. But Iranian production was less. Average shrimp production was 1 tons per crops and Iran had only one crop per year in 1996. In 2001, production increased to 2.2 tons shrimp per hectare which was still lower than 3 ton per crop. But in 2, 2 tons is low than 3 tons per crops. In Thailand some farms using the intensive systems and have in every crop 5 tons shrimp productions and have two crops in the year so the farm has 10 tons productions in the year. And also Iran production is so far than other shrimp producer. Iran need to effort to increase productivity per unit.

Table 18: Comparison world production yield and Iran production yield during 1993- 2001.

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001
Iran Production yield (mt/ha)	**0**	**0**	**0.8**	**1**	**1.6**	**1.8**	**2**	**2.1**	**2.2**
World Production yield (mt/ha)	**2.6**	**2.6**	**2.7**	**2.8**	**2.8**	**2.8**	**2.9**	**3**	**3**

Statistics Iranian Fisheries Yearbooks 2002.

Sensitivity analysis of costs show that some productions are more sensitive .If productivity changes in fact profits can change. Result of sensitivity can show that production in the shrimp farms is so sensitive to profitability. For example if production 100 % increased, profits 42 % increase. In fact is sensitive. So if feed costs 100 % increased, profits changes to -55 %,then if labour cost 100% increased, profits changed to -44 % and also post larvae cost 100 % increased profits -42 % changes. The results can show that price and production are so sensitive after feed cost, labour cost and post larvae cost more sensitively. Other costs have less sensitivity to profits.

Productivity shows that the shrimp farms in one site and one region by similar surface (every farm is 13 hectare) had different productivity. Maximum productivity in shrimp farming was 1.7 ton /ha and minimum was just 0, 6 ton/ ha. This is so much less because semi intensive production farms estimated at least for 3 ton/ha and productivity was so weak. But in 2002, were some small changes. Maximum productivity was 2, 5 ton/ha and minimum was 0, 7 tons / ha. If fact, should be the gap between maximum and minimum productivity increased. Basically, between maximum and minimum have gap approximately 1, 9 tons/ha. So this is show that the productivity in are weak.

Fundamentally , Iran have just one crop in the year and totally for one farm per hectare maximum productivity is 2.5 ton/ha in year but in one farm by similar system in South East Asia have 3 tons per hectare and also have 2 crops per year. Finally have 6 tons per hectare in the year. Comparison can show that production per hectare is so far and productivity is weak. Finally one of the reasons for unpredictability is low productivity in the shrimp farms.

5.5 Access to markets

In this project only looking to Farms Prices (EX) and therefore will elaborate about farms prices.

Prices (Ex Farm) = Prices (world Market) – Prices (Transportation & Processing costs) – Profits (of Middle Men)

This is formula for estimating prices for shrimp marketing in the farm. There are world market prices and also other prices like transportation and particularly processing costs. Then we have costs for middle man for sales shrimp.

We have some possibility for increases profitability. One is situation for world

market prices and if these factors increased, in fact prices for shrimp farms increase. But other prices like transportation or processing are opposition. In fact if price for middle man increased prices for shrimp farm decreased.

When looking the future we can understand the prices for shrimp markets not so increases, so if we need to profitability, just have possibility to decreasing other prices like transportation for shrimp or decreasing the prices for processing or decreasing the prices middle man. In fact the decreases the prices for middle man is practical than others.

5.5.1 Conclusions regarding the outlook

The shrimp market in these traditional markets is complicated in the outlook. The most excellent possibility for shrimp producers and traders is to look for new marketplace, and here can observe new markets are rising in south East Asia and Latin America .As most of the shrimp production also concentrated in these areas , it should be rather easy to variety export ,and create markets in neighbouring areas.

Accordingly above descriptions, and with no sustained solutions unpredictability problems in shrimp farms, in fact, every farms go to depreciations in the short time while and also there is possibility that the shrimp culture production in farms is gradually going to stop in the future.

Generally, shrimp farmer can not continuing for long time by loss. Therefore after one or two crops stopped the works and does not works. And should be if all shrimp farms have lost the complete shrimp farming, then stopped and probable bleak future.

6 The future of the Iranian Shrimp culture: Possible strategies

The above analysis shows that the Iranian shrimp culture is in serious trouble. Losses are high. In 2002, revenues did not even cover variable costs. The outlook for the future does not suggest much if any relief. Thus, it is clear that crucial decisions have to be made. The first major decision is should the shrimp culture be continued or should it be stopped. Thus, we have two basic options. However, both options may entail some further actions. Thus, in the case where it is decided to continue shrimp culture, we need to determine actions or strategies that make it possible. After all, as we have seen, the industry is not sustainable at current level of losses. In the case where it is decided to end the shrimp culture program, further actions may involve relief to those most hurt by the end of the industry, relocation etc. In any case we may illustrate the possible strategies with the help of the following flow diagram.

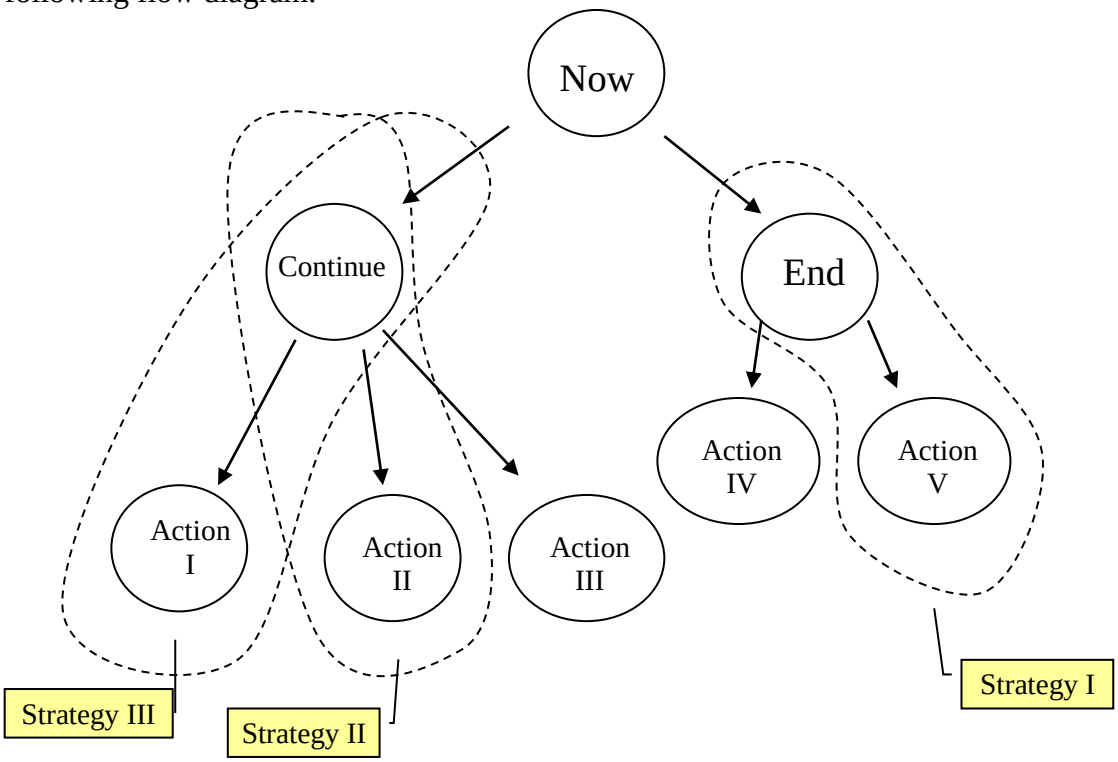

Figure 31: Strategies Stylized diagram

In this diagram, all paths from "Now" downwards constitute a strategy. The diagram illustrates five such strategies. The first one consists of (i) the decision to

continue and (ii) certain set of actions to make that feasible. The second strategy consists of (i) the decision to continue and (ii) another set of actions and so on. Obviously, depending on the available range of actions for both basic options; continue vs. end, there can be a lot more strategies. However, in order to limit the possibilities I will in this section try to identify strategies that are both economically efficient and minimize the risk of doing irreversible harm to future opportunities. Needless to say, these strategies are formulated from the perspective of the relevant government authority. Thus, the actions suggested are government actions.

6.1 Strategies

Strategy is perspective, position, plan, and pattern. Strategy is the bridge between policy or high-order goals on the one hand and tactics or concrete actions on the other. Strategy and tactics together straddle the gap between ends and means. In short, strategy is a term that refers to a complex web of thoughts, ideas, insights, experiences, goals, expertise, memories, perceptions, and expectations that provides general guidance for specific actions in pursuit of particular ends. Strategy is at once the course we chart, the journey we imagine and, at the same time, it is the course we steer, the trip we actually make. (Mintzberg, 1993)

We consider three strategies for the shrimp culture. The first involves ending the shrimp culture program. The second and third continue the shrimp culture but include different actions to make this economically feasible for the operators based on the analysis in chapter 4.

6.1.1 Strategy 1: Ending shrimp culture production in Iran

This strategy is to end the shrimp culture production in Iran. The benefit of this action is to end the economic losses currently experienced in the industry. As we have seen in Chapter 4, the industry currently produces no value-added, i.e. the sum of profits and wages is negative. According to the data analysis results in chapter 4, average profitability in this case was -25800 US$ in 2002 .Thus, assuming prices to be reasonably true, the industry contributes less than nothing to the GDP, even if the shadow cost of labour is zero.

The costs of ending the shrimp culture are several. Most importantly from a national economic perspective is the loss of expertise, technological know-how and training as well as the eventual loss of facilities. This is a loss of human and physical capital which will be costly if, in the future, these abilities would become useful for instance because shrimp or other fish culture becomes profitable again. Thus the extent of this particular cost is uncertain. Ending the shrimp culture entails, at least with the passage time, a reduction in the ability to run a shrimp culture. This, basically, represents a loss of an option. This option may be a valuable one. Conservatively estimated, the current shrimp infrastructure in Iran can produce 30.000 tons/year of shrimp[1] with direct and indirect employment of perhaps 30-50 thousand people and export value of 60-120 m. US$ depending on the price of shrimp. Other costs associated with ending the shrimp culture industry involve the

[1] Fisheries of Iran (2002).

pain and suffering experienced by the current participants in the industry and its suppliers, derived impacts on the surrounding economy, regional impacts and possible social unrest and the associated political problems and economic waste.

To end the shrimp culture no particular government action is needed. Due to the heavy losses, the industry will soon collapse by itself. If some farms manage to survive, all go to the better. This would only show that they have become sufficiently efficient to be profitable.

The collapse of the shrimp culture industry, however, will have repercussions that may require some action. First, a number of people will lose their jobs.[2] Second, a number of people and firms, including suppliers and lenders, will suffer losses of assets. Third, the regional economies will suffer partly directly due to the bankruptcies and partly indirectly due to linkages and multiplier effects. All of these effects will lead to social and political problems as well which may evolve into serious unrest with possibly additional economic losses.

Thus, it is totally unclear whether the benefits, in terms of reduced operating losses, of ending the shrimp culture program will, in fact, exceed the losses.

6.1.1 Strategy 2: Continue the shrimp culture and improve operating results

This strategy attempts to make continuing shrimp culture possible by reducing operating costs and increasing productivity or the value of production in the farms. We look first at the cost items.

The three most important cost items in our sample of Iranian shrimp culture and their respective costs and shares in total costs as well as total costs and revenues are given in Table 19.

Table 19: Most important costs items (Sample of 30 firms)

Costs	Cost (US$)	% of total cost
Feed	**30.624**	**34%**
Labour	**22.103**	**24%**
Post-larvae costs	**18.036**	**20%**
Total	**70.736**	**78%**
Total costs	**90.526**	**100%**
Total revenues	**64.707**	-
Profits	**-25.819**	-

[2] Almost 10.000 people are currently employed in the shrimp industry and associated activities. About 3.300 are employed in the shrimp culture itself and about 6.600 in the shrimp culture supply industries (feed and post-larvae production) and the processing and distribution industries. Fisheries of Iran, 2002.

From Table 19, it is a simple matter to calculate that these three cost items have to be reduced by 36, 5% in order for the operations to break even. How realistic is this?

It is unlikely that labour costs can be reduced significantly. The farms are already paying low wages and given the investment and technology it is unlikely that less labour can be used.

Similar considerations apply to the feed costs. The global feed industry is quite competitive and does not appear to offer significantly lower prices than in Iran. Moreover, the price of the most important material in the feed, i.e. fish meal, shows an increasing trend due to increased world wide demand and, if anything, contraction in supply. Thus, it is unlikely that feed prices can come down much. However, feed costs can be reduced if the FCR (food conversion ratio) can be increased. That may be possible by improved farming technology. Reasonably one may not expect more than 10-20% increase in FCR based on this.

The post-larvae cost is perhaps the item that has most room for a reduction. The current technology of harvesting life adults and hatch their egg is not particularly efficient. Efforts are currently underway in Iran to produce post-larvae shrimp from a continuous brood stock. This may significantly reduce costs and perhaps also lead to genetically improved post-larvae shrimp for culture. Given a determined effort in this direction, an optimistic prediction for post-larvae cost reduction could be about 50%.

Thus, we see that even with a systematic, determined effort to reduce costs, it is unlikely that costs can be reduced by more than, say, about half of the annual average shortfall of 25.8 thousand US$. While, this will not save the average farm, it is nevertheless important to realize, that this cost reduction is nevertheless sufficient to return the most efficient farms to profitability.

Looking at the revenue or productivity side, we can infer from Table 19 that revenues must increase by almost 40% to covert the shortfall. This will be met if there is a price rise of 40%. To see this in context, it should be noted that this increase is less than half of the price decrease since 1999. However, unless there is a lasting global increase in shrimp prices, which as discussed in section 5 doesn’t seem likely, this price rise will not materialize automatically. However, by improved product development, reduced transportation and marketing costs and better marketing it may be possible to increase the price to the farms (ex farm price) even when global shrimp prices remain constant. It appears that determined efforts of this nature could in principle increase prices to the farms very substantially, perhaps by 40%.

As already discussed, the Iranian shrimp culture technology is not intensive [semi-intensive]. This leads to less productivity although also less costs. Moreover, production per unit of pool surface, the FCR and average shrimp size can clearly be improved substantially. The current production per ha is 2, 48 tons while the basic technology suggests that 3 tons/ha should be possible. Moreover an average shrimp

size of 16 gr. instead of the current one of 12 gr., which implies a considerably higher unit price, should be possible. A reasonable estimate would be of a possibly 15-35% increase in productivity based on these factors. Some of this increase, however, implies more feed costs. Moreover, to accomplish this requires considerable technical and educational efforts as well as perhaps some investment in infrastructure, which is also both time consuming and costly. Thus, even, if a high productivity increase can be achieved, this will have a net return of considerably less than this percentage.

In summary, it appears by determined efforts to reduce costs, improve productivity and marketing, it may be possible to turn the industry and certainly the most efficient farms to profitability. However, as already mentioned this will not be accomplished automatically. It requires a systematic and determined effort to be achieved. This will require both time and finance. Most likely, this will have to come from the government.

6.1.2 Strategy 3: Public sector supports: Subsidies

One way to sustain the Iranian shrimp culture is for the government to subsidize the activity. This is perhaps not as far-fetched as may appear. The Iranian government already subsidizes the shrimp culture in different ways. Research and infrastructure have been provided by the government. Some of the inputs such as post-larvae shrimp are supplied with the support of by government facilities. Recently, the government has begun to subsidize the price of shrimp for export. Moreover, the Iranian government has many ways to provide additional subsidies. It can arrange for lower interests on loans or provide longer term loans. It can reduce the price of power and help to reduce post larvae prices for shrimp farmer and/or feed costs.

However, is the strategy of providing subsidies is selected it is almost certainly preferable to subsidize production, e.g. by paying a price subsidy, rather than subsidize some of the inputs. The reason is that subsidizing inputs is likely to distort production toward increased use of subsidized inputs and less use of unsubsidized ones. This distortion is a real economic cost in addition to the subsidy itself (or rather the economic loss of production). With a production subsidy, this kind of an additional distortion is avoids. Besides, the management cost of the subsidy is probably less.

To bride the current economic shortfall in the shrimp culture with subsidies requires a great deal of funds. As shown it Table 20, the average farm losses in 2002 amounted to 25.819 US$. The Iranian shrimp culture as a whole consists of 280 farms. Thus given that they are all like the average in our sample, the necessary subsidies to break even is about 7, 2 million US$ / year**.**

However, as already pointed out, the sample of farms discussed in section 4 and represented in Table 20, probably represents the best part of the Iranian shrimp industry. Thus, it may well be that to maintain zero profitability for the average firm; the annual subsidy may have to be considerably, perhaps 20%, higher.

Note also that this subsidy of 7-8, 5 million US$ annually [or 9,000/ton of production] will only suffice for the average farms. This means that in time the rest of the farms, those less efficient than the average, will either have to become more efficient or stop production. Moreover, it may not be sufficient just to attain break-even to keep the industry going. Given other investment opportunities, not to mention the high interest paid by banks, it may well be the owners of farms will chose to end their operations and move their human and malleable physical capital elsewhere even when they are breaking even. For both of these reasons, a subsidy of the above type and magnitude will not be sufficient to avoid a major reorganization of the industry.

6.1.3 Conclusions: Recommended strategy

Strategy 1, letting the industry collapse, implies a significant loss of human capital and possibly infrastructure. In addition it is probably not politically and socially feasible. Strategy 2 is good as far as it goes, but is unlikely to return the industry to profitability, at least within a relatively short span of time (2-3 years). Therefore, if the industry is to survive, it may be necessary to resort to Strategy 3 at least in part. To the extent that Strategy 3 is employed it should consist of output price supports, which are almost certainly less distorted than input subsidies.

I conclude that the most promising strategy is to use Strategy 2 and 3 in combinations for the next few years in order to maintain the industry and thus both avoid social losses due to irreversibility and provide time for a deeper analysis of its problems and opportunities on which a better informed long term strategy can be built.

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ACKNOWLEDGMENTS

I would like to express sincere gratitude to my supervisor professor Ragnar Arnason, Economics Department, University of Iceland and Dr. Tumi Tumason, director of Fisheries Program, United Nations University, and other staff for help and guidance. Without them this project would never have been possible**.**

Appendix:

Appendix 1: Abbreviation

NACA	**Net work of Aquaculture Centre in Asia - Pacific**
ADB	**Asian Development Bank**
AIT	**Asian Institute of Technology (Thailand)**
ASCC	**Asian Shrimp Culture Council**
DOF	**Department of Fisheries (Thailand)**
NSO	**National Statistical office and Development of fisheries**
TDRI	**Thailand Development Research Institute**
Shilat	**Fisheries Department Government I.R. of Iran**
I.F.R.T.O	**Iran Fisheries Research and Training Organization**
P.D.O.F.I	**Planning and Development office fisheries of Iran**
FCR	**Feed Conversion Ratio**
ASCC	**Asian Shrimp Culture Council**
MIDAS	**Mekong international Development Associates**
TDRI	**Thailand Development Research Institute**
Stocking Density	**PL/M2**
Survival Rate	**Percent %**
Harvest Size	**gr.**
Total Ponds Harvests	**bit / ha**

Appendix 2: Iranian Shrimp Information

Figure 32: Boushehr coastline map.

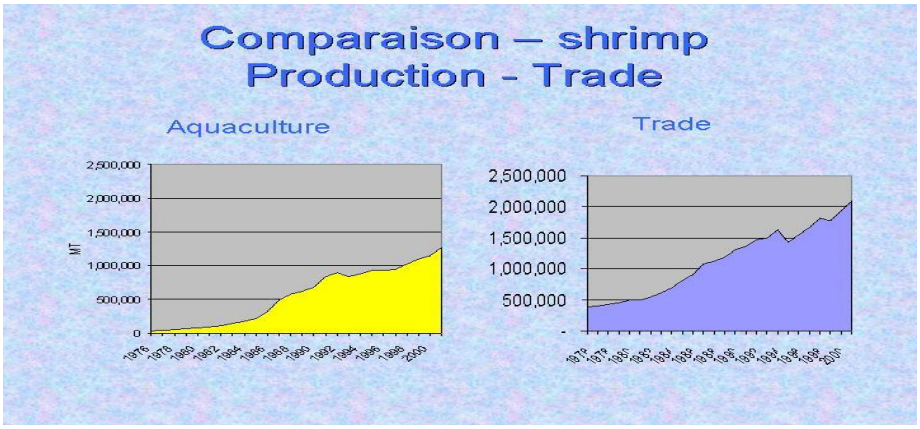

Figure 33: Comparison Shrimp Production and Trade[3]

Table 20: Comparison some information Bushehr Province and another province about shrimp culture in Iran, 2002.

Provinces	Total Area Hectare	Farm Area Hectare	Pond Area Hectare	Land Allocation Plan(ha)	
				Large Farm	Small Farm
Khozestan	13000	9750	7800	5900	7100
Busher	10250	8270	6616	2000	8250
Hormozgan	13085	10525	8420	8435	4650
Sistan & Balochestan	6050	4350	3480	3550	2500
Golestan	3000	2100	1600	0	1600
Total	45385	34995	27916	19885	24100

Aquaculture Dept, fisheries of Iran, Feb 2002.

[3] FAO, statistics, 2003.

Table 21: Comparison some information Bushehr Province and another province about shrimp culture, 2002.

Provinces	Present Status of Land			Current year
	Operational	Construction	Permission	Pond area
Khozestan	1600	500	5480	1
Busher	2080	2740	10250	2
Hormozgan	1450	1090	8615	3
Sistan & Balochestan	1050	2950	6050	4
Golestan	0	0	1000	5
Total	6180	7280	31395	15

Aquaculture Dept, fisheries of Iran, Feb 2002.

Table 22: some shrimps sites in Boushehr province in south of Iran

Name of Sites	Number Of shrimp Farms	Number of Pools	Surface (ha)	Production (Ton)
Helleh	52	790	699.4	2034.5
Mond	24	225	262.8	707.8
Delvar	33	363	439.2	956.3
Rood shour	1	30	36	88.9
Total	110	1408	1437.4	3787.5

Aquaculture Dept, fisheries of Iran, Feb 2002.

Table 23: shrimp culture Statistics in I.R.of Iran (1990- 2001).

Year	1990	1991	1992	1993	1994	1995
Pond area(ha)	0	0	2	33	51	171
Total Shrimp Production(mt)	0	0	3	16	57	136
Total Pl s Production (million Pcs.)	0	(0.03)	3	7	6	23
Feed Production(mt)	0	0	30	40	115	272
No. of shrimp Farms	0	0	12	12	37	40
No of shrimp Hatcheries	0	1	2	2	3	3
No. of feed mill plants	0	0	0	0	0	0
No. of Processing Plants	-	-	2	2	2	2
No of Direct employee in Farms	-	-	15	50	110	180
No. of Direct employee in Hatcheries	-	15	30	30	120	120
Year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Pond area(ha)	183	442	620	1337	2450	3600
Total Shrimp Production(mt)	162	521	868	1830	4005	7500
Total Pl s Production (million Pcs.)	31	87	126	373	655	1030
Feed Production(mt)	324	990	1590	3700	6500	11000
No. of shrimp Farms	60	80	137	258	278	278
No of shrimp Hatcheries	6	8	10	19	23	31
No. of feed mill plants	1	1	2	2	4	4
F.C.R.	2	2	2	2	2	2
No. of Processing Plants	4	8	12	17	17	20
No of Direct employee in Farms	360	540	720	1220	2500	3100
No. of Direct employee in Hatcheries	90	120	150	285	345	465

Aquaculture Dept, fisheries of Iran, Feb 2002.

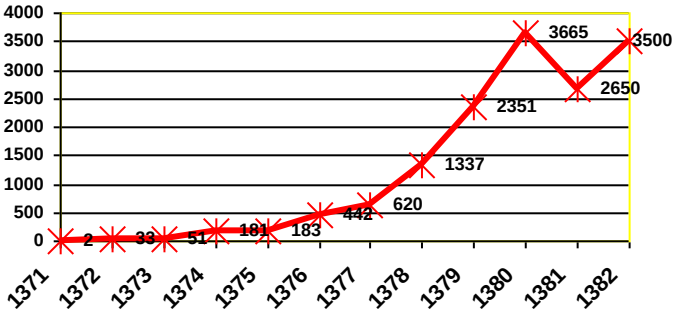

Figure 34: Surface Shrimp Culture in Iran

Table 24: Number of Shrimp Farms Active in Iran[4] , 2003

Province/Year	1998	1999	2000	2001	2002
Boushehr	70	104	108	108	110
Hormuzgan	20	62	75	75	75
Sistan	0	29	32	32	32
Khozestan	47	63	63	63	63
Total	137	258	278	278	280

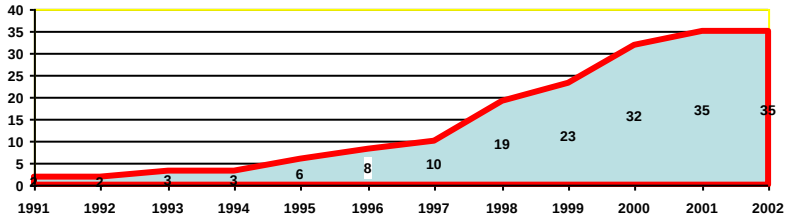

Figure 35 : Number of Reproduction Shrimp Farms in Iran

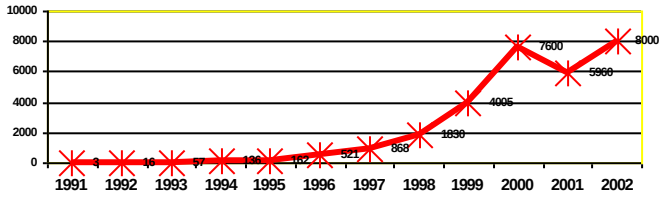

Figure 36: Trend Post Larvae shrimp in 2003 (Million Bits)

[4] Aquaculture Dept, fisheries of Iran, Feb 2003

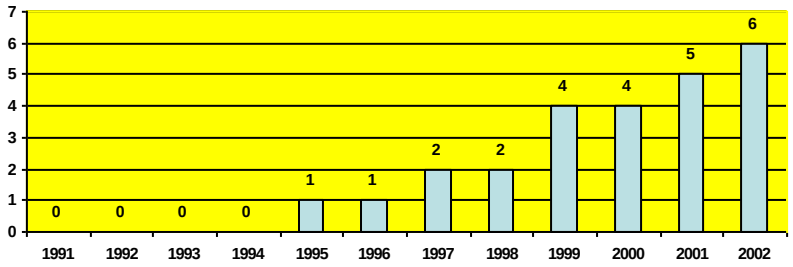

Figure 37: Number of Shrimp Food manufactures in Iran.[5]

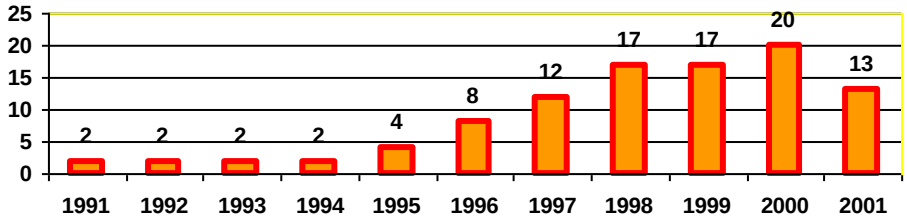

Figure 38: Number of processing Shrimp Sites in Iran.

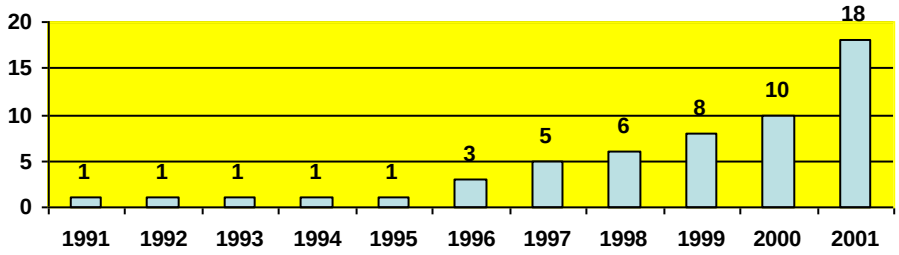

Figure 39: Number of Shrimp Companies Exporters in Iran.

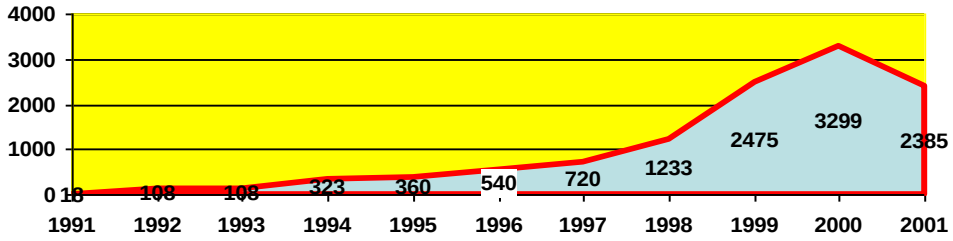

Figure 40: Number of Employers in Iranian Shrimp Farms.

[5] Aquaculture Dept, fisheries of Iran, Feb 2003

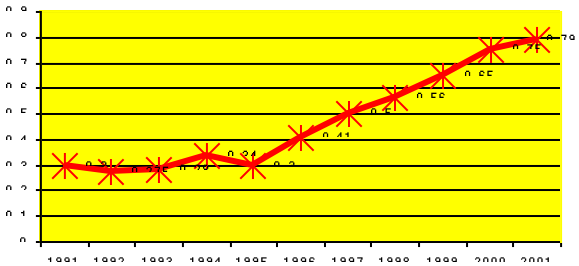

Figure 41: Shrimp Meal Production (Kg) in Iran[6] , 1991-2001.

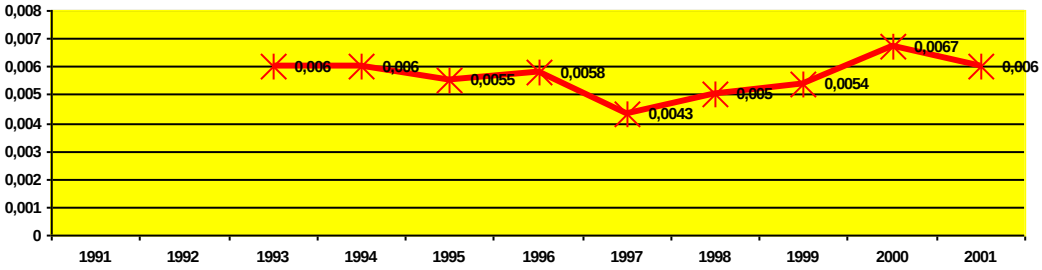

Figure 42 : Post-Larvae Prices (Us$ /bits).

Table 25: Shrimp capture, culture production and capture[7], 1980-2001.

Unit: Ton

Year	Capture	Culture	Total shrimp	Year	Capture	Culture	Total shrimp
1980	1396305	71897	1468202	**1991**	1834364	838229	2672593
1981	1333052	88601	1421653	**1992**	1893295	897045	2790340
1982	1448507	112014	1560521	**1993**	1942074	835207	2777281
1983	1494157	142180	1636337	**1994**	2152079	881963	3034042
1984	1536467	172178	1708645	**1995**	2200803	929839	3030642
1985	1720664	213643	1934307	**1996**	2308932	927933	3236865
1986	1725716	319673	2045389	**1997**	2385520	945916	3331436
1987	1696222	494120	2190342	**1998**	2519007	1017117	3536124
1988	1783973	576915	2360888	**1999**	2782964	1094345	3877309
1989	1736757	621212	2357969	**2000**	2829613	1143072	3972685
1990	1746588	679923	2426511	**2001**	2696018	1270875	3966893

6 Aquaculture Dept, fisheries of Iran, Feb 2003.

7 FAO, Rome; Italy, 2002.

Table 26: World shrimp culture during [8]1984 – 2001

Year	Average Value (US$)	Value of cultured shrimp (million US$)	World shrimp culture (Thousand t ons)	Year	Average Value (US$)	Value of cultured shrimp (million US$)	World shrimp culture (Thousand tons)
1984	38234	851	172	**1993**	12571	5293	835
1985	38112	1076	213	**1994**	23894	5858	881
1986	11444	1694	319	**1995**	21702	6122	929
1987	44713	3072	494	**1996**	22068	6118	927
1988	31564	3951	576	**1997**	14763	6048	945
1989	13667	3956	621	**1998**	11110	6407	1017
1990	46539	4257	679	**1999**	38267	7768	1094
1991	42887	5170	838	**2000**	18384	6287	1143
1992	45078	5588	897	**2001**	29312	6096	1270

Table 27: Comparison Average Revenues, feed, larvae, labour costs and profits.

Average 30 Farms	1998	1999	2000	2001	2002
Average Revenues	89446	100615	85076	91427	64707
Average Feed Costs	26203	27833	29783	29958	30624
Average Larvae Costs	15700	16554	17140	17601	18036
Average Labour Costs	15704	17359	18883	20579	22103
Average Profits	10365	17829	-1296	3220	-25819

8 F.A.O. Statistics, 2002.

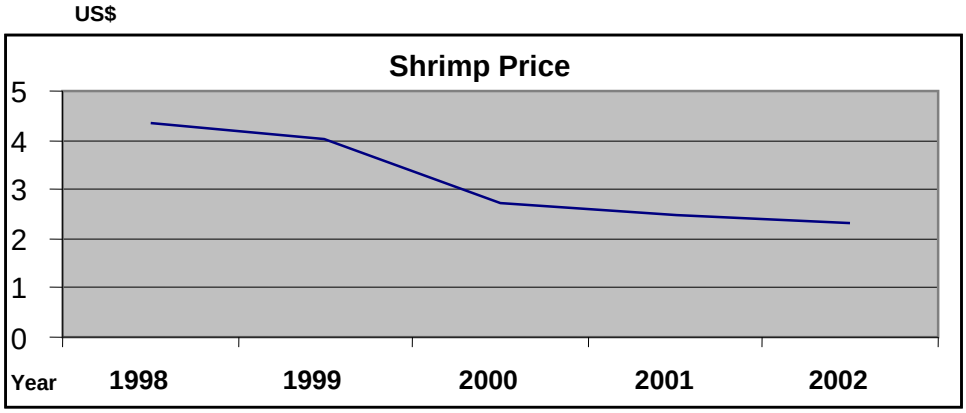

Figure 43: shrimp prices in Iranian farms[9] (1998-2002)

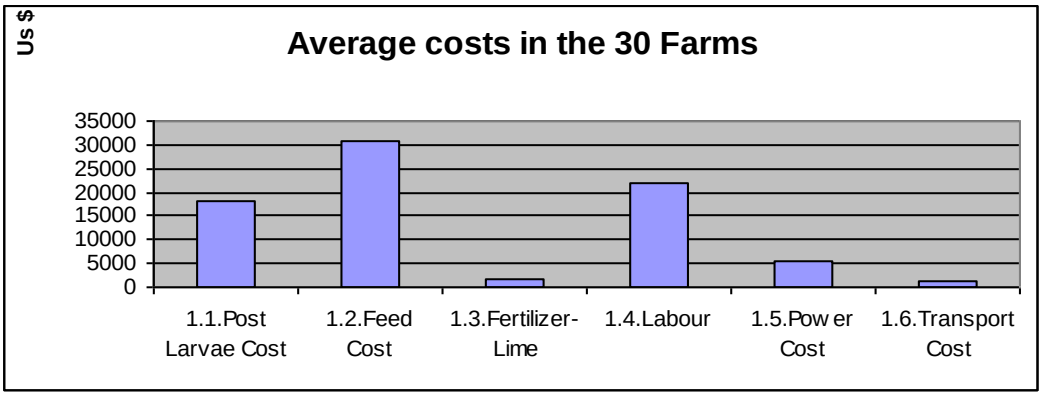

Figure 44: Average costs in 30 shrimp farms, 2002.

Table 28: Average costs shares in 30 shrimp farms (1998-2002).

Type of Average of Total costs %	1998	1999	2000	2001	2002
Post Larvae Cost	25,17	24,59	23,74	23,71	22,86
Feed Cost	42,09	41,33	41,27	38,96	38,87
Fertilizer-Lime	1,82	1,84	1,93	1,95	2,03
Labour	25,17	25,77	26,16	27,74	28,05
Power Cost	4,57	5,22	5,59	6,24	6,72
Transport Cost	1,2	1,26	1,31	1,4	1,47
Total operating cost	100	100	100	100	100

[9] Planning and development office, fisheries of Iran, 2002

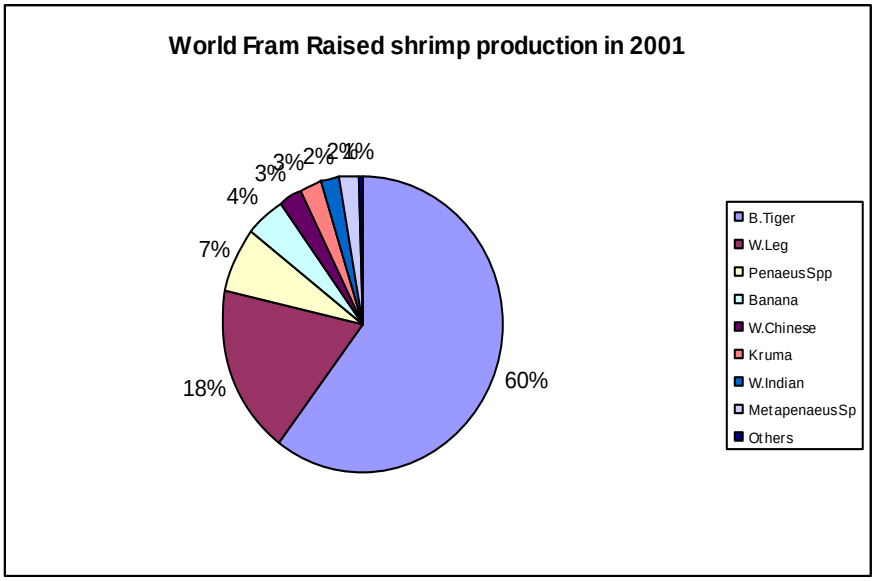

Figure 45: shrimp species culture production in the world10, 2001.

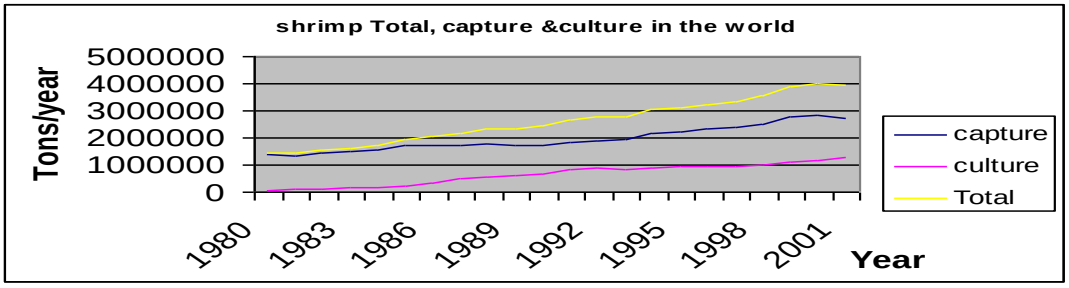

Figure 46: Total shrimp capture and culture in the world 11(1980-2001).

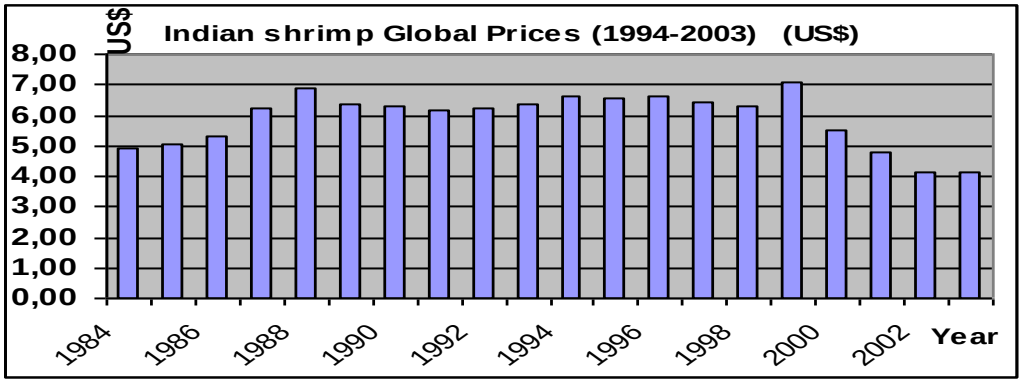

Figure 47: Indian shrimp global Prices (1996-2003).

[10] FAO Statistics Information,2002
[11] FAO, statistics, 2003

Appendix 3: Analysis Data in this Project

Table 29: Analysis Data Shrimp data in the farms

No of farm: 1 / Year	1998	1999	2000	2001	2002
Revenues					
Production(Kg)	19697	21337	21216	24750	24750
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	78788	85348	63648	74249	49499
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	14665	15537	16171	16488	17439
1.2.Feed Cost	21859	23419	22122	25655	26907
1.3.Fertilizer-Lime	430	560	680	740	850
1.4.Labour	12000	13200	14500	15600	17200
1.5.Power Cost	550	690	880	1030	1140
1.6.Transport Cost	600	680	760	860	940
II. Total operating cost	50103	54085	55112	60373	64476
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	5000	4500	4000	3500	3000
III. Total capital costs	16000	14767	13533	12300	11067
IV.Total costs:	66103	68852	68645	72673	75543
Contribution to fixed costs (I-II):	28684	31263	8536	13876	-14976
Profits (I-IV):	12684	16496	-4997	1576	-26043
No of farm: 2 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	18256	21207	25282	27717	27861
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	73024	84828	75847	83151	55721
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	13951	16091	16488	16805	17043
1.2.Feed Cost	20594	24052	26978	28393	27521
1.3.Fertilizer-Lime	550	640	730	980	1200
1.4.Labour	11000	14500	16400	17300	18400
1.5.Power Cost	670	830	850	910	1030
1.6.Transport Cost	580	670	860	890	980
II. Total operating cost	47345	56783	62306	65278	66173
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	5000	4500	4000	3500	3000
III. Total capital costs	16000	14767	13533	12300	11067
IV.Total costs:	63345	71550	75839	77578	77240
Contribution to fixed costs (I-II):	25679	28045	13541	17873	-10452
Profits (I-IV):	9679	13278	8	5573	-21519

No of farm: 3 / Year	1998	1999	2000	2001	2002
Revenues					
Production(Kg)	19206	22208	23108	24625	26097
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	76823	88831	69324	73874	52194
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	16171	16171	16567	16646	16567
1.2.Feed Cost	22836	23427	23249	25225	26256
1.3.Fertilizer-Lime	650	750	790	860	1300
1.4.Labour	12400	14500	16700	18300	19600
1.5.Power Cost	650	780	930	1030	1180
1.6.Transport Cost	590	670	890	980	1020
II. Total operating cost	53297	56297	59126	63042	65923
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	5000	4500	4000	3500	3000
III. Total capital costs	16000	14767	13533	12300	11067
IV.Total costs:	69297	71064	72659	75342	76990
Contribution to fixed costs (I-II):	23526	32534	10198	10832	-13729
Profits (I-IV):	7526	17767	-3335	-1468	-24796

No of farm: 4 / Year	1998	1999	2000	2001	2002
Revenues					
Production(Kg)	21228	23560	28178	25242	27435
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	84912	94239	84533	75727	54870
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	15457	15695	16171	16884	16488
1.2.Feed Cost	24594	26577	31270	27551	29275
1.3.Fertilizer-Lime	670	890	960	1200	1380
1.4.Labour	11400	12500	15400	17300	19500
1.5.Power Cost	430	490	560	890	1700
1.6.Transport Cost	650	680	730	769	1050
II. Total operating cost	53201	56832	65091	64594	69393
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	5000	4500	4000	3500	3000
III. Total capital costs	16000	14767	13533	12300	11067
IV.Total costs:	69201	71599	78624	76894	80459
Contribution to fixed costs (I-II):	31712	37408	19442	11133	-14523
Profits (I-IV):	15712	22641	5909	-1167	-25590

No of farm: 5 / Year	1998	1999	2000	2001	2002
Revenues					
Production(Kg)	16982	22450	24738	24834	26221
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	67930	89800	74214	74502	52442
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	12366	15457	16091	15933	16409
1.2.Feed Cost	21746	26009	27906	27560	27820
1.3.Fertilizer-Lime	720	630	870	760	1140
1.4.Labour	10300	12700	13400	15800	18300
1.5.Power Cost	380	560	720	840	1020
1.6.Transport Cost	580	690	790	860	1050
II. Total operating cost	46092	56046	59777	61753	65738
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	5000	4500	4000	3500	3000
III. Total capital costs	16000	14767	13533	12300	11067
IV.Total costs:	62092	70813	73310	74053	76805
Contribution to fixed costs (I-II):	21838	33753	14437	12749	-13296
Profits (I-IV):	5838	18986	904	449	-24363

No of farm: 6 / Year	1998	1999	2000	2001	2002
Revenues					
Production(Kg)	18461	22086	24560	25719	29346
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	73845	88343	73681	77157	58692
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	13317	14823	15537	16012	16805
1.2.Feed Cost	23640	24914	26357	27287	29883
1.3.Fertilizer-Lime	730	680	860	640	980
1.4.Labour	10900	13560	15000	14700	18700
1.5.Power Cost	560	830	860	1060	1230
1.6.Transport Cost	590	640	670	750	970
II. Total operating cost	49737	55447	59284	60449	68568
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	5000	4500	4000	3500	3000
III. Total capital costs	16000	14767	13533	12300	11067
IV.Total costs:	65737	70214	72817	72749	79634
Contribution to fixed costs (I-II):	24109	32896	14397	16708	-9876
Profits (I-IV):	8109	18129	864	4408	-20942

No of farm: 7 / Year	1998	1999	2000	2001	2002
Revenues					
Production(Kg)	21004	22138	23735	25678	26174
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	84015	88550	71205	77035	52347
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	14268	14982	15299	15695	16091
1.2.Feed Cost	24334	25512	25327	26305	26333
1.3.Fertilizer-Lime	550	760	870	980	1140
1.4.Labour	10500	12400	13700	16500	17400
1.5.Power Cost	310	490	840	1040	1150
1.6.Transport Cost	650	690	760	860	1050
II. Total operating cost	50612	54834	56796	61380	63165
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	5000	4500	4000	3500	3000
III. Total capital costs	16000	14767	13533	12300	11067
IV.Total costs:	66612	69601	70329	73680	74231
Contribution to fixed costs (I-II):	33403	33716	14410	15655	-10817
Profits (I-IV):	17403	18949	877	3355	-21884

No of farm: 8 / Year	1998	1999	2000	2001	2002
Revenues					
Production(Kg)	19144	21941	23235	26769	27510
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	76577	87763	69704	80308	55019
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	14823	15537	15933	16329	16567
1.2.Feed Cost	23463	26490	27485	30197	29355
1.3.Fertilizer-Lime	640	740	890	760	1100
1.4.Labour	10200	13600	14300	17400	18800
1.5.Power Cost	470	730	960	1040	1270
1.6.Transport Cost	680	760	970	1090	1120
II. Total operating cost	50276	57856	60538	66816	68212
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	5000	4500	4000	3500	3000
III. Total capital costs	16000	14767	13533	12300	11067
IV. Total costs:	66276	72623	74071	79116	79279
Contribution to fixed costs (I-II):	26300	29907	9166	13492	-13193
Profits (I-IV):	10300	15140	-4367	1192	-24259

No of farm: 9 / Year	1998	1999	2000	2001	2002
Revenues					
Production(Kg)	21980	24586	26997	29631	25714
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	87921	98342	80990	88894	51428
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	14982	15616	16488	16646	17043
1.2.Feed Cost	26537	29083	30618	31438	26341
1.3.Fertilizer-Lime	530	750	960	830	990
1.4.Labour	10800	13600	16300	17500	18400
1.5.Power Cost	680	730	890	1030	1280
1.6.Transport Cost	640	770	850	970	1150
II. Total operating cost	54169	60549	66106	68415	65204
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	5000	4500	4000	3500	3000
III. Total capital costs	16000	14767	13533	12300	11067
IV.Total costs:	70169	75316	79639	80715	76271
Contribution to fixed costs (I-II):	33752	37794	14884	20480	-13776
Profits (I-IV):	17752	23027	1351	8180	-24843

No of farm: 10 / Year	1998	1999	2000	2001	2002
Revenues					
Production(Kg)	17212	21010	28348	23412	27743
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	68847	84040	85045	70235	55486
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	15299	16488	17439	17835	18073
1.2.Feed Cost	21095	25238	30077	25410	28589
1.3.Fertilizer-Lime	730	870	840	930	1200
1.4.Labour	11200	12500	14600	16300	17500
1.5.Power Cost	290	380	450	820	990
1.6.Transport Cost	670	740	840	920	1050
II. Total operating cost	49284	56216	64246	62216	67402
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	5000	4500	4000	3500	3000
III. Total capital costs	16000	14767	13533	12300	11067
IV.Total costs:	65284	70983	77779	74516	78469
Contribution to fixed costs (I-II):	19563	27825	20799	8019	-11916
Profits (I-IV):	3563	13058	7266	-4281	-22983

No of farm: 11 / Year	1998	1999	2000	2001	2002

Revenues					
Production(Kg)	20920	27087	31040	35586	32390
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	83680	108349	93119	106757	64780
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	16646	17280	17677	18073	18152
1.2.Feed Cost	23599	29895	33879	33850	29230
1.3.Fertilizer-Lime	1150	1450	1630	1530	1320
1.4.Labour	15600	16400	17300	18500	19900
1.5.Power Cost	1070	1250	1540	1790	2680
1.6.Transport Cost	450	630	750	890	930
II. Total operating cost	58515	66906	72775	74633	72212
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	75515	82673	87308	87933	84279
Contribution to fixed costs (I-II):	25165	41444	20343	32124	-7433
Profits (I-IV):	8165	25677	5810	18824	-19499

No of farm: 12 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	20920	27087	31040	35586	32390
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	83680	108349	93119	106757	64780
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	15933	16567	16805	17360	18628
1.2.Feed Cost	25553	26490	28893	28844	34236
1.3.Fertilizer-Lime	1200	1130	1560	1120	1500
1.4.Labour	16400	17800	18400	19440	21300
1.5.Power Cost	1080	1530	1680	1950	2050
1.6.Transport Cost	630	740	760	530	890
II. Total operating cost	60796	64257	68098	69243	78604
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	77796	80024	82631	82543	90671
Contribution to fixed costs (I-II):	22884	44092	25021	37514	-13825
Profits (I-IV):	5884	28325	10488	24214	-25891

No of farm: 13 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					

Production(Kg)	23284	26750	31679	33127	34609
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	93137	107002	95038	99382	69217
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	16488	17360	18549	18866	17835
1.2.Feed Cost	26834	27729	32452	34541	34820
1.3.Fertilizer-Lime	1190	1420	1720	1500	1630
1.4.Labour	17300	17600	18400	19700	22100
1.5.Power Cost	1360	1640	1970	2700	3670
1.6.Transport Cost	580	620	680	750	850
II. Total operating cost	63751	66369	73771	78057	80905
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	80751	82136	88304	91357	92972
Contribution to fixed costs (I-II):	29385	40633	21267	21325	-11688
Profits (I-IV):	12385	24866	6734	8025	-23754

No of farm: 14 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	25189	25529	28205	32533	34868
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	100757	102116	84615	97598	69736
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	16091	16567	16805	17439	17915
1.2.Feed Cost	30719	30510	30097	32731	33593
1.3.Fertilizer-Lime	1120	1300	1400	1620	1720
1.4.Labour	16400	17800	18600	19700	21800
1.5.Power Cost	1050	1530	1840	2450	2890
1.6.Transport Cost	670	790	830	960	1100
II. Total operating cost	66050	68497	69572	74900	79017
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	83050	84264	84105	88200	91084
Contribution to fixed costs (I-II):	34707	33618	15043	22698	-9281
Profits (I-IV):	17707	17851	510	9398	-21347

No of farm: 15 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	23588	25348	26159	30270	35509

Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	94353	101391	78478	90811	71018
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	15695	16171	16567	16646	17756
1.2.Feed Cost	28335	28748	29030	31931	37025
1.3.Fertilizer-Lime	1230	1530	1340	1740	1530
1.4.Labour	16300	18500	17900	19800	21040
1.5.Power Cost	1030	1430	1820	1980	2400
1.6.Transport Cost	630	670	610	760	790
II. Total operating cost	63220	67049	67267	72858	80541
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	80220	82816	81800	86158	92607
Contribution to fixed costs (I-II):	31133	34342	11210	17953	-9523
Profits (I-IV):	14133	18575	-3323	4653	-21589

No of farm: 16 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	24466	26454	31192	32432	32456
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	97863	105815	93575	97297	64913
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	16488	16646	17360	17835	18628
1.2.Feed Cost	29538	28228	31953	30455	29884
1.3.Fertilizer-Lime	1160	1340	1730	1820	1900
1.4.Labour	14900	16400	17600	18900	20100
1.5.Power Cost	990	1800	2670	3400	4780
1.6.Transport Cost	580	640	660	670	790
II. Total operating cost	63656	65054	71972	73080	76082
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	80656	80821	86505	86380	88148
Contribution to fixed costs (I-II):	34207	40760	21603	24217	-11169
Profits (I-IV):	17207	24993	7070	10917	-23236

No of farm: 17 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					

Production(Kg)	24811	21881	26228	23417	26934
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	99243	87525	78685	70252	53869
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	15695	15933	16329	15965	17122
1.2.Feed Cost	30408	24683	28627	23703	26277
1.3.Fertilizer-Lime	1200	1140	1520	1620	1820
1.4.Labour	15700	16300	17600	18600	19300
1.5.Power Cost	3260	4600	5670	7500	8600
1.6.Transport Cost	520	670	780	840	910
II. Total operating cost	66783	63326	70527	68227	74029
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	83783	79093	85060	81527	86096
Contribution to fixed costs (I-II):	32460	24199	8158	2024	-20161
Profits (I-IV):	15460	8432	-6375	-11276	-32227

No of farm: 18 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	22722	23393	28531	31419	36264
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	90887	93573	85594	94258	72527
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	16250	16567	17043	17360	18549
1.2.Feed Cost	23969	23536	27662	28929	32947
1.3.Fertilizer-Lime	1020	1090	1430	1620	1740
1.4.Labour	15300	16700	17600	18900	19400
1.5.Power Cost	4500	4900	5400	5900	6700
1.6.Transport Cost	510	570	590	620	740
II. Total operating cost	61549	63363	69724	73329	80076
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	78549	79130	84257	86629	92142
Contribution to fixed costs (I-II):	29338	30210	15870	20930	-7548
Profits (I-IV):	12338	14443	1337	7630	-19615

No of farm: 19 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	22841	24701	27204	28958	33159

Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	91362	98804	81613	86873	66318
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	15774	16488	17439	17439	18628
1.2.Feed Cost	27576	28768	31020	31606	32350
1.3.Fertilizer-Lime	1140	1320	1630	1550	1720
1.4.Labour	15700	16300	18300	19400	20300
1.5.Power Cost	3700	4600	5780	6780	7680
1.6.Transport Cost	640	720	760	830	980
II. Total operating cost	64530	68195	74929	77605	81658
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	81530	83962	89462	90905	93725
Contribution to fixed costs (I-II):	26832	30609	6684	9267	-15340
Profits (I-IV):	9832	14842	-7849	-4033	-27407

No of farm: 20 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	21850	25102	27483	32222	33238
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	87402	100409	82450	96665	66477
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	15616	16091	16488	17122	18073
1.2.Feed Cost	26247	28316	29327	32811	31617
1.3.Fertilizer-Lime	1230	1080	1380	1680	1800
1.4.Labour	16400	17800	18400	19600	20100
1.5.Power Cost	5400	5900	6700	7890	8700
1.6.Transport Cost	420	480	560	590	740
II. Total operating cost	65313	69668	72855	79693	81030
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	82313	85435	87388	92993	93097
Contribution to fixed costs (I-II):	22089	30741	9596	16972	-14553
Profits (I-IV):	5089	14974	-4937	3672	-26620

No of farm: 21 / Year	**1998**	**1999**	**2000**	**2001**	**2002**

Revenues					
Production(Kg)	21652	25421	27972	31442	34111
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	86607	101685	83916	94326	68223
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	16646	17677	18152	18628	19421
1.2.Feed Cost	24688	27746	28142	29717	31199
1.3.Fertilizer-Lime	1550	1640	1760	1840	1990
1.4.Labour	18800	19400	21900	23400	26000
1.5.Power Cost	6500	7600	7890	8900	9900
1.6.Transport Cost	890	960	1040	1120	1300
II. Total operating cost	69074	75023	78885	83605	89810
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	86074	90790	93418	96905	101877
Contribution to fixed costs (I-II):	17532	26662	5031	10722	-21587
Profits (I-IV):	532	10895	-9502	-2578	-33654

No of farm: 22 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	21337	25213	29288	33378	34045
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	85348	100852	87865	100134	68091
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	16805	17360	18549	19659	19024
1.2.Feed Cost	21727	23829	25895	29104	28856
1.3.Fertilizer-Lime	1670	1730	1860	1930	2100
1.4.Labour	19700	22400	25600	27800	29600
1.5.Power Cost	6600	6800	7890	8760	8900
1.6.Transport Cost	1040	1200	1340	1540	1780
II. Total operating cost	67542	73319	81134	88793	90260
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	84542	89086	95667	102093	102327
Contribution to fixed costs (I-II):	17806	27533	6731	11342	-22169
Profits (I-IV):	806	11766	-7802	-1958	-34236

No of farm: 23 / Year	**1998**	**1999**	**2000**	**2001**	**2002**

Revenues					
Production(Kg)	26394	26090	32871	36548	40814
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	105577	104360	98612	109644	81627
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	16329	17360	18866	19421	19817
1.2.Feed Cost	28648	28476	34875	36771	38574
1.3.Fertilizer-Lime	1490	1540	1720	1860	2130
1.4.Labour	17600	18700	19500	21500	23400
1.5.Power Cost	6500	7560	8760	9870	11200
1.6.Transport Cost	1100	1240	1360	1480	1560
II. Total operating cost	71667	74876	85081	90901	96681
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	88667	90643	99614	104201	108747
Contribution to fixed costs (I-II):	33911	29484	13531	18742	-15054
Profits (I-IV):	16911	13717	-1002	5442	-27120

No of farm: 24 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	25251	30147	34286	33995	31863
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	101004	120589	102859	101985	63726
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	17439	17439	18628	19738	15933
1.2.Feed Cost	30948	36765	41394	32129	27200
1.3.Fertilizer-Lime	1670	1740	1980	2400	2120
1.4.Labour	16400	18900	19600	23000	24500
1.5.Power Cost	6400	7800	8790	8600	11300
1.6.Transport Cost	1040	1290	1380	1460	1630
II. Total operating cost	73897	83934	91772	87327	82683
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	90897	99701	106305	100627	94750
Contribution to fixed costs (I-II):	27107	36655	11086	14658	-18957
Profits (I-IV):	10107	20888	-3447	1358	-31024
No of farm: 25 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	26301	33946	34201	35668	43479

Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	105202	135782	102604	107003	86959
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	16567	19024	19024	18866	19738
1.2.Feed Cost	31432	38292	36287	31970	34996
1.3.Fertilizer-Lime	1670	1730	1860	1780	2020
1.4.Labour	19700	21400	24500	26800	27600
1.5.Power Cost	6780	7650	7890	8540	8800
1.6.Transport Cost	990	1060	1180	1270	1300
II. Total operating cost	77139	89157	90741	89226	94453
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	94139	104924	105274	102526	106520
Contribution to fixed costs (I-II):	28063	46626	11863	17777	-7495
Profits (I-IV):	11063	30859	-2670	4477	-19561

No of farm: 26 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	26255	26175	28330	29386	33518
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	105019	104699	84991	88157	67037
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	17439	17439	18311	18232	18945
1.2.Feed Cost	31538	29526	27467	28311	31066
1.3.Fertilizer-Lime	1720	1830	1940	2010	2030
1.4.Labour	21000	22400	23670	25680	27900
1.5.Power Cost	4900	6400	7540	8650	9870
1.6.Transport Cost	1060	1240	1480	1680	1590
II. Total operating cost	77657	78835	80408	84562	91401
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	94657	94602	94941	97862	103468
Contribution to fixed costs (I-II):	27362	25863	4583	3595	-24364
Profits (I-IV):	10362	10096	-9950	-9705	-36431

No of farm: 27 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	23133	26375	28806	35710	37551
Price (US$/Kg)	4	4	3	3	2

I. Total revenues:	92530	105500	86417	107130	75102
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	16567	17439	16567	18549	19421
1.2.Feed Cost	28351	30074	30738	33968	32056
1.3.Fertilizer-Lime	1540	1830	1750	1940	1670
1.4.Labour	21500	22500	24600	27600	28900
1.5.Power Cost	5200	6430	7650	8970	9700
1.6.Transport Cost	1030	1320	1450	1660	1580
II. Total operating cost	74189	79593	82755	92687	93327
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	91189	95360	97288	105987	105393
Contribution to fixed costs (I-II):	18342	25907	3662	14443	-18224
Profits (I-IV):	1342	10140	-10871	1143	-30291

No of farm: 28 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	24264	27482	30293	34729	35252
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	97057	109930	90878	104186	70504
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	16012	16567	17122	17756	18311
1.2.Feed Cost	27667	29326	30293	30705	29663
1.3.Fertilizer-Lime	1600	1430	1750	1940	2010
1.4.Labour	22300	22400	24560	26900	27800
1.5.Power Cost	5600	6900	7400	8900	9700
1.6.Transport Cost	980	1200	1310	1430	1620
II. Total operating cost	74159	77823	82435	87631	89104
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	91159	93590	96968	100931	101171
Contribution to fixed costs (I-II):	22898	32107	8443	16554	-18600
Profits (I-IV):	5898	16340	-6090	3254	-30667

No of farm: 29 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	22389	29504	32797	34925	38495
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	89557	118016	98392	104776	76989

Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	16012	17043	17360	18549	20134
1.2.Feed Cost	25666	30943	32797	30879	30514
1.3.Fertilizer-Lime	1740	1820	1730	1430	1800
1.4.Labour	22450	26700	27790	28700	29450
1.5.Power Cost	5800	6890	7400	7900	8540
1.6.Transport Cost	1130	1320	1450	1680	1690
II. Total operating cost	72798	84716	88527	89138	92128
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	89798	100483	103060	102438	104195
Contribution to fixed costs (I-II):	16759	33300	9865	15638	-15139
Profits (I-IV):	-241	17533	-4668	2338	-27205

No of farm: 30 / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	30106	28402	33759	34565	40814
Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	120422	113607	101278	103696	81627
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	16171	17360	18152	18945	19817
1.2.Feed Cost	31941	28402	31289	30772	34343
1.3.Fertilizer-Lime	1400	1820	1740	1860	2210
1.4.Labour	20980	21300	24360	26750	28800
1.5.Power Cost	4500	5690	6780	7650	8760
1.6.Transport Cost	1030	1090	1240	1420	1590
II. Total operating cost	76022	75661	83561	87397	95520
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	17000	15767	14533	13300	12067
IV.Total costs:	93022	91428	98094	100697	107587
Contribution to fixed costs (I-II):	44400	37945	17716	16299	-13893
Profits (I-IV):	27400	22178	3183	2999	-25960

Table 30: Average cost & Benefits for 30 farms (1998-2002).

No of farm: Average / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Revenues					
Production(Kg)	22361	25154	28359	30476	32354

Price (US$/Kg)	4	4	3	3	2
I. Total revenues:	89446	100615	85076	91427	64707
Costs					
1.Operating Costs:					
1.1.Post Larvae Cost	15732	16559	17133	17591	18012
1.2.Feed Cost	26203	27833	29783	29958	30624
1.3.Fertilizer-Lime	1130	1239	1396	1449	1601
1.4.Labour	15704	17359	18883	20579	22103
1.5.Power Cost	2907	3514	4033	4626	5294
1.6.Transport Cost	738	848	944	1038	1158
II. Total operating cost	62414	67352	72172	75240	78793
2. Capital costs:					
2.1 Depreciation					
Fixed capital	7700	7187	6673	6160	5647
Liquid capital	3300	3080	2860	2640	2420
Total depreciation	11000	10267	9533	8800	8067
2.2 Interest payments	6000	5500	5000	4500	4000
III. Total capital costs	11000	10267	9533	8800	14067
IV.Total costs:	73414	77619	81705	84040	92859
Contribution to fixed costs (I-II):	27032	33262	12904	16187	-14085
Profits (I-IV):	16032	22995	3371	7387	-28152

Table 31: Shrimp Production in the Farms (1998-2002).

Production in the Farms					
No of farm: Average / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Farm 1	19697	21337	21216	24750	24750
Farm 2	18256	21207	25282	27717	27861
Farm 3	19206	22208	23108	24625	26097
Farm 4	21228	23560	28178	25242	27435
Farm 5	16982	22450	24738	24834	26221
Farm 6	18461	22086	24560	25719	29346
Farm 7	21004	22138	23735	25678	26174
Farm 8	19144	21941	23235	26769	27510
Farm 9	21980	24586	26997	29631	25714
Farm 10	17212	21010	28348	23412	27743
Farm 11	20920	27087	31040	35586	32390
Farm 12	20920	27087	31040	35586	32390
Farm 13	23284	26750	31679	33127	34609
Farm 14	25189	25529	28205	32533	34868
Farm 15	23588	25348	26159	30270	35509
Farm 16	24466	26454	31192	32432	32456
Farm 17	24811	21881	26228	23417	26934
Farm 18	22722	23393	28531	31419	36264
Farm 19	22841	24701	27204	28958	33159
Farm 20	21850	25102	27483	32222	33238
Farm 21	21652	25421	27972	31442	34111
Farm 22	21337	25213	29288	33378	34045
Farm 23	26394	26090	32871	36548	40814
Farm 24	25251	30147	34286	33995	31863
Farm 25	26301	33946	34201	35668	43479
Farm 26	26255	26175	28330	29386	33518
Farm 27	23133	26375	28806	35710	37551
Farm 28	24264	27482	30293	34729	35252
Farm 29	22389	29504	32797	34925	38495
Farm 30	30106	28402	33759	34565	40814
Average	22361	25154	28359	30476	32354
St. deviation	3022	3003	3491	4299	5017
Distribution	0,14	0,12	0,12	0,14	0,16
Upper limit	25383	28157	31850	34775	37371
Lower Limit	7744	3248	5400	4089	8460

Table 32: Revenues for 30 Farms (1998-2002).

No of farm: Year	1998	1999	2000	2001	2002
Farm 1	78788	85348	63648	74249	49499
Farm 2	73024	84828	75847	83151	55721
Farm 3	76823	88831	69324	73874	52194
Farm 4	84912	94239	84533	75727	54870
Farm 5	67930	89800	74214	74502	52442
Farm 6	73845	88343	73681	77157	58692
Farm 7	84015	88550	71205	77035	52347
Farm 8	76577	87763	69704	80308	55019
Farm 9	87921	98342	80990	88894	51428
Farm 10	68847	84040	85045	70235	55486
Farm 11	83680	108349	93119	106757	64780
Farm 12	83680	108349	93119	106757	64780
Farm 13	93137	107002	95038	99382	69217
Farm 14	100757	102116	84615	97598	69736
Farm 15	94353	101391	78478	90811	71018
Farm 16	97863	105815	93575	97297	64913
Farm 17	99243	87525	78685	70252	53869
Farm 18	90887	93573	85594	94258	72527
Farm 19	91362	98804	81613	86873	66318
Farm 20	87402	100409	82450	96665	66477
Farm 21	86607	101685	83916	94326	68223
Farm 22	85348	100852	87865	100134	68091
Farm 23	105577	104360	98612	109644	81627
Farm 24	101004	120589	102859	101985	63726
Farm 25	105202	135782	102604	107003	86959
Farm 26	105019	104699	84991	88157	67037
Farm 27	92530	105500	86417	107130	75102
Farm 28	97057	109930	90878	104186	70504
Farm 29	89557	118016	98392	104776	76989
Farm 30	120422	113607	101278	103696	81627
Average	89446	100615	85076	91427	64707
St. Deviation	12087	12012	10474	12898	10035
Upper limit	101532	214221	186354	195123	146334
Lower Limit	77359	12992	16201	12269	16920
Distribution	0,14	0,12	0,12	0,14	0,16

Table 33: Total operating Costs for 30 Farms (1998-2002).

Total Operating Costs					
No of farm: Average / Year	**1998**	**1999**	**2000**	**2001**	**2002**
Farm 1	50103	54085	55112	60373	64476
Farm 2	47345	56783	62306	65278	66173
Farm 3	53297	56297	59126	63042	65923
Farm 4	53201	56832	65091	64594	69393
Farm 5	46092	56046	59777	61753	65738
Farm 6	49737	55447	59284	60449	68568
Farm 7	50612	54834	56796	61380	63165
Farm 8	50276	57856	60538	66816	68212
Farm 9	54169	60549	66106	68415	65204
Farm 10	49284	56216	64246	62216	67402
Farm 11	58515	66906	72775	74633	72212
Farm 12	60796	64257	68098	69243	78604
Farm 13	63751	66369	73771	78057	80905
Farm 14	66050	68497	69572	74900	79017
Farm 15	63220	67049	67267	72858	80541
Farm 16	63656	65054	71972	73080	76082
Farm 17	66783	63326	70527	68227	74029
Farm 18	61549	63363	69724	73329	80076
Farm 19	64530	68195	74929	77605	81658
Farm 20	65313	69668	72855	79693	81030
Farm 21	69074	75023	78885	83605	89810
Farm 22	67542	73319	81134	88793	90260
Farm 23	71667	74876	85081	90901	96681
Farm 24	73897	83934	91772	87327	82683
Farm 25	77139	89157	90741	89226	94453
Farm 26	77657	78835	80408	84562	91401
Farm 27	74189	79593	82755	92687	93327
Farm 28	74159	77823	82435	87631	89104
Farm 29	72798	84716	88527	89138	92128
Farm 30	76022	75661	83561	87397	95520
Average Tot. Operating Cost	62414	67352	72172	75240	78793
St. Deviation	9957	10045	10456	10702	10871
Distribution	0,16	0,15	0,14	0,14	0,14
Upper limit	72372	77397	82628	85943	89663
Lower Limit	52457	57307	61717	64538	67922

Table 34: Contribution to fixed costs for 30 farms (1998-2002).

No of farm: Year	1998	1999	2000	2001	2002
Farm 1	28684	31263	8536	13876	-14976
Farm 2	25679	28045	13541	17873	-10452
Farm 3	23526	32534	10198	10832	-13729
Farm 4	31712	37408	19442	11133	-14523
Farm 5	21838	33753	14437	12749	-13296
Farm 6	24109	32896	14397	16708	-9876
Farm 7	33403	33716	14410	15655	-10817
Farm 8	26300	29907	9166	13492	-13193
Farm 9	33752	37794	14884	20480	-13776
Farm 10	19563	27825	20799	8019	-11916
Farm 11	25165	41444	20343	32124	-7433
Farm 12	22884	44092	25021	37514	-13825
Farm 13	29385	40633	21267	21325	-11688
Farm 14	34707	33618	15043	22698	-9281
Farm 15	31133	34342	11210	17953	-9523
Farm 16	34207	40760	21603	24217	-11169
Farm 17	32460	24199	8158	2024	-20161
Farm 18	29338	30210	15870	20930	-7548
Farm 19	26832	30609	6684	9267	-15340
Farm 20	22089	30741	9596	16972	-14553
Farm 21	17532	26662	5031	10722	-21587
Farm 22	17806	27533	6731	11342	-22169
Farm 23	33911	29484	13531	18742	-15054
Farm 24	27107	36655	11086	14658	-18957
Farm 25	28063	46626	11863	17777	-7495
Farm 26	27362	25863	4583	3595	-24364
Farm 27	18342	25907	3662	14443	-18224
Farm 28	22898	32107	8443	16554	-18600
Farm 29	16759	33300	9865	15638	-15139
Farm 30	44400	37945	17716	16299	-13893
Average	27032	33262	12904	16187	-14085
St. Deviation	6305	5647	5585	7218	4421
Upper limit	33336	38909	18489	23405	-9664
Lower Limit	20727	27616	7319	8969	-18507
Distribution	0,23	0,17	0,43	0,45	-(0,31)

Table 35: Results profits for 30 farms (1998-2002).

No of farm: Year	1998	1999	2000	2001	2002
Farm 1	12684	16496	-4997	1576	-26043
Farm 2	9679	13278	8	5573	-21519
Farm 3	7526	17767	-3335	-1468	-24796
Farm 4	15712	22641	5909	-1167	-25590
Farm 5	5838	18986	904	449	-24363
Farm 6	8109	18129	864	4408	-20942
Farm 7	17403	18949	877	3355	-21884
Farm 8	10300	15140	-4367	1192	-24259
Farm 9	17752	23027	1351	8180	-24843
Farm 10	3563	13058	7266	-4281	-22983
Farm 11	8165	25677	5810	18824	-19499
Farm 12	5884	28325	10488	24214	-25891
Farm 13	12385	24866	6734	8025	-23754
Farm 14	17707	17851	510	9398	-21347
Farm 15	14133	18575	-3323	4653	-21589
Farm 16	17207	24993	7070	10917	-23236
Farm 17	15460	8432	-6375	-11276	-32227
Farm 18	12338	14443	1337	7630	-19615
Farm 19	9832	14842	-7849	-4033	-27407
Farm 20	5089	14974	-4937	3672	-26620
Farm 21	532	10895	-9502	-2578	-33654
Farm 22	806	11766	-7802	-1958	-34236
Farm 23	16911	1377	-1002	5442	-27120
Farm 24	10107	20888	-3447	1358	-31024
Farm 25	11063	30859	-2670	4477	-19561
Farm 26	10362	10096	-9950	-9705	-36431
Farm 27	1342	10140	-10871	1143	-30291
Farm 28	5898	16340	-6090	3254	-30667
Farm 29	-241	17533	-4668	2338	-27205
Farm 30	27400	22178	3183	2999	-25960
Average	10365	17829	-1296	3220	-25819
St. Deviation	6313	5621	5671	7133	4557
Distribution(SD/Ave)	0,61	0,32	-(4,38)	(2,21)	-0,18
Upper limit	16678	23450	4376	10353	-21262
Lower Limit	4052	12207	-6967	-3912	-30375