A STRATEGIC ANALYSIS OF CARP CULTURE DEVELOPMENT IN IRAN

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DEDICATED TO:

My wife, Kobra

Who proved to be very patient and helpful during my study,

she looked after every body at home,

how deeply I am indebted to her.

To my son Mostafa who was very helpful to me.

To my dear daughter Zahra.

DECLARATION

I, Hassan Salehi, hereby declare that all the work embodied in this thesis has been carried out by myself, and has not been submitted for any other qualification or degree. Any results or comments of others used in this thesis has been specifically acknowledged by references.

Candidate Signature ....Hassan Salehi

Supervisor Signature ....

Supervisor Signature ....

Date ..25 January 2000.

IN THE NAME OF GOD

THE MERCIFUL, THE COMPASSIONATE

My God!

To You is due all praise, always and forever,

eternally, increasing, not diminishing, as You like and please.

My God!

Provide me with a heart, the passion of which may bring it near to You; with a tongue, the truth of which may be offered up to You; and with a vision whose character may bring it nigh to You.

Amen!

(From The Munajat-e- Sha'baniah)

Abstract

The thesis is concerned with the strategic analysis of carp culture development in Iran, based on an assessment of the supply potential from various forms of carp farming, and on the potential demand, market features and price determinants for carp and carp products.

Based on a sample of 188 farms from the three main carp farming provinces plus two case studies, all farmers in all locations and categories made a profit, with feed and fertiliser dominating variable costs. Considerable variation in production costs and profitability was observed. Where some degree of investment and support services have been provided, major increases in output have occurred. The culture of carp is technically possible in a variety of conditions within the country, though, expanding large scale farming mainly depends on reducing the cost of feed and fertiliser. Future targets could be to integrate with other agricultural activities, intensify smaller farms in the Caspian area, and consider developing larger scale commercial production in Khuzestan.

A market and consumer survey was conducted, including a sample of 357 consumers in Tehran and Karaj, and 96 sellers in 11 main cities from 6 provinces. Younger consumers had the strongest preferences for ready meals product, while to increase consumption, a rise in income and decline in price will have a greater effect on older groups, larger sized families and educated people. The growing willingness to buy new product forms, particularly by younger consumers, educated groups, inland urban dwellers and high-middle income groups might be expected to increase demand.

A range of supply/demand scenarios has been presented, offering projections for the year 2010, suggested target levels of 284,000-348,000 t. In broad terms a policy for carp production was described to meet these targets. As in developing markets elsewhere, the traditional wholesale sector may lose its position as multiple retailers and supermarket chains become increasingly important outlets for carp and its products, and opportunities may arise for adding value in a range of ways. Within rural areas, and smaller cities, consumers may also increase their ability to buy fresh fish at the farm gate or at local outlets.

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I never forget and always remember my beloved father who passed away when I was in Stirling (God bless his soul!).

List of abbreviations

BhC	bighead carp
CBI	Central Bank of Iran
CC	common carp
CDSD	Comprehensive Development Studies Department
ECO	Economic Co-operative Organisation
FAO	Food and Agriculture Organization of the United Nations
FCR	food conversion ratio
FFYDP	First Five Years Development Plan
GC	grass carp
GIS	Geographical Information Systems
GDP	Gross Domestic Product
GNP	Gross National Product
HVP	high-valued product
IFCO	Industrial Fishing Company
IFRTO	Iranian Fisheries Research and Training Organisation
PBO	Planning and Budget Organisation
R&D	research and development
SC	silver carp
SCI	Statistical Centre of Iran
SD	standard deviation
SFYDP	Second Five Years Development Plan
TFYDP	Tired Five Years Development Plan
TAP	total animal protein
TC	total cost
TFC	total fixed cost
TVC	total variable cost
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization

TABLE OF CONTENTS

LIST OF FIGURES

APPENDIX FIGURES

LIST OF TABLES

APPENDIX TABLES

Chapter one

1. Introduction

1.1. Background

This thesis is concerned with the strategic analysis of carp culture development in Iran, a large and rapidly developing country whose pattern of supply and demand may be expected to change markedly over coming years. Carp farming is currently the most important sub-sector of fisheries and its rapid development has attracted considerable attention for animal protein supply during last decade. Three issues are addressed and sought in this thesis: the determinants of the micro-economic structure of carp farming, the role and impact of cultured carp on the fish market and the development of the carp culture industry.

Before developing the main themes of the work, it is important to provide some background to the state, its resources and its people. The Islamic Republic of Iran (henceforth referred to as Iran) covers an area of about 1.6 million square kilometres (Statistical Centre of Iran (SCI), 1994), and has a population of about 60 million in 1994. Across the 25 provinces in Iran, distribution ranges from the most densely populated, the northern provinces Gilan and Mazandran, the western provinces and Tehran, to the sparsely populated areas in eastern and southern provinces such as Sistan-Baluchestan and Hormozgan (Table 1.1). In 1982 the balance was 51% in urban[1] and 49% in rural[2] areas, while preliminary statistics published in 1997 showed a change to 61% urban and 39% rural for 1996 (Haghy, 1997), (Figure 1.1), (see details in Appendix

[1] - The area with municipality and mayor are known as urban area (SCI, 1994 *op.cit*).

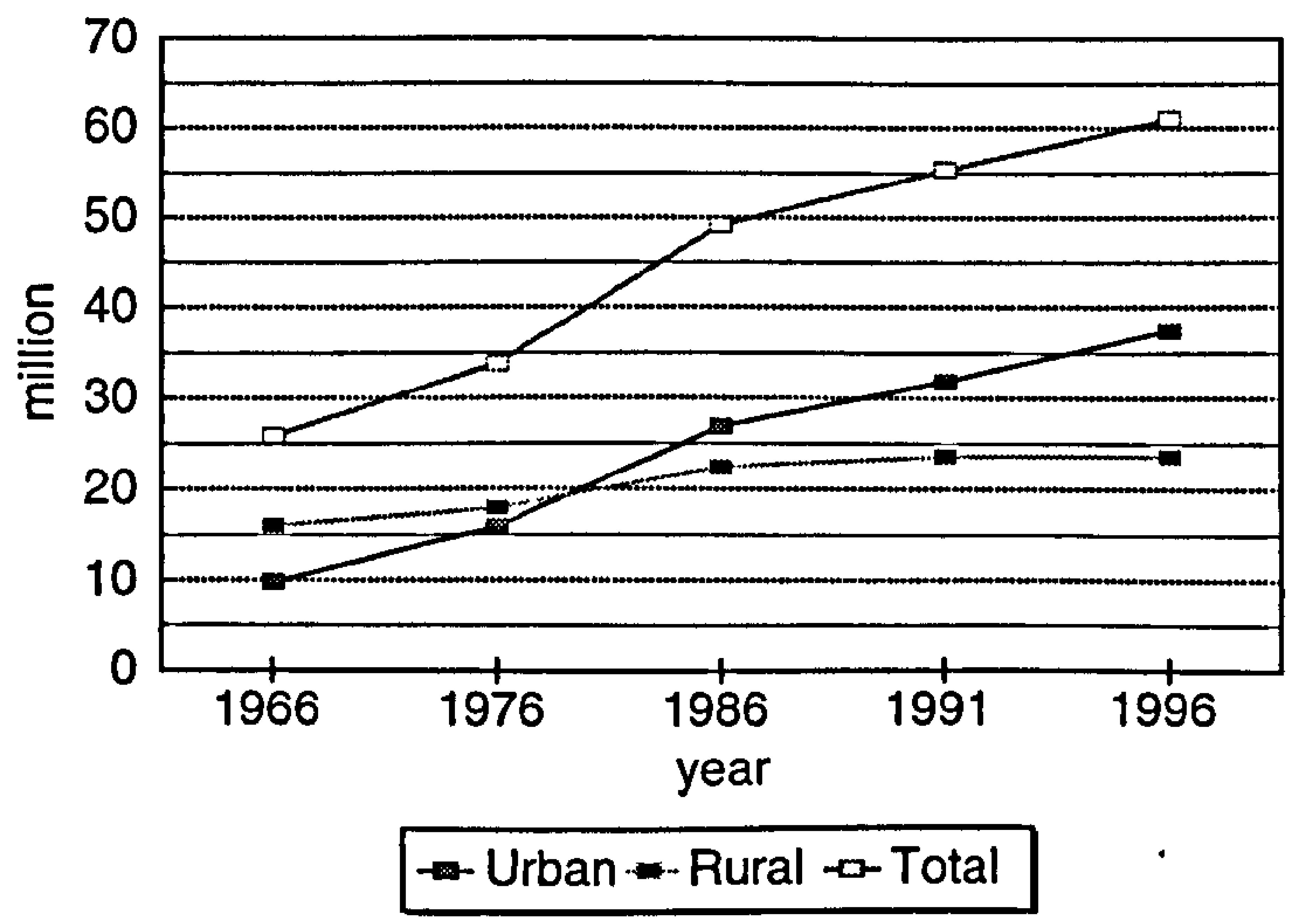
I), a significant measure of migration from rural to urban areas. Over the 1991-96 period, population has grown 2% annually, falling from a previous high of 3.8% (World Bank, 1995). While the urban population has grown by 3.3% annually, the rural population has stabilised. A consequence of the high birth rate in recent years is that 55% of the population is under 19 years of age (SCI, 1994 *op.cit*), presenting a real need for employment opportunities, and a structural change in the composition of the population which will impact upon subsequent generations, and their needs, including food.

Table 1.1: Population, area, and density of population in provinces in 1991.

Group	No. of province	Population (000)	Area (km^2)	Density per km^2
1	2	12186	55656	>100
2	8	17795	257673	Between 50-85
3	7	14011	388790	Between 25-50
4	4	9241	585827	Between 10-23
5	3	2604	342620	<10
All	24	55837	1630569	34

Provinces were grouped based on their population density.
Source: SCI, 1994 *op.cit.*

Figure 1.1: Population and distribution trends in Iran.



Source: SCI, 1994 *op.cit* (for 1966...1991)
and for 1996 (Haghy, 1997 *op.cit*).

Since the end of the Iran-Iraq war in 1988, Iran has undergone a process of economic transition, changing from a government controlled military economy towards a more

[2] - Areas without municipality and mayor are known as rural area (SCI, 1994 *op.cit*).

liberal and market oriented economic structure. In 1989, Iran embarked on a major programme of reconstruction and economic reform based on its "first five years development plan[3] ", (FFYDP) largely with its own resources, aiming to reform and rebuild the economy, damaged during the protracted and highly destructive war[4]. Key aspects have been privatisation and the removal of subsidies, and these and other policies have led to several positive achievements (Khadempour, 1996).

However, though recent changes have occurred, the government continues its policy of subsidising certain goods and basic foodstuffs, including bread, oil, petrol and occasionally butter, milk, medicine and some meat products. Prices for some products, such as bread, medicine, and petrol are almost fixed or have a very low price growth, while supplies of others such as oil, rice, and sugar, are partially issued through coupons. However, meat or fish are not included. In any event, there is a tendency gradually to reduce subsidies and allow the free market to operate fully. Examples are the price of subsidised bread which has doubled over the past two years, and based on the "second five years development plan", (SFYDP), an increase in the price of petrol of 20% per annum.

Key factors contributing to the government's decision making have been the large population growth, as well as the attempt to optimise management of the economy by privatisation. An important development has been the growth of the co-operative movement. According to the Iranian constitution, the economy consists of three sectors, the public sector, the co-operatives and the private sector (Abzigostar, 1996). Developments in the economy after the Islamic revolution in 1979, have favoured an

[3] - 1988-1993

immense growth of the public sector, limiting the scope of non-Government developments. However, since the beginning of the FFYDP the tendency has been to the unload some of the responsibilities from the public sector. In 1991, to emphasise its commitment and to promote the co-operative sector, the Iranian government established a Ministry of Co-operatives, with the aim of easing the pressure on the public sector and its budget, and of mobilising capital into co-operatives which would then manage development projects. The success of its policy has been reflected in growth figures; the number of co-operatives related to production, distribution, and services in 1989 was 5,225, 14,209, and 299 respectively, reaching 8,015, 21,781, and 1,741 in 1996 (Mirzadeh, 1997 *op.cit*).

Another key social development has been rapid urbanisation, as indicated earlier. Job opportunities, living standards, literacy levels, growth of student numbers in universities, growth in the role of women[5] in society (such as employment, responsibility and decision making) and better facilities in urban areas have all contributed to net migration. However, all of these key factors have also improved more recently in rural areas. In overall terms, and as indicators of development the percentage of population under the poverty line has declined from 47% in 1975, to 17% in 1995, while the number of university students has risen from 447,265 in 1989 to 1,300,000 in 1996, 44% of whom are female (Mirzadeh, 1997 *op.cit*).

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[4] - It is estimated that Iran sustained damages of US\$ 1000×10^9 during eight years of the war imposed on the country, 1980-1987 (Mirzadeh, 1997).

[5] - E.g. female literacy rate which stood at 35% in 1979 has risen to 75% in 1995 (Mirzadeh, 1997 *op.cit*).

1.2. Macro-economic indicators

A number macro-economic indicators is available to describe the process of development in Iran, summarised as follows:

Gross Domestic Product (GDP) and Gross National Product (GNP)

To measure whether a country is progressing towards satisfying more of its population's needs, the volume of goods and services that can be produced through its economic activities, needs to be defined. For this purpose, GNP is defined as the total market value of all final goods and services produced by the economy (Jolly and Clonts, 1993) including external earnings by the nation, minus earnings by foreigners who work or invest in the country. GDP defines the total market value generated internally by the nation and by foreigners who work or invest in the country[6]. In Iran, apart from the most recent 2-3 years, there is little notable difference between GDP and GNP, indicating the relative unimportance of external earnings (Table 1.2), (see details in Appendix I).

After the revolution of 1979 the Iranian economy can be described in three periods. From 1979 to 1985, the economy initially stagnated, but grew from 1981 with rising oil prices, continuing until the end of 1985. Over the second period, up to 1988, the oil price strongly decreased, war continued and the economy again declined. The third period started in 1988 and continues; up to 1995, the economy initially grew very rapidly but then slowed down. Real GDP declined 11% during 1980-81, increased up to 1985, then declined an average 7% per year during the second period (up to 1988),

[6] - According to Hall and Taylor (1993) "GDP refers to production during a particular time period (year). GDP is the flow of new products internally during the year.
GDP = Consumption + Investment + Government purchases + Net exports (Exports - Imports)
GDP can be computed by adding up products of all goods and services in different industries in the country, or as the sum of the value added by all the firms located in the country.

followed by growth of real GDP of an average 7% per year in third period (see Appendix I).

As Table 1.2 shows, the Iranian economy remains heavily dependent on oil, accounting for 19% of GDP in 1994, although falling from 51% in 1974 and 30% in 1978. However, the economy is gradually diversifying with a rising share of manufacturing goods, agriculture and other main groups.

Table 1.2: Major economic groups in GDP (constant 1982 price).

Year	1974	1980	1982	1985	1989	1992	1993	1994
GNP (bR)*	9395	9560	10540	12058	9797	12986	13371	13582
GDP (bR)	9466	9556	10540	12072	9781.5	12879	13084	13181
Agriculture %	15	20	20	21	28	26	27	28
Mining %	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Manufacturing %	8	10	9	10	14	16	15	16
Oil %	51	9	18	14	19	20	20	19
Others	25.6	60.4	52.4	54.4	38.4	37.4	37.4	36.4

*: bR: billion Rials, Source: SCI, 1991...1996.

As shown in Table 1.2 the agriculture sector is the most important contributor to the economy, varying from 15% of GDP in 1974 to 20% in 1980 and to 21% in 1985. Though the share of agriculture grew to 28% in first year of the FFYDP, its importance has been declining over the years 1990-93. The agriculture sector is not as closely linked to foreign trade as other economic groups such as industrial manufacturing and mining, though, the effect of oil export in the agriculture sector has been negligible over the last two decades.

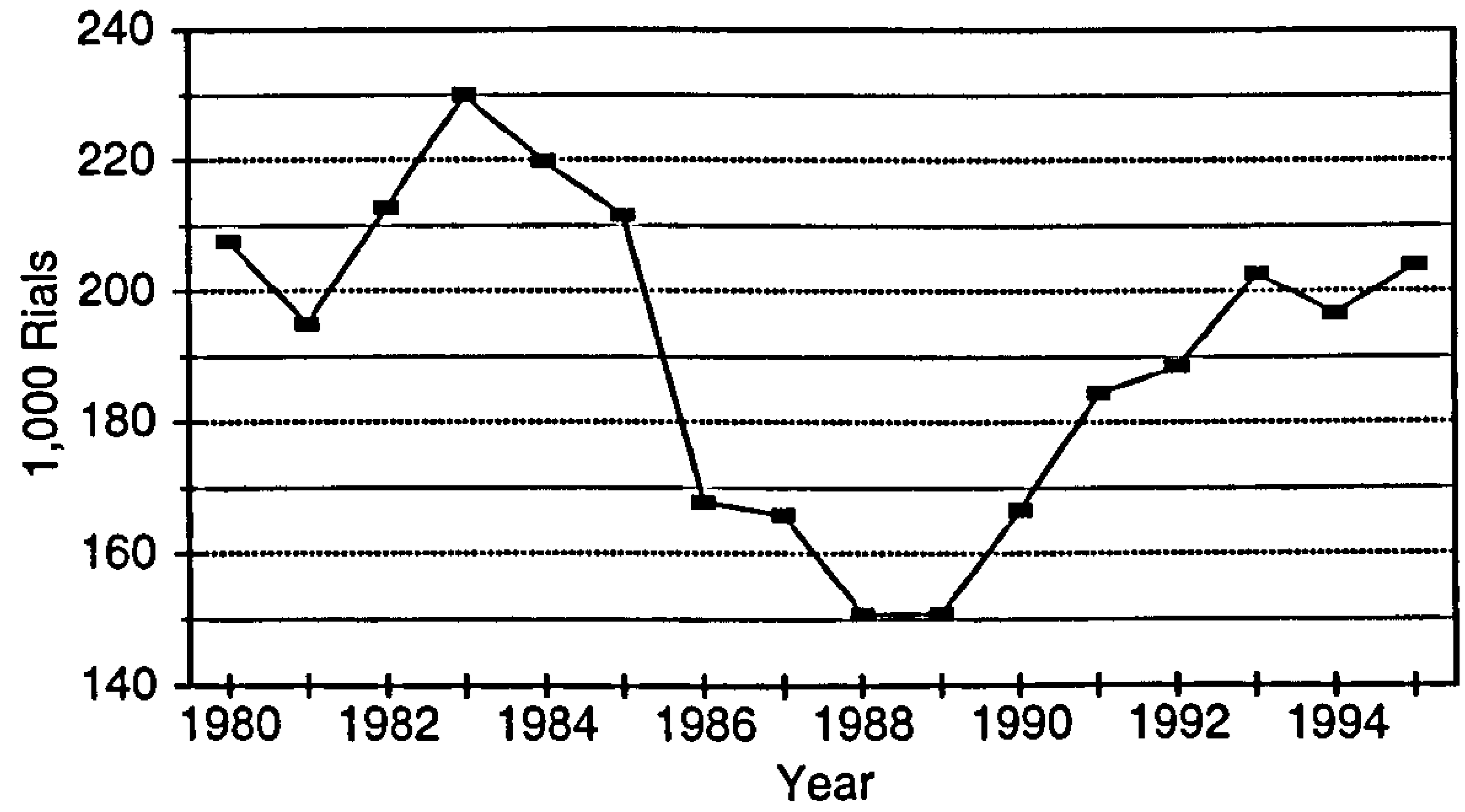
The price of oil strongly reduced in 1993, and had a negative effect on the economy (Central Bank of Iran (CBI), 1995). *Per capita* income also varied; as shown in Figure 1.2, in constant 1982 prices rising to a peak of 230,000 Rials[7] in 1983, declining to a

* GNP = GDP + income from the rest of the world by nation - income to the rest of the world by foreigners.

7 - The exchange rate of R 1 to US$ was 0.011983 (or US$ 1=R 83.45) in 1982 (see Appendix III).

lowest level of 151,000 Rials in 1988, and increasing again to under 204,000 Rials in 1995.

Figure 1.2: ***Per capita*** **income over the years 1980-95 (constant 1982 price).**



Source: CBI, 1992, 1993[c], 1994...1997.

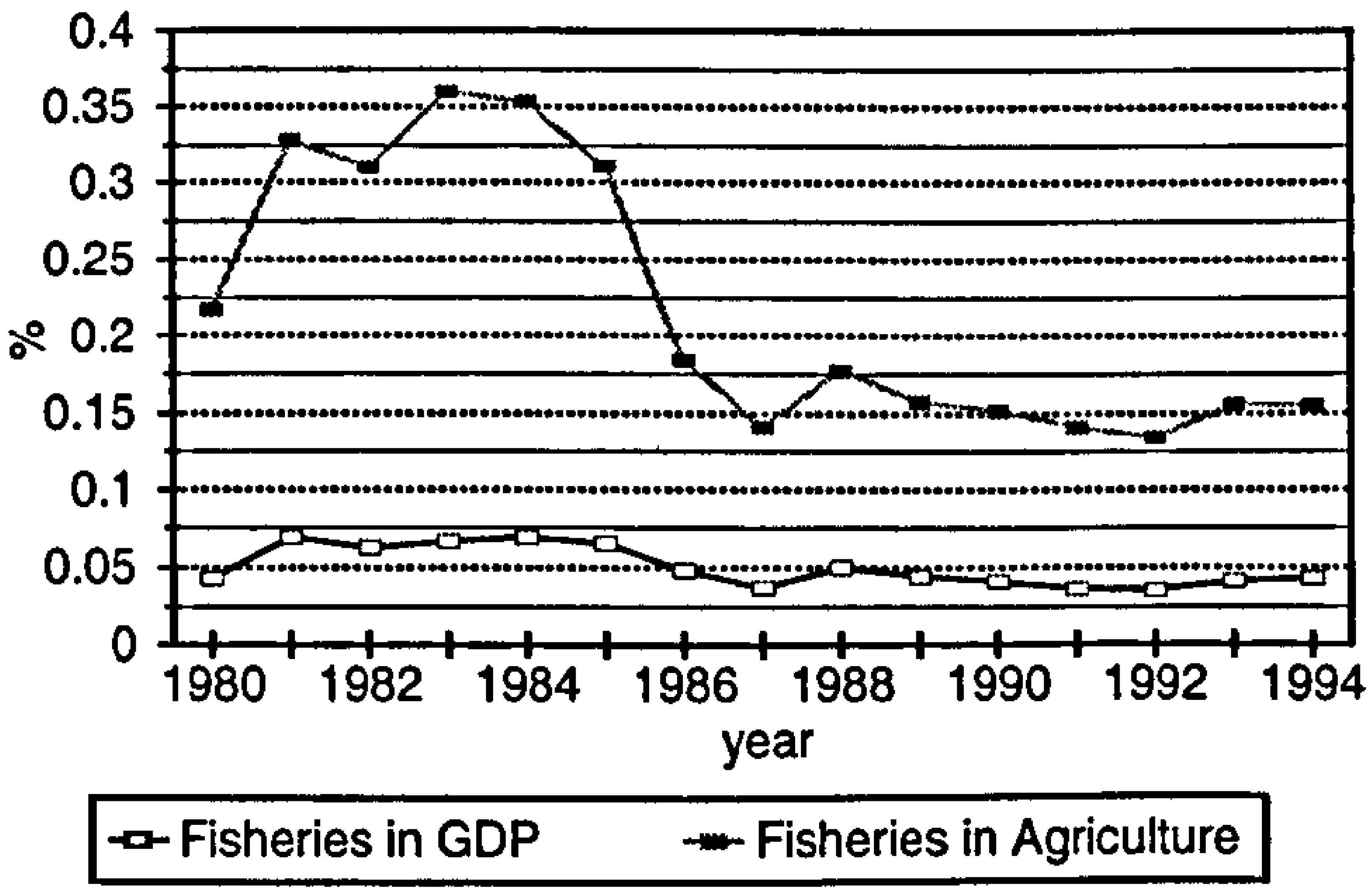
Employment

In 1979, the population of the country was some 38 million with an unemployment[8] level of 11.4%, rising in 1988 to around 53 million people and a peak level of 14.4%. From the start of the FFYDP in 1989, unemployment decreased over 3 percent. In 1991 the economically active population was assessed by the national census to be about 14.7 million, with an unemployment level of 10.9% (CBI, 1992 *op.cit*), further reducing to 10.5% in 1993. Based on Central Bank data (CBI, 1996 *op.cit*) the 1995 population was around 60 million, with an unemployment rate of around 10.7% for the economically active population of 17.7 million. The government policy is to develop production, establish co-operatives and provide credit to reduce the rate of unemployment (PBO, 1993).

The contribution of the total active population engaged in the agriculture sector reduced steadily from 33% in 1974 to 22% in 1993 (CBI, 1992, 1993[a], 1993[b], 1994, 1995 *op.cit*).

The employment share in industrial manufacturing and mining decreased from 18% in 1974 to 11% in 1988[9], though under the FFYDP this has risen to near 17% in 1993 (SCI, 1992...1995 *op.cit*).

Figure 1.3: Contribution of fisheries sector in national economy.



Source: CBI, 1992, 1993[a], 1993[b], 1994...1996 *op.cit.*

As Figure 1.3 shows, the fisheries sub-sector represent a minimal portion of the national economy and agricultural sector (0.04% and 0.16% respectively by 1994). However, though the fisheries sector is unimportant in national economic terms, its contribution is important in the coastal provinces, for which Table 1.3 shows the GDP, population and the employment related to fishing and aquaculture.

Table 1.3: Regional economic indicators, 1994.

Provinces	GDP billion rials	Population 1,000	Fishing employment	Aquaculture employment	Onshore employment	Total employment
Khuzestan	452	2868	18278	420	650	19348
Boushehr	79	643	32255	-	1588	33843
Hormozgan	122	823	16479	-	1391	17870
S-Baluchestan	164	1290	10226	588	700	11514
Gilan	377	2200	5886	11790	730	18406
Mazandran	614	3618	5724	2298	160	8182
Other	-	-	925	842	550	2317
Total coastal provinces (% of country)	1808 (14%)	11444 (19%)	88848 (99%)	15096 (95%)	5219 (90%)	109162 (98%)

Source: Abzigostar, 1996 *op.cit.*

[8] - As defined by Hall and Taylor (1993 *op.cit*) unemployment rate, which is the percentage of the labour force who are not working but who are looking for work.
[9] - In 1988 the war was stopped.

As a percentage of the overall population in coastal provinces, 5% in Boushehr, 2% in Hormozgan, 0.8% in Gilan, 0.7% in Sistan-Baluchestan, 0.6% in Khuzestan, and 0.2% in Mazandran engage in the fisheries sector. With the exception of Gilan, and to a slight extent, Mazandran, the contribution of aquaculture to employment is negligible. However, it is expected, over the coming years, with the development of aquaculture, and fisheries industries (such as fishing facilities, processing, marketing and other services), not only will the employment of fishery sector increase but its contribution to the national economy will also increase, and coastal provinces become particularly significant.

Inflation

Inflation has had a significant impact on production and consumption in the fishery sector as elsewhere. The relative changes in input costs and value is discussed in next chapters. According to the Central bank of Iran (CBI, 1992...1996 *op.cit*), the annual rate of inflation based on the standard consumer price index (CPI)[10] was between 15-25%, over the period 1974-1979, between 10-29%, in the war era and more than 17% in 1989 to more than 24% in 1994 (World Bank, 1995 *op.cit*), peaking to a level of 48% in 1995 (Abzigostar, 1996 *op.cit*) and declining again to 24% in 1996 (CBI, 1997). The average rate of inflation was 25% over the years 1989-1995; this rate declined to less than 20% by 1997 (Mehnatfar, 1999). Inflation depends on many factors, and the government aims to reduce its rate.

[10] - Consumer price index (CPI) is a measure of the average level of prices for commodities purchased by consumer (Jolly & Clonts, 1993 *op.cit*), normally based on goods; in Iran defined by the Central Bank and usually changed every 3-4 years.

Balance of trade

In Iran, trade is highly dependent on oil exports, the trade balance varying markedly with changes in the oil price. During 1979-1985, especially over 1981-85, the price of oil increased, and consequently the Iranian economy also improved, while over the years 1986-88 the price of oil strongly decreased and the economy stagnated. In 1986, oil export income was less than US$ 6 billion, compared with almost US$ 21 billion in 1976. However, once the FFYDP started and the government commenced in its aim to generate income from exports of non-oil commodities and services, both exports and imports increased over 1989-93 (Table 1.4), with a significant impact on the Iranian economy. In 1988 total exports were US$ 10.71 billion, of which only US$ 1.04 billion (~10%) were non-oil commodity exports. As shown in Table 1.4, in 1991 total exports increased to US$ 18.66 billion, of which US$ 2.65 billion (14%) were from non-oil sources and in 1994 exports increased to US$ 19.43 billion, of which US$ 4.83 billion (~25%) were non-oil. In 1995, due to a change in government policy[11] non-oil exports declined to US$ 3.23 billion, (almost 18%) of total exports of US$ 18.38 billion. The trade balance declined from US$ 0.1 billion in 1988 to US$ -6.53 billion in 1991, recovering to US$ 6.82 billion in 1994, and US$ 5.7 billion in 1995.

Table 1.4: Oil & non-oil exports, and total commodities imports.
Unit: billion US$.

Year	Oil income	Non-oil income	Total exports	Total imports	Trade balance (million US$)
1971	2.1	n	n	n	n
1976	20.6	n	n	n	n
1986	6	n	n	n	n
1988	9.67	1.03	10.7	10.6	101
1991	16.01	2.65	18.66	25.2	-6529
1993	14.33	3.75	18.08	19.29	-1207
1994	14.6	4.83	19.43	12.62	6817
1995	15.14	3.23	18.37	12.68	5697

Source: CBI, 1992...1996 *op.cit.*
n: Not available

[11] - In 1995 government decided to control the price of foreign currency, requiring exporters to sell their foreign currency to the Central bank, creating a negative impact on non-oil exports.

The country's economic planners are trying to stimulate the export of non-oil goods as much as possible (Khadempour, 1996 *op.cit*), encouraging Iranian merchants and exporters to engage in export and to develop a presence in international markets, by providing support and facilities. At the same time, with the establishment of various important basic industries in the country, import needs for various goods and services have been reduced. The government continues to view the exports of non-oil goods as an important task; Khadempour (1996 *op.cit*) suggested that the country has a sustainable natural and human resources potential to allow for diversification of its economy, and that its climatic range enables Iran to produce a variety of agricultural crops and fishery products, which can help develop its food industry. Looking ahead, the long-term outlook seems promising, as a substantial potential resources including natural gas, a wide range of gas and minerals, steel, petrochemicals, a variety of agricultural products, tourism and handicaps industry will allow for greater diversification of Iran's economy. The Government is seeking to establish an appropriate incentive structure to enhance efficiency and productivity in the use of natural resources and to create a proper environment for the private sector to ensure sustained and rapid economic growth. The economic reforms which started in 1989 are likely to continue including an increase in free trade zones, and the opening up of access for foreign investments.

1.3. The role of the fisheries sector

According to Schmidtsdorff (1995) almost 1% of people's food[12] is fish, and nearly 10% of animal protein intake is fish protein. As indicated by FAO (1997[a]) data, fishing, essentially a form of hunting, still provides the majority of fish, but catches from nature are approaching their limits, and aquaculture is rapidly increasing its contribution.

Westlund (1995) indicated that the forecast demand for fish for direct human consumption up to 2010 will grow faster than the sector will be able to supply. The world is facing increasing demands for food supply, and has a need for higher quality food resources, in which aquatic products are an important component (UNDP, 1994). It has often been suggested that aquaculture will expand to compensate for shortfalls from catches, and the present trend, with aquaculture as the only fisheries sector to be increasing, would appear to support this contention (Welcomme, 1994). Muir (1995) proposed that aquaculture is capable of significant development, and may in at least some circumstances help to address increasing problems of food supply and food security. However, he noted that its dependence on natural resources, and its potential for placing greater demands on these, may place it in direct competition and possible conflict with other demands.

In Iran, over the last two decades, the share of the fishery sector (including fisheries and aquaculture) has been very variable, though at a relatively low level accounting for between 0.03% to 0.06% of the GDP. Three basic fisheries resources in Iran collectively impact on the national economy, and individually impact provincial economies, especially in coastal provinces;

• The northern capture fisheries; marine fisheries in the Caspian Sea, comprising the provinces of Gilan and Mazandran.

• The southern capture fisheries; marine fisheries in Persian Gulf and Oman Sea, comprising the provinces of Khuzestan, Boushehr, Hormozgan, and Sistan-Baluchestan.

• aquaculture and inland fisheries, comprising the intensive, semi-intensive, and extensive warm and coldwater[13] aquaculture systems throughout the country. These are located largely in Gilan, Mazandran, Khuzestan, and Tehran provinces, but the fisheries of natural and artificial waterbodies such as Hamon Lake, Aras Dam, and etc., and their surrounding wetlands are distributed throughout the interior provinces.

Table 1.5: Percentage regional economic indicators (value-added[14]), 1995.

Province	Fishing industry	Aquaculture & inland fishery	Onshore processing	Other onshore	Total fisheries
Khuzestan	16	32	21	12	17
Boushehr	18	-	22	23	17
Hormozgan	39	-	25	27	35.6
Sistan-Baluchestan	10	-	9	19	9.5
Gilan	9	53	1	15	12
Mazandran	8	8	1	3	8
other	-	6	20	-	1

Source: Abzigostar, 1996 *op.cit.*

Table 1.5 outlines the value-addition of the fishing industry, aquaculture, processing and other related industries in the coastal provinces. This shows the relative importance of Hormozgan in catching sub-sector and total fisheries, Gilan, Khuzestan and Mazandran in aquaculture, and processing in Hormozgan, Boushehr and Khuzestan. In terms of

[12] - Seafood products are derived from various tissues including the whole fish body, muscle, roe, stomach, kidney, liver, skin and fins (Haard, 1995).
[13]- Warmwater refers to species with temperature optima at or above 25°C, coldwater refers to those with temperature optima below 20°C (Stickney, 1994)
[14] - According to Iran Statistical Yearbook (SCI, 1994 *op.cit*), value-added is defined as the price of output at the production place minus the price of its input (raw material). The value-added by a firm is the

sectoral contribution, the fishing industry accounts for 88%, aquaculture 6%, processing 3%, and other 3%.

As Table 1.6 shows, in term of exports, fishery products accounted for US$ 52.8 million by 1994. Caviar represents one of the main agricultural commodity exports, accounting for some US$ 32 million in 1994, declining from US$ 52 million in 1990. Other important export products are shrimp, followed by fresh and frozen sturgeon, cuttlefish, and canned tuna, other fishery products being negligible. The policy is to develop shrimp culture in S coast, increasing its role in exports.

Table 1.6: Main fishery product exports, (1990-1994).

Year	1990		1992		1994	
	t	US$ million	t	US$ million	t	US$ million
Canned tuna	1377	0.11	6830	0.37	7711	0.47
Cuttlefish	17	0.07	267	0.50	715	2.1
Shark	8	0.01	58.2	0.07	97	0.92
Shrimp	2182	6.6	1630	7.80	1188	9.0
Sturgeon	511	3.34	293	2.81	134	0.69
Caviar	251	52.21	169	42.81	156	31.86
Lobster	14.7	0.34	12	Na.	15.4	0.41
Hair tail	Na	Na	Na	1.80	Na	7.37

Source: FAO, 1995[b] and CDSD[15], 1997[a].

Imports of products for direct human consumption are not as high as fishmeal, and recently decreased following a period of high growth in 1991. The balance of trade in fishery products moved from US$ -62 million in 1981 and US$ 37 million in 1990, to a reduced deficit of US$ 6 million in 1992, increasing again to a surplus of US$ 31 million in 1994 (Figure 1.4). The quantity and value of main imported fishery products is shown in Table 1.7. On average, the import of fish meal accounted for 71,500 t annually over the 1991-95 period, and edible fish averaged 21,819 t annually over the same period. In the future, with increased kilka[16], sardine *(Sardinella longiceps, S.*

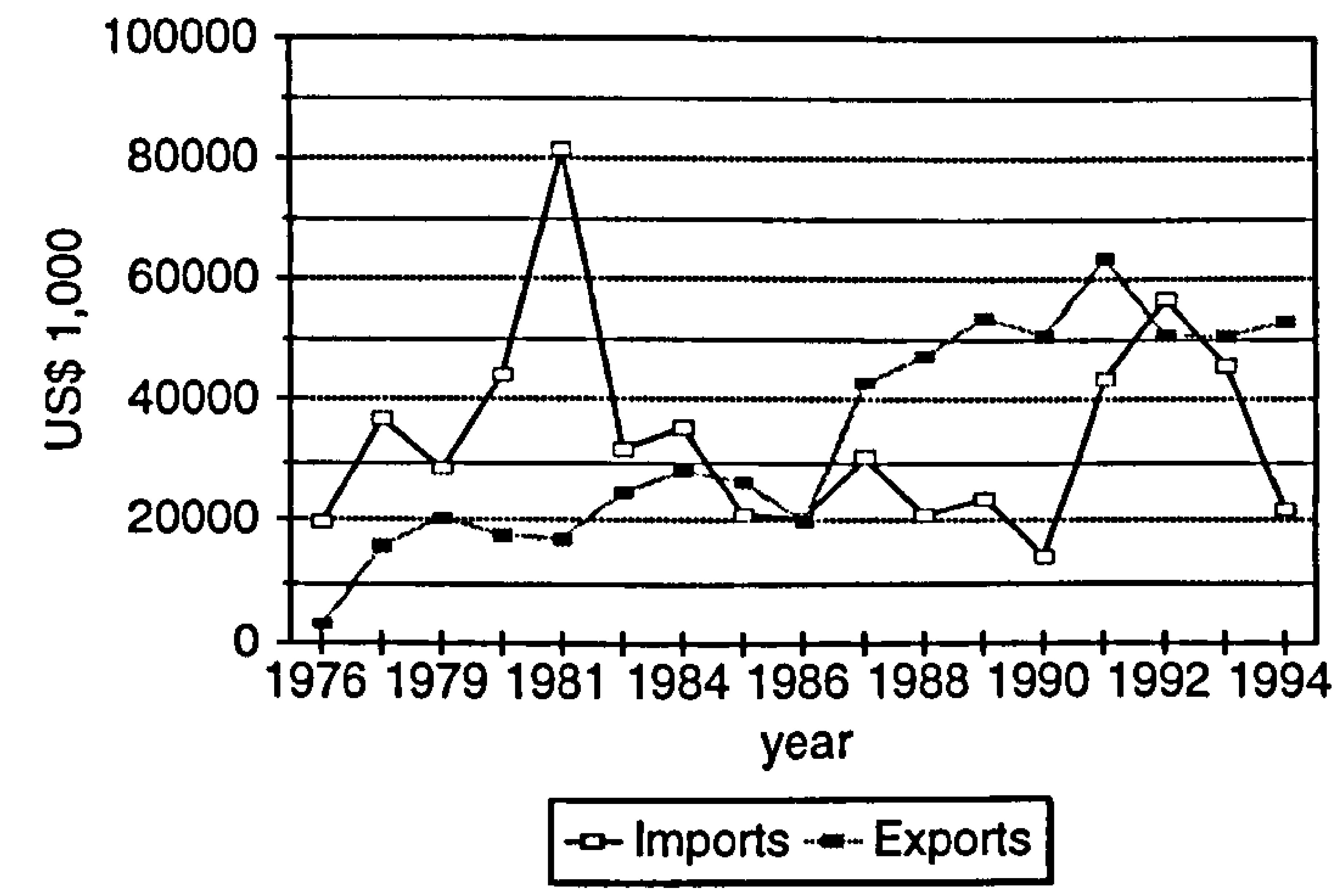
difference between the revenue the firm earns by selling its products and the amount it pays for the products of other firms it uses as intermediate goods.

[15] - Comprehensive Development Studies Department (CDSD) of Shilat.

[16] - Kilka is a Persian name for *Clupeonella spp.*

gibbosa, S. melannura & Dussumieria acta) and mesopelagic production, the import of fish meal may decline, though, with the development of aquaculture and poultry production demand may also increase.

Figure 1.4: Seven[17] fishery commodities groups (imports & exports).



Source: FAO, 1988[b]...1996[b].

Table 1.7: Main imported fishery products, 1991-1995.
Unit: US$ 1,000 (tonnes)

Year	1991	1992	1993	1994	1995
Edible fish v (Q)	15340 (25564)	10620 (27000)	12000 (25000)	10880 (16000)	11939 (15532)
Fish meal v (Q)	28150 (58900)	40640 (84400)	33700 (92300)	21850 (41191)	31800 (80709)

*: Including fresh and frozen, Source: FAO, 1996[b] and 1997[b].

As noted earlier, the contributions of exported fishery product to the non-oil goods group are important, and in 1994, reached almost US$ 52 million of which US$ 32 million (62%) was from caviar, shrimp US$ 9 million (17%), hair tail US$ 7 million (13.5%), and cuttlefish US$ 2 million (4%). Other products made up the balance (<4%). In 1994, for the first time, 19 t of cultured frozen silver carp were exported, valued at US$ 33,600 (CDSD, 1997[a] *op.cit*), mostly to Arabian countries in the Persian Gulf area and to countries north of Iran. Compared with other exported groups, this share is very

[17] - Seven fishery commodities are including; fish; fresh, chilled or frozen- fish; dried, salted or smoked-crustaceans and molluscs; fresh, frozen, dried, salted- crustaceans and molluscs productions and

small, but importantly, as silver carp represent almost 60% of carp production and foreign markets may attract and expand carp culture development.

1.4 Consumption trends

If the fishery sub-sector is to be developed, and able to meet the needs of domestic demand, consumption trends need to be understood. The most important factors which influence demand for fish and fishery products are population and income growth rates, but social factors such as tradition and shifts in eating habits also play significant roles (Abzigostar, 1996 *op.cit*). According to Welcomme (1994 *op.cit*) "changes in consumer patterns are influencing the nature and the distribution of the products of fisheries. Areas where fish are not accepted as a regular item of diet were relatively common, but with increasing education and shortages in food supply such cases are becoming rare. At the same time, the trend to urbanisation is creating demand for more varied diets". Other critical factors include competition with other products, competition with natural catches, red meat, and poultry, local culture, religion, and tradition also play an important role in demand in some regions (Shang, 1981).

The contribution of fish, red meat and poultry consumption is higher in urban than rural populations (Figures 1.5 & 1.6), though all are subject to significant change, and with the 40% decrease of imported red meat in 1993 consumption of meat declined notably (CBI, 1993[b] *op.cit*).

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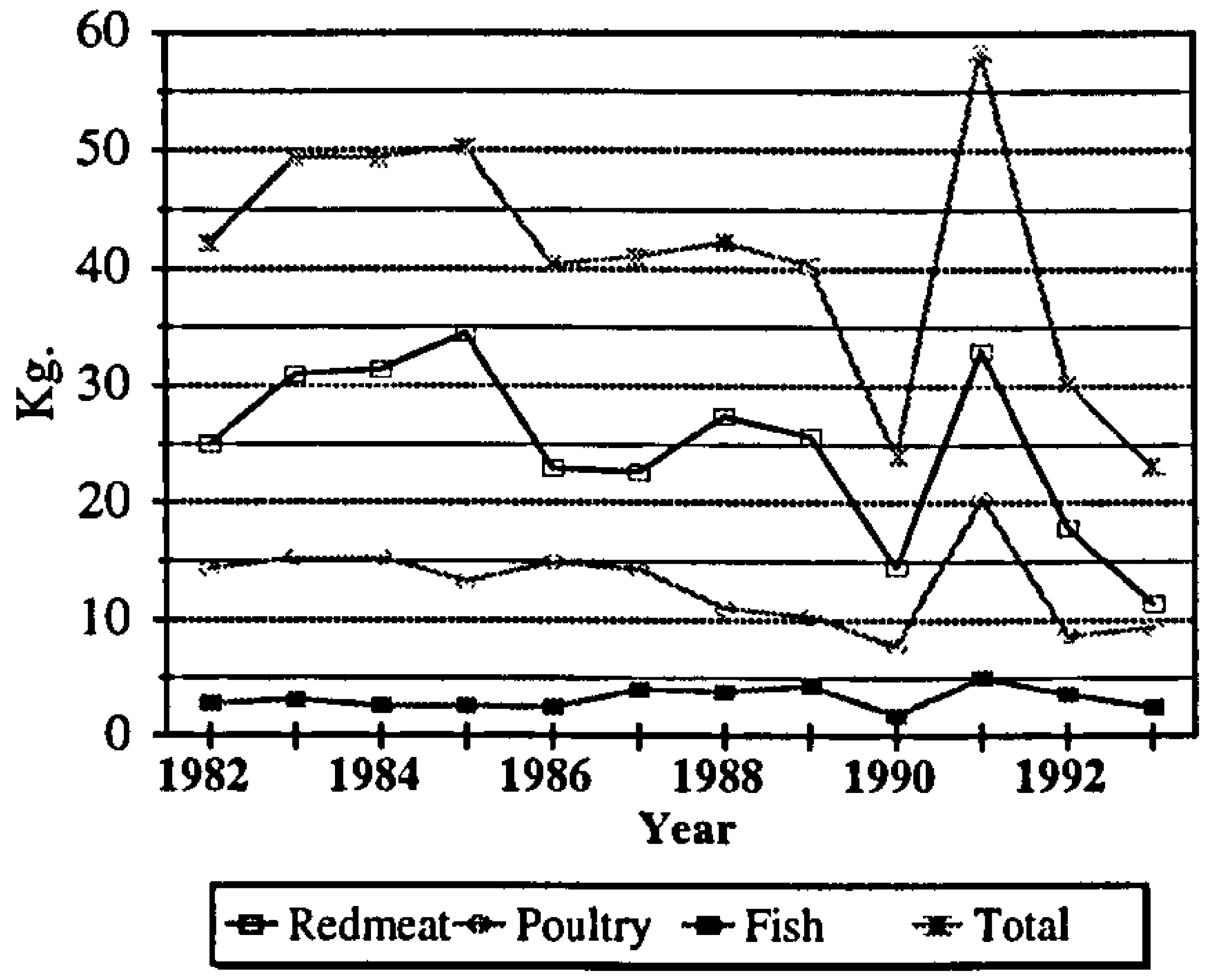
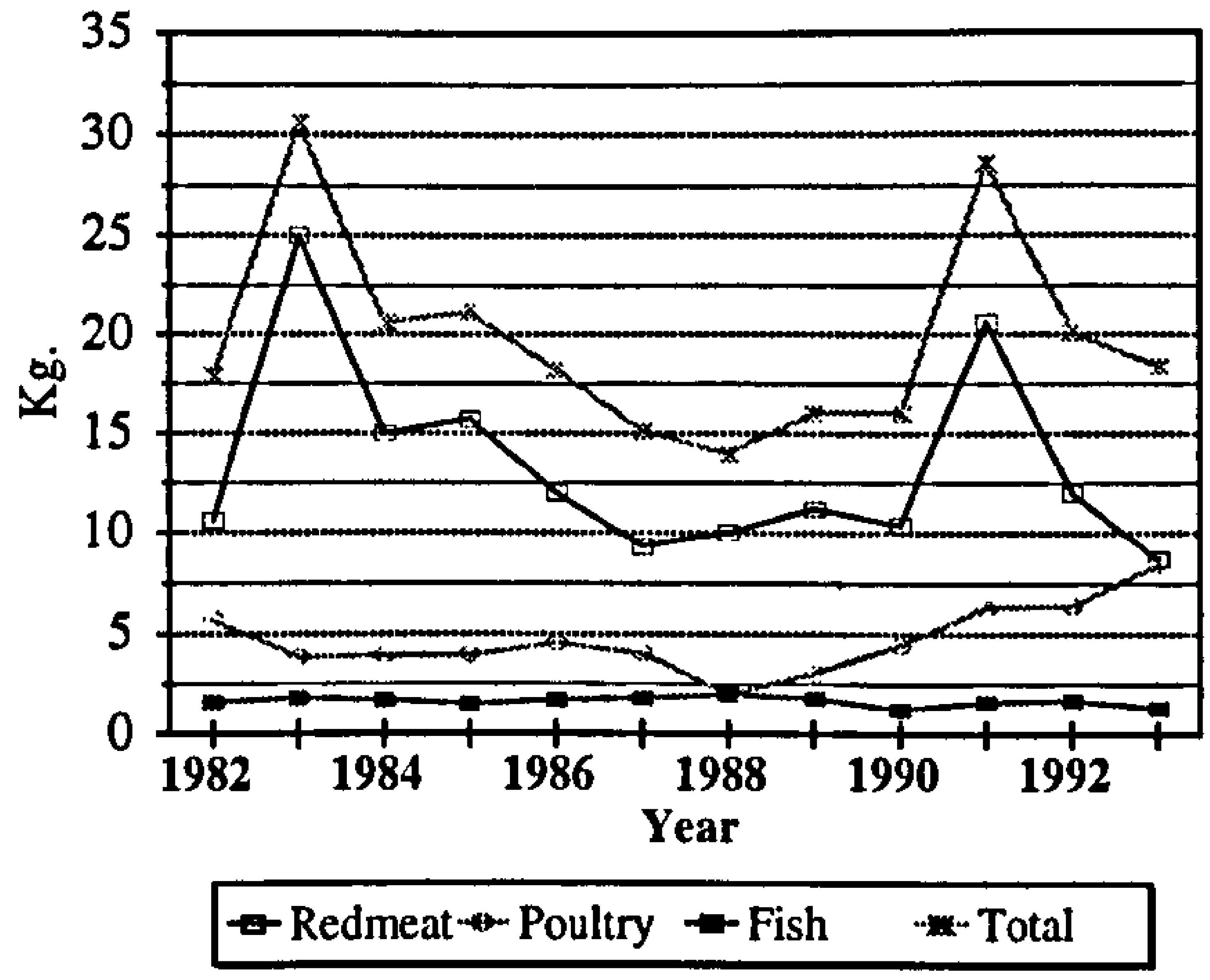
preparations- oils and fats, crude or refined- meals, soluble and similar animal feedingstuffes- caviar and substitutes.

Figure 1.5: Per capita meat consumption in urban areas.



Source: SCI, 1992...1995 *op.cit.*

Figure 1.6: Per capita meat consumption in rural areas.



Source: SCI, 1992...1995 *op.cit.*

Total meat consumption ranges between 23.2 kg to 58.3 kg *per capita* per year in urban areas and 14 kg to 28.5 kg in rural areas over the years 1982-93. In urban areas, the contribution of fish consumption varied from 2.8 kg in 1982 to 5 kg in 1991[18] and then to 2.5 kg in 1993, while there was little change in rural areas. The overall characteristics of total meat consumption over 1982-93 can be described as follows:

[18] - In 1991, based on the growth income from oil and growth import, meat consumption was growing fast up.

(1) In both rural and urban areas, red meat consumption is higher than poultry, which in turn is higher than fish,

(2) Total meat, red meat, poultry and fish consumption is higher in urban areas than in rural areas,

(3) Total meat consumption declined, except in 1991 in urban areas and the years 1983[19] and 1991 in rural areas,

(4) In urban areas, the highest level of fish consumption was 5 kg, compared with 2 kg in rural areas,

(6) The percent share of fish consumption to total meat was higher in urban areas and this share has generally grown.

Statistics based on sampled households (SCI, 1992...95 *op.cit*) showed that, in urban areas, the contribution of fish to total meat consumption increased from 5% in 1982 to 9% in 1991, and declined to 7% in 1993, while in rural areas, it increased from 5% in 1982 to 8% in 1988, and declined to 5% in 1993. *Per capita* fish consumption in urban areas increased from 2.75 kg hd^{-1} yr^{-1} to 5 kg over 1982-91 and declined to 2.5 kg in 1993, while in rural areas, this increased from 1.6 kg to 2 kg over 1982-88, declining to 1.3 kg in 1993. The other important feature is the consumption difference related to income distribution. According to the Statistical Centre of Iran (SCI, 1992...1995 *op.cit*), in urban areas the distribution of expenditure on fishery products by the 20% of national population (classified as higher income household- group U1), 40% of national population (middle income- group U2), and 40% of national population (lower income- group U3), were 71%, 26% and 3%, in 1983 respectively, changing to 51%, 41%, and 8% In 1993 (Figure 1.7). Thus, the expenditure share of lower and middle income

[19] - In 1983, the coupons of meat distributed in some part of rural areas.

households on fishery products gradually increased and for higher income declined over the last decade. In 1995, the contribution of *per capita* expenditure on fish in group U1 was 2.5 times as high as U2, which in turn was 2.9 times as high as U3 (SCI, 1997 *op.cit*). In urban areas, it appears the changes over the 1989-90 is mainly due to changes of expenditures different income groups (Khalatbari, 1999 & Hajimirzai, 1999).

Figure 1.7: Contribution of fish consumption expenditure based on income distribution in urban areas.

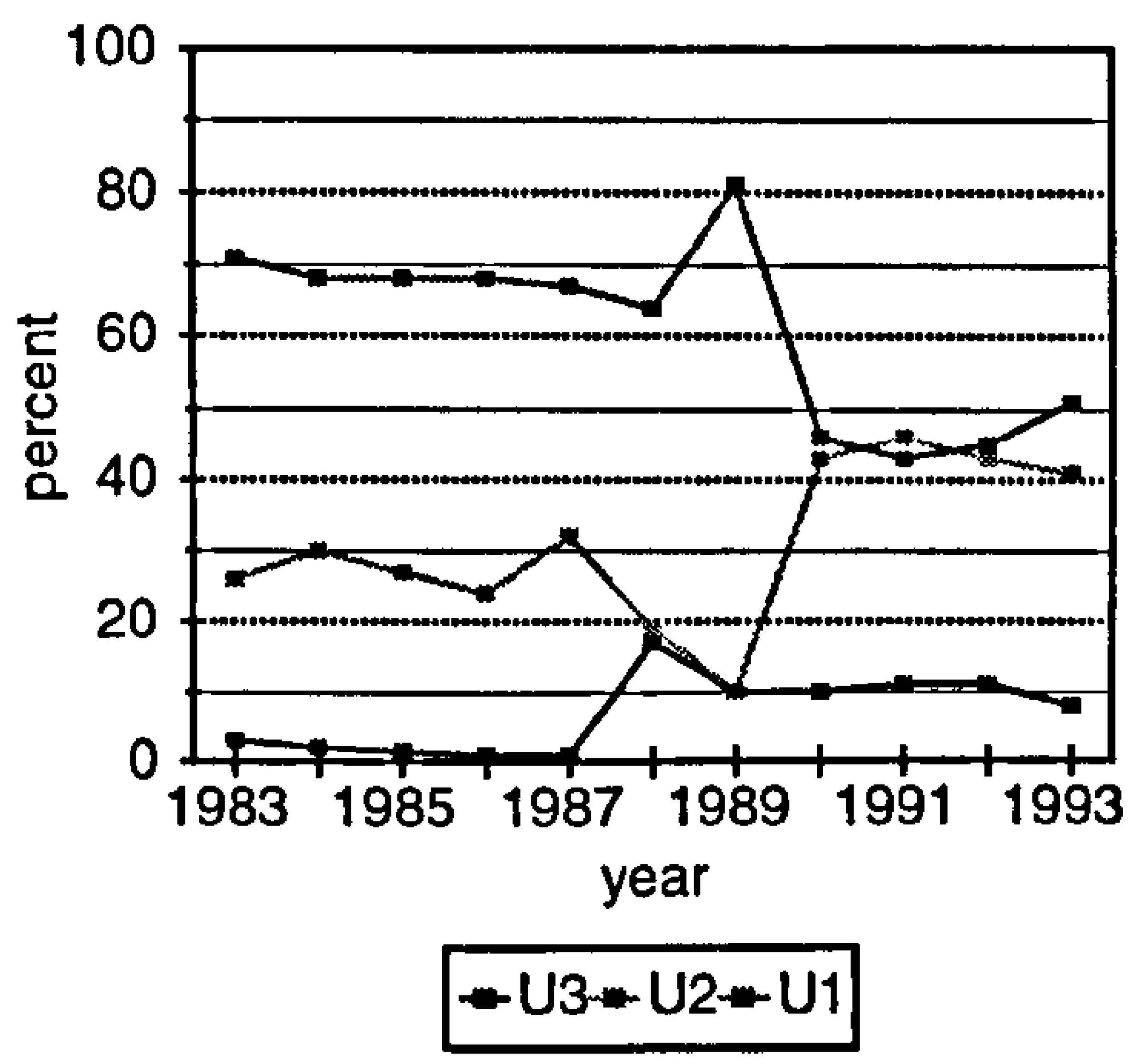
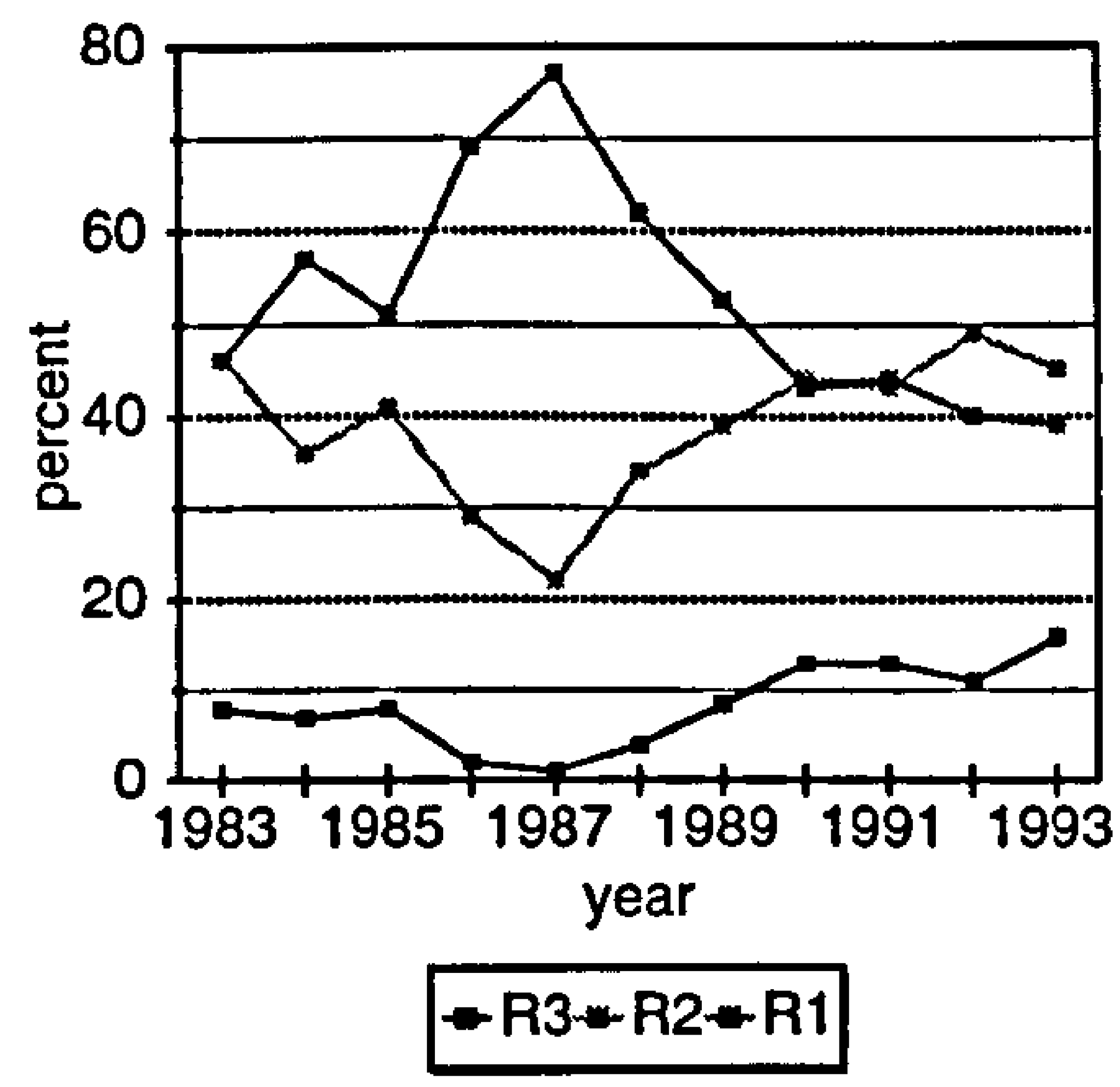


Figure 1.8: Contribution of fish onsumption expenditure based on income distribution in rural areas.

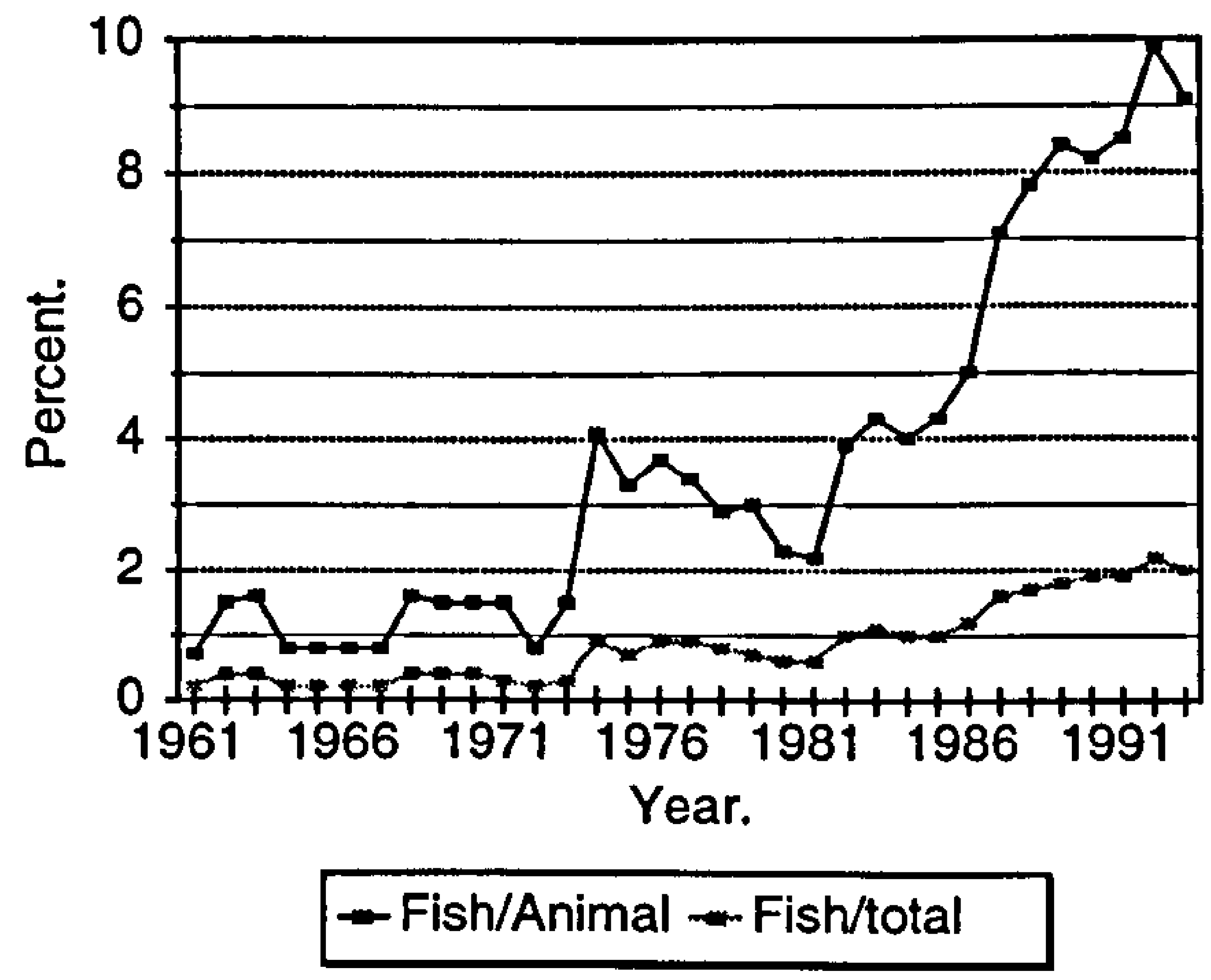


Source: SCI, 1992…95 *op.cit.*

Using the same classification in rural areas, 20% of national population as the higher income household (group R1), 40% as the middle income (group R2), and 40% as the lower income (group R3), the share of expenditure on fishery products in 1983, was 46%, 46% and 8% respectively, changing to 39%, 45% and 16% in 1993 (Figure 1.8), showing less of an income related difference than in urban groups. In 1995, the contribution of *per capita* expenditure on fish in group R1 was 2 times as high as R2, which in turn was 1.9 times as high as R3 (SCI, 1997 *op.cit*). In rural areas, it appears the changes over the 1987-88 is mainly due to changes of expenditures different income groups (Khalatbari, 1999 & Hajimirzai, 1999).

In 1995, the ratio of relative in income grouping for U1/R1, U2/R2 and U3/R3 were 2.2, 1.8 and 1.2 respectively. Thus, in 1995, *per capita* expenditure on fishery product in urban areas was almost twice as high as in rural areas, increasing with income rise. However, differences for red meat and poultry are lower than those for fish.

Figure 1.9: The contribution of fish consumption to total protein* and total animal protein, g caput^{-1} day^{-1} in Iran, 1961-93.



*: Including both vegetable proteins and total animal proteins.
Source: FAO (1996[d]) Fisheries Circular No. 821, Food Balance Sheet (1961-1993).

As national population increased from 22 m to 60 m (~3 times) between 1961-93, the availability of fish proteins moved from 0.1 to 1.6 (16 times) g caput^{-1} day^{-1}, compared to total animal proteins which rose from 13.4 to 17.5 (1.3 times) and total proteins (both vegetable and animal) which increased from 51 to 79 (1.5 times) g caput^{-1} day^{-1} over the same period (FAO, 1996[d] *op.cit*). Based on such trends, fishery product consumption may become increasingly important in providing protein for future needs. The share of fish protein to total animal protein consumption increased from 0.7 % in 1961 to more than 9% in 1993, and the share of fish protein to total protein consumption increased from 0.2% to 2% over the same period (Figure 1.9). However, compared with neighbouring countries, these levels are low. In 1995, apparent fish consumption was estimated to be about 5 kg yr^{-1} *per capita*, compared with 27 kg in Oman, with only Iraq (almost 1 kg) exhibiting lower levels of fish consumption (Abzigostar, 1996 *op.cit*). *Per capita* fish consumption is less than the global average[20] and the average for developed and developing countries. According to Bjorndal (1990) *per capita* fish consumption in developed countries is mainly due to increase in levels of personal disposable income and increased awareness of the health aspects of seafood. In Iran, the contribution of fishery product consumption increased over the last decade and may increase further.

Most of the growth of fish consumption has been in coastal provinces and in the capital, Tehran. In the last two decades fish supply has rapidly expanded, increasing from 133,425 t in 1976 to 382,300 t in 1995 (CDSD, 1997[a] *op.cit*). In 1995, total aquatic production continued to be dominated by Persian Gulf and Oman Sea (63%), Caspian Sea (15%), aquaculture and inland fisheries (15%), the balance being from international waters. The increase has came mainly from aquaculture, southern water fisheries and from kilka. Southern water fisheries production increased from 110,000 t in 1986 to 265,000 t in 1995, aquaculture and inland water fisheries from 12,000 t in 1986 to 52,890 t in 1995, and kilka from 7,902 t in 1989 to 41,000 t in 1995. A review by FAO (1992[e]) concluded that fisheries are relatively well developed, particularly the marine sub-sector, with most of 350,000 t production in 1991 being sold in the domestic market.

[20] - The global average *per capita* fish consumption is 14 kg yr^{-1}, ranging from almost 27 kg in developed and 9 kg in the developing countries. Developing countries account for about half of the fish production, but are responsible for a little less than half of the world's fish consumption (Kent, 1986), though, lower population, higher income and higher production has remained at a high level of *per capita* fish consumption in developed countries.

The Government's policy for the fisheries, livestock and poultry sectors is aimed at increasing protein production to meet domestic needs (PBO, 1988 & 1993). However, the limited supply from marine capture fisheries is unlikely to meet growing demand. The FAO review (1992[e] *op.cit*) proposed that for the fisheries sector, this would mainly come from aquaculture, which has the largest potential for further production increase. Shehadeh (1996) has proposed the direction of effort towards the development of freshwater aquaculture and the enhancement of fish stocks (culture-based fisheries) in inland water bodies.

Each year the government spends foreign currency on meat (mainly red meat), fishmeal and imported fodder for poultry and animal husbandry. Imports of red meat averaged around 180,000 t per year over the last decade (Musanejad, 1995[a]), while average levels of imported fishmeal were near 70,000 t per annum over the same period (Customs House Yearbook, 1984-94). To enhance overall protein supply, and meet the needs of a growing population, options are rather limited. Grazing is under increasing pressure within the country and there are few prospects for reform at present (Musanejad, 1995[a] *op.cit*). As already noted, supplies of marine fish are unlikely to increase further (FAO, 1992[e] *op.cit*), with few additional resources for capture fisheries except for kilka in the Caspian Sea, sardines in the Persian Gulf, possible opportunities in the Sea of Oman with modernisation of vessels for increasing tuna catching (Abzigostar, 1996 *op.cit*). According to FAO (1992[e] *op.cit*) Iran has tremendous opportunities to increase the products of fisheries through development of aquaculture and management of cultured-base fisheries.

1.5 Carp culture and its potential

The carp are freshwater bony fish belonging to the family Cyprinidae. There are 3,000 species of cyprinids, which make up the second most important group and the most important freshwater species; they are found in very diverse habitats (e.g. streams, rivers, lakes, and ponds) and have a wide geographic distribution due to the intervention of man (Billard & Marcel, 1986). According to Jhingran & Pullin (1985) this group includes seven major species: The common carp (*Cyprinus carpio*), the grass carp (*Ctenopharyngodon idella*), the silver carp (*Hypophthalmichthys molitrix*), the bighead carp (*Aristichthys nobilis*) and the black carp *(Mylopharyngodon piceus)* commonly referred to as "Chinese carps"; and the catla (*Catla catla*), the rohu (*Labeo rohita*), the mrigal (*Cirrhina mrigala*) and the calbasu *(Labeo calbasu)* commonly referred to as "Indian major carps". Other cyprinids of importance for aquaculture are the Crucian carp (*Carassius carassius*), the goldfish (*Carassius auratus*), the mud carp (*Cirrhina molitorella*), and the tench (*Tinca tinca*) (Hulata, 1995). Indian minor carps; *Labeo bata, Labeo angra, Cirrhinus reba* and *Puntius sarana* are also of importance (Jhingran, 1978).

The carp is one of the most widely cultivated warm-water fish, and has been introduced into some 81 countries (Welcomme, 1988; Holcik, 1991), particularly in developing countries, where, the various species are grown in fertilised ponds or with low-level supplementary feeding. Common, Chinese and Indian major carps are cultured wherever traditional markets exist. However, according to Pullin (1986) their culture potential elsewhere is limited by market acceptability and lack of culture experience.

A group of carp that has become more important in aquaculture consists of the species popularly known as the Chinese carps: the grass carp, the silver carp, the bighead carp, the black carp and the mud carp. East European countries, and USSR have made progress in the culture of these carps, and many countries in Asia, Middle East, and South America have introduced Chinese carps for pond culture (Pillay, 1990). Carp occur in a wide range of freshwater habitats from clear mountain lakes to degraded rivers (Sharifpour, 1997). They are found in lakes, large and small rivers, large reservoirs, shallow ponds, still pools, swamps and bogs, large slow-moving rivers, fast-flowing streams and even some tidal and torrential rivers, creeks, underground water courses, and estuaries (Panek, 1987; Howes, 1991).

In Iran, carp farming was started about 30 years ago, initially as an attempt at hatching of Chinese carp, for which the first generation was imported from Romania (Razavi, 1995) Carp culture initially focused on the Caspian Sea area, where the local farmers constructed fish ponds beside their paddy fields. Activities expanded quickly into Gilan and Mazandran provinces.

To expand supply of fish to Iran's consumers, and develop fresh water aquaculture, there would appear to be good potential to expand carp culture, particularly of common, silver, grass and bighead carps. It has undoubtedly seen great success over the last decade, production rising from less than 12,000 t in 1986 to more than 52,000 t in 1995 (CDSD, 1997[a] *op.cit*). Though, the potential of carp culture to expand may be apparent, it may be constrained by market demand and producer profitability. How then can its expansion be guided an effective manner to avoid wasting resources?

1.6. Statement of the problem

Population growth, urbanisation and rapidly development may be expected to change the pattern of supply and demand on fishery products over coming decade in Iran. Though, the population growth rate may slow down, urbanisation, literacy level, living standards and better facilities in urban areas may rise, all of which factors may positively affect fish demand. Over the FFYDP[21] and early years of SFYDP[22], key factors contributing to the government's decision making have been population growth and attempt to optimise management of the economy by privatisation and removal of subsidies. It is clear that these two plans have led the country down the road to economic reform and it is expected, reforms will continue. Moreover, the government will continue changing the economy towards a market oriented structure, and as a result, the share of public sector will decline and that for co-operatives and private sectors will increase. At a macro-economic level, the trend will be to reduce the role of oil and to generate income from various sources such as tourism, petrochemicals, mining, agricultural and industrial products and services. However, in the short term, the international price of oil will strongly affect the potential to develop facilities and infrastructure. In the fisheries sector, the supplies of capture fisheries (for consumption) may probably not increase much further, and increased demand of fishery product would have to be met through aquaculture. Market prospects for fresh water fish and opportunities to increase the products of aquculture development and management of open water bodies may lead to the establishment of a strategy for carp culture development over the next years.

[21] - FFYDP = 1988-1993
[22] - SFYDP = 1995- 2000 (it was one year gap between the two plans).

Assuming that the capture fisheries will level out in the next few years, the problem occurs of maintaining and increasing current *per capita* fishery product in the face of population growth, urbanisation growth and income rise. Since carp is the predominant species in aquaculture in Iran (>95% of production in 1995), the study will analyse current and changing trends of its production, consider market demand for carp products and attempt to outline a strategy for further development of the industry. Key questions to be answered include: whether and how the carp sector can develop to meet market needs, and what would be the implications for development planning. What is the market size, and which form of products and in which market is acceptable? Is it possible to identify both primary and secondary markets for carp and its products? Is there a favourable market for expanded carp culture in new areas? What are the critical factors affecting the economics of carp culture at the farm level? Which of these, increasing yield, reducing costs, increasing efficiency of resource use or increasing price, are possible?

1.7 The research structure

The aim of the study is to investigate potential supply and demand for carp culture production in Iran, and the objective is to highlight key issues related to its development. An attempt is made to balance carp supply, consumer demand for its products and a strategy for development in a linked series of subject areas, bringing these together to define future potential. The work is subdivided into seven chapters whose relationship is illustrated in Figure 1.10, and content outlines as follows:

Chapter 1 has summarised the national context, its resources, population, distribution and its trends, and key macro-economic indicators. The role of fisheries sector and its impact to the national economy, consumption trends and a background to the carp culture development in Iran are also addressed.

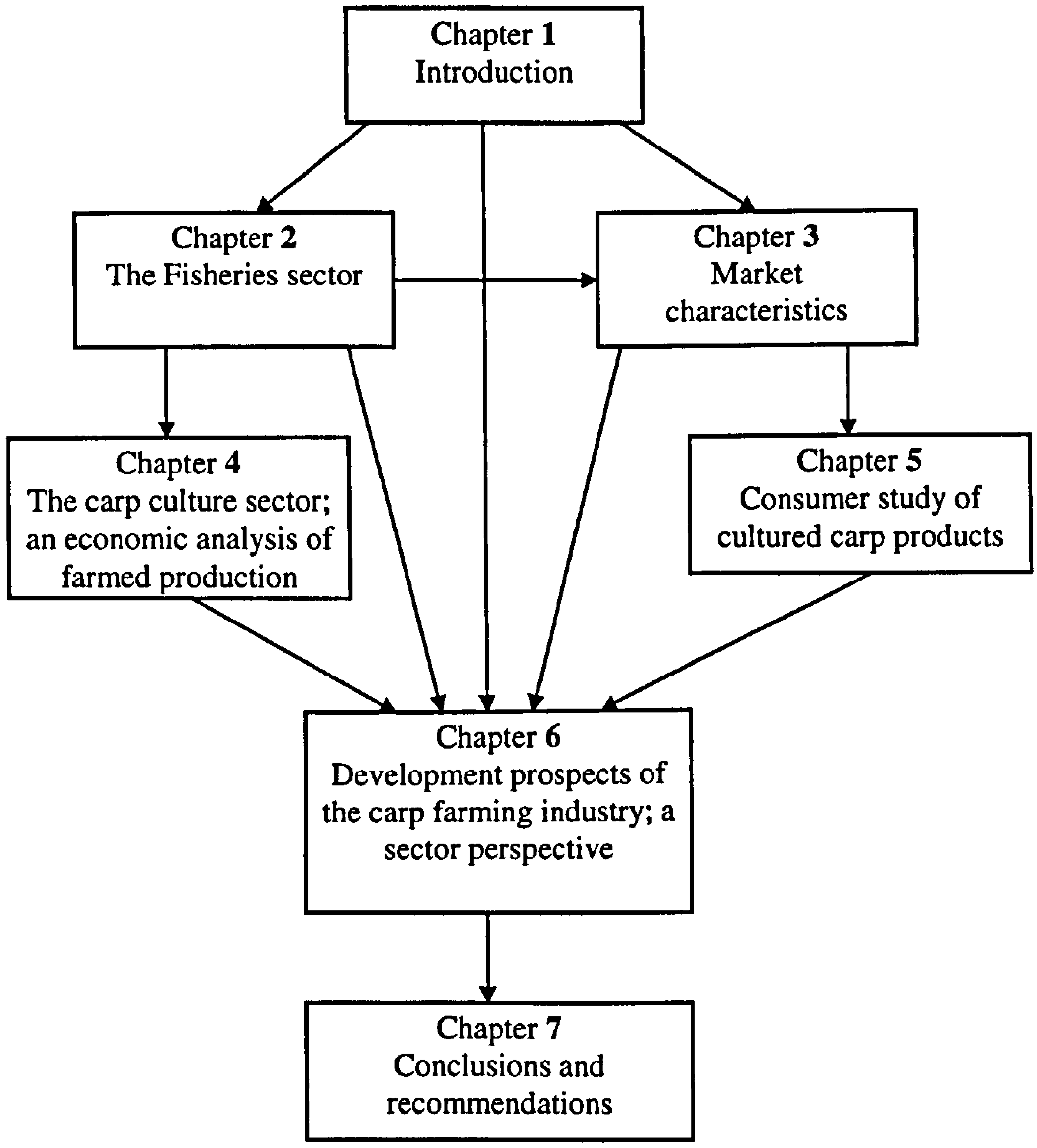
Chapter 2 describes the structure and characteristics of the fisheries sector in the Caspian Sea, Persian Gulf and Sea of Oman; including species, fishing systems and practices, physical infrastructure and handling and processing. The characteristics of aquaculture and inland fisheries production are described including background, the environment for production, species, distribution of production by provinces. Characteristics of carp culture production in particular are described to define the study context.

Chapter 3 provides the background of market characteristics; including trends in meat production, trends in expenditure on meat and fish consumption in urban and rural areas, trade of fish and fishery product, the role of aquaculture and carp in fish consumption, fish market structure and consumer trends.

Chapter 4 develops an economic analysis of farmed carp production, in key provinces and emerging areas. The includes cost structure, profitability and analyses the role of location and the role of farm size.

Chapter 5 examines and analyses the markets for cultured carp and its products; including marketing channels, consumer behaviour, species and product form preferences, effect of supply change, seasonality, and income/price change, attitudes in purchasing carp, the role of location, the role of age, the role of educational level, the role of job and the role of family status.

Figure 1.10: The structure of thesis.



Chapter 6 develops a sector perspective based on the analyses in the previous chapters, relating cost and quantity of supply issues with market demand: This is developed further to consider implications for carp market development, competitive products, short term production potential and potential areas of development. A series of market-linked scenarios is developed to illustrate potential outcomes.

Chapter 7 provides conclusions and recommendations for the development of carp culture in Iran based on results from the previous chapters.

Chapter two

2. The fisheries sector

2.1 Background

"Shilat", synonymous with the English term "Fisheries", refers to the Iranian fisheries organisation, an affiliate of the Ministry of Jehad-e-sazandgy. Shilat[23] is responsible for all aspects of Iran's fishery activities including resource management, fisheries development, infrastructure establishment, and research. It also provides training and extension services, support services for fishermen and fish farmers, and others such as handling, processing and marketing.

The Shilat headquarters are in Tehran with general offices in each coastal province, expanded to other interior provinces with the rise of aquaculture since 1992. In Tehran, Shilat is organised into three sections; Fishing and Fisheries Industries, Aquaculture, and Planning and Administration, and six general departments; Finance, Legal Affairs, Public and International Relation, Fishing Port construction, Fishing Port support services, and Inspection and Audit. Three sub companies and one research organisation are also affiliated:

(a) Iranian Fisheries Research and Training Organisation (IFRTO).

(b) Industrial Fishing Company (IFCO).

[23] - According to the constitution of Shilat (the national fisheries administration) which is approved by parliament, Shilat is operated by managing boards, the head of the organisation is vice Minister of Jehad-e-sazandagi and is appointed by General Assembly, including Ministries of Jehad-e-sazandagi, Agriculture, Co-operative, Interior and Economic and two Vice presidents, including Planning and Budget and Executive. The head of Assembly is Minister of Jehad-e-sazandagi. Generally, Shilat policy is generated by boards and is approved by Assembly. The operating capital of Shilat comes from the sale of Caviar, and the investment capital from public sector.

(c) Shilat Trading Corporation.

(d) Kilka Industries Company.

Increased resource exploitation, expanded fisheries industries, rural development and improving living standards for fishermen particularly in the south have all changed the role of Shilat over the last decade. Following the Islamic revolution, the Northern (Caspian Sea) and Southern (Persian Gulf and Oman Sea) Fisheries Companies combined in 1980, after which Shilat's activities officially started in 1985, initially under the Ministry of Agriculture. In September 1987, with the approval of the late Imam Khomeini, Shilat came under the authority of Ministry of Jehad-e-sazandagy, the changes resulting government policy to use the sector as an instrument for rural and coastal development. Initially based round the two production companies, with monopoly control of production, harvesting, handling, and fish marketing on behalf of the government, Shilat's activities have been directed towards domestic supply, and to the export of sturgeon products, shrimp, and other fishery products. Investment and operating capital come from the sales of these products.

Since 1989, privatisation and improvement in efficiency of the sector have led the policy to reduce Shilat's intervention and its dominance. Harvesting, processing, handling and marketing of fish (except for shrimp and sturgeon) have been gradually transferred to co-operatives and the private sector. By 1991, Shilat saw that the period of expanding catch of many consumed resources was over, and it embarked on two major aims; first to introduce management measures aimed at reducing and controlling exploitation and second to diversify and improve the quality and value of fishery products. Since 1992, all aspects related to the shrimp industry have also been transferred to other sectors, and since 1995, Shilat's role has been reduced further, with the exception of the Caspian Sea sturgeon fishery. Most fisheries activities, except for the exploitation, processing and marketing of sturgeon meat and caviar, are carried out by co-operatives and private sector operators, and Shilat has been given new responsibilities for sectoral planning, co-ordination, management, stock assessment, research and development.

2.2 The structure and characteristics of the fisheries sector in Iran

2.2.1 The Caspian Sea fisheries

In 1995 about 9,500 fishermen (CDSD, 1997[a] *op.cit*) worked in the Caspian Sea (see Appendix II). The catch mainly comprised sturgeon and various bony fishes such as, kutum, mullet, carp, pike-perch, bream, roach, Caspian trout, kilka and others (Table 2.1). As already noted only the Shilat fishes for sturgeon, and the co-operatives and private sector fish for kilka and bony fish. In 1995, there were 201 co-operatives, with 698 vessels (624 boats, 68 dhows, and 6 steel ships) (CDSD, 1997[a] *op.cit*), the largest steel vessel being engaged for research.

Table 2.1: Major species in the Caspian Sea.

Group name	Scientific name	Common name
Sturgeon	*Huso huso* *Acipenser spp.*	beluga asetra, sevruga & sterlet
Kilka	*Clupeonella spp.*	anchovy, bigeye & alamanka
Bony fish	*Rutilus firisii kutum* *Mugil spp.* *Cyprinus carpio* *Lucioperca stizostedion* *Abramis brama orientalis* *Rutilus spp.* *Salmo trutta caspius kessler*	kutum mullet carp pike-perch bream roach Caspian trout

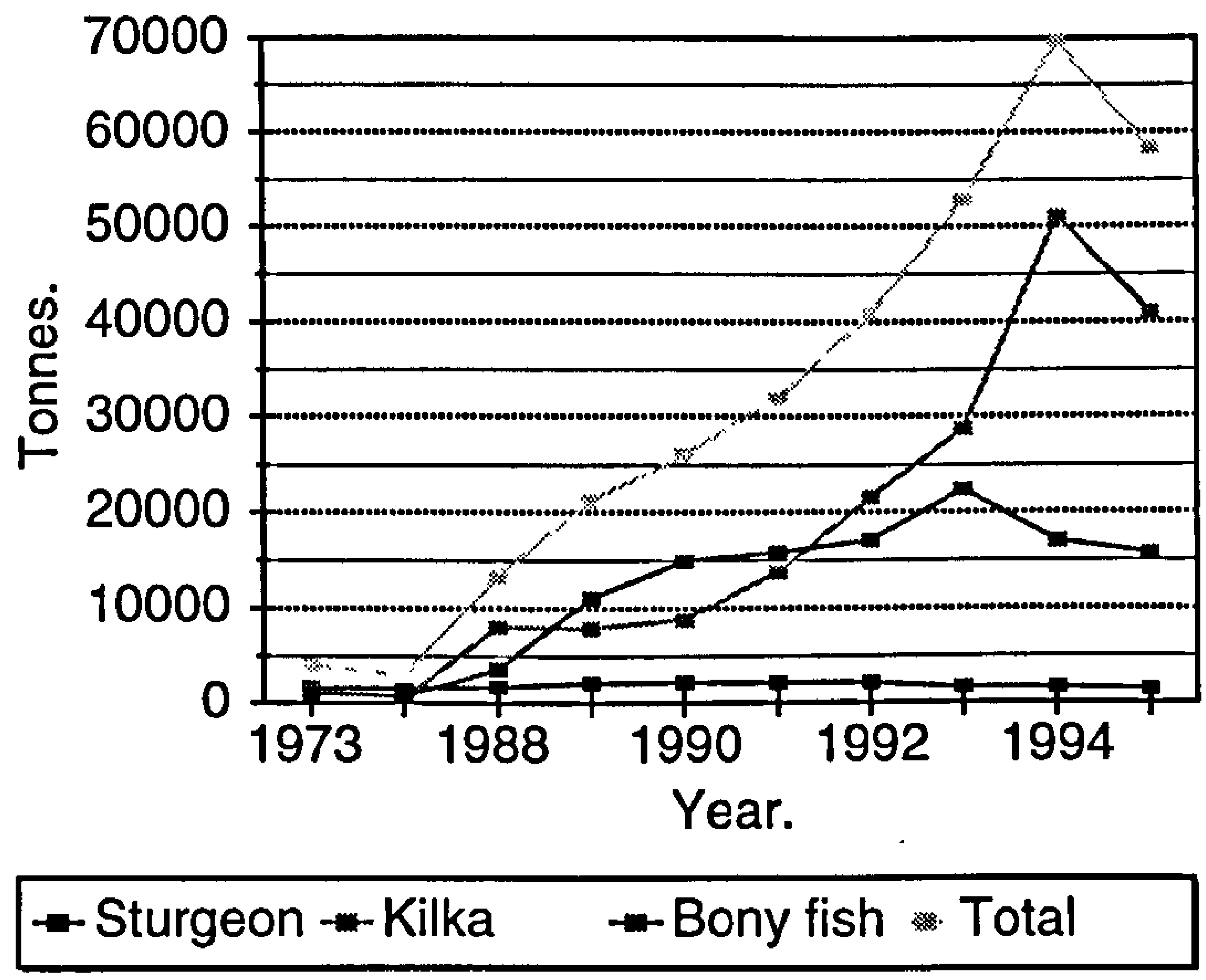
Fishing systems and practices

(i) The sturgeon fishery: Shilat operates this in association with fishermen's co-operatives from 51 coastal stations, 24 in Gilan and 27 in Mazandran province. Sturgeon accidentally caught by beach seine co-operatives engaged with bony fish are obliged by law to be reported to its state office. An observer is also posted by Shilat to each beach seine unit. At each station, under close supervision, the caviar is removed from the fish, prepared, and despatched to Anzali or Babolsar for final inspection and grading. The fish is sold fresh or frozen. Fishing is carried out from small fibreglass boats, and the only gear permitted is the gill net, the mesh specially designed for the targeted species. Over the last decade, mainly since the break up of the former USSR, destruction of immature fish through the use of non-selective gear, inappropriate open seasons or inadequate management by fishermen have caused critical conditions in all Caspian Sea countries, with total catches (by 5 countries) declining from 26,080 t in 1982 to 7,256 t by 1993 (Razavi, 1997), Iran's catches declining from 2,240 t in 1990 to 1,500 t by 1995 (CDSD, 1997[a] *op.cit*).

(ii) The bony fish fishery: this has undergone a remarkable change in recent years (Figure 2.1). Historically, the main fishing effort involved the use of beach seines. In the 1980s this gear was replaced by gill nets, to the detriment of the sturgeon stocks, but following Shilat's intervention, the beach seine is now fully back in use. Each net may require up to 100 people and a tractor to operate. There are 107 co-operative units operating in Mazandran and Gilan (CDSD, 1997[a] *op.cit*), with a union in each province for support. Total catches fish increased to 22,328 t in 1993 and declined to 15,800 t in 1995, due partly to climatic conditions, and partly to the reintroduction of beach seines.

According to FAO (1997[a]) over the 1989-95 period, catch composition was 63% kutum, 18% mullet and the balance other species.

Figure 2.1: Fishery production in the Caspian Sea[24].



Source: CDSD, 1997[a] *op.cit.*

(iii) The Kilka fishery: The modern fishery, began in 1973 with six Russian steel vessels. It depends upon the ready availability of three species of small clupeid, *C. engrauliformis* "anchovy", (about 80% of catch), *C. grimmi* "bigeye", (~15%) and the balance, *C. cultiventis* "alamanka" (Abzigostar, 1996 *op.cit*). Except for 2-20 May, fishing continues throughout the year. The fishing technique is relatively simple, based on the attraction of kilka towards light. The gear is a funnel-shaped lift-net, which is supported centrally under powerful electric light. Operations are suspended over the full moon period, when the fish are scattered. In 1995, 68 dhows of (wood, steel, or fibreglass) ranging from 15-30 meters, and 5 steel ships were engaged in the kilka fishery employing 875 persons (Shilat, 1996). Kilka production is expected to increase

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[24] - According to Shilat (1998) the catch of sturgeon, bony fish and kilka were 1,600 t, 15,500 and 57,000 respectively by 1996; except for kilka there are no significant changes from 1995.

over the coming years, and this may be mainly for fishmeal, though use for direct consumption's may also increase.

Physical infrastructure

Shilat has established two general offices in Gilan and Mazandran provinces and has divided the coast line of some 900 km length into 5 regions from west to east.

- Gilan province:
  - Region 1- headquarters Bandar Anzali, direction over 15 fishing stations,
  - Region 2- headquarters Keyashahr, direction over 9 fishing stations,
- Mazandran province:
  - Region 5- headquarters Nowshahr, direction over 9 fishing stations.
  - Region 3- headquarters Babolsar, direction over 9 fishing stations,
  - Region 4- headquarters Bandar Turkman, direction over 9 fishing stations.

There are over 50 landing centres along the Caspian coast. Facilities are limited to essential services such as fuel, fresh water, fishing gear, tools, electronics, and local services. Anzali, located in the SW is the most important port, with boatyards, maintenance facilities, ice plants, work shops, processing factories, such as fish meal and canning, and other essential services. Elsewhere in Gilan, ports are under construction at Keyashahr and Astara, and plans are in hand to develop harbours at Talesh and Rudsar. For the kilka fleet, in Mazandran, Amirabad is already well established, and the port at Babolsar is undergoing improvement.

Handling and processing

The handling and processing of sturgeon and caviar is carried out by Shilat. Procedures of caviar preparation are strictly controlled, and processing and other staff are specially clothed and wear masks and gloves to limit any possible contamination. After caviar processing, all fish are removed to cold stores, at Babolsar, Anzali, Bandar Turkaman, Keyashahr and Nowshahr. Shilat sells gutted fresh/frozen sturgeon meat for the domestic and export market; recently processed product such as fillet and canned sturgeon have also been presented on the domestic market. Most bony fish from the Caspian are purchased directly by wholesalers and/or retailers and sold into the local fish markets or other main provincial fish markets. A small quantity is also smoked or salted for urban markets. Fish that is not sold fresh is also smoked or salted and stored for later sale. The kilka fishing grounds are almost 1-2 hours from harbour, catching takes place at night, and more than 90% of catch goes for fish meal, less than 10% being processed, mainly canned. There are 11 fish meal plants and 8 canneries presently operating in the area (CDSD, 1997[a] *op.cit*). Since kilka has shown major expansion, the establishment of processing plants for canning and other added-value products is expected to increase, with an increased human consumption.

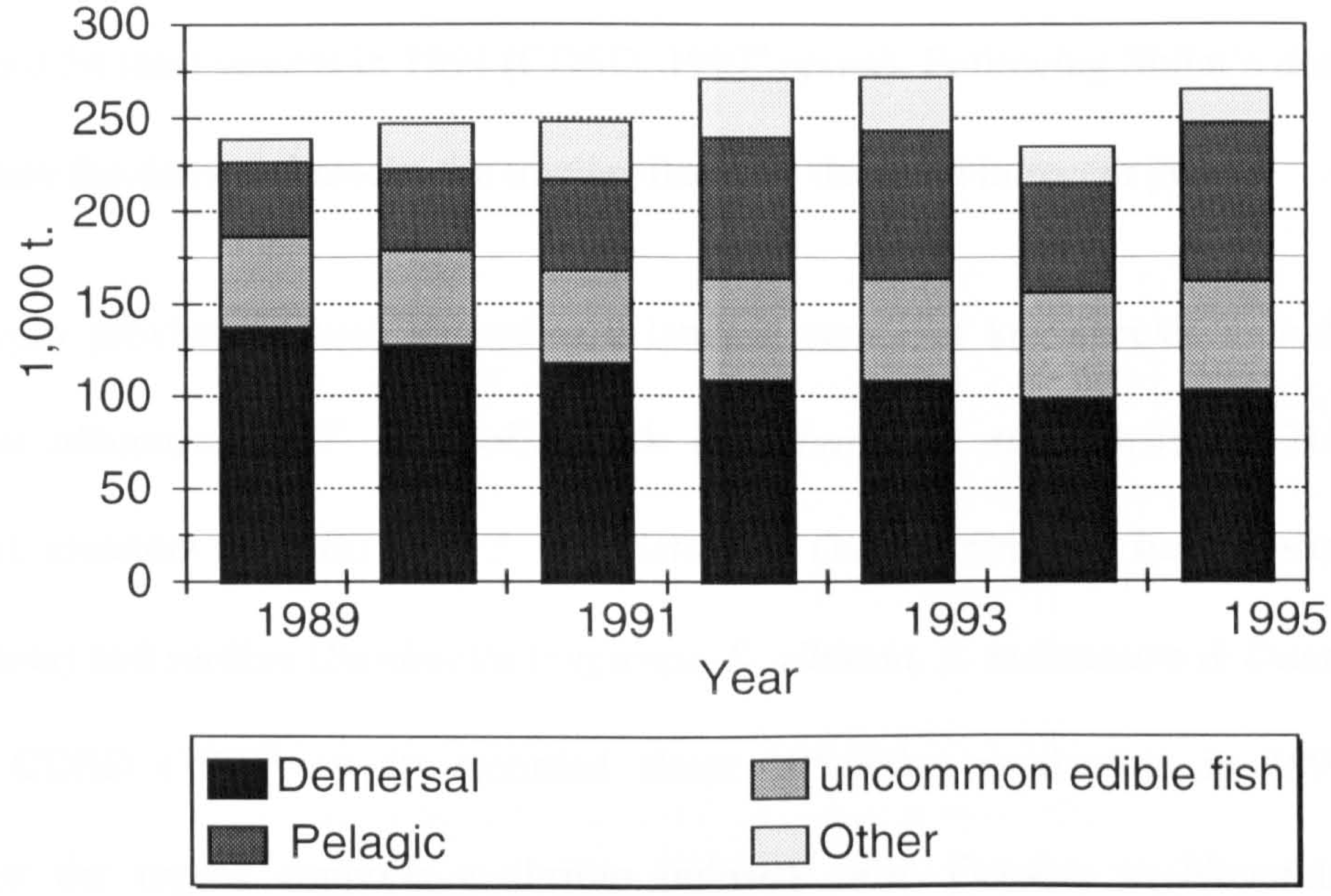
2.2.2 The Persian Gulf and Sea of Oman capture fisheries

The Persian Gulf is ~990 km long and from 56 to 338 km wide, with an area of ~240,000 km^2. The Gulf of Oman is about 565 km long and 320 km wide, the combined length of the Iranian southern coastline being about 1,880 km. The four provinces, from NW to SE are Khuzestan, with the smallest coast length of 220 km, Boushehr with 625 km, Hormozgan 735 km, and Sistan-Baluchestan with 300 km.

The wide range of fish, crustaceans and molluscs from the Persian Gulf and Oman Sea accounted for 265,000 t production, in 1995 declining from a peak of 272,000 t in 1993 (CDSD, 1997[a] *op.cit*). Demersal fish landings in 1995, were 105,000 t, from a peak of 139,000 t in 1989. "Uncommon edible fish" such as shark (*Carcharhinus spp.*), cuttlefish (*Sepia officinalis*), hairtail (*Trichiurus lepturus*), and others grew very slowly to 59,000 t in 1995. Large pelagic fish including yellowfin tuna (*T. albacares*), frigate tuna (*Auxis thazard*) , kawakawa (*Euthynus affinis*), king mackerel (*Scomberomorus guttatus*), long tail tuna *(Thunnus tonggol),* Spanish mackerel (*Scomberomorus commerson*), skipjack tuna *(Katsuwonus pelamis),* and chub mackerel *(Scomber japonicus)* the most important species in the southern region, and have increased significantly from 29,000 t in 1989 to 77,000 t in 1995 (Figure 2.2).

Through improvement of on-shore facilities and increasing vessel capacity and modernisation of vessels, productivity of the sector might be expected to increase in the future. However, small pelagic fish such as sardines *(Sardinella longiceps, S. gibbosa, S. melannura & Dussumieria acta)* and other anchovies declined to 8,000 t in 1995 from a peak of 20,000 t in 1993. The mesopelagic Lantern fish recorded about 2,000 t, in 1995, though based on stock assessments carried out from 1993-1996 by IFRTO; it may be possible to catch at least 600,000 t in the Sea of Oman annually, a substantial increase in output. However, other less optimistic projections have been made. The policy of Shilat is to increase production of small and mesopelagic species. Though it is expected, that the contribution of these groups will rapidly increase over the coming decade, most of the catches may be used for fishmeal. The following features of the fisheries explain the diverse background of the production of southern coastal provinces.

Figure 2.2: Fishery production based on main groups in south coast.



Source: CDSD, 1997[a] *op.cit.*

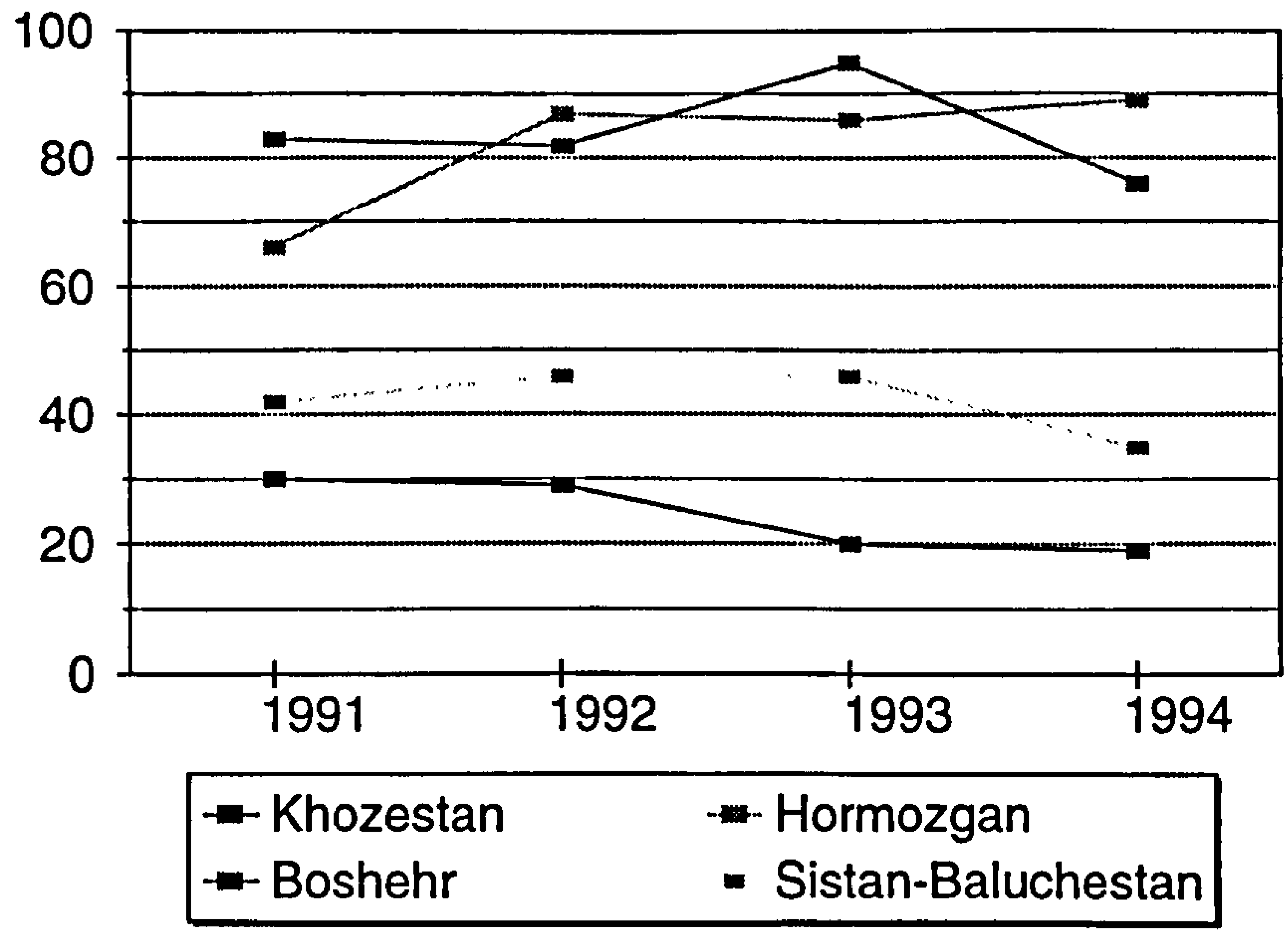
Khuzestan province is mainly associated with a small white fish industry, key species being croakers (*Johnius spp.*), white pomfret *(Pampus argeneus)* and grouper (*Epinephelus spp.*). There is also an important fishery for shrimp, particularly *metapenaeus affinis*. The area was seriously impacted by the Persian Gulf war and the fishermen are beginning to return to the region. There is little notable port structure, and many vessels operate from the many small inlets in the Arvandrud delta. The key ports are Abadan and Mahshar, both with surrounding creeks; and Hendijan, a landing centre almost 25 kilometres up the Hendijan River in the East of the province. 20,000 t of fish were landed in the province in 1995 (CDSD, 1997[a] *op.cit*). In 1995, about 1,290 boats, 593 dhows and 13 steel vessels were reported in the fleet.

Bushehr province is well known for its landings of green tiger shrimp (*Penaeus semisulcatus*), and other demersal species. Total production of all species was reported as 80,000 t in 1995. The shrimp fishery is closed all year except for two months. The province has more than 20 ports, mostly constructed during the FFYDP and SFYDP. The oldest ports are Boushehr and Dayer. The fishery is associated with 1,975 boats 786 dhows and 54 steel vessels in 1994 (CDSD, 1997[a] *op.cit*). Following Shilat's decision to rehabilitate the demersal stocks the trawler fleet has declined in recent years.

Hormozgan province is well known as a landing centre of key species included tuna (*Thunnus albacares & T. tonggol*), shark (*Carcharhinus spp.*), hairtail (*Trichiurus lepturus*), croakers (*Johnius spp., J. maculatuse & Otolithes ruber*), banana shrimp (*P. merguensis*) and sardine (*Sardinella longiceps, S. gibbosa, S. melannura & Dussumieria acta*). CDSD (1997[a] *op.cit*) recorded about 105,000 t production in 1995. Like Boushehr the region supports a shrimp industry from October to November, and involves both local dhow vessels as well as industrial vessels. The three main provincial fishery centres are Bandar[25] Abbas, Bandar Lengeh and Jask; other landing centres include a few constructed ports, such as Qeshem Island and Bandar Kolahi, and village beach landings widely scattered along the southern coast. The west of the province, mainly Bandar Lengeh and its islands, is associated with a small artisanal pearl oyster activity, which is now heavily controlled. The total fishery is associated with 1,591 boats 687 dhows and 43 steel vessels in 1994 (CDSD, 1997[a] *op.cit*).

The fisheries industry in Sistan-Baluchestan province only began to expand after the revolution in 1979, and has domestically and historically concentrated on tuna, associated with a local dhow and inshore primary fishery. The fishery and fishing capacity in both small craft and dhow vessels have rapidly facilitated a canning plant, fishmeal plant, net-making factory and an extensive port development programme, which enable fishermen to easily operate. Since the area was underdeveloped, government policy after the revolution, has targeted development of fisheries industries to improve living standards for coastal populations, including construction of 9 harbours. Key species include tuna, shark, croakers and groupers (*Epinephelus spp.*). The only important lobster fishery *(Palinurus spp.)* in Iran is in this province but landings are low and a closed season is strictly enforced. Total production in the province recorded by CDSD (1997[a] *op.cit*) in 1995 was about 44,000 t. Throughout the country, tuna processing units have usually been supported by this province and it is expected, that modernisation of vessels will also enable fishermen to operate in the N Arabian Sea as well.

Figure 2.3: Production based on provinces in south coast.



Source: CDSD, 1997[a] *op.cit.*

The fishery is associated with 737 boats and 595 dhows in 1994 (CDSD, 1997[a] *op.cit*). Consequently, Hormozgan, with 40% of the southern fishery's production has the most important role, followed by Boushehr with 35%, and 25% from the other two provinces.

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[25] - "Bandar" in Persian is synonymous with English "port".

The fishermen and its co-operatives

Vessel and employment statistics show an average crew complement of ~8 persons; small boats usually have no more than two members, dhows no more than 12, and large vessels no more than 18 (Abzigostar, 1996 *op.cit*). All provinces have witnessed growth in numbers of fishermen. The registered number of fishermen grew from 39,633 in 1989 to 77,238 in 1995 an annual growth rate of almost 11%, ranging from 6% in Boushehr to 45% in Khuzestan. The marked growth in Khuzestan reflects a return to fishing activity following the end of the war. Based on the average crew size, as noted earlier, the active number of fishermen is about 47,848, ~62% of the total registered number.

The number of vessels has decreased in Boushehr province, reflecting decreased stocks of demersal fish. Of the 78 fishery co-operatives in south coast, there are 30 in Hormozgan, 29 in Boushehr, 11 in Sistan-Baluchestan, and only 8 in Khuzestan. Membership of co-operatives in the S is lower than in the N; according to Shilat estimates some 36% of fishermen in the four the south provinces belong to co-operatives, compared with 90% in the north coast. Co-operatives are too small to operate all related fishery aspects, especially post-harvesting management. However, there is no official published data related to the productivity of southern fishermen and vessels, and it appears that the lack of fishermen's knowledge, inadequate vessel facilities and processing units and the weakness of co-operatives may have caused limited efficiency and productivity in the south.

Harvest facilities

During the last decade specially over the FFYDP and SFYDP, Shilat has developed harbour facilities throughout the coastline of the Persian Gulf and Oman Sea. These have included extensive breakwaters, jetties, covered markets, and integrated sites for onshore facilities, fishing harbour infrastructure.

There is a plan for construction of processing factories, handling facilities, and covered fish markets in some harbours. There has also been a policy to develop coastal areas, increase added-value and move to a greater role for the market. Given the high levels of economic dependency on fishing activity within coastal provinces, and the national Government policy to reduce urban immigration and encourage new workers to these coastal areas, this is a notable development priority.

Considering the tropical situation of the southern coast, most of the larger ports and some minor ones have ice factories. These usually produce block ice, with daily production typically 10 to 40 t day^{-1}, though there are flake ice plants in Boushehr City and Bandar Abbas City with a daily capacity of almost 50 t day^{-1}. Most ice factories are privately or co-operatively owned (Table 2.2).

Table 2.2: The capacity of fisheries industry in south coast region.

Year	1973	1978	1988	1995
Ice factories (t/day)	20	170	1075	4108
Cool storage (t)	330	3500	7700	65365
Frozen tunnels (t)	20	155	460	n
Can factories (million can per year)	3	5.9	12	65
Fish meal (t/day) raw material	0.2	13	n	190.5

Source: CDSD, 1997[a] *op.cit.* n: data not available.

Cold stores are mainly equipped with blast freezers, but some extensive cold stores also exist in important coastal towns, such as Bandar Abbas and Chabahar. Of the 126 freezer and cold stores built and under construction, 22 are in Khuzestan, 38 in Bushehr, 33 in Hormozgan, and 33 in Sistan-Baluchestan. As shown Table 2.2 the capacity of ice plants increased 273% from 1,075 t day^{-1} in 1988 to 4,108 t day^{-1} in 1995 and cool storage capacities increased a remarkable 749% from 7,700 to 65,365 t over the same period.

There are 25 fishmeal plants in the country with a total capacity of 350 t day^{-1} raw material (Tables 2.3 & 2.4). According to Abzigostar (1996 *op.cit*), 22 are located in the larger ports in S, with a capacity between 30,000- 40,000 t yr^{-1}, 3 are in Khuzestan, 7 in Boushehr, 6 in Hormozgan, and 6 in Sistan- Baluchestan. The policy has been to reduce imported fish meal and also increase productivity of unconsumed products, though they are used primarily to process fish offal, sardines, shark, other inedible fish and poorer quality fish. Based on current production, facilities such as cold storage, and fish meal in some larger ports may have excessive capacity, and future investment may best be directed towards higher quality product in these ports and in the expansion of these facilities to other areas. However total fish meal consumption in Iran is estimated at more than 100,000 t annually, while national production is about 10,000- 15,000 t yr^{-1} (Ulofeh company, 1995).

Table 2.3: The number of fisheries industry units in the country (1978-1995).

Remarks/ Year	1978	1989	1993	1995	% change 1989-95
Ice plant	10	25	94	138	452
Canning factory	1	4	26	33	725
Fish meal plant	2	6	13	25	317
Coastal cold stores	8	16	35	68	325
Freezing unit	8	18	35	45	150

Source: CDSD, 1997[a] *op.cit.*

Table 2.4: The capacity of fisheries industry units in Iran (1978-1995).

Remarks/ Year	Unit	1978	1989	1993	1995	% average annual growth 1989-95
Ice plant	1,000 t day^{-1}	0.17	1.08	3.7	5.8	35
Canning factory	million can yr^{-1}	35	65	120	150	15
Fish meal plant	Raw material t day^{-1}	100	150	316	350	16
Coastal cold storage	1,000 t	3.6	14.5	32.7	83.3	34
Freezing unit	t day^{-1}	110	360	520	620	10

Source: CDSD, 1997[a] *op.cit.*

Handling and processing

Processing related to the Southern fisheries is mainly dominated by canned tuna, frozen shrimp, and fishmeal, though canning of sardines and other species has started more recently. The main processing centres are in the coastal provinces, Tehran province, and in larger central cities such as Isfahan, Karaj and Qazveen. In 1996, prices for frozen tuna at the canneries (C&F kg^{-1}) were Rials 4,100 ($1.37 US) for yellowfin (*Thunnus albacares*), skipjack (*Katsuwonus pelamis*), and long tail tuna (*T. tonggol*), and Rial 2,870 ($0.96 US) for frigate mackerel, and kawakawa (eastern little tuna) (*Euthynus affinis*) (Abzigostar, 1996 *op.cit*). Nationally, the number of canning factories increased from four in 1989 to 33 in 1993, of which 18 are located in the S (Table 2.5). Tables 2.4 and 2.5 show the trends of related processing capacity.

Table 2.5: The capacity of industry related to fisheries in provinces in 1995.

Province	Ice factories t/day	Cool storage (t)
Gilan	482	9075
Mazandran	1183.5	8880
Bushehr	1045	8248
Hormozgan	1348	26890
Khuzestan	1275	25380
Sistan- Baluchestan	440	4850
Total	5773.5	83323

Source: Fishing and Fisheries Industries Department, 1997.

Production costs were found to differ notably within the canning sector; raw material cost ranges from 60-71% of total production costs, with yields varying from 28-37%, and differing labour and other costs. In 1995 total sales of canned fish in Iran were 60 million, or 25-28,000 t of fish, of which 3,000 t were kilka (Abzigostar, 1996 *op.cit*). National policy has aimed to increase investment in all elements of the post-harvest sector, giving particular attention to the construction of modern coastal infrastructure, diversifying fishery products, and improving quality control to meet international standards and improve market opportunities. Total exported products from the S increased from US$ 7 m in 1990 to US$ 19 m in 1994 (CDSD, 1997[a] *op.cit*).

An overall assessment of coastal fisheries development

Policies such as increasing fishing, improving handling and raising the productivity of the processing sector, expanding fisheries industries, improving living standards for fishermen, developing on-shore facilities in coastal areas, and promoting the use of under-exploited species, while at the same time reducing the intervention of Shilat[26] has dramatically changed its role over the last decade. It now has responsibility for the sustainable management of fisheries, with objectives such as an increase in foodfish supply, employment, promotion of regional development and an increase in the role of the fisheries sector in the national economy. Sustainable management will direct it to preserve and rehabilitate key resources, mainly sturgeon and bony fish in the N and demersal species in the S, and may also lead it to diversify into large pelagic and industrial fish species in the Oman Sea and into under-exploited species such as kilka in the N and sardines and mesopelagic species in the S.

The development of the sector may improve output of added-value products, and expand and develop fish markets with variety of products from low value fishmeal to higher value items for human consumption. The transition of key activities such as harvesting, handling, processing, marketing and other services to co-operatives and private sectors, and the undertaking of Shilat's new role will improve efficiency, increase the contribution of fisheries to the national economy. This policy is expected to continue over the next years, and therefore, the contribution of fishery product for

[26] - Considering FFYDP and SFYDP, policy of Shilat was suggested by managing boards and approved by general assembly.

human consumption both locally and internationally may increase, and a variety of product will be distributed throughout the country. In addition, the expanded harvest of under-exploited species such as kilka, sardines and mesopelagic species will also increase fish meal production to meet feed demands for animal feeds, e.g. in the poultry and aquaculture industry.

2.3 Aquaculture and inland fisheries sub-sector

2.3.1 Background

Before the revolution (1979) there was little significant activity in the aquaculture sub-sector, though its foundation in Iran, dates from the attempts to enhance sturgeon fisheries in the Caspian sea, started by Russian experts at Rasht City in Gilan province in 1922. This was expanded in 1954 with the release of juveniles of kutum in the northern rivers. In 1962 and 1965, a private company bought 15 million rainbow trout eggs for culture from Denmark to create the first stages of the trout industry. Since 1979, aquaculture has gradually developed, particularly along the Caspian Sea littoral. As well as managing fisheries, the Shilat is responsible for the hatchery and propagation of juveniles for release into the Caspian Sea and other waterbodies.

The first hatchery was built with the support of Russian experts in 1969, and since 1972 has started to produce 4 or 5 key Caspian species. During last decade aquaculture has grown in importance, with investments in land-based farming of fresh water fish, such as warmwater carp and coldwater trout. Most carp farms are located in the Caspian Sea coast, followed by the province of Khuzestan. Shrimp culture has continued in the South coast provinces in 1991.

In 1970, Shilat established the carp culture research station in Astaneh in Gilan province, while the first commercial facility for carp culture was established at Safeedrud in Gilan in 1969, supported initially by Romanian experts. The area of farm was ~8 ha, has gradually developed, and now is about 800 hectares. Since 1985 aquaculture has been developed mostly by private and co-operative sectors.

The increasing development of the aquaculture sector from 1985 provided the necessary impetus to carp culture, as successful fish farming was dependent on the enterprise of families owning and operating relatively small-scale farms, specially in Gilan and Mazandran provinces. Since 1990 Shilat started to transfer all its commercial carp farms to the private and co-operative sectors, together with the responsibility for the propagation of fry and fingerling to private and co-operative hatcheries, except for the production of juveniles for the culture-based fisheries in the Caspian sea including sturgeon, kutum, bream, Caspian trout, and pike-perch. It also carries out the culture of carp and rainbow trout and other species to stock artificial lakes and reservoirs, and supplements these resources through other private and co-operative hatcheries.

Since 1991, Shilat has initiated developments of marine shrimp farming in the southern coast provinces. Initial trials were carried out with FAO/UNDP assistance in the years 1991-92, producing post-larvae of local species such as *P. semisulcatus, P. merguiensis & M. affinis* and reviewing areas favourable for shrimp culture. The development of shrimp culture in the region has attracted considerable investment. During recent years Shilat, on behalf of the public sector has developed hatcheries and ~4,000 ha of ponds and supporting physical infrastructure. Total marine shrimp production increased to 136 t in 1996 (CDSD, 1997[a] *op.cit*). The first hatchery for marine shrimp was constructed in

1991, and in 1995, hatchery production was ~22.6 million PL15[27] of indigenous species species such as *P. semisulcatus, P. merguiensis & M. affinis.*

Small-scale trials are also being conducted by Shilat on carp culture in cages and pens in the Anzali lagoon (FAO, 1992[e] *op.cit*), along the SW of the Caspian Sea. Shilat is also carrying out cage culture of carp in Des Dam reservoir in Khuzestan province, and cage and pen culture of rainbow and Caspian trout in the lagoon of Gorgan in the SE of Caspian Sea in Mazandran province. Cage culture of rainbow trout and carp has also been carried out in dams and reservoirs in other parts of the country over the last 2-3 years.

Fully marine aquaculture is restricted at present to the development of pearl oyster culture including *Pinctada margaritifera and P. vulgaris.* Pilot production tests and research projects have been underway for a few years at the station of Bandar Lengeh, and its farm in Kish Island.

In terms of total production, the aquaculture sub-sector is as yet relatively unimportant by comparison with capture fisheries, and small by comparison with many other Asian countries. However, the share of both aquaculture and inland fisheries to total fishery production in Iran has increased from 6% in 1973 to 9% in 1986 and to more than 15% by 1995 (CDSD, 1997[a] *op.cit*).

National production in 1995 from both aquaculture and inland fisheries was 52,980 t of which 24,836 t derives from national and artificial water bodies and 26,812 t from warmwater fish farming- mostly carp, 1,332 t from coldwater fish farming-mostly rainbow trout, and 136 t from cultured shrimp (Aquaculture Department, 1997).

[27] : 15 days old post larvae.

According to the recent statistics (CDSD 1997[a] and Aquaculture Department, 1996 & 1997 *op.cit*) production has grown from 1,414 t in 1973 to 33,685 t in 1988 and to 52,980 t in 1995 (Table 2.6), an overall, average annual growth rate of 20% and 5% over the 1973-95 and 1989-95 period respectively. Production did not increase significantly during FFYDP (1989-1993), but has grown subsequently[28].

Table 2.6: Total aquaculture and inland fisheries production in Iran, 1973-1995.
unit : tonnes

1973	1978	1986	1987	1988	1989	1991	1993	1994	1995	% annual change (1973-95) 1989-95
1414	3219	12000	15000	33685	40490	45131	44120	45300	52980	(20) 5

Source: CDSD, 1997[a] *op.cit*, and Aquaculture Department for 1995, 1997 *op.cit.*

The Shilat is increasingly considering aquaculture as an alternative source of fish and shellfish products, and as a contributor of animal protein to food security through raising fish consumption towards the world average (14 kg per capita). Production targets of 550,000 t in 10 years and 1,000,000 t in 25 years are being contemplated by Shilat for aquaculture alone, based on an increase in the number of farms, increased yields per unit area, and the maximum utilisation of the country's varied water resources. There is now a deputy for aquaculture and inland fishery development in each general office of the six coastal provinces, together with eighteen independent aquatic general offices affiliated with Shilat in other inland provinces, where activities relate to all aspects of aquaculture and inland fisheries, and in particular carp culture.

In 1996, four animal and poultry feed manufacturers were producing artificial feeds for fish farming. Abzigostar (1996 *op.cit*) estimated that they produced 6,000 t feed in 1995, of which 80% was for carp farming and 20% for trout farming. The protein source is mostly fish meal imported from Peru and Chile. Apart from imported raw material

28 - According to the recent statistics (Aquaculture Department, 1999) annual growth rate of total

and some special technical equipment and laboratory instruments, the country is self-sufficient in manufacturing equipment (e.g. fibreglass fabricators to make hatchery and grow-out tanks, net, plastic pipework, paddle wheel aerators and water circulation, etc.), to support the sector.

Over the FFYDP and SFYDP high priority has been placed on aquaculture development as a major source of increased fishery production. Over the next decade, It is expected, that this trend will continue and aquaculture development will also more substantially expand into brackish and marine water.

2.3.2 The environment for aquaculture production

The environment for aquaculture in Iran is based on five major geographic zones (Figure 2.4) with different climatic conditions and natural resources availability. These are:

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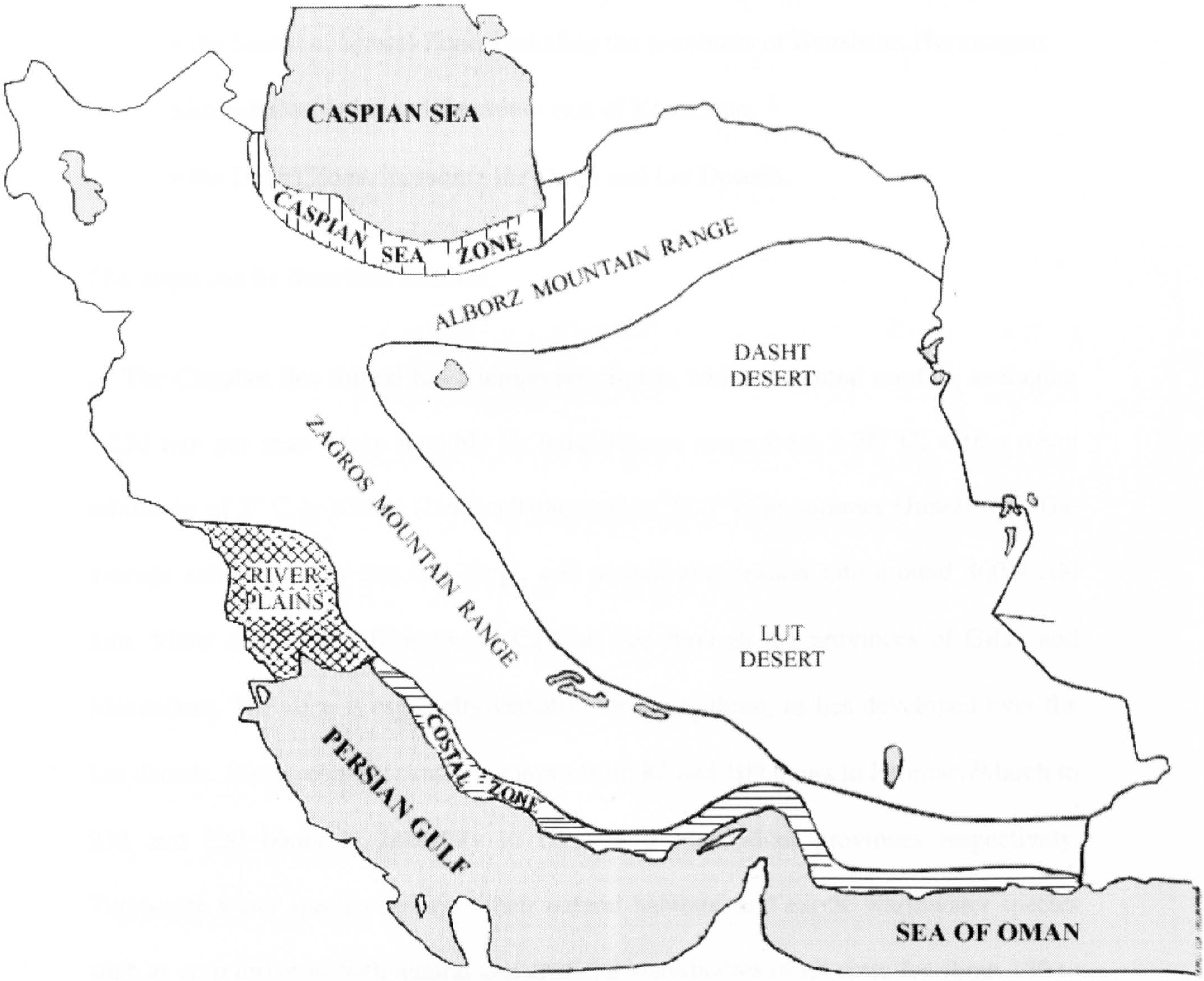
aquaculture and inland fisheries production was 10% over the 1995-98 period.

Figure 2.4: Five principal aquaculture zones in Iran.



Source: Abzigostar, 1996, *op.cit*

- the Caspian Sea region, predominantly the Gilan and Mazandran provinces,
- the Mountain Range, including the long Alborz ranges separating the Caspian littoral from the Central part of the country and Zagros Ranges, predominantly west and some Central areas,
- the River plain, predominately Khuzestan province,
- the Southern coastal Zone, including the provinces of Boushehr, Hormozgan, Sistan-Baluchestan and the South east of Khuzestan,
- the Desert Zone, including the Dasht and Lut Deserts.

The zones can be described follows:

(i) The **Caspian Sea** littoral has a temperate climate with substantial rainfall, averaging 1,250 mm per year. Mean monthly air temperatures range from 5-28° C, with a mean minimum of 2° C in winter (January/February) to 35.5° C in summer (June/July). The average salinity of the Sea is ~13ppt, and annual evaporation rate around 800-1,200 mm. Many short rivers flow to the Caspian Sea through the provinces of Gilan and Mazandran. The zone is especially versatile for aquaculture, as has developed over the last decade. Mean monthly sunshine ranges from 82 and 109 hours in February/March to 233 and 220 hours in June/July in Gilan and Mazandran provinces respectively. Temperate water species thrive in their natural habitats, and exotic warmwater species such as carp thrive in both natural and artificial waterbodies of all sizes for about 180 to 200 days of the year when water temperatures are ~20° C or more. The main sources of water for fish farms are the irrigation channel systems, formed by the diversion of most of the catchment rivers and freshwater lagoons along the Caspian Sea (FAO, 1992_b

op.cit). In this area (mainly Gilan and the W of Mazandran), land available for the expansion of carp farms is largely limited to swampy areas not suited for agriculture.

(ii) The **Mountain Range** describes the vast Alborz and Zagros Mountains. The Alborz Range stretches 600 km from E to W, with the highest being Damavand point, NE of Tehran, at 5,610 m. The central Alborz is typically Alpine, while the two outside zones are Mediterranean. Yearly rainfall area ranges greatly from 300 to 1200 mm. The Alborz Range is a major watershed with at least 200 large and small rivers flowing through the Northern provinces into the Caspian Sea. The main rivers, from W to E being the Aras, Karganrud, Sefeedrud, Tonekabon, Haraz, Tejen, Gorganrud, and Atrak provide spawning grounds for the migratory anadromous fish species. The Zagros Range is 1,350 km S to W, with a maximum width of 125 km north of Dezful city. The range has two parts; the NW area, from Fars province to the border with Iraq, is highly folded with little agricultural land, while the SE part, is less folded with intermittent plains suitable for agriculture (Abzigostar, 1996 *op.cit*). Considering the expanse of the ranges, the climate is very mixed from hot-semi desert in South to a Mediterranean climate, and cold Alpine on the peaks. Rainfall varies from 300 to 1,200 mm, averaging about 600 mm. Principal rivers flow to the Persian Gulf, and there are also many lakes, especially in the province of Fars. Though, the area is particularly suited for trout culture, there are many low lands and open water bodies, which may be used for carp culture.

(iii) The **River Plain** describes the most important province in the SW, Khuzestan. The zone has an arid climate, with annual rainfall of 150-300 mm, and evaporation rate of about 2,000-3,000 mm. It contains almost one-third of the country's water resources, but average mean monthly air temperatures range from 12.3-36.2° C, with a mean minimum of 6.9° C in winter (January) to a mean maximum of 45.8° C in summer

(July). Daily temperatures often reach 50° C (Abzigostar, 1996 *op.cit*). Mean monthly sunshine ranges from 179 hours in December/January to 306 hours in June/July in SW and from 144 to 321 hours respectively in the NW and centre of the province. The river plain zone extends from the foothills of the Zagros Range to the flat hot regions of the head waters of the Persian Gulf. There are six major rivers, of which the largest is the Karon, about one-third of a large natural lake (the Houralazim wetlands), and the extensive wetlands in the S of the province around the Shadegan lagoon. Most rivers are dammed for irrigation waters; some of the country's more important dams are located in the province and the area is suitable for agriculture.

Khuzestan has more versatile potential for fresh and brackish water aquaculture and for inland fisheries than Gilan and Mazandran provinces. Coldwater species thrive in the rivers and streams of the highlands, and since 1997 trout culture has commenced. The growing season for exotic carp is estimated at 280 days in natural, semi-natural and artificial water-bodies, though problems can be expected in the summer, when temperatures exceed 30° C. The extensive flat coastline of the southern provinces are also suited for marine aquaculture, particularly the production of shrimp. As a result, there are considerable areas of non-arable land which is suitable for carp culture.

(iv) The **southern coastal zone** borders the Persian Gulf and the Sea of Oman littoral, including the four main fisheries provinces of Khuzestan, Boushehr, Hormozgan, and Sistan-Baluchestan. Mean minimum and maximum monthly air temperatures ranges are 6.9° C (January) to 45.8° C in Khuzestan and 19.7° C to 34.1° C in Sistan-Baluchestan respectively. Annual rainfall is sparse, with 250 mm in the Khuzestan, to about 90 mm in Sistan-Baluchestan, though evaporation rates are relatively similar throughout, ranging from 1,500-1,800 mm. The zone is restricted to marine aquaculture, and temperatures are suitable for two cycles of marine shrimps in the two eastern provinces. However, there are also some open water bodies or irrigation waters which may be used for carp culture.

(v) The **Desert Zone,** constitutes the central and eastern territory of the country. This includes the lowlands of the Dasht and Lut deserts, with scattered mountainous blocks in the east running in a NS direction. The deserts are hot and arid, with no rainfall recorded for some years, although some places are less severe. Annual mean rainfall in most of the area is below 100 mm, with some places above 150 mm. Average air temperatures are typically 5-25° C. The desert zone is sparsely populated areas with less than 10 person per km^2 in most provinces (Table 1.1).

There are no permanent rivers except for the Zayandeh-rud, which flows from the Zagros mountain range, passes through Isfahan city and discharges into a lagoon nearby. However, in N and central Sistan-Baluchestan (the third largest province, stretching well into the interior of the country) is Hamoun lake, ~500 m above sea level, on the border of Afghanistan. It is the largest freshwater lake in the country with an area varying from 2,000-5,000 km^2 and may provide options for freshwater fish production. A traditional fishery for warmwater species exists and though its desert climate is warm, dry, and rather windy, carp can be sustained for several months of the year. There are, also large resources of subterranean water, most of which is brackish, and areas that can flood at certain times of the year (Abzigostar, 1996 *op.cit*). There are many temporary rivers in the area, and over the last two decades, the government has constructed many reservoirs for irrigation waters (mainly with earth dams), which may be used for carp culture.

2.3.3 The characteristics of aquaculture production

The development of aquaculture has been influenced by the aquatic resources of the areas concerned and is primarily based in Gilan, Mazandran, Khuzestan and the south coast, though some projects have been recently started for carp and trout culture in other zones.

Fingerlings of most important species including the kutum, sturgeon, Caspian salmon, bream, and pike-perch are produced in the Shilat hatcheries and all are released into the Caspian Sea. Total production of these five key species was about 150 million in 1995 (Table 2.7). During the last decade the large number of national, semi-national and artificial freshwater bodies which exist in provinces have also been stocked with carp fingerlings from Shilat hatcheries.

Table 2.7: Annual fingerling production of key species, 1981-1995.
Unit: 1,000

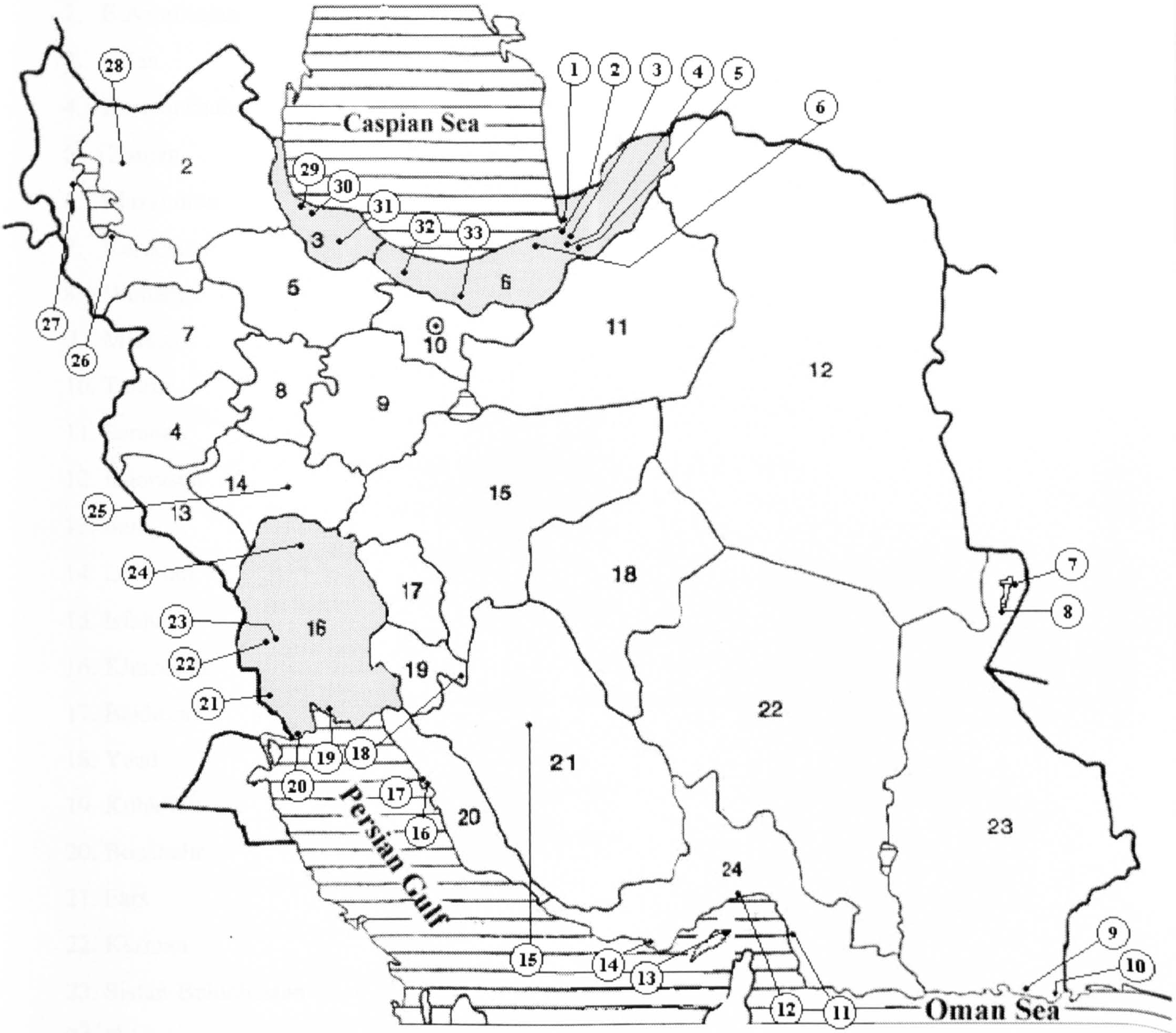
Species\Year	1981	1985	1989	1992	1993	1994	1995
Kutum°	405	38000	140158	144680	100047	142734	125119
Sturgeon°	2044	1132	3149	3457	4176	6295	9125
Carp•	5	12836	61176	42709*	73321	104089	112824
Salmon°	0	0	0	360	335	640	800
Trout•	0	1805	7280	1834*	7401	8423	11937
Bream°	0	0	0	5929	5524	10350	11217
Pike-perch°	0	0	0	2443	1160	2888	2270
Total	2454	53773	211763	200782	191964	275418	273292

° Species released in the Caspian Sea. • Species used in farms or released elsewhere.
* Only from Shilat hatcheries.
Sources: CDSD, 1997[a] *op.cit* and Aquaculture Department, 1997 *op.cit* for 1995.

Small reservoirs, earth ponds and tanks have been constructed in all provinces to conserve water for irrigated agriculture. Some of these, especially in the Caspian Sea littoral are initially stocked with carp fingerling, and are usually fished by local villagers or co-operatives to supplement both diet and income. Rivers, streams, and springs are scattered throughout the country, providing good quality freshwater for both warmwater and coldwater fish production. Coastal zone and protected islands bordering the marine waters have become areas for farmed production of marine shrimps. Shilat now has more than 30 projects in various stages of planning, construction, and transition to the private and co-operative sectors (Figure 2.5), and has also planned the next steps in production in other provinces[29].

[29] - Kerman, Isfahan, Khorasan, Zanjan, Tehran, Qazveen, and Markazy.

Figure 2.5: Aquaculture activities of Shilat.



Source: Aquaculture Department 1997 *op.cit*

(I) Name of provinces

1. W.Azarbiajan
2. E.Azarbiajan
3. Gilan
4. Kermanshah
5. Zanjan
6. Mazandran
7. Kordestan
8. Hamadan
9. Markazi
10. Tehran
11. Semnan
12. Khorasan
13. Ilam
14. Lorestan
15. Isfahan
16. Khuzestan
17. Bakhtiari
18. Yazd
19. Kohkileh
20. Boushehr
21. Fars
22. Kerman
23. Sistan-Baluchestan
24. Hormozgan

(II) Distribution of aquaculture activities

1. Centre for training and extension in brackishwater fish and shrimp, Gomishan
2. Propagation and culture of kolmeh, Bandar Torkaman
3. Shilat marjani sturgeon hatchery

4. Gorgan sturgeon hatchery
5. Study for Gorgan warmwater fish hatchery
6. Shahid Rajaei hatchery
7. Warmwater fish culture, Kian-Abad, Zabol
8. Warmwater fish hatchery, Zahak, Zabol
9. Marine shrimp production site, Govater, Chahbahar
10. Centre for training and extension in marine shrimp, Bris, Chahbahar
11. Marine shrimp hatchery, Kolahi
12. Marine shrimp production site, North and South Tiyab
13. Marine shrimp production site (Study), Qeshm
14. Marine shrimp hatchery, Bandar-Lengeh
15. Warmwater fish hatchery, Marvdasht, Fars
16. Centre for training and extension in marine shrimp and fish, Heleh
17. Marine shrimp production site, Heleh
18. Shahid Motahari salmonid hatchery
19. Marine shrimp hatchery, Bandar Emam Komini
20. Marine shrimp production site
21. Centre for training and extention in marine shrimp and fish, Shahid Kiani
22. Project for warmwater fish culture, Azadegan
23. Warmwater fish culture, Shahid Maleki, Ahvaz
24. Project for warmwater fish culture, Hore-Bamdig
25. Project for warmwater fish culture, Tanor Dur
26. Project for warmwater fish culture, Phesendoz
27. Centre for development of lake Uromia
28. Project for warmwater fish culture, Dashte-Tabriz
29. Shahid Beheshti sturgeon hatchery
30. Shahid Ansari fish hatchery
31. Siahkal fish hatchery
32. Project for salmonid (S.truta) production
33. Shahid Bahonar trout hatchery, Kelardasht

2.3.4 The carp culture sector

Carp culture production

Iran has recently directed considerable effort to developing freshwater aquaculture and enhancing fish stocks (culture-based fisheries) in inland water-bodies (Shehadeh, 1996 *op.cit*).

According to CDSD (1997[a] *op.cit*), over the 1989-95 period, the number of carp farms increased 3.1% annually, from 2,210 farms in 1989, and the area of carp farming annually increased 3% from 6,916 ha in 1989. In 1995, there was some 2,639 registered carp culture farms, with a combined active pond water surface of almost 8,100 ha (see Appendix II for more details). Warmwater fish production in the country now includes several cyprinid species, raised either in monoculture or polyculture in earthen ponds or in local or national water-bodies. Annual production figures for carp show large changes from year to year. Though the trend over the last decade has been positive (Table 2.8), common carp production has declined 11% since 1988 from its peak of 9,500 t to 8,481 t in 1994, while silver carp production has increased 193% from 6,000 t in 1984 to 17,587 t in 1994. Production of grass carp decreased by 33% from a peak of 6,500 t in 1989 to 4,357 t in 1994, and bighead carp production declined by almost 9% from 1,500 t in 1989 to 1,371 t in 1994. According to Shehadeh (1996 *op.cit*), the decline of grass carp is due to poor survival of fry and disease problem.

Table 2.8: Carp culture production in Iran, 1984-1994.

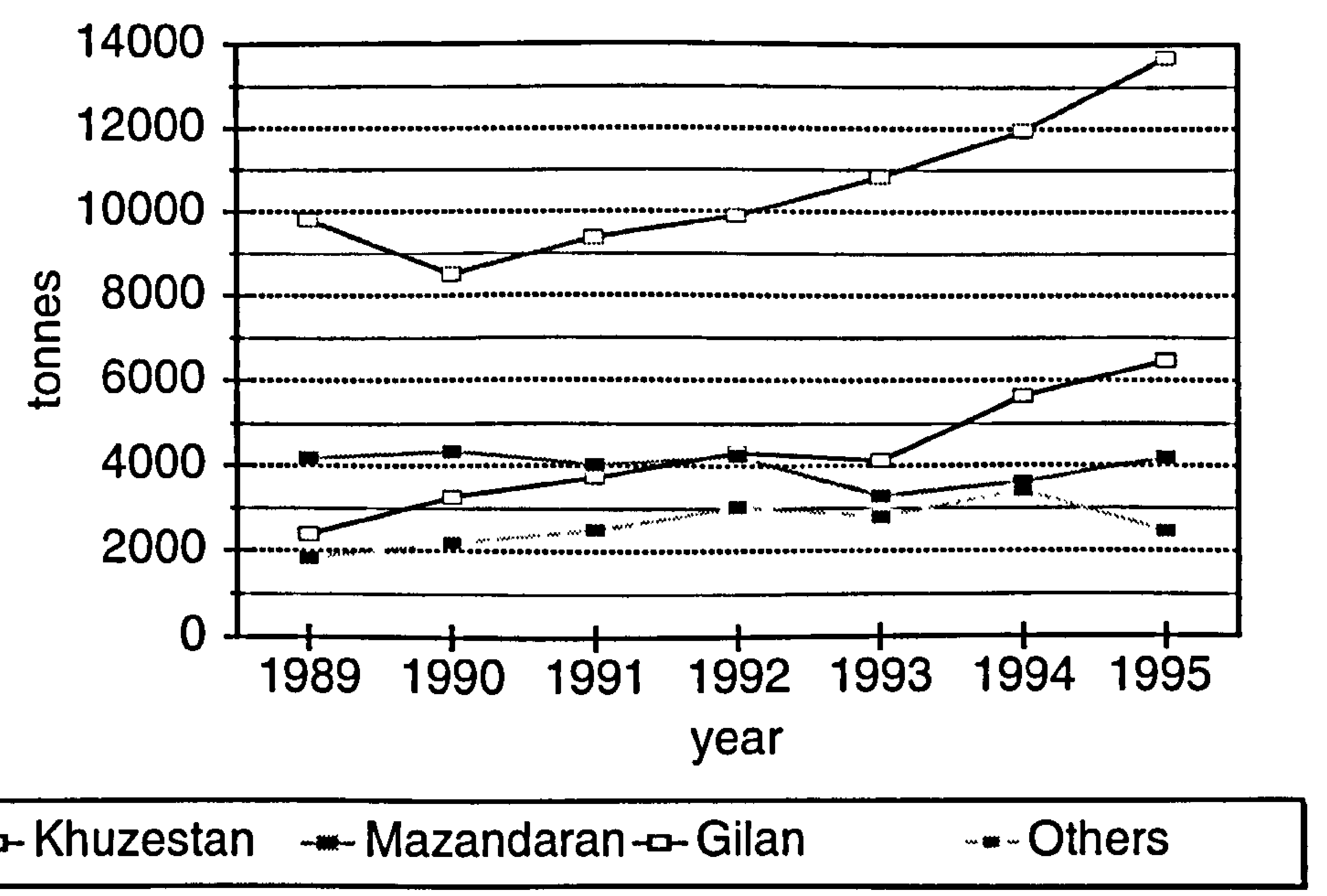
Unit: t

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	% growth 1984-94
CC	7296	7687	7872	9479	9500	11000	6563	5502	5000	4206	8481	20
BhC	600	649	928	1221	1500	1500	1312	983	1000	1052	1371	130
SC	6000	5700	7000	8000	10500	11000	13127	10019	12000	12619	17587	190
GC	4000	3000	4200	5300	6500	6500	5252	3143	3000	3155	4357	10
Total	17896	17036	20000	24000	28000	30000	26254	19647	21000	21032	31796	80

Source: FAO 1995[c], and 1996[c].

In 1994, the share of silver carp was ~55%, followed by common carp at 27%, and grass carp at 14% with the balance being bighead carp. As Figure 2.6 shows, the main provinces involved are Gilan, Mazandran, and Khuzestan. Production declined in Gilan in 1990 due to the rising price of rice, attracting some farmers towards rice culture. From 1992, Khuzestan's share in production has grown. According to CDSD (1997[a] *op.cit*) total farmed carp production was 26,812 t, of which 51% come from Gilan, 24% was from Khuzestan, 16% from Mazandran and the balance from other provinces.

Figure 2.6: Contribution of carp farming production in 3 main provinces, 1989-1995.



Sources: CDSD, 1997[a] *op.cit* and Aquaculture Department for 1995, 1997 *op.cit.*

Hatchery production

The hatchery production of carp species, the fundamental resource for both farming and culture-based fisheries, is an important objective. Production of carp fingerlings has grown 17% annually, from ~62 million in 1989 to 113 million in 1995 (mainly the Caspian area), of which 18% was produced by Shilat (Table 2.9 & 2.10).

Table 2.9: Carp fingerling production 1981-1995.
Unit: 1,000

1981	1983	1985	1987	1989	1991	1993	1994	1995	% annual growth 1989-95
5	2186	12836	19045	61176	84208	73321	104089	112824	17

Sources: CDSD, 1997[a] *op.cit* and Aquaculture Department for 1995, 1997 *op.cit.*

Table 2.10: Contribution of carp fingerling production by Shilat and private sector, 1994-95.
Unit: 1000

Year	1994	1995	% Share in 1995
Gilan (private)	71175	62050	55
Mazandran (private)	15260	15260	13
Khuzestan (private)	10000	10000	9
Other provinces (private)	7000	5200	5
Total private	103435	92510	82
Shilat	654	20314	18
Total	104089	112824	-

Source: Aquaculture Department, 1997 *op.cit.*

According to the FFYDP, Shilat has decreased its role in the production of the carp and in 1995, more than 20 private hatcheries produced about 90 million carp fingerlings (Table 2.10). Of these Gilan produced 55%, followed by Mazandran with 13%, Khuzestan 9%, while other provinces only produced 5%. It is expected, in the next few years, that all hatchery production of carp species will arise from co-operatives and/ or private sectors.

Production systems and practices in carp farming

As noted, traditional fish farming in the country was based on the European common carp, and this was expanded with the introduction in 1971 of the Chinese carp, namely the grass, silver and bighead carp. The carp are easy to raise in hatcheries in very large numbers at little cost, and distribute to farms to grow-out in excavated ponds or any enclosed water-body. The common carp and the Chinese carp are often reared in polyculture, although some farmers prefer to keep common carp in monoculture. All are produced using techniques based on well-established European procedures.

After hatching, larvae are transferred to tanks of increasing size, and fed changing diets of powdered yolk and powdered milk. When the larvae are about 8 days of age they are transferred from the hatchery to prepared nursery ponds, where they feed on natural productivity. The fry (at 10 g size) usually transported for release into suitable water-bodies, or grown out to market size on fish farms. Recently, both public and private hatchery operators have been testing the traditional Chinese technique. This avoids all handling of the spawning adults until the eggs are ready for transfer to the hatchery or, in some cases, the eggs hatch and the larvae remain in the tanks until transfer to nursery ponds (Abzigostar, 1996 *op.cit*). The species-based trends of carp culture are shown in Table 2.8.

FAO (1992[e] *op.cit*) concluded that carp farming in Iran was an economically appealing proposition. In Khuzestan, it noted that carp farming was profitable but claimed that the cost of construction of ponds had drastically increased, possibly making carp farming a risky investment. In Gilan and Mazandran, where carp farming is mainly an artisanal activity carried out by small farmers as a sole or a part-time activity, it is considered as another income-generating venture. These aspects will be discussed later.

According to Abzigostar's (1996 *op.cit*) estimation, there are almost 15,800 non-governmental persons active in carp farming. The majority of these people will also have another employment, either seasonal or non-seasonal activity.

Production systems and practices in the culture-based fisheries

There are estimated to be about 1,900 natural, semi-natural and artificial water-bodies in Iran, associated with 150 earth dams with 64,000 ha, 235 barrage dams with 8,000 ha, 1,500 irrigation reservoirs with 31,000 ha and large natural water-bodies with 455,000 ha water surface. The total water surface is estimated at 558,000 ha. These are distributed through all the provinces and can be used for fresh fish culture especially carp culture (see Appendix II). The composition of the carp used to stock these water-bodies depends on the availability of fingerlings from the Shilat or other hatcheries, but is usually (28-32%) common carp, (40-50%) silver carp, and (5-10%) bighead carp with the balance being grass carp.

Table 2.11: production in open water-bodies in key provinces, 1989-1995.
Unit: tonnes

Year	1989	1990	1991	1992	1993	1994	1995	% share in 1995	% annual change 1989-95
Khuzestan	8935	8935	9119	6018	6019	2520	2830	11	-11
Gilan	6035	6096	6689	1629	2164	2272	1445	6	-12.6
Mazandran	1914	2138	1958	2917	3813	6703	8975	36	61.5
Sistan-B.	2758	3510	4353	4106	3000	3200	4600	19	11
Fars	205	420	216	973	2657	800	1320	5	90.6
W.Azarbiajan	917	869	875	1070	1065	1440	1633	7	13
Others	905.5	1223	1693	3470	3539	3669	4036	16	57.6
Total	21670	23191	24903	20183	22257	20604	24836	100	2.5

Sources: CDSD, 1997[a] *op.cit*and for 1995 Aquaculture Department, 1997 *op.cit.*

Harvests of carp and a few number of other warmwater species from the water-bodies, either natural, semi-natural or artificial, are difficult to measure, though incomplete production data prepared for the provinces by the aquaculture department indicate average yields of 43 kg ha^{-1} in 1993, and 40 kg ha^{-1} in 1994, increasing to 49 kg ha^{-1} in 1995. In 1995, the provincial shares of production are shown in Table 2.11. More than 66% of open-water production were obtained from the three provinces including, Mazandran, Khuzestan and Sistan-Baluchestan.

Because of the large and important agriculture sector in the country, currently about 21% of GDP, there is considerable emphasis on water conservation and management. As part of this national effort, there are many thousands of small artificial reservoirs, earthen ponds, and tanks constructed as integral parts of irrigation schemes for valuable agriculture lands. These small units, many of which are seasonal, are used as focal points for village fish farms, in which villagers, working as a co-operative, take up fish farming as a supplementary pastime. In the first year, the units are stocked with fingerlings and certain operational needs provided by Shilat free of charge, after which the co-operative has to buy both fingerlings and any fertiliser required. Typically, fingerlings are 30 g in weight, and are stocked (usually by April) at a density of 2,500 ha^{-1}. With growth possible only during the warm months of the year, this type of extensive production differs from region to region. With suitable farming practices, but without additional aeration and possibly without additional water, the yields range from 300-500 kg ha^{-1}, though yields have improved over recent years, and in Mazandran province have been observed to reach 1,300 kg ha^{-1} by 1997.

Rainbow trout culture

The rainbow trout (*Onchorynchus mykiss*) culture sector is smaller than that of carp culture, though starting almost 30 years ago in the NW of Tehran by the University of Agriculture in the city of Karaj. However, it is now widely practised, the number of farms annually increasing 26% from 19 in 1989 to 69 in 1995 with the almost 18% growth in area from 4.8 to 12.6 ha. Table 2.12 shows the relative significance of the main producing provinces during recent years, Fars and Tehran are the biggest, but W-Azarbiajan, Charmahal-B and Mazandran are also rapidly growing. In the coming decade, all provinces located in mountain areas may be targeted for trout culture.

Table 2.12: Production of trout culture and its share in main provinces, 1989-1995.
Unit: t

Province/Year	1989	1990	1991	1992	1993	1994	1995	% share in 1989	% share in 1995	% annual growth 1989-95
W-Azarbiajan	4	4	30	22	25	104	72	1	5	153.7
Tehran	297	302	250	308	283	265	320	50	24	2.3
Charmahal-B	25	39.5	70	70	105	220	234	4	18	50.2
Fars	219	118	104	148	203	410	422	37	32	21.1
Mazandran	30	60	97	150	140	141	191	5	14	40.9
Others	24	26	27	77	79	88.6	93.5	4	7	36.3
Total	599	550	578	775	835	1229	1332	100	100	16.2

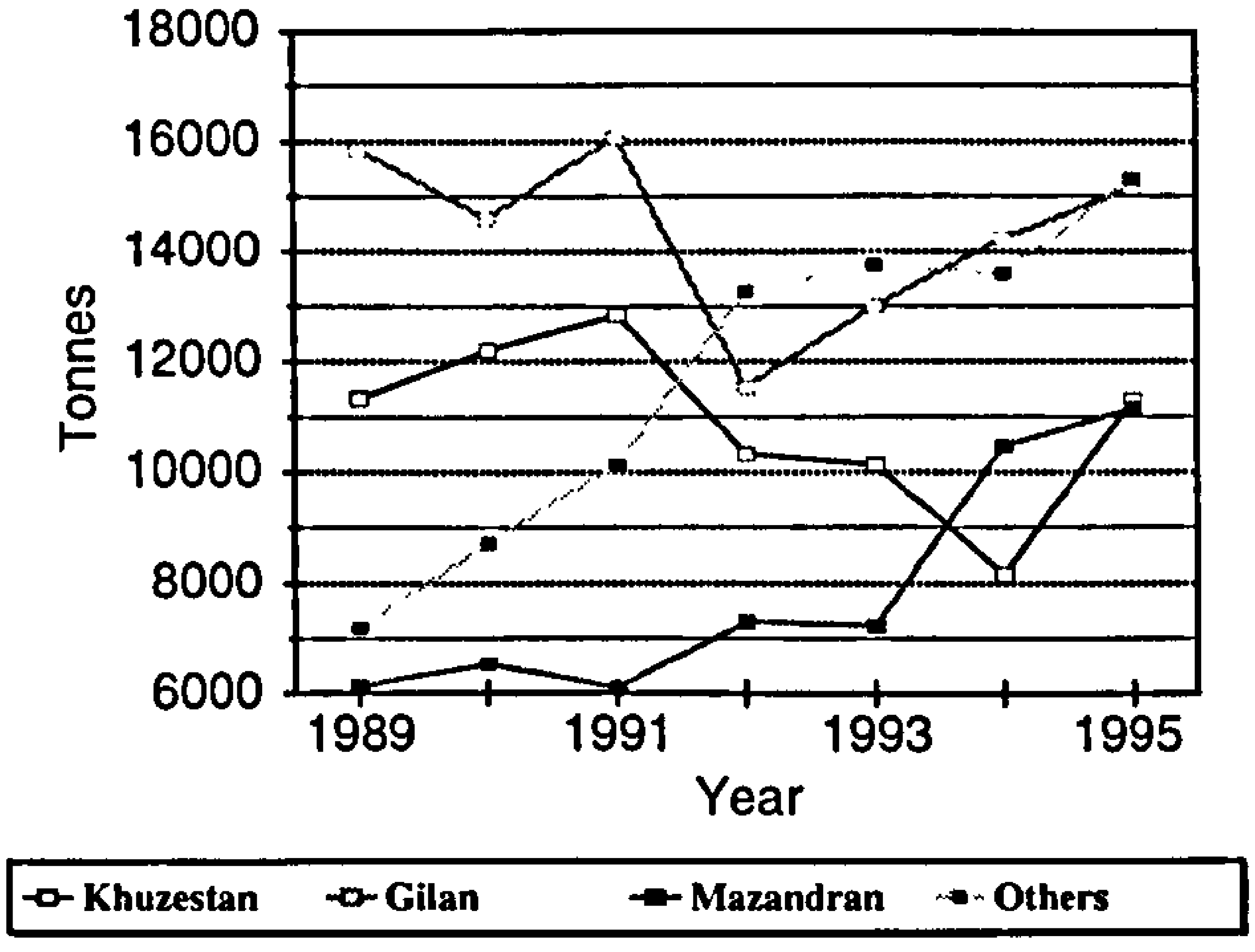
Sources: CDSD, 1997[a] *op.cit* and for 1995 Aquaculture Department, 1997 *op.cit.*

Distribution of aquaculture and inland fisheries production by province

Aquaculture and inland fisheries are distributed throughout the country. The large number of natural and artificial water bodies exist in almost every province and are stocked for fish (mostly carp) culture. Over 1989-95, while total aquaculture and inland fisheries production increased 89% in Mazandran province, it decreased in Gilan and Khuzestan provinces. This reduction is primarily due to a decrease in natural water production. According to the Aquaculture Department (1997, *op.cit*), in 1995, average carp farm production yield was 3.3 t ha^{-1}, rainbow trout farm was 10 kg per m^3 and natural and artificial fish production was 49 kg ha^{-1}, though ranging widely from over 1,100 kg ha^{-1} (in Mazandran province) to below 15 kg ha^{-1} (in Khuzestan and Sistan-Baluchestan provinces).

As noted before, the characteristic of aquaculture and inland fisheries are influenced by the aquatic resources of the two principal zones, namely the Caspian littoral and the river plain. These areas include the provinces of Gilan, Mazandran, and Khuzestan, which in 1995, accounted for more than 71% of total national production with 29% in Gilan, 21% in Mazandran and 21% in Khuzestan. Their relative contribution has also changed over recent years, with the share of Mazandran increasing and that of Khuzestan and Gilan decreasing (Figure 2.7) (see Appendix II for details).

Figure 2.7: Contribution of main provinces in total inland fisheries production 1989-1995.



Sources: CDSD, 1997[a] *op.cit* and for 1995 Aquaculture Department, 1997 *op.cit.*

The Fishery enhancement programme is planned and carried out by Shilat, on certain artificial lakes designated as protected areas. The Organisation for the Protection of the Environment is also engaged in the control of the fishery. The Organisation only sometimes issues short-term licences for fishing. As Table 2.13 shows, over the 1989-95, total warmwater farm production increased 47%, while open water production increased only 14% over the a same period. It seems, over the period, decline in hatchery production by Shilat had negative impact in open water production.

Table 2.13: Trends of inland fisheries and aquaculture production, 1988-1995.

Unit: tonnes

Year	1989	1990	1991	1992	1993	1994	1995	% growth over 1989-95
Aquaculture (warm water)	18213	18292	19650	21463	21031	24614	26812	47
Aquaculture (cold water)	441	558	579	775	835	1229	1332	202
Reservoirs (warm water)	21706	23060	24765	19746	22000	20436	24836	14
Reservoirs (cold water)	130	130	140	437	254	169	n	30*
Total	40490	42040	45134	42421	44120	46448	52980	31

* - Growth over 1989-94, Source: Shilat 1997 and CDSD, 1997[a] *op.cit.*

An overall assessment of aquaculture and inland fisheries

Aquaculture and inland fisheries production has grown rapidly during the last decade, with large increases in both farms and open water-bodies resulting in rapidly expanding carp production. However, most fish farming is seen as a way of producing cheap protein for "the masses". Carp production practices have had a traditional background (30 years) in the Caspian region, but further intensification may require the addition of food sources, since natural production in farms and open water-bodies, as well as land, is limited in the region. Thus, expansion and development of carp production outside the Caspian region may be expected to improve, since a large potential is available in other zones. As noted earlier, demand for fishery product will increasingly be met with aquaculture products. Production increases may come from farming fresh water species, especially carp. Shrimp (aimed mainly exports) and trout farming may also increase, though, both of these luxury species could be seriously constrained by environmental issues and increasing competition for water and other resources. Production from open water-bodies will be expected to increase, since management may be improved and other production systems such as cages, and pens may also be used. Further expansion of carp may be practised in other provinces such as Khuzestan, Ilam, Sistan, Kermanshah, Azarbiajan and other areas where land and water is available. Over the last decade, the rapid development of aquaculture and inland fisheries has mainly been due to initiatives by the Ministry of Jehad-e-sazandagy and Shilat, especially hatchery production and other subsidies; the policy to increase production and support services such as extension, credit and initiative for other related industries such as feed production, basic facilities may be continued. However, though, the physical potential for carp production may be clear, the profitability for producers and the market demand for its products less certain. Micro-economic analysis of carp production and market demand condition for its products will be discussed in the next chapters.

Chapter Three

3. Market characteristics

3.1 Introduction

As a specialised function of management, marketing is generally interpreted as including all these activities concerned with the development, production, and distribution of products to identifiable market, where they will provide satisfaction to those who buy them (Chisnall, 1992 *op.cit*). According to Jolly & Clonts (1993 *op.cit*) market or consumer demand is a reflection of the expressed willingness to purchase goods and services according to prevailing price conditions. Those with agricultural orientation usually stress the functional aspects of activities involved in movement of farm-produced raw material from the farm to the ultimate consumer.

Since in this chapter emphasis is with markets for fishery products, the role of marketing is to identify the consumer demand for fishery products, and to ensure that the products satisfy consumer needs, following which producers can begin to use price, promotion and distribution of products to generate the required level of sales. In Iran, aquaculture is a relatively new industry, and knowledge of the marketing process is required for locating markets for new and established products, for channel establishment, for price determination, for new markets expansion and development, for setting quality standards, and for development of a variety of products. As production and consumption of aquaculture products increases, marketing will become an increasing area of importance.

The medium-term global demand of fish food is largely determined by population growth, changes in income and the pace of urbanisation (FAO, 1996[d]). The FAO Kyoto conference has noted that the large population in Asia, including Iran, means that this region could account for about two-thirds of total fish demand in the year 2010 (Muir, 1995) and it is this change in demand which must be tackled. The broad objective of this chapter is to provide an overview of the market for fishery products in Iran, with a particular emphasis on the consumption of fish and fishery products and the related market factors, drawing together statistical information from various sources, together with additional primary research.

The size and expected growth of markets for fishery products are important in determining development for the fisheries sector. Evaluation of market demand, marketing infrastructures, and marketing channels would be a primary step in planning for fisheries development. Market potential analysis aids policy makers in formulating a sound policy for distribution, enabling them to determine the profit potential associated with changes in price and production (Shang, 1981 *op.cit*).

The various changes in the fish and fishery products market in Iran over the last 10 years require to be analysed, and this chapter considers the trends in production, and expenditures, the changing importance of *per capita* consumption and the different types of fishery products in the market. Information on current trends in potentially competing products, and differences between urban and rural consumers are reviewed, and current market conditions for red meat, poultry and fishery products are presented, with a view to understand the role of aquaculture (mostly carp) and the usage of its products. Before describing the current situation of market characteristics related to meat and fish products, some concepts relating to marketing are addressed.

3.2 Marketing concept

A farmer or small community producing fish and seeking to exchange the fish is involved in the activity of marketing. According to Chaston (1983 *op.cit*) marketing is an ancient tradition, and as defined by Kotler (1994), is generally conceived of as human activity directed at satisfying needs and wants through exchange processes, which defined by Baker (1983) as exchange between individuals and/or organisations, concluded to the mutual benefit and satisfaction of the parties. As Kinsey (1988 *op.cit*) indicated, the marketing concept is basically the idea that the entire enterprise should be oriented towards the satisfaction of consumer needs and wants, and that a business is most likely to achieve its goals when it organises itself to meet the current and potential needs of customers more effectively than competitors (Doyle, 1994). Marketing has a fundamental role to play in the process of economic development. As Kotler (1994 *op.cit*) noted, marketing at its best, goes beyond meeting existing customer needs, to create new products and services not even imagined by the market place.

In aquaculture, initial management orientation has centred on the production process with the central problem being to find effective ways to increase output, whereas a marketing oriented[30] approach to management has been slow to emerge. Marketing of aquacultural products is the performance of all business activities involved in the flow of aquacultural products and services from the point of initial production until they are in the hands of consumers. It also contains prior activities before the production, consumption process, in building and operating the farm, and after, in the hands of

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[30] - "Production orientation: company belief that developing technologically superior products is the route to success, lies in producing the product more efficiently than competitors and Marketing orientation: company recognises the primacy of customer led demand, what customers want and, how production and resources can be organised to meet these wants" (Doyle, 1994 *op.cit*)

consumers in evaluating their response. It considers functions such as; production, hauling, processing, storage, wholesaling and retailing, in aquaculture will focus on both fresh and processed products (Jolly and Clonts, 1993 *op.cit*).

According to Shaw and Muir (1987 *op.cit*) the marketing function requires decisions about the markets towards which the products are to be targeted, the types of processing required by those markets, pricing, choices of the methods of communication with the consumers. A market may be described in addressing questions such as;

a) What (species, size, price, season, and kind of processing) to produce?,

b) How much (of each species, each size, quality, season, kind of processing) to produce?,

c) How to distribute?,

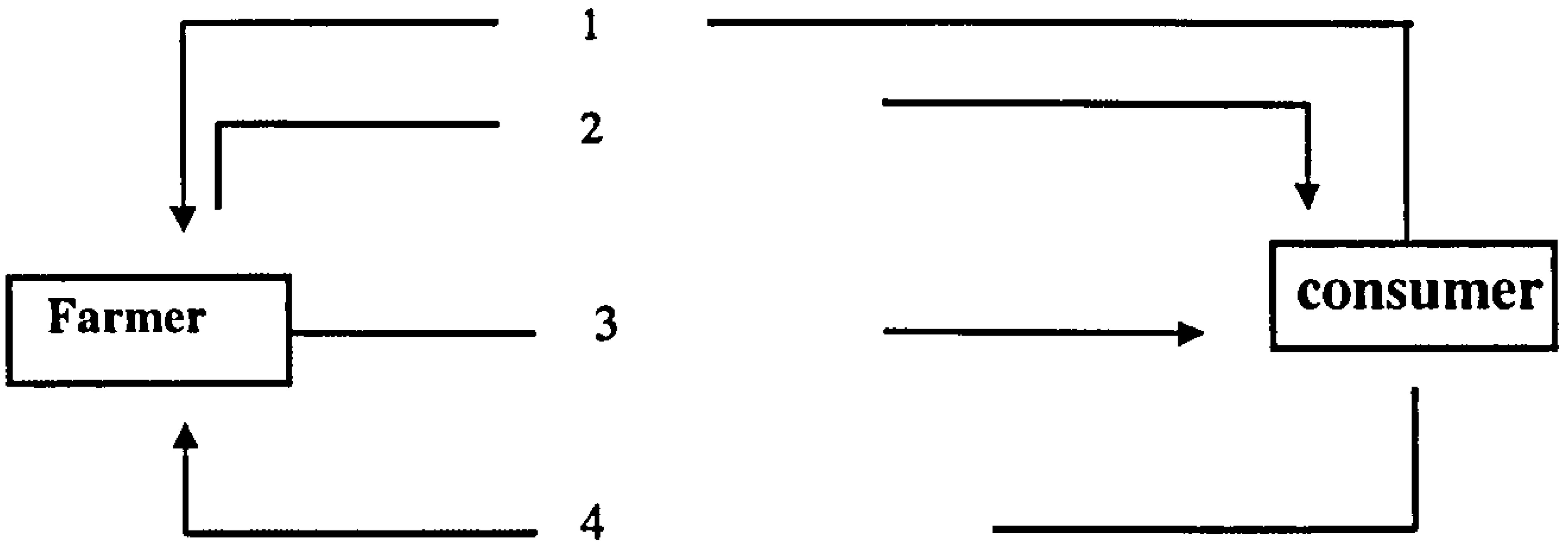
d) What mechanisms will be used for distribution?,

e) What channels will be used? etc.

3.3 Marketing system

Various forms of institution exist for an exchange relationship between producer and consumer. The simple system of the farmer selling directly to the customer exists only in some small-scale rural aquaculture units. In this regard, as Figure 3.1 shows, there is a flow of information between farmer and customer related to customer need, price and availability of fish, followed by transaction of product and payment.

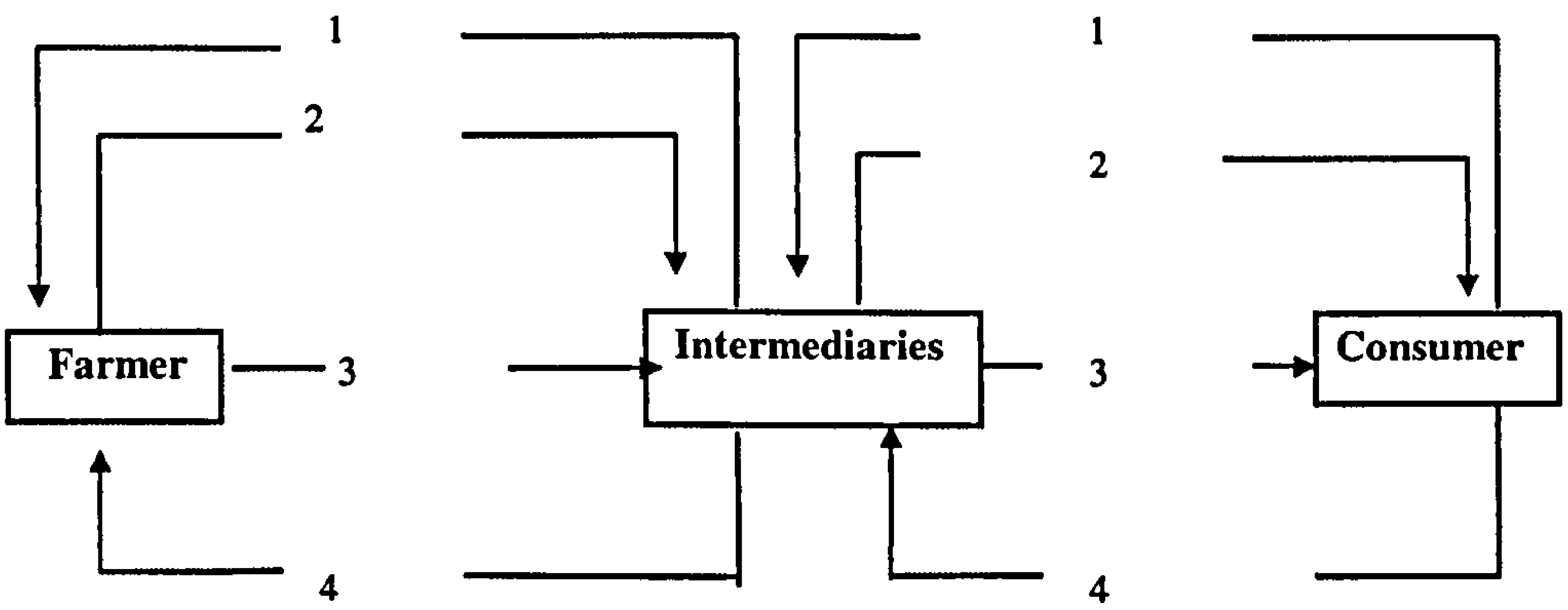
Figure 3.1: Basic marketing system for a farmer and consumer.



[1] Identification of need,
[2] Information on the price and availability of production,
[3] Product flow in currency,
[4] Payment flow in currency

A complex marketing system is usually done through intermediaries or middlemen, which may be described for the flow of products and information in the markets (Figure 3.2). Intermediaries link the farmer to the final customer, in circumstances where producer and consumer are physically distant and/or there are great differences between the scale of production and consumption.

Figure 3.2: Marketing system for consumers located some distance from farmers.



[1] Identification of need,
[2] Information on the price and availability of production,
[3] Product flow in currency,
[4] Payment flow in currency

At the industry level, the market system for a particular sector is composed of five key elements:

1- the producer,

2- the intermediaries supplying the market,

3- the distribution channel linking the producer to the final customer,

4- the population which consumes the output from the aquaculture, and

5- the market system surrounding the industry (Chaston, 1983 *op.cit*).

As Kotler (1994 *op.cit*) indicated, management needs to monitor the larger forces in the marketing environment if it is to keep its products and marketing practices current. It also noted that the company's macro-environment is the place where the company must start to research for opportunities and possible threats, involving of six major forces, including demographic, economic, natural, technological, political and cultural forces. "Thus, fish marketing is concerned with the broad range of activities of individuals and organisations which relate to the exchange of products and services within a continuum between decisions of capture and consumption. Human environmental forces such as economic, sociocultural, technological, and political factors, and natural environmental forces such as, oceanographic, climatic, physical, and biological factors surround the market. The core marketing system comprises producers, processors, intermediaries and markets which are also surrounded by government, public, trade associations, general public, pressure groups, media, and business and financial community" (Young, 1987). Key market environment elements are described in turn.

Demographic environment; related to fishery products in Iran, the first demographic force is population growth because people make up markets. The second cause is population growth which is highest in urban areas and larger cities. Other issues include age distribution (the high portion of young people) variety of ethnic origins (such as; Kurd, Turk, Fars, Gilac, Baluch, Lor, Arab, Turkaman, etc.), locational differences from coastal to inland areas, differences in household patterns and educational levels, all of which make a difference in product preferences. Some of these differences relating to carp products consumption will be discussed in Chapter five.

Economic environment; it is clear that as well as people, markets require purchasing power. As noted in Chapter one, since 1989, *per capita* income has grown, and amounted to almost US$ 2,500 by 1991(UNDP, 1994 *op.cit*). *Per capita* consumption on fishery products has also grown and inequity of expenditure on fishery products between income groups has declined. Any major changes in incomes, expenditures, inflation, interest rate and so on may have an impact on fish markets, factors such as rises in income and price movements on carp products will also be discussed later.

Natural environment; threats and opportunities related to aquaculture may be associated with input materials such as land, water, solar energy, wind, and temperature, increased costs of inputs such as feed, fertiliser, energy, labour and seed, increased levels of pollution and changes in the role of government in environment protection, all of which factors and their impacts may also affect carp markets.

Technological environment; in the face of technology change, a wide range of innovational opportunities may occur in products such genetic, feed, and processing. The emergence of new techniques and products will influence production and consequently carp markets.

Other factors such as political, legal and cultural factors may also affect the aquaculture industry, and some aspects of these will also be addressed in the next chapters.

3.4 Consumer behaviours and market analysis

In general, the consumer is the key decision maker, and it is essential to know who the consumer is, what they are buying, when, why and how they buy, as well as who is involved in the buying process. As Kinsey (1988 *op.cit*) indicated, because of differences in;

a) income levels and the nature of demand,

b) the supply situation,

c) cultural factors,

There are also significant differences in consumer behaviour, which is the subject of a large and rapidly growing field of research. Consumer behaviour is defined as those activities directly involved in obtaining, consuming and disposing of products and services, including the decision processes that precede and follow these activities (Engel, et al, 1995). Every market exhibits unique features during the transaction process, and on this basis markets can be divided into two types, the consumer market and the industrial market (Chaston, 1983 *op.cit*). A consumer market relates to products purchased by individuals and households for personal consumption, and in industrial markets materials are purchased for the purpose of generating a tangible economic return. Industrial markets are also greatly affected by the attitudes, performance, and habits of individuals and households. However, in approaching any new market situation, the marketer needs to know the objectives of the customers, because there is a key difference in the nature of the buying behaviour in the two types of market.

Food consumers are conventionally grouped into three categories: households, restaurants, and institutions (catering). The main marketing variables for any type of consumer are described as product quality, price, place of market, and market promotion, though it is not always easy to understand the relationship between these and purchasing behaviour (Pillay, 1990 *op.cit*). According to Kinsey (1988 *op.cit*) culture is one of the most significant aspects which may be used to explain differences in consumer behaviour, and the influence of social class, family structure, and educational status on consumer behaviour are particularly significant in many developing countries. As Engel, et al, (1995 *op.cit*) emphasised, cultural sensitivity is especially needed in developing countries. To understand the relationship between consumer purchase behaviour and the influence on the marketing mix, Kotler (1994 *op.cit*) assumes five components:

a) need recognition,

b) information need on potential products,

c) evaluation of the alternative propositions,

d) the purchase decision and

e) post-purchase evaluation of the product.

Consumer decision making as classified by Engel, et al, (1995 *op.cit*) into seven stages, including need recognition, search for information (from memory or from environment), pre-purchase alternative evaluation, purchase, consumption, post-purchase alternative evaluation and divestment. However, it is influenced by many factors and determinants, but can be classified into three categories, including individual differences, environmental influence and psychological processes.

Continued usage of the product is usual for fishery products and this will cause post purchase evaluation which can positively or negatively influence the next purchase. Internal and external sources of information also affect the consumer decision.

3.5 Trends in total meat[31] production

After the revolution (1979) one of the most important national strategies has been self-sufficiency[32] in food production as well as food security, particularly for low income groups and rural areas (PBO, 1988, 1993 & 1999 *op.cit)*. The war has had an important impact and government food policies have had an important role over the last decade, and so political as well as economic considerations have been present, including the support of red meat and poultry through subsidising their prices. Swinbank (1987) has remarked that the legal framework is important in conditioning the circumstances within which industries operate and products are marketed; given the critical importance of food for human survival, the policy can be understood, particularly if supplies are less than demand. According to Shaw and Muir (1987 *op.cit*) the level of profitability at all stages in an aquaculture production sector is affected by the interaction of demand and supply, and the level of demand[33] will determine the extent to which it is worthwhile to increase supplies.

As Table 3.1 shows, total meat production increased about 7% annually from 642,000 t in 1982 to 1,362,000 t in 1993. During this period beef and veal production (20% of the

[31] - In this study, total meat (meat) = red meat + poultry + fishery products.

[32] -The contribution of *per capita* meat consumption of urban to rural is 2:1, however, differences between provinces and social groups are also notable. Iran is facing increasing demand for food supply, to inhance overall protein option are rather limited, thus, growing demand would mainly come from aquaculture.

[33] - Consumer demand is defined as the various quantities of particular commodity a consumer is willing and able to buy as the price of the commodity varies, when all other factors affecting demand are held constant (Jolly and Clonts, 1993 *op.cit*).

1993 total) increased 4.6% annually to 275,000 t, though mutton and lamb (19%) increased less than 4% annually to 253,000 t.

Table 3.1: Meat production in Iran 1973-1993.
Unit: 1,000 t

Year	1973	1978	1982	1983	1985	1987	1989	1991	1993	% average annual growth 1982-93
Beef & Veal (% growth)	121 (n)	160 (n)	170 (n)	165 (-2.9)	168 (1.8)	174 (1.8)	201 (11.7)	235 (11.9)	275 (1.9)	4.6
Mutton & Lamb (% growth)	125 (n)	152 (n)	166 (n)	173 (4.2)	192 (5.5)	208 (1.5)	216 (1.9)	240 (3.9)	253 (1.6)	3.9
Poultry meat (% growth)	110 (n)	176 (n)	210 (n)	220 (4.8)	240 (4.3)	250 (2)	280 (7.7)	356 (18.7)	490 (15.3)	8.2
Fishery products (% growth)	20 (na)	67 (na)	69 (na)	112 (16.7)	119 (2.6)	211 (38.8)	260 (10.6)	276 (2.2)	344 (3.3)	12.9
Total (% growth)	376 (n)	555 (n)	642 (n)	670 (4.4)	719 (3.8)	843 (9.1)	957 (7.9)	1107 (9.5)	1362 (6.6)	7.1

n: not available, Source: FAO, 1992[d] *op.cit* and 1996[d] *op.cit.*

Two other large sectors are poultry products (36%) with more than 8% annual growth to 490,000 t, and fishery products (25%) notably increasing at around 13% annually, growing to 344,000 t. Over the 1982-93 period, with population growth, total meat production is also increased. However, the annual growth rate of fishery products was much higher than that for other animals, and the market for fishery products in Iran can be regarded as increasing. This arises from the increased demand arising from population growth, urbanisation, and the move into healthier products.

Table 3.2: Food consumption in Iran, 1973-1992.
Unit: Kcal *per capita* per day

Year	1973	1978	1982	1985	1988	1989	1990	1991	1992	% average annual growth 1982-92
Total Food	2272	2568	2761	2674	2663	2781	2647	2780	2860	0.4
Animal Products	227	281	290	271	238	232	242	255	245	-1.3
Meat & Offal	79	105	117	101	90	89	92	97	103	-1.1
Fish & Seafood	1	3	4	4	8	8	8	8	8	7.7

Source: FAO, 1992[d] *op.cit* and 1996[d] *op.cit.*

As Table 3.2 shows, total food consumption in energy terms increased by 0.4% annually from 2,761 kilocalories (kcal) to 2,860 kcal capita^{-1} day^{-1} from 1982 to 1993, though consumption of animal products and meat and offal products decreased by 1.3% and

1.1% respectively. However, fish and seafood products increased about 8% annually over the same period from 4 kcal to almost 8 kcal capita^{-1} day^{-1}, which though still low in overall terms represents a sizeable increase. This indicator suggests that the market for fishery products will tend to become even more pronounced in the future. Recently, also notable trends in consumer demands have favoured seafood product attributes, perceived as being healthier, low in saturated fats and offering greater convenience (Abzigostar, 1996 *op.*cit). This appears to be occurring mainly in urban areas and particularly in larger cities, and such preferences may apply across a range of fishery products over the coming years.

Table 3.3: Total meat imports, 1973-1993.
Unit: US$ million.

Year	1973	1978	1983	1985	1987	1989	1990	1991	1992	1993	% average annual growth 1982-93
Meat products (% growth)	21 (n)	188 (n)	512 (-1.5)	257 (-30.4)	164 (-22.3)	233 (-6)	290 (24.5)	234 (19.3)	228 (-2.6)	231 (1.3)	-4.6
Fish products (% growth	4 (n)	27 (n)	32 (-15.8)	21 (-41.7)	31 (55)	24 (14.3)	14 (-41.7)	43 (207.1)	57 (32.6)	12 (-78.9)	9.7

Source: FAO, 1992[d] *op.cit* and 1996[d] *op.cit.*

Over the same period, the value of total imported meat and preparations decreased 4.6% annually from US$ 520 million (m) to US$ 231 m, but imported fishery products increased about 10% annually, though with significant variability and a notable decline in 1993 (Table 3.3). Since 1993, the decline in oil earnings appears to have had a negative impact on imported fishery products, as elsewhere. The majority of imported fishery product is fishmeal (Table 1.6). Since the FFYDP and with more emphasis in the SFYDP, government policy has been to reduce imported food products and increase domestic production. Thus, it is expected, over coming years, that imported red meat and fishery products will decline.

3.6 Trends in expenditure on meat and fish consumption

3.6.1 Introduction

Household incomes, and expenditure for consumption of red meat, poultry and fishery products are discussed in the following sections. Comparing official household income estimates with expenditure, unofficial sources of income may also need to be accounted. Khalatbari (1994) has described four different "underground" economies in Iran, namely the, (1) household, (2) informal, (3) irregular, and (4) illegal sectors. There is no information related to the share of these sectors, but the contribution of the household sector, that is activities of economic value taking place inside the household e.g. carpet and/or other hand making or such agricultural activity, involving almost 20% of the national population is very important, especially in rural areas. The ratio of urban to rural expenditure is almost 2:1 (SCI, 1996 *op.cit*), though this hides the fact that the majority of rural inhabitants produce their own staple foods. However, even allowing for this, according to SCI (1996 *op.cit*) the share of expenditure on food items by urban families, as a percentage of their total expenditure, is lower than in rural areas. The contribution of household expenditure on food products are varies with location, from 26% in Tehran to ~54% in Sistan-Baluchestan.

3.6.2 Urban population

As Table 3.4 shows, average urban household[34] expenditures on total meat consumption increased in real terms from about 108,000 rials to 138,000 rials from 1982 to 1984. From 1984 to 1987, during economic recession, spending in real terms fell sharply; a year-on-year increase was seen from 1987 to 89, and a decrease was recorded from 1990 to 1993. Total meat expenditures decreased an average 5% annually in real terms during the period. However, recent evidences show, over 1993-96, total meat expenditures also decreased 18% in real terms[35] (SCI, 1998).

Table 3.4: Household expenditures of meat consumption in urban population at constant price to 1982.
Unit: Rial 1,000

Year	1982	1984	1987	1989	1991	1993	% average annual growth (1982-93)
Red meat (% growth)	83.9 (n)	112.2 (12)	75.5 (-7)	69.7 (1)	41.7 (-54)	36.1 (-10)	-5
Poultry (% growth)	18.7 (n)	21.3 (3)	15.4 (-35)	16.6 (37)	5.3 (-62)	8.5 (31)	-1
Fish (% growth)	5.3 (n)	4.7 (-6)	4.4 (33)	3.9 (8)	2.4 (-51)	3.7 (3)	1
Total (% growth)	107.9 (n)	138.2 (10)	95.3 (-12)	117.1 (6)	49.4 (-55)	48.3 (-4)	-5

Source: SCI, 1991-1995 *op.cit.*

Since 1992 fishery product and poultry expenditures have increased year-on-year, but red meat expenditure has decreased, over 1982-93, in the urban population red meat and poultry expenditures annually decreased 5% and 1% respectively, compared with an annual 1% increase in fishery products expenditure (Table 3.4). Though, total meat production increased, average expenditure declined over the period. This appears to have arisen from population growth, the effect of war before 1988, and the reconstruction the country and economic reform since 1988, which strongly increased inflation. According to CBI (1996 *op.cit*), on average the price of total meat increased annually about 19% over the period, red meat, poultry and fishery product increasing 19%, 26% and 21% respectively. Within the overall decline for total meats expenditure,

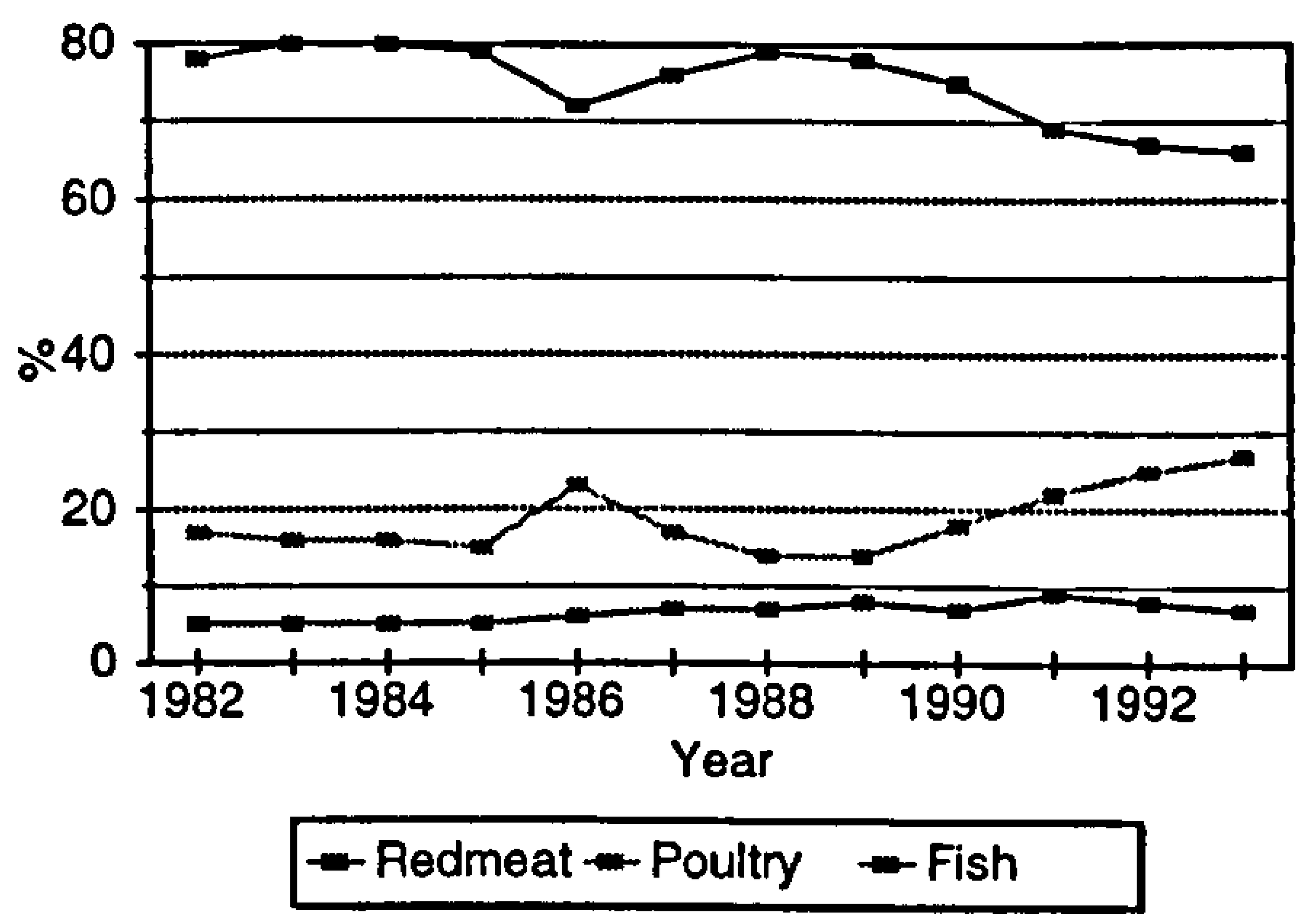
[34] - According to (SCI, 1996 *op.cit*) average size of a household was 5.2, from 4.9 members in urban areas to 5.6 members in rural areas.

[35] - $-R Exchange rate has varied and that was used R as basic unit, though $-R exchange rate is shown in Appendix III.

there have been notable changes in fishery products, mainly due to supply expansion, rising to ~8% of total meat expenditure by 1993 a notable increase from 5% in 1982.

According to SCI (1995 *op.cit*) expenditure on total meats (as a percent of total household food) has declined by 10% over the 1982-93 period, due mainly to the reduction in red meat expenditure (Figure 3.3). Growth in the share of poultry has been largely due to imports before the revolution, and to governmental support for national production after the revolution. Equivalent *per capita* figures (Table 3.5) for red meat, poultry and fishery products consumption show an annual increase of 2.6% in total meat consumption during 1982-93, but a sharp decrease in the last two years.

Figure 3.3: Contribution of fishery product, poultry and red meat to total meat expenditure in urban population, 1982-93.



Source: SCI, 1991-1995 *op.cit.*

During the period *per capita* fish consumption increased about 11% while the contribution of fishery products to total meats consumption increased from 7% to 11%. In urban areas, the characteristics of meat and fish consumption over the period can this be briefly described as follows:

- red meat consumption is higher than poultry, which is higher than fish,

• except for 1991, with expanded meat (imports), total meat consumption (especially over the last two years) declined during the period.

• the highest level of fish consumption was 5 kg in 1991,

• the share of poultry and fish to total meats consumption increased over the period, while that of red meat declined.

Though, the contribution of fish expenditure is still low, in the past decade there has been a shift in demand towards 'healthier' sources of food, and this change has benefited fish producers in general and fish farming in particular.

Table 3.5: ***Per capita*** **consumption of red meat, poultry and fishery products in urban population, 1982-93.**
Unit: kg

Year	Red meat	Poultry	Fish	Total	Fish as % of total
1982	25	14.3	2.8	42.1	7
1984	31.4	15.3	2.6	49.3	5
1987	22.7	14.3	4	41	10
1989	25.7	10.3	4.3	40.3	11
1991	33	20.3	5	58.3	9
1992	17.9	8.7	3.6	30.2	12
1993	11.4	9.3	2.5	23.2	11
% average annual growth (1982-93)	1.6	5.4	10.9	2.6	--

Source: Iran Statistical yearbook (SCI, 1991-95 *op.cit*).

As earlier noted, the highest *per capita* fish consumption is in coastal areas, where there is a strong preferences for fresh rather than frozen fish and its processed products. However, it might be expected, that in the coming years, increased demand for fishery products will arise in urban areas, particularly in larger cities throughout inland provinces.

3.6.3 Rural population

A similar comparison of consumption can be done for rural population, though recorded figures may be distorted by the considerable quantities of non-marketed production (their production), for which there is no published information.

Table 3.6: Household expenditures on meat consumption in rural population at constant price to 1982.
Unit: Rial 1,000

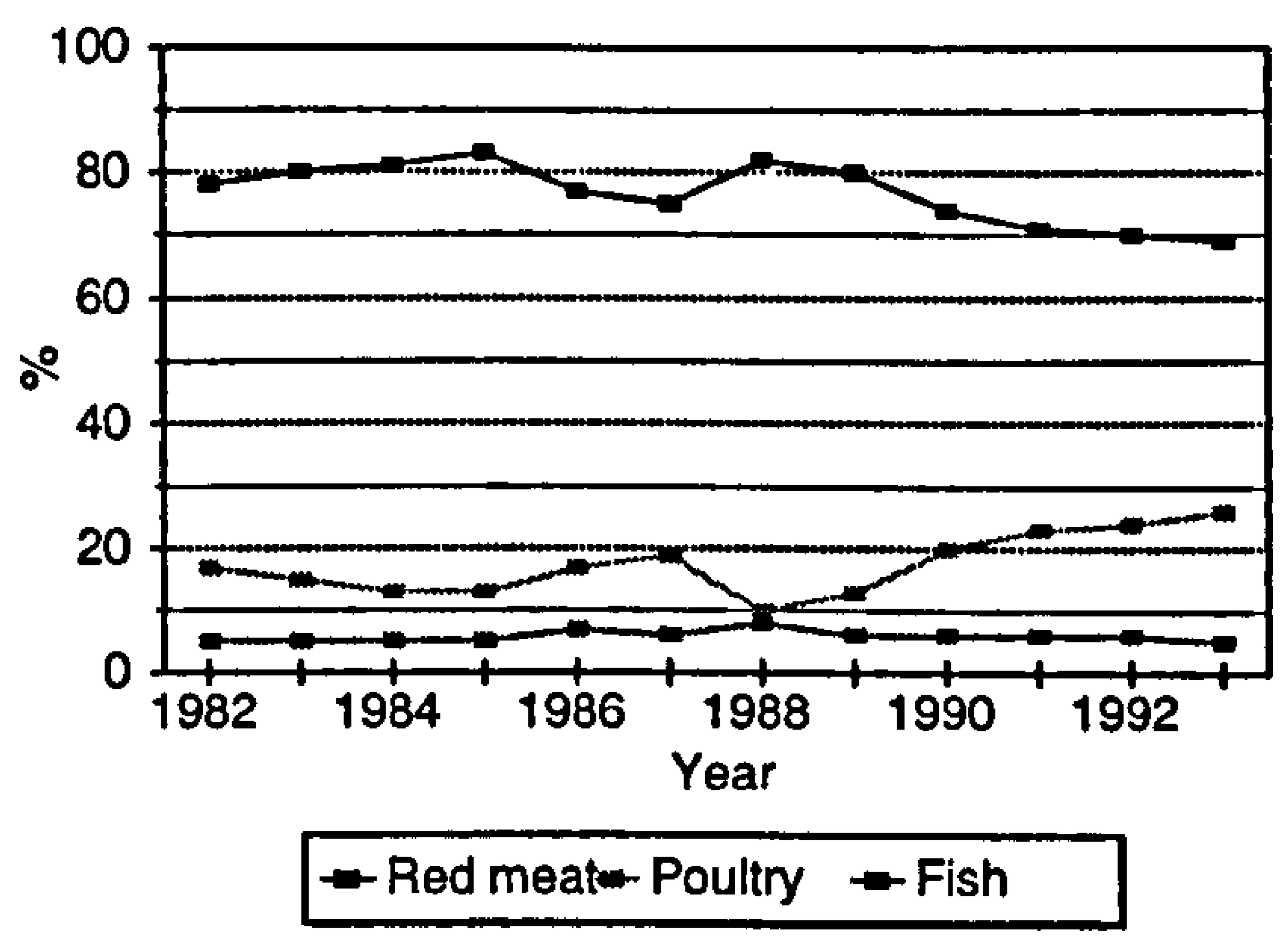
Year	1982	1984	1987	1989	1991	1993	% average annual growth (1982-93)
Red meat (% growth)	50.7 (n)	62.7 (17)	43.6 (-19)	54.7 (15)	45.6 (-1)	34.4 (-15)	-2
Poultry (% growth)	11.1 (n)	10 (-4)	9.8 (-8)	8.6 (110)	7.6 (-30)	8.1 (14)	5
Fish (% growth)	3 (n)	2.7 (-4)	2.3 (-4)	1.7 (-15)	2.4 (33)	2.2 (-19)	0
Total (% growth)	64.8 (n)	75.5 (13)	55.7 (-17)	65 (21)	55.6 (-6)	44.7 (-11)	-2

Source: SCI, 1991-1995 *op.cit.*

As Table 3.6 shows, average household expenditure on meat consumption increased in real terms (1982 prices) from about 65,000 rials in 1982 to almost 76,000 rials in 1984. During the period 1984-89, spending fluctuated, and decreased slowly over 1990-93. Total meat expenditure decreased less in real terms than in urban areas, a rate of -2% annually over the whole period (compared with -5% in urban areas). Before the revolution most of the subsidised meat was distributed in urban areas, but since the early years of the war, subsidised poultry was distributed in rural areas as well, and this practice had a positive impact on the expansion of expenditure on poultry. As a result, during the years 1982-93 red meat expenditure in rural households decreased 2% annually, poultry expenditure increased by 5% and fishery product expenditure remained stable (Table 3.6). However, evidences show, households expenditure on total meats decreased 13% in real terms, over the 1993-96 period (compared with 18% decline in urban areas), but that for fish increased 11% (SCI, 1998 *op.cit*). The war period and the post-war reconstruction of the country has affected annual expenditure on meat, in rural areas, but this effect was much lower than that in urban areas, probably due to the dependence of rural families on their own resources (Abzigostar, 1996 *op.cit*).

Contribution of red meat expenditure decreased 1% annually from 78% in 1982 to 69% in 1993, while poultry expenditure increased 7% (from 17% to 26%) and fishery product expenditure was stable (at 5% level) (Figure 3.4). However, the contribution of total meats to total food expenditure remained stable, compared with the 10% decline in urban areas. In 1988, when the war stopped and subsidies for poultry also declined, the price of poultry increased and consequently the share of red meat and fishery product increased.

Figure 3.4: Contribution of fishery product, poultry and red meat to total meat expenditure in rural population, 1982-93.



Source: SCI, 1991-1995

Table 3.7 shows *per capita* consumption of red meat, poultry and fishery product from 1982 to 1993, with total sector consumption increasing 5% annually from 17.9 kg to 18.4 kg. While *per capita* consumption of poultry and red meat has increased by ~9% annually, fish consumption has not notably changed, apart from an increase to 2 kg during 1986-89. In the rural areas the contribution of fishery products to total meats consumption decreased from 9% in 1982 to 7% in 1993. However, households expenditure increased over the 1993-96 period. Over the years 1982-93, in rural areas, the characteristics of meat and fish consumption can be briefly described as follows:

- as in urban areas, red meat consumption is higher than poultry, which in turn is higher than fish,
- total meat, red meat, poultry and fish consumption in rural areas is lower than that in urban areas,
- the highest level of fish consumption was 2 kg in 1988, compared with 5 kg in urban areas.
- on average the share of poultry and fish to total meat consumption increased over the period, while the share of red meat declined,
- on average, as in urban areas, household expenditure on total meats consumption annually decreased,
- household expenditure on red meat annually decreased, that for poultry increased, while expenditure on fish remained stable; though, in rural areas, households expenditure on red meat (63% of total meats expenditure by 1996) dominates all meat expenditure, followed by poultry (31%) and fishery products only 6% (compared with 8% in urban areas) (SCI, 1998 *op.cit*). Though, the contribution of fish expenditure seems very low, there has recently been a shift in demand. The development of aquaculture in inland provinces may positively affect demand in rural areas.

Table 3.7: ***Per capita*** **consumption of red meat, poultry and fishery products in urban population, 1982-93.**
Unit: kg

Year	Red meat	Poultry	Fish	Total	% Fish/Meat
1982	10.6	5.7	1.6	17.9	8.9
1984	15	3.9	1.7	20.6	8.3
1987	9.3	4	1.8	15.1	11.9
1989	11.2	3	1.8	16	11.3
1991	20.6	6.3	1.6	28.5	5.6
1992	12	6.4	1.7	20.1	8.5
1993	8.7	8.4	1.3	18.4	7.1
% average annual growth, 1982-93	9	9	0	5	--

Source: Iran Statistical year book, household sample budget for 1982-1993 (SCI, 1991-95 *op.cit*).

It is evident that the rural population in Iran has also been attracted to fishery products and poultry, but their growth rate were slower than that for urban areas. However, growth over the last two decades, might be expected to continue and the contribution of fishery products to total meat consumption may also increase.

3.7 Protein supply and *per capita* consumption

Table 3.8 shows how fish and fishery products and other forms of protein consumption have changed during last decade. According to FAO (1996[b] & 1996[d] *op.cit*), with fish production in Iran increasing about 13% annually from 95,724 t in 1982 to 343,886 t in 1993, exports and imports of fishery products annually increased by 3% and 15% respectively, total food fish supply increasing almost 13% annually. As population growth rate was estimated at near 3.8% over the period[36] fish supply increased some 8% annually from 2.3 kg to 5.3 kg *per capita* per year in 1993, fish protein consumption increased at the same rate from 0.8 to 1.6 g *per capita* day^{-1} in 1993, while animal proteins fell from 18.4 to 17.1 g *per capita* day^{-1} over the same period, and annual

[36] - The real population growth rate could be less than FAO estimation.

increase in consumption (animal and vegetable protein) increased by only 1% (FAO, 1996[d] *op.cit*).

Table 3.8: Food balance sheet of fish and fishery product in live weight and fish contribution to protein supply[37].

Year	Unit	1975	1980	1983	1986	1989	1991	1993	Average 1982-93	% average annual growth 1982-93
production	(000 t)	66.7	43.5	111.9	151.7	260.2	275.7	343.9	210.3	12.5
Non-food	(000 t)	0	0.85	1.4	2.3	3.4	2.95	3.25	2.38	9.5
Imports	(000 t)	0.53	7.14	14.5	0.02	0.03	28.4	30	7.1	15
Exports	(000 t)	6.38	1.71	1.49	0.09	1.49	2.06	1.7	1.52	3
Total food supply	(000 t)	60.9	67.9	123.5	148.7	255.5	299.1	339.5	213.5	12.5
Population	(000)	33344	39254	44782	50982	57046	60766	64164	53821	3.8
Per capita	kg	1.8	1.2	2.8	2.9	4.5	4.9	5.3	4	8
Fish	GCD[1]	0.5	0.4	0.8	0.8	1.3	1.4	1.6	1	8
Animal	GCD	15.1	17.1	18.4	15.9	15.4	16.5	17.5	17	0
Total[2]	GCD	69.3	68.8	75.5	68.8	72.8	75.3	78.5	72	1
Fish/animal	%	3.3	2.3	4.3	5	8.4	8.5	9.1	7	--
Fish/total	%	0.7	0.6	1.1	1.2	1.8	1.9	2	1.6	--

[1]- GCD: Grams *per capita* per day,

[2]- Total: Total protein including animal and vegetable protein.

Source: FAO Food Balance Sheets (1961-1993), No. 821, revision 3 (FAO, 1996[d] *op.cit*).

Growth in fish consumption has arisen from increasing imports and domestic production. Table 3.8 shows that the contribution of fish to animal protein consumption increased from 3.9% in 1982 to 9.1% in 1993 and its share of total protein consumption increased from 1% to 2% over the same period. The average share of imported fish to total fish supply was 3.3%, while the average share of exported fishery products were only 0.7% during the decade.

With the exception of 1983, 1991 and 1992, when imports notably increased, the fish production trend is similar to that of total fish supply, and with the exception of 1984, 1985 and 1993, *per capita* fish supply increased year on year. *Per capita* fish protein consumption has notably increased over the 1982-93 period, and this trend may positively affect demand for fishery products over the coming years.

[37] - For details see Appendix III.

3.8 The role of aquaculture in fish consumption

Overall, the contribution of inland fisheries and aquaculture to total fish production increased from 7.9% to 13.7% over the 1982-95 period (Table 3.9). Aquaculture production and its apparent consumption, as well as its contribution to total fish consumption increased over the same period. Apparent fish consumption has been estimated at around 4.5 kg head^{-1} yr^{-1} in 1995, of which some 0.83 kg head^{-1} yr^{-1} represents cultured carp. The apparent levels of carp consumption increased annually by 17% from 150 g head^{-1} yr^{-1} in 1982 to 830 g in 1995. The contribution of apparent levels of carp consumption to total fish consumption increased from 6.3% in 1982 to 18.2% in 1995, though during 1992-94, when production costs increased, apparent consumption of carp slowly decreased. Though, carp culture is still a relatively new industry in Iran, it has experienced rapid expansion in both the Caspian region and the Khuzestan province in recent years.

Table 3.9: Contribution of aquaculture production and its apparent consumption to total fish production and fish consumption in Iran, 1982-95.

Year	Total fish production	Inland & aquaculture production	Apparent fish consumption	Apparent aquaculture consumption	Aquaculture share to fish production	Aquaculture share/ to fish consumption
Unit	t	t	kg head^{-1} yr^{-1}	kg head^{-1} yr^{-1}	%	%
1982	78349	6215	2.3	0.15	7.9	6.5
1984	94934	8636	2.6	0.19	9.1	7.3
1987	159401	15000	4.1	0.29	9.4	7.1
1989	300683	40490	4.25	0.74	13.5	17.4
1991	327727	45131	4.4	0.78	13.8	17.7
1992	354189	42420	4.25	0.72	12	16.9
1993	368888	44120	4.5	0.73	12	16.2
1994	350000	45300	4	0.73	12.9	18.3
1995	382300	52890	4.5	0.83	13.7	18.4
% average annual growth 1982-95	14	21	6	17	--	--

Source: Developed from CDSD, 1997[a], 1997[b] and SCI, 1991-97 *op.cit.*

As noted earlier, there are few additional resources for edible fish to meet future needs, and aquaculture, particularly culture of carp in fresh water may play an important role.

The economic transition of the FFYDP has already influenced this sector and though inland fisheries production remained almost static, fresh water aquaculture showed an annual ~21% growth rate over the 1982-95 period and based on recent growth[38], the longer-term outlook seems promising.

3.9 Fish market structures in Iran

3.9.1 General consideration in fish market

The factors influencing the demand for fishery products may be grouped under five headings:

- population size and its distribution by age and geographic areas,
- consumer income and distribution,
- consumer taste and preference,
- own price (i.e. price of the product concerned) , and
- price and availability of substitutes for the fishery product (s).

It is possible that market demand for aquaculture product can be expanded more easily than for wild fish, as through controlled production, fish farmers can guarantee a certain quantity and quality of production, market their produce when natural supplies are seasonally low or not available, and in some cases exploit the potential for selective production to meet consumer preference for taste and other market requirements (Hulse, et al., 1981).

[38] - According to Aquaculture Department (1998 *op.cit*) inland fisheries and aquaculture production was 65,000 t by 1997.

The basic price of fish generally depends on the species, quality, season, competitive, availability of marine fish, and consumer demand. The goals and objectives of producers and consumers meet in the marketplace (Allen, *et al*, 1984). In aquaculture, farmers seek the highest possible price, but would be prepared to produce wherever there is sufficient margin above a cost of production, while consumers wish to satisfy their needs at the lowest possible price and will increase their purchases at lower prices.

As noted, *per capita* consumption of fish in Iran is extremely low, and fish consumption ranges widely between provinces from as little as 0.2 kg in W-Azarbiajan to 35.5 kg *per capita* per year in Hormozgan. Consumption in the N and S coastal regions are above average, but in all other areas, including urban centres, it was less than 5 kg *per capita* in 1995 (Abzigostar, 1996 *op.cit*). Recently Shilat has introduced a programme to increase fish consumption in the inland provinces. With more than 60 million people, mostly living in urban areas, the domestic market for fish consumption is potentially large, and of this just below 1 kg appears to be freshwater fish (FAO, 1992[e] *op.cit*).

Marketing begins at the point of production in the farm and ends with the satisfied consumer. Fisheries products are transferred from producer to consumer, generating at the same time a flow of information. Shaw and Muir (1987 *op.cit*) noted that the workings of distribution and marketing channels are explained not only by the patterns of formal and institutional structures but also by the nature of working relationships between buyers and sellers.

3.9.2 Market chain survey

The diverse structure of the markets for carp products throughout the country and its supplies, are such that extensive primary data would be prohibitively time consuming. The emphasis of research was therefore focused on selected primary investigations together with secondary data analyses. In order to verify and expand the data available from published sources, a series of personal and telephone interviews of sellers, consumers and marketing experts was also conducted (details are provided in appendix III). Primary data was collected from;

1) carp producers
2) market intermediaries,
3) consumers, and
4) other sources, such as Shilat's experts and marketing experts.

Secondary data was collected from;

1) Shilat and its affiliated departments
2) Central Bank of Iran (CBI)
3) Statistical Centre of Iran (SCI)
4) International organisations, such as FAO, World Bank and UNDP.

No specific study of the cultured carp market in Iran is known to have been published, in spite of the importance of the cultured carp sector, and so secondary data has had to be collected from a number of different (and incomplete) sources. The survey of wholesalers and retailers related to cultured carp products was conducted in 11 main cities from 6 provinces including, Gilan and Mazandran provinces (main producer areas), Tehran Province (main consumer area), Isfahan province in the desert zone area, Azarbiajan province in the mountain zone area and Fars province in the S of the country. A face to face interview was carried out with 96 sellers in these cities (detail of the questionnaire is in appendix III), selected by random sampling[39]. There are no special processing units for cultured carp, though some data was obtained through personal communication with new processors and marketing experts in Shilat and private sector. Due to the comparatively small sample size interviews and telephone surveys were conducted using an unstructured questionnaire which sought to obtain qualitative, rather than quantitative data.

3.9.3 market structure

In Iran, main fish markets are located in the coastal provinces and the capital Tehran and the major freshwater fish markets are in the provinces of Gilan, Mazandran and Tehran. Rasht in the centre of Gilan province is the main fresh water fish market in the Caspian sea area, followed by Anzali and Langarod. The main fish distributors are in the major cities of these provinces. Some co-operative agents are also active in fish markets.

Farmers usually sell their cultivated fish, over December to March. In the Caspian Sea, the fishing season usually starts in the second half of October to the end of March, and the carp harvest is usually also starts in October. In Gilan province, where capture fishery has a very long tradition, marine species, especially kutum have strong consumer preference. Fish sent to the capital Tehran by wholesalers are sold through agents (at 8-12% commission[40]) on the day of arrival at an auctioned price. There are no strong fish

[39] - No specific study of the number of intermediaries related to cultured carp is known to have been published.
[40] - Source: Modiry, 1998 *op.cit* and Beheshty, 1998.

transport networks in the country, and as a result, most products are marketed close to the centres of production, excluding Khuzestan as noted earlier, from which more than 85% of the carp production is transported to Tehran (i.e. loads of 2-10 t) (Figure 3.7). Typically, fish farmers or wholesalers deliver the fish in trucks or covered pick-up vehicles to urban centres (Modiry, 1998). The maximum distance for transportation is less than 700 km which usually take an over night drive 10-12 hours.

Unfortunately there is a dearth of statistics on the fish marketing sector compared with that of other animal proteins. This is primarily due to its rather disorganised structure, based on traditional patterns. Fish marketing can take place in coastal areas and elsewhere in the country, but can broadly be divided into two main categories; local traditional, using local species, and developed, using a wide range of species. However, customers living near the sea or rivers, lakes and farms may buy fish directly, with no market intermediaries. Most fish supply (from coastal provinces) passes through a fish market area which is located in the centres of inland provinces. The consumer can buy fish by in several different forms, though fresh fish is generally the most common.

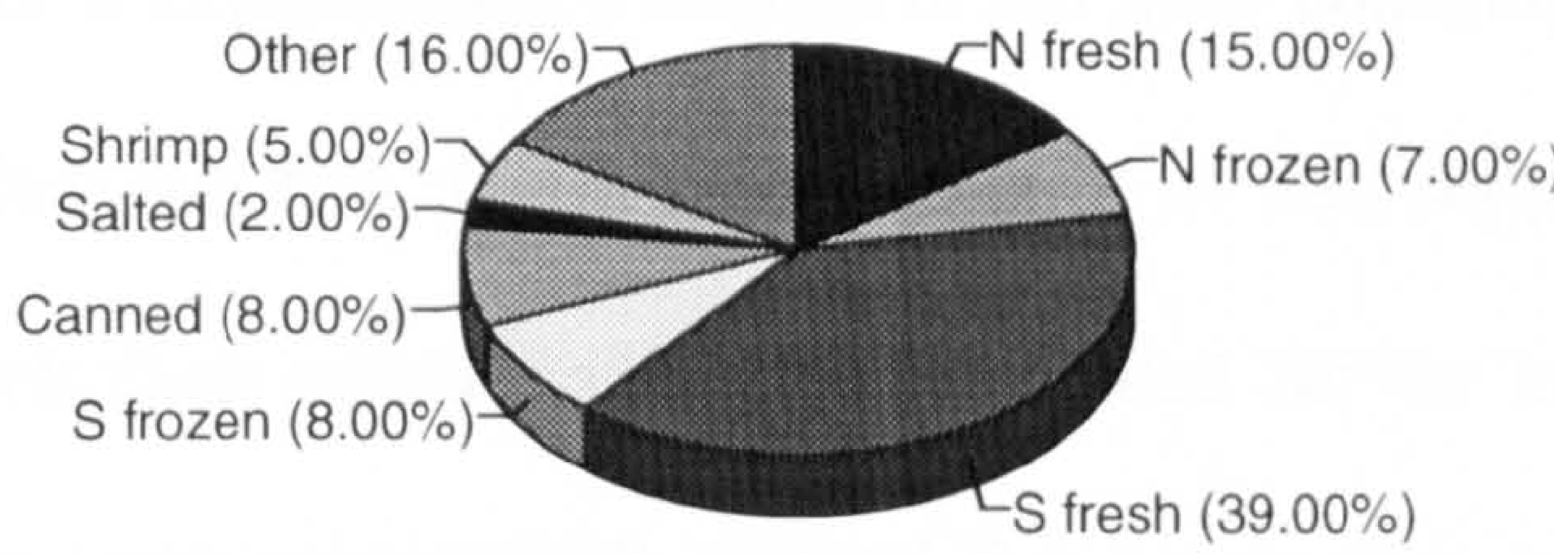
Though some fish are sold directly to customers, most production enters the market system, using auction procedures. Most of the fish distribution system is very old and relatively underdeveloped. Results show excluding Tehran's Sarcheshmeh fish market, the majority are characterised by low sales volume, small physical space, low inventories, inadequate storage facilities and little standardisation.

In inland provinces fish usually is distributed through intermediaries without any processing and consequently in each step, quality declines though price increases. It appears that most distributors make profits at a level of operation which is generally inefficient in terms of volume variety or quantity to provide adequate margin. The consumer must pay for these inefficiencies through higher prices, and the producer must sell at lower prices (Abzigostar, 1996 *op.ci* & Modiry, 1998 *op.cit*)

Figure 3.5, shows the sourcing of edible fishery product in the Iranian market in 1992. Supply from the N coast area contributes 15% of fresh fish and 7% frozen fish, the S coastal area 39% of fresh fish and 8% frozen fish, while canned fish represent 8%, and shrimp and salted fish 5% and 2% respectively, the balance being mainly fresh and frozen carp. Thus, it was estimated that almost 85% of fishery product consumed is in the fresh or frozen forms (CBI, 1995 *op.cit*).

Khalatbari (1996) estimated the distribution of edible fishery products in live weight terms in 1995 to be; 44% fresh, 26% frozen, (70% fresh and frozen of 85% in 1992), 25% canned, and only 5% dried, salted and smoked. This appears that the share of frozen and canned products has increased, but fresh fish has decreased. This may have been because almost 8% of total production came from international waters, mainly used for canning, as well as increases in the share of small pelagic and kilka for food consumption, also mainly canned. In 1995, Khalatbari (1996 *op.cit*) estimated that 27% of total domestic production was used for fishmeal.

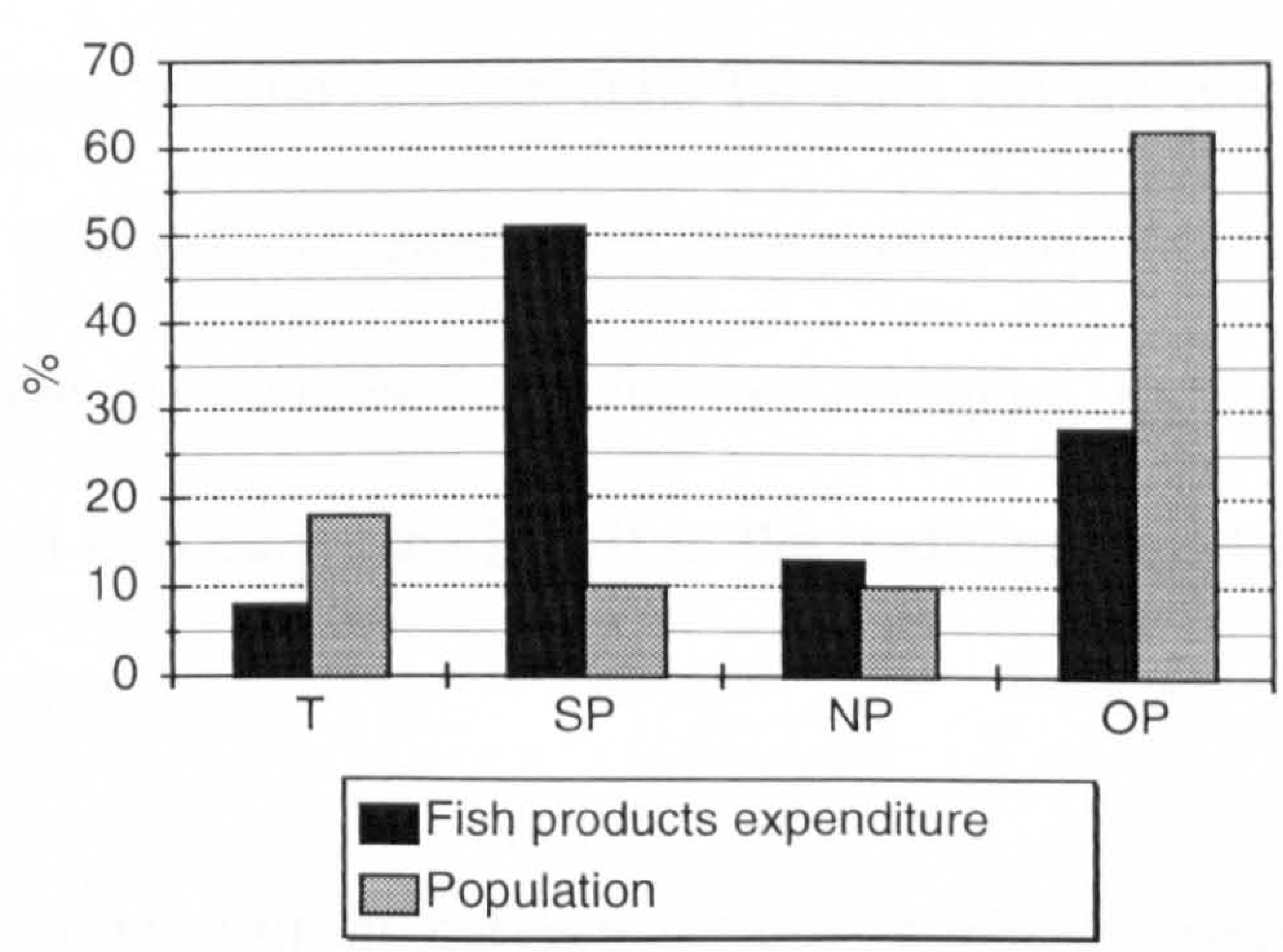
Figure 3.5: Percentage of market share of fishery products in Iran, 1992.



Source: CBI, 1995 *op.cit*

As Figure 3.6 shows, the distribution of expenditure on fishery product is very uneven. In 1993, 51% of expenditure was incurred in the S coastal provinces, with almost 10% of national population, 13% occurred in the two N coastal provinces, with less than 10%, 8% was assumed by Tehran province, with almost 17%, and only 28% was incurred by other provinces, representing 63% of the population.

Figure 3.6: Expenditure distribution of fishery products in Iran, 1993.



T: Tehran province, SP: Four S provinces, NP: Two N provinces, and OP: Other provinces.
Source: Household Statistical Centre (developed from SCI, 1995 *op.cit*).

3.9.4 Market structure for carp

As noted earlier, Iran is experiencing a decline in red meat consumption and an increase in demand for poultry and fish. Until 1985, the bulk of fish supply was from capture fisheries, after which farm-raised production accounted for an increasing proportion, and carp production (with almost 15% of total fish production in 1995) may become increasingly important. Studies of the market structure for fish culture have not yet been given attention in Iran, and so it is important to examine marketing concepts related to carp culture with respect to both fresh and processed products. Iranian people traditionally prefer fresh fish and fish usually sell in the traditional markets, though processed fish (mostly fillet) has gained interest attention recently in modern markets in Tehran and other larger cities (Beheshty, 1998 *op.cit*, Modiry, 1998 *op.cit*, Khalatbari, 1996, *op.cit* & Abzigostar, 1996 *op.cit*). Co-operatives, companies and single distributors may all be involved in city markets (Modiry, 1998 *op.cit*). There are no special fish processing or cold storage units for carp culture products, though some capacity has been allocated for demand of processed carp. Some farmers and main distributors may have the own facilities for fish transport. As Figure 3.7 shows, the majority of fresh and iced carp usually sell in the traditional markets in Gilan, Tehran and Mazandran provinces.

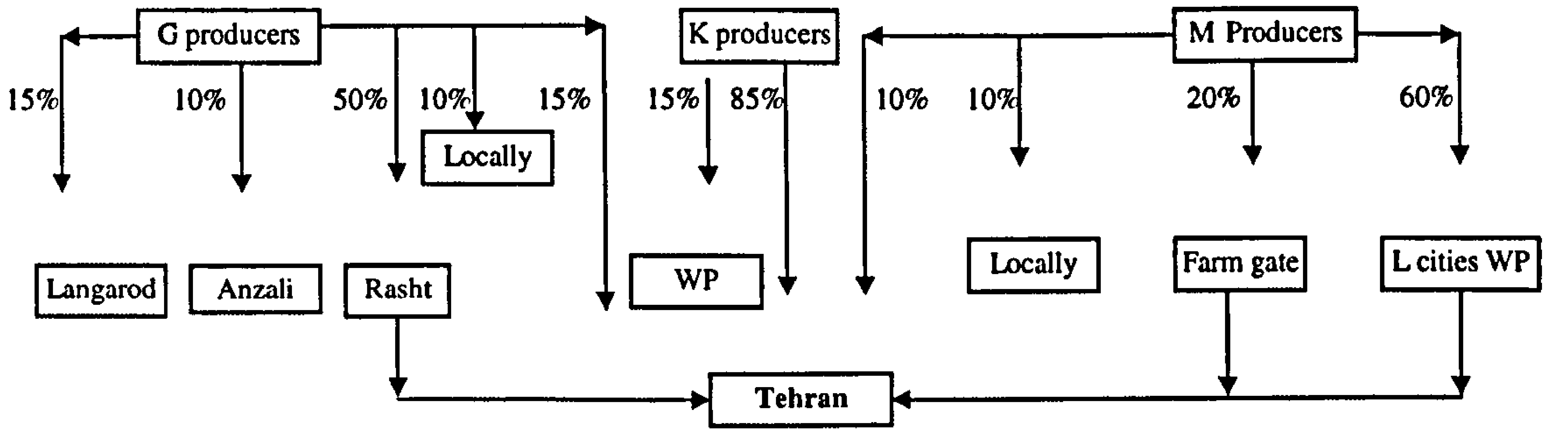
Typically, farmers sell most of the harvests directly to wholesalers, though the majority is directly transported to the market. However, a few kg of product is usually sold to retailers or even consumers at farm gate or local market. Some farmers sell their products through agreements at the time of stocking or before harvesting. Most of the carp is usually marketed at 1-2 kg per piece through the main markets. Overall, more than 70 percent of carp supply is distributed in the Caspian area, the remainder is dispatched to the capital Tehran.

In summer when the weather is warmer, total fish supply declines. Based on the climate and the culture situation, the market size of carp is reached in September and October (Figure 3.11), when demand starts to grow, and there is generally a low supply of marine fish. However, during September to December the fish market appears to have a limited capacity, due to increased fishery landings, and so most farmers prefer to wait for better market conditions. Most farmers harvest and sell their fish during January to March.

The majority of farmers transport their fish to the market at Rasht, where they are sold to wholesalers who generally sell some on the spot, transport some, iced and crated to Tehran, and smoke or freeze the remainder. The other option is to freeze or smoke the fish and sell it later, when the market looks more favourable. Smoked fish has a good market in Gilan and in Tehran and can be stored for a period, typically 2-3 months (Modiry, 1997 & Kazerony, 1997). Results showed, in 1996, daily carp product marketed in Rasht, range from 25-35 t in the period of December to March and from 3-6 t in April to September (developed from various sources as shown in Figure 3.7).

Marketing of carp in Mazandran, also a traditional fishery province , is not as significant as Gilan, but appears to follow a similar pattern, and is also auctioned at the market place or farm gate. In contrast, most farmers in Khuzestan sell their fish to wholesalers at the farm gate, from where it is transported directly to Tehran over night after icing and crating. Over January to February more than 85% of carp production in Khuzestan is transported to and sold in Tehran (Figure 3.7). Farmers usually adopt production patterns to supply seasonal demand, and have created their own transportation and distribution channels. However, the processing sector is undeveloped and the share of processed carp is less than 10%. Carp marketing in these and other areas, especially in the Caspian region, Tehran, mountain and desert zones are examined later.

Figure 3.7: Carp marketing outlets in main provinces.

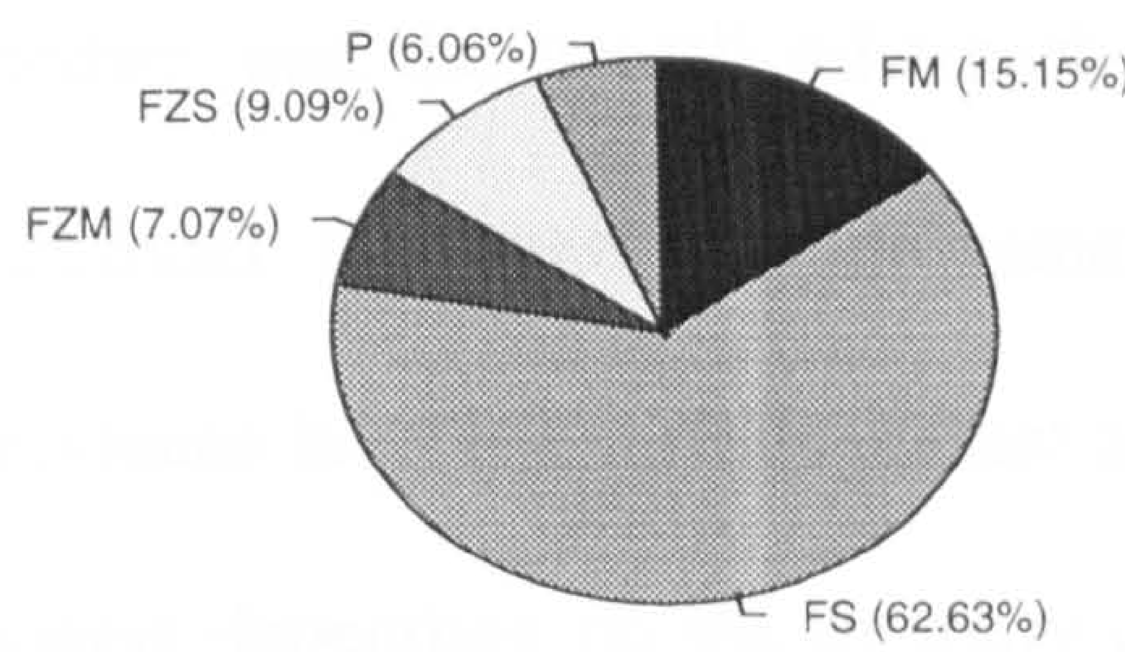


WP: Within province, L cities WP: Large cities within province
G: Gilan province, M: Mazandran province, and K: Khuzestan province
Source: developed from survey data, 1998, Modiry, 1997 & 1998 *op.cit*, Kazerony, 1997 & 1998 *op.cit*, FAO, 1992[e], *op.cit* & Abzigostar, 1996 *op.cit*.

The markets for cultured carp in Iran can be characterised by a number of factors. In some but not all respects these are common to the overall fish sector, particularly for traditional capture supplies. A number of activities take place to reach the product to consumers, either by farmers themselves or by separate distributors. The ability of distribution channels to handle fish efficiently and meet customer demand makes an important contribution to the overall success of the marketing of carp products. Since the majority of carp product is distributed in fresh form, if products are handled badly and quality control is not maintained, or if delivery is at the wrong time, markets will be lost. Prices also are affected directly by the efficiency of operation in the channel.

As shown in Figure 3.8, the results of the preliminary market survey (see appendix III) showed that 78% of cultured carp is delivered fresh, 16% frozen and only 6% is processed (mostly smoked and more recently canned and fillet), generally following traditional capture fisheries consumption.

Figure: 3.8: Delivery form of cultured carp in the market in 1996 in Iran.



FM: Mixed size fresh, FS: Separated size fresh, FZM: Mixed size frozen,
FZS: Separated size frozen, and P: Processed form.
Source: developed from market survey

3.9.5 Carp harvesting and distribution channels

The marketing channel is the network linking the producer to the final consumer. According to Jolly and Clonts (1993 *op.cit*) the length and complexity of the distribution channel will depend on the volume of fish moved, the number of functions performed, the scale of operation at each stage, and the distribution system chosen. The number of intermediaries, i.e. the length of the distribution channel, can be explained to a considerable extent by the relationship between the size of orders, the volume of supplies handled by a harvester or processor (Shaw and Muir, 1987 *op.cit*) and product diversity. These factors are closely linked with the geographical characteristics of the sources of supply and the location of markets. Since most carp products are distributed in the Caspian region and the capital Tehran, it is unusual to find wholesalers in other provinces buying much fresh or frozen carp.

Custom and precedent also play a role in distribution channel structures. According to Shaw and Muir (1987 *op.cit*) the workings of distribution channels are not only explained by the patterns of legal structures but also by the nature of the working relationships between buyers and sellers. Marketing channels for carp culture must be studied to understand the marketing system within the provinces, the relation of markets and agencies to one another, and the overall relationship between supply, price and demand. The market channel represents the movement of fish from farmers to consumers and in the provinces involves various market agencies. The carp farmers use different marketing channels depending on the quantity of fish they have for sale, the distance to their intended market, the availability of vehicles for transport and the credit they may receive for production. In general, small carp producers may sell to local markets, dealers or wholesalers within the same province, whereas large producers may ship directly to Tehran or other large provincial fish markets, or auction at the farm gate.

The marketing channels for carp differ between provinces. In Gilan and Mazandran harvesting starts in September, but in Khuzestan it may be two or three months later. The standard marketable size for carp is about 1 kg in weight, and some farmers may delay their harvesting up to November, or even December to achieve larger sizes and potentially better prices. However, this delay is constrained by additional cost, and most farmers, except a few with large farms and high capital investments, are unable to do so. Harvesting is by draining water from the pond or by using a net, and is usually carried out by the farmers. Buyers are usually responsible for transporting the fish into the market. The majority of farmers harvest only once annually per pond, or even once per farm, but very large ponds or large farms may require more than one harvest.

A variety of market outlets ranges from local fish markets, wholesalers within each province, the co-operatives or wholesalers at Tehran. The results show, wholesalers within the provinces, mostly in Gilan and Mazandran, have often provided credit to the farmers. As Figure 3.7 showed, in Gilan province, overall, 50% of carp production is sold to wholesalers at Rasht city, the centre of Gilan province, 15% to the Langarod fish market, 10% to the Anzali fish market and the balance is sold to local market, co-operatives or is sold at Tehran. The wholesalers at Rasht transport and sell some 50% of their carp to wholesalers in Tehran (developed from survey data, 1998, Modiry, 1997 & 1998 *op.cit* & completed from both FAO, 1992[e], *op.cit* & Abzigostar, 1996 *op.cit*).

In Mazandran province, more than 60% of cultured carp is sold to wholesalers in the large cities of the province, though small farmers may sell their fish in the local market, and 20% of cultured carp is sold in auction at the farm gate. A small amount of the fish sold by auction in wholesalers or at the farm gate are transported to Tehran. In Khuzestan province more than 85% of carp production is sold to wholesalers in Tehran, less than 10% sold at Ahvaz city, centre of the province, and the balance is sold in local market.

The complexity of alternative marketing channels for carp in Iran is shown in Figure 3.9 At each transaction stage, a price differential or marketing margin occurs, and large chains tend to have greater overall difference between farm-gate price and that paid by the consumers.

Apart from this study there is no published data on the share of distributors of carp in the channels, though as noted earlier, it was estimated more than 60% of Gilan's carp products are sold to wholesalers within the province who generally sell part on the spot and transport part to Tehran (mainly selling to wholesalers in Sarcheshmah[41]). Almost 60% of carp products in Mazandran are sold to wholesalers within the province who sell

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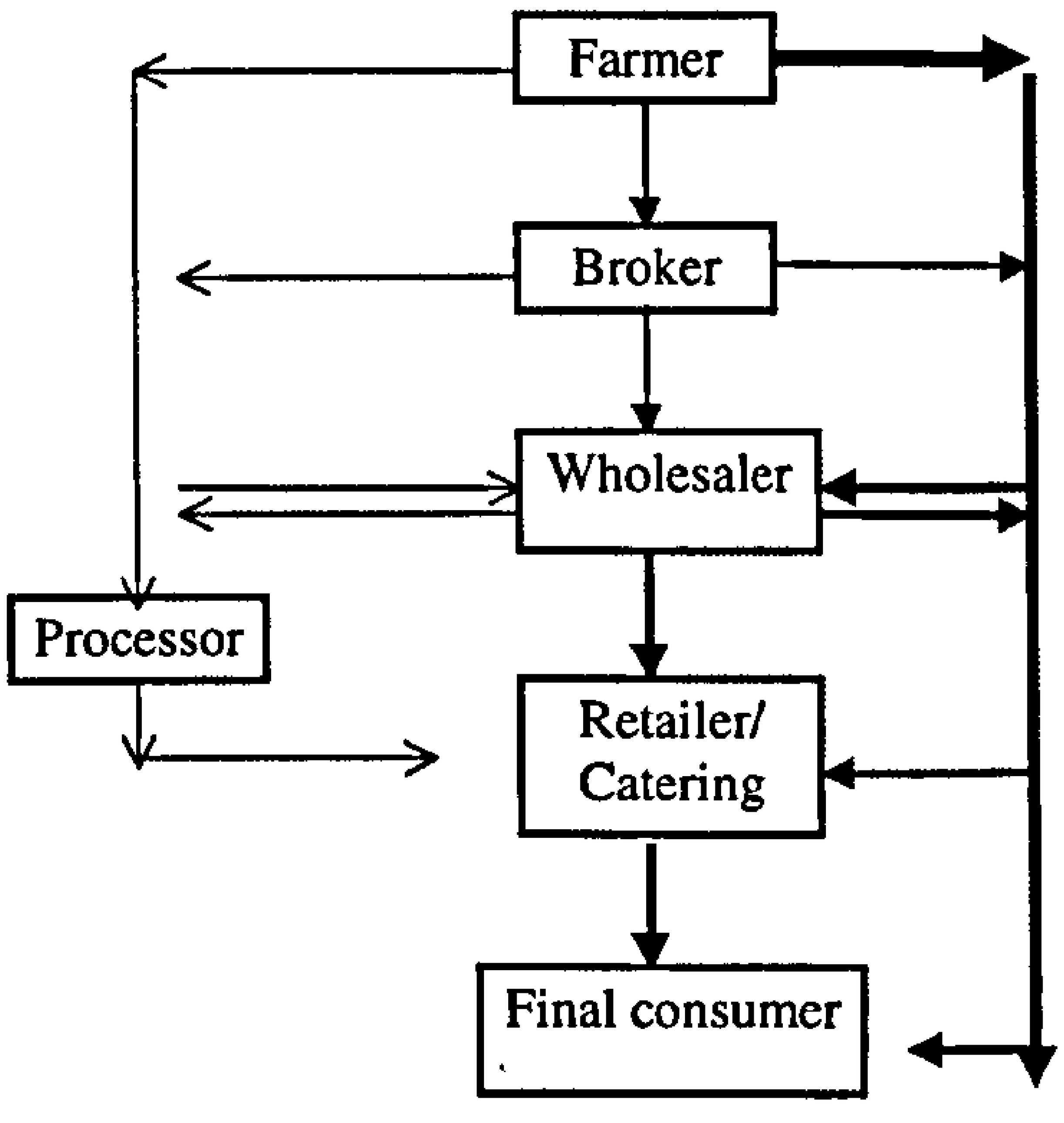
[41] - The main wholesale market in Tehran.

most of them on the spot, but most of the carp products in Khuzestan are bought by wholesalers in Tehran (mainly Sarcheshmah). Overall, most carp products are sold through traditional wholesalers who are also engaged in the markets of capture fishery.

Figure 3.9: Distribution channels for carp in Iran.



Source: developed from survey data

3.9.6 Supply management

In Iran, the prices of carp are low relative to prices of red meat and chicken, and these have fallen in real terms by 15-33% between 1992 and 1995 (CDSD, 1997[a] *op.cit*). Grass carp usually has the highest price followed by silver carp, while common carp has the lowest price. The price of bighead varies between silver and common carp. In spite of the relatively low prices of carp species, these are constrained by marketing problems, though, in March 1996, in the new Iranian year, demand and prices rise (CDSD, 1997[a] *op.cit*), mainly due to the decline of supply in Caspian species. The apparent decline of price of carp in real terms may be a result of a complex of factors, including price of substitutes, exchange rate changes and the overall significance of carp as a consumer item. These points will be investigated later.

Fish farms close to main markets may reduce costs of intermediate market stages by selling fish directly to retailers or consumers, and so obtain a higher margin on production costs. In some areas traders or co-operatives[42] may go to farms and offer prices for the quantity of fish they want, the farmers selling to the highest bidder. Some farmers may retain part or all of their stock, with the aim of selling later at a higher price.

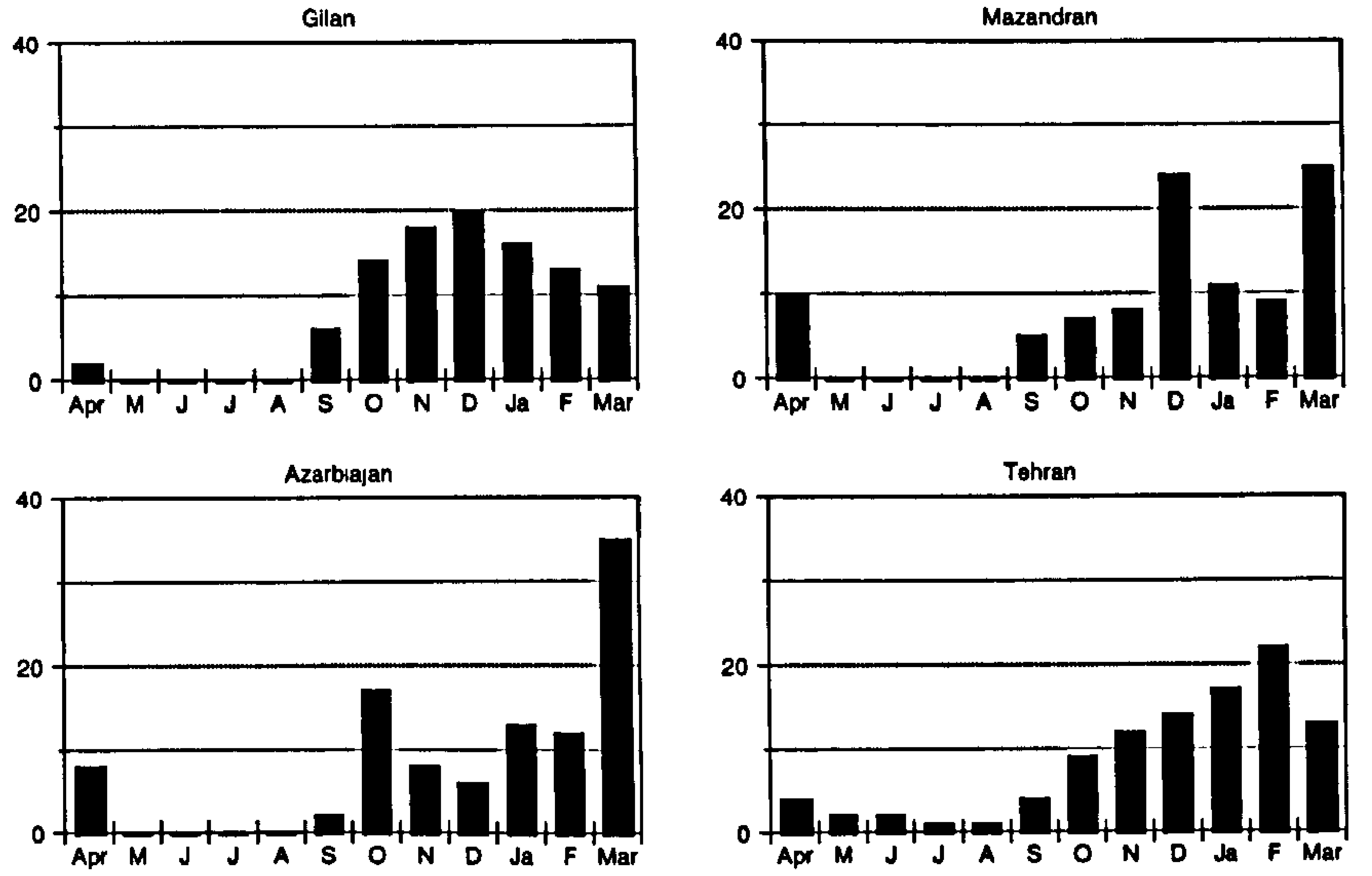
With poor marketing and handling facilities, distribution problems arise because of the limited shelf life of the fresh product, combined with the fact that fresh carp are usually marketed in autumn and wintertime through traditional channels, the season for Caspian Sea wild capture species, which are preferred to culture fish. Thus, prices are depressed and carp farmers face many difficulties in marketing their fish at such times.

Seasonalities

The preliminary market survey indicated that sales have a pronounced seasonal pattern, as shown in Figure 3.10, which indicated the peak over October-March in the four different provinces. The decline in demand in Gilan and Tehran during March is primarily due to the migration (and catch) of semi-anadromous species (mostly kutum) in Gilan rivers, while the steep rise in other provinces is due to traditional purchasing at new year.

[42] - Note, these are consumer co-operatives rather than producer (fishery) co-operatives. These are usually established in association with specific offices or factories. They are usually able to negotiate better prices than in normal markets.

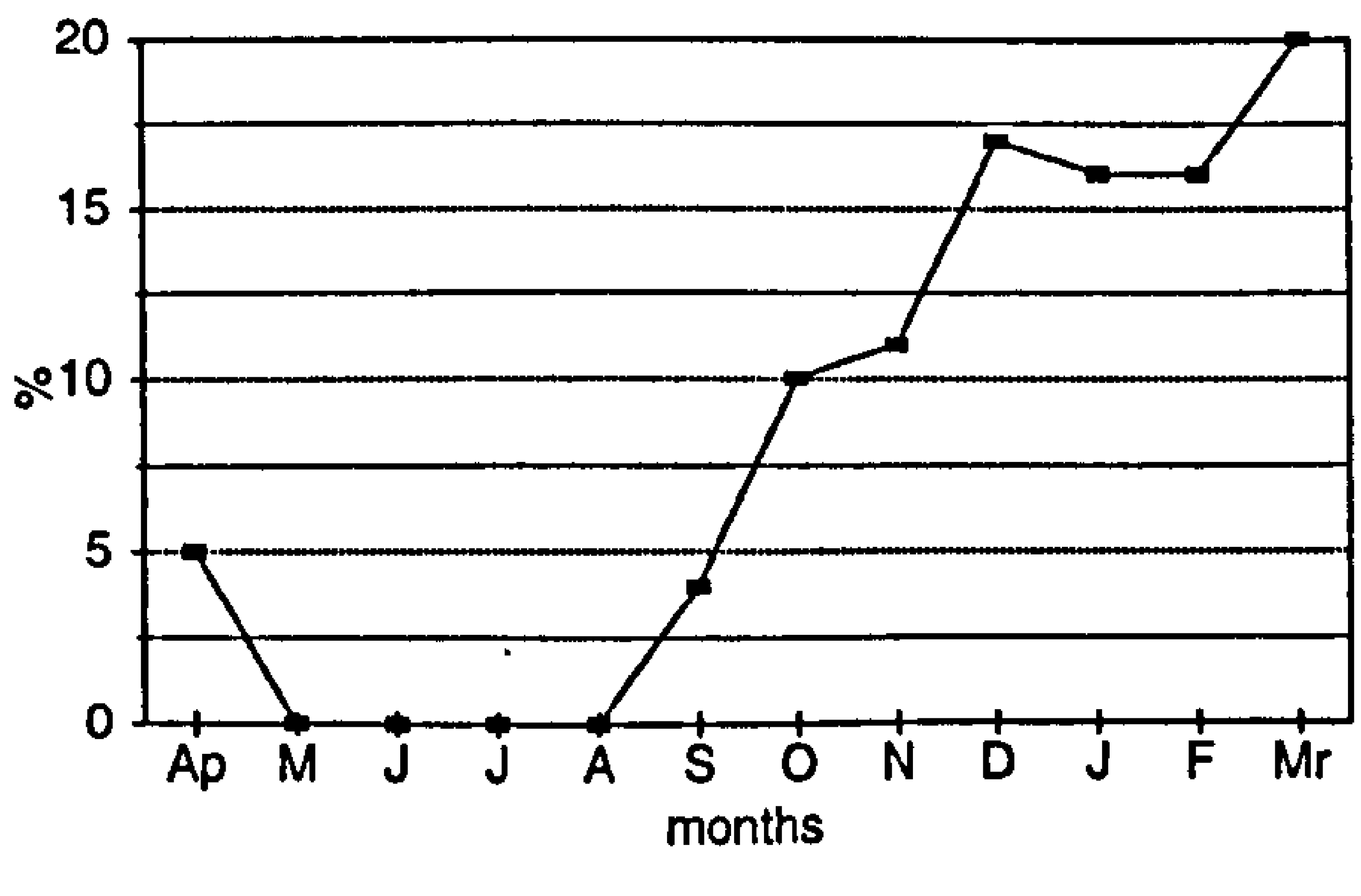
Figure 3.10: Percentage seasonality of carp purchase by consumers in four provinces by 1997.



Source: Survey data

The aggregate seasonality selling of cultured carp in the market is shown in Figure 3.11. The result shows the market building up in September, increasing in December (when the climate becomes colder) and peaking in March, with almost 90% supplied over October-March.

Figure 3.11: Seasonality purchasing of cultured carp in Iran in 1997.



Ap: April, Mr: March; Source: : Survey data

Chapter four

4. The carp culture sector; an economic analysis of farmed production

4.1 Introduction

4.1.1 The history and use of cultured carp

The culture of carp is an ancient activity and common carp is now one of the few truly domesticated fish species (Billard & Gall, 1995). According to Rath (1993) carp culture was widespread in China in 2000 BC. The purpose of its introduction or transfer has included aquaculture, sport, fishing and improvement of wild stocks or ornamental use (Biro, 1995).

According to Billard, *et.al.* (1990) record levels of aquaculture production have been obtained in Asia, and in China in particular, using a mixture of four species: plankton-eating carp, herbivorous carp, benthivorous carp, and others, this level continues during the 1990s (FAO, 1997[c]). The popularity and world-wide application of carp production systems can be attributed to the fact that protein production is highly energy-efficient in these systems (Varadi, 1995). The common carp is presently cultured all over Asia, in most parts of Europe, and on a small scale in some countries of Africa and Latin America. It has also been introduced in North America and Australia (Pillay, 1990 *op.cit*).

Overall, common carp is probably the most widespread aquaculture species (Jeney & Jeney 1995). New & Csavas (1993) gave a figure of (850, 530 t)[43] for common carp

[43] - Corrected from FAO data.

production in 1990 and a forecast production of 1,073, 704 tonnes for Asia for the year 2000. According to FAO (1997[c] *op.cit*), in 1995, total cultured carp production of common, grass, silver and bighead carp reached 1.78 million t, 2.1 m t, 2.56 m t and 1.26 m t respectively.

Though carp is still widely sold and used in its fresh, whole form, a range of value additions may also be observed. Carp filleting plants have sprung up in a number of locations, and related activities have developed (Vallod, 1995). "According to Sharifpour (1997 *op.cit*) bighead carp can be a source of oil used in the manufacture of pure medicated organic soap. The head of bighead carp consists of 20% oil with vitamins A, D and B complex. This oil in different grades (refined) can be used for vitamin and livestock feed preparations, manufacture of perfumes, cosmetics, soap and paints. Carp meat can also be used as an extender in the preparation of products as diverse as hot-dogs and sausages, as a substitute for corn starch, and in the preparation of fish protein concentrate for baby food. The internal organs of carp are used as inoculates and liquefied hormonal fertiliser for agriculture, while the spines and meat on the tail are dried and ground as feed appetiser. The head of the common carp is a good source of pituitary gland, the extracts of which are utilised to induce early breeding and fry production in carps and other species of fish".

According to Pillay (1990 *op.cit*) Hungary depends on export markets in the Middle East for their production of silver carp, while the main interest in Western Europe and the USA has been in using the grass carp as a biological weed control agent, for which purpose the species has been introduced. Carp is not only valuable human food but also a valuable angling fish (Horvath *et al.*, 1992).

4.1.2 The suitability of carp for culture

Carp have a range of attributes which not only affect their general suitability for culture but also confer other advantages. Thus carp can feed more efficiently in the dark by the smell and taste than many sight-feeders, and enjoy a competitive advantage in turbid waters (Panek, 1987 *op.cit*). They have an exceptional environmental tolerance, and can survive long exposure to <1° C (Pullin, 1986 *op.cit*) temperatures up to 40° C (Sharifpour, 1997 *op.cit*), and also rapid temperature changes. They can live in brackish water and have been grown routinely at 5 ppt salinity (Wood & Ghanndi, 1985), and up to 12ppt experimentally (Kim et al., 1975). They will tolerate in waters of pH from 5-9 (Pullin, 1986 *op.cit*). According to Horvath et al. (1992 *op.cit*) "the metabolism of carp and consequently its demand for food slows down gradually along with the decrease in temperatures, and practically stops at a water temperature of 4° C. The capacity for rapid growth which is characteristic of the species, manifests best at a water temperature of above 20° C".

Carp can grow rapidly, with occasional specimens reaching body weights of 20 Kg (Kim *et al.* 1975 *op.cit*; Wood & Ghannudi 1985 *op.cit*; Billard & Marcel 1986 *op.cit*; Panek 1987 *op.cit*; Howes 1991 *op.cit*; Horvath *et al.* 1992 *op.cit*; Tescredzic *et al.* 1995). According to NACA (1987), the largest specimen of silver, bighead, grass and common carp found so far were 20 kg, 40 kg, 35 kg and 40 kg respectively.

Feeding and growth

Cyprinids feed at all levels of the trophic chain: phytoplankton, macro and microzooplankton, benthos, macrophytes and even fish (Billard & Marcel, 1986 *op.cit*). The combination of species of carps for utilising all available natural food organisms in different niches of pond ecosystem appears to have been developed in China (Rath, 1993 *op.cit*).

According to Horvath (1992 *op.cit*) "the grass carp consumes higher aquatic plants as well as some of the supplementary feed used for common carp, but the silver carp filters unicellular algae produced in the ponds and the bighead carp filters larger algae. The common carp will consume cereal grains. The development of the carp will be good if the ratio of natural and supplementary feed is one to one". Growth rates are genetically controlled, as well as being closely related to water quality, water temperature, nourishment, stocking density, and management (NACA, 1987 *op.cit*). Carp feed at almost all hours of day and night, if the temperature is suitable (Sarig, 1966).

The nutritional requirements of carp differ little from those established for carnivorous fish, despite the particularities of the digestive tact; its stomach and long intestine being absent. Thus when expressed in absolute terms, i.e. quantity of intake per day, protein needs are similar to those of other fish (Wilson, 1985).

Unfortunately the majority of studies to date, and in particular those for omnivorous warm water fish species, have had little or no practical applicability; the bulk of nutrient requirement studies having been conducted under controlled artificial laboratory conditions. Despite the fact that silver, common, grass, and bighead carp are the most cultivated species in the world, little or no information exists concerning their dietary nutrient requirements under practical semi-intensive pond farming conditions (Tacon, 1995 and Hepher, 1985).

In fish ponds, most active feeding occurs at sunrise and sunset when water is calm and there is less disturbance by potential predators. Carp feed at different levels in the water, from the bottom to the surface. Fish are kept in much higher densities than in the natural environment and as a result, the natural food supply of the pond is not capable of providing adequate nutrition for the weight of fish. Supplementary feeds therefore have to be added to compensate. In the case of carp farming, many varieties of cereal grains are suitable for this supplementary feed.

The appetite of fish varies in response to many factors and the daily ration of feed changes, according to temperature, through the growing season. According to Horvath *et al.* (1992 *op.cit*) appetite will obviously depend on temperature but other factors are important; these authors conclude it to be extremely advantageous that 50-60% of feed requirements can be satisfied with cereals, the other 40-50% being made up from small animals living in the ponds (lower crustaceans, larvae of insects, molluscs and etc.).

Fish grow fast during their active feeding life stages; spring, summer and early autumn months in most years, when the water temperature remains steadily above 12-14^{o} C. There is no growth during the non-feeding period, and in fact some weight loss may occur. During this period, fish withdraw to the bottom water layers where, by maintaining their metabolism at minimum level, they survive the cold winter season. Overall growth rate is also significantly influenced by a number of other factors, e.g. stocking density, quality and quantity of food, oxygen concentration, etc. (Horvath *et al.* 1992 *op.cit*).

According to Pillay (1990 *op.cit*) "many fish farmers adopt the system of multisize stocking, which involves stocking fry, fingerlings and young adults belonging to different size-groups in the same pond, in order to utilise the food resources efficiently. This practice involves periodic harvesting of the marketable fish and in some cases even additional stocking. There is also the practice of multistage stocking which consists of stocking fish in progressively larger ponds as they grow in size, reducing the stocking rates as required". Common carp in cages grow from 40-80 g to 400 g in about four months and has shown growth to about 800 g in 6-8 months in Indonesia and Japan (Coche, 1979).

Breeding and reproduction

As the common carp breeds naturally in confined waters, several methods of propagating the species have been developed in different areas, but a more advanced method uses special spawning ponds for spawning, hatching and larval rearing (Pillay, 1990 *op.cit*). The spawning season for common carp in temperate climates is in the spring, when water temperature rises above 18° C. In China, brood stock for Chinese carp are obtained from fish farms, rivers, reservoirs or lakes. Females of silver carp are chosen over 3 years, bighead carp 4 years, and grass carp 5 years. Grass carp prefer clean water and so there should be a regular renewal of water.

The reproductive capacity of carp is extremely high, and during one season 0.5-1 million fry may be produced from one female (Horvath *et al.* 1992 *op.cit*). For a long time in carp culture practice, reproduction was not controlled and spawning occurred spontaneously in rearing ponds. Carp prefer to hide rather than find safety in flight and will often bury themselves in mud or sands as a means of avoiding predatory birds. Such behaviour, in addition to high fecundity, enable carp to rapidly establish populations in suitable habitats (Panek, 1987 *op.cit*). Populations have also grow through the release of fry in rivers, paddy field, and lakes.

Controlled reproduction started in the 1950s, when research on reproduction and gamete biology began (Billard *et al.*, 1995). In several production systems, male and female carp are introduced into spawning ponds or tanks and reproduced naturally. A change in environment, commonly a rise in temperature, and also the presence of spawning substrates, induces ovulation followed by oviposition and fertilisation, Eggs are attached to various spawning substrates.

Incubation and hatching may occur in the spawning pond or tank, or substrates with attached eggs may be transferred to various incubators (Billard *et al,*. 1995 *op.cit*). A wide variety of methods are used to produce carp fry. Many are based on simple techniques unchanged over years, while in contrast, others involve sophisticated technology to produce vast numbers of fry throughout the year. The methods chosen will depend upon the resources of the farm or country and also upon the economics of the enterprise (Horvath *et al.*, 1992 *op.cit*).

When the majority of carp is cultured in tanks, they do not generally receive sufficient environmental stimuli such as water flow to breed naturally. This makes it necessary to use additional hormones to induce ovulation. Traditionally, freshly extracted pituitary glands are taken from donor fish and after extraction, the hormones are immediately injected into the mature fish. Hormonally induced spawning is commonly used for carp and related species, and knowledge of endocrinology of reproduction is required to improve the use of these techniques. The success of these techniques can also be improved by manipulating environmental conditions (temperature, photoperiod, water quality, social factors) (Weil *et al.* 1986).

4.1.3 Production systems

As a group, carp appear to be especially suited for pond culture, although other systems of culture; in cages and rice fields, and stocking in open water, are carried out experimentally or commercially on a small scale (Pillay, 1990 *op.cit*). According to Billard, *et al.* (1990 *op.cit*), the extensive and semi-intensive breeding of fish can make use of a range by-products through of human and agricultural activities, decreasing costs through integration. The different carp production systems are as follows:

- Monoculture in earthen ponds: the degree of culture intensity in this system varies; from low stocking densities with no supplemental feeding or fertilisation to highly intensive production systems.

- Intensive monoculture: in this system, feeding is entirely with artificial feed and water with strong aeration or running water (raceways). Common carp is the most effective species; other carp species being usually cultivated in polyculture.

- Integrated monoculture: traditional carp monoculture has been associated with agriculture (rice, cereals), or farming (duck) in several regions. In agro-aquaculture integrated systems, some distinctions may be made according to whether integration is direct, indirect ,parallel, or sequential.

- Polyculture and integrated fish farming : this system is the culture of several fish species in the same pond feeding on different natural resources, to utilise the productive potential of a pond. It is an important management technique.

• Open water polyculture in cages and enclosures: this includes cage and pen culture, and became popular during the 1980s in China where market-sized fish culture in cages is carried out with Chinese carp, common carp or tilapia. The traditional polyculture concept is also practised in pen culture systems where large-sized fingerling (>13 cm) and 2-years-old yearling are grown to market size.

The techniques of carp culture are highly diversified, ranging from extensive production systems in ponds or open waters with no fertilisation or supplemental feeding, to highly intensive systems in concrete tanks or cages. Like production of other animals, carp production has environmental effects, but compared with the highly intensive culture of some species (e.g. salmonids), carp culture has limited negative impacts, and may play a positive role in well-managed integrated systems, by recycling efficiently the wastes from other livestock animals, and by contributing to water management within catchments.

Polyculture

Normally polyculture of carp involves a surface feeder, column feeder and bottom feeder (Sinha, 1986). Breeding a single species of fish in a pond does not allow full advantage to be taken of all the resources available in the environment, such as phytoplankton, macro-invertebrates, benthic, zooplankton, macrophytes, organic waste, and etc. (Billard, *et.al.*, 1990 *op.cit*). Fertilisation, supplementary feeding and polyculture, or multiple stocking, can achieve total yields of 5-10 t ha^{-1}, of which the bulk may be carp species usually common and silver carp (Hepher & Pruginin). The common carp, due to its feeding habit, consumes only certain kinds of feed organisms, and therefore other species that feed on phytoplankton, zooplankton, or even macro vegetation can be additionally stocked in a polyculture system without competing.

Growth rate is an important criterion in the evaluation of production efficiency, though the silver, bighead, grass, black and common carp with their larger size and rapid growth are the dominant cultured species for polyculture in most integrated fish farms in China (NACA, 1987 *op.cit*). According to Ahmad and Rab (1992) combining the culture of Indian major carps {catla (*Catla catla*), rohu (*Labeo rohita*), mrigal (*cirrhina mrigala*)} with common carp may result in an increase in productivity by as much as three-fold. The common carp is considered as a scavenger in polyculture as it may consume the faeces of the grass and the silver carp, which contain large amount of undigested plant matter (Pillay, 1990 *op.cit*). Polyculture makes possible the better utilisation of natural food resources, saving artificial food or using food that is less expensive. According to Opuszynski (1986) it can also improve pond environmental conditions and the control of aquatic weeds.

Integrated fish farming

Integrated fish culture probably first developed in densely populated parts of Asia and Central Europe, which were essentially agriculturally based and had limited access to wild fish stocks (Little and Muir, 1987). According to Sinha (1986 *op.cit*) "Asia has been the cradle of integrated carp-crop-live stock farming systems, mainly based on empirical knowledge of the farmers. The system helps poor fisherman and small farmers who are having small holdings for crop production and a few heads of livestock to diversify their farm production, to increase cash income, improve quality and quantity of food produced and exploit unutilised resources particularly labour and waste". According to Muir (1986) potential benefits of integration with aquaculture, industrial or water supply activities are apparent and carp provide in many ways a very suitable basis on which common forms of integrated aquaculture may be based, particularly in polycultures.

According to Sinha (1986 *op.cit*) fish in paddy fields increase rice production by about 10%. In integrating vegetable production some 60-70 kg of grass and vegetable tops produce about 1 kg of grass carp whose faecal matter in turn provides adequate feed for three other fish. Use of farm wastes to reduce feed requirements could also provide substantial economic gains (Muir, 1986 *op.cit*). Tens of millions of hectares of irrigated rice-field exist globally and fish farming in rice fields has been practised in India and South East Asia for a very long time (Billard, *et.al.*, 1990 *op.cit*). After a period of decline associated with heavy pesticide use, rice-fish culture is currently regaining importance in the region (Halwart, 1994). These systems often to be economically more profitable than rice culture alone (De La Cruz, 1980; Middendorp and Verreth, 1987). The consequences of fish feeding in rice fields may be of great importance both in increasing the adoption of rice-fish technology, as well as in reducing pesticide use in rice.

Ducks, geese and chicken can be raised on ponds. As Sinha (1986 *op.cit*) indicated, a well managed fish pond provides much cleaner and healthier environment for ducks, and pond-reared ducks are generally free from parasites and diseases. In the conditions of fish cum duck farming, if duck production is the primary aim fish production costs practically nothing and can be considered a valued addition to the breeding of ducks (Billard, *et.al.*, 1990 *op.cit*).

According to Woynarovich (1979) "in Hungary, it is estimated that 4-6% of the duck manure added to a pond is converted into fish flesh and 3 to 4% of the required digestible protein of duck food comes by forage in the pond. The pond-reared ducks also produce excellent clean feathers, which are worth 13-15% of the value of their meat." Irrigating a terrestrial crop with pond water may also be offer advantages since impounded water is more fertile and can add nutrients for plant growth (Sinha & Venkateswarlu, 1983).

The production of chickens or ducks with fish is also carry out in Asia (Edwards, *et.al.*, 1983 & 1986). According to Hatch, *et al.*, (1995) fish-poultry integrated ponds produced more fish than high-nutrient, non-integrated fish farming, and pond labour requirements were one-third lower. According to Little and Muir (1987 *op.cit*) integrated fish farming is also especially suited to improving the distribution of fish, particularly when local fish culture and consumption is required.

The social and economic conditions that encouraged integrated carp culture with agricultural activities to evolve in the past in Asia, now occur in many parts of the world, and, integration with other activities can complement and improve the overall efficiency of many types of carp farming. More efficient use of water and labour, and the recycling of agricultural such as animal or crop wastes are evident benefits. Processing of agricultural wastes or by-products can also be carried out to make them more useful, and fish processing wastes can be recycled as a feed for livestock. Irrigation and other water supplies, can be used to produce fish, herbivorous fish can keep irrigation channels clear of weed, and pond water can in turn be used for crop production. In many parts of Iran, especially in rural areas, where agricultural activities and animal husbandry dominate, integrated aquaculture may be a viable and often superior option, giving relatively high yields with fairly low input cost, and so attempts to adapt integrated carp culture methods to present traditions and farming systems may have considerable potential.

Current practices in Iran

Since, the 1970_S carp farming has spread around the Caspian coast. The structure of fish consumption has also changed, and thus the demand of carp species has grown. However, compared with sea fish, demand for cultured carp is currently still limited, and compared with other countries in the region, aquaculture is underdeveloped, especially in inland provinces. Though ideas and technologies may have been introduced from elsewhere in the past, these have generally been without appropriate knowledge of the natural and social environment of farmers and of the fish consumers (Abzigostar, 1996 *op.cit* & IFRTO, 1995).

Significant development of carp farming dates back to the mid 1980_S, and output reached a peak in 1995 with production of almost 27,000 t (FAO, 1997[c] *op.cit*). A common problem at present is that harvests move into the market at the same time, usually from October-March and capture within the sector, for fresh product and with other fishery sectors, for which landings may be high. In most part of Iran, the fish growth period is during spring, summer, and early autumn when the water temperature remains steady above almost 12° C. During the non-feeding period, some loss in body weight may occur.

4.2 Economics of production

4.2.1 Introduction

According to Jolly and Clonts (1993 *op.cit*) production may be defined as the process of combining resources and forces in the creation of some valuable good or services, and the purpose of production is to satisfy human wants and needs. The primary interest in most sectors is directed toward establishing viable industries for the purpose of domestic consumption, export, employment opportunities, income distribution, or a combination of these objectives (Shang, 1981 *op.cit*). This development may not be achieved unless a minimum level of income and profitability are attained.

The production process in aquaculture is determined by biological, technological, economic and environmental factors, and can be considered in terms of interactions between technological and biological factors and the culture environment (Bjorndal, 1990 *op.cit*). As Shang (1990) noted, take out elements such as biology, technology, feed and nutrition, engineering, fish pathology, and institutional factors all affect the economics of production. From a micro-economic view point the primary motivation of a fish farm may be profit making, although these can sometimes be other considerations. According to Ruddle and Grandstaff (1978), a typical aquaculture resource system has subsystems of procurement, transformation and delivery. The procurement subsystem includes the acquisition of inputs, and the transformation subsystem includes the selecting of fry or fingerling stock and use to be reared, which method is engaged, and which technology is used to produced stock of marketable size. The delivery subsystem includes the various marketing channels, marketing structures, the consumers' attitude and the marketing strategy.

In the grow-out of carp, either in monoculture or in polyculture, the basic objective is the production of an optimum quantity of the desired size of fish, at minimum cost. A number of interdependent factors affect productivity and cost. The stocking rate or the density of fish in the pond, the quality and quantity of food produced by artificially supplied fertilisations/or feed, water temperatures, availability of oxygen and build-up of metabolites, all influence growth rate and production. The size of fish at stocking, the duration of culture and the size at which the fish are harvested will also influence total yield. According to Pillay (1990 *op.cit*) the genetic growth potential of the strain used is another important factor. To this should be added the influence of natural productivity of fish food in the ponds, even when fertilisation and feeding are adopted.

Research on the economics of carp culture plays an important role in its development. According to Shang (1981 *op.cit*), economic assessment provides a basis not only for decision making among farmers but also for formulating government aquaculture policies. Economic analysis is essential to evaluate the viability of investment, determine the efficiency of resource allocation, improve existing management practices, evaluate new culture technology, assess market potential, and identify areas in which research success would have high potential payoffs (Shang, 1990 *op.cit*).

Cost assessment

It is essential to the development and management of a farm to know the production costs and their evolution, showing the main items on which the cost reduction is worth effort. It also helps the manager in decision making and in adjusting to changes. It also gives the price level under which the product cannot be sold without losses. Basically the production cost comprises all the expenses incurred during the production process, which subtracted from the turnover (sales), determines the income before taxes (Bailly et al., 1990). Interest on working capital and interest plus depreciation on the invested capital must also be considered. Many variables influence production costs for farmed fish.

As noted by Shang (1981 *op.cit*), the collection and analysis of data on costs and earning based on farm records provide the information necessary;

- to determine the relative profitability of various production techniques or systems,
- to compare the productivity of major inputs, such as land labour, and capital, with that of alternative production activities, and
- to improve the efficiency of the farm operation.

Details of output records such as species harvested (with its amount and its unit prices), and the disposition of the products needs be considered. Gross revenue of the production would include the cash and credit sales of the products and the imputed values of quantities consumed on the farm. Based on annual or seasonal records, several indicators that evaluate the performance of an operation can be calculated. Profitability of a farm is dependent on three major factors:

- Level of yield,
- Cost of production, and
- Price of products sold.

Carp culture production economics

Carp culture production, like many economic decisions, involves benefits and costs that are expected to occur during the operation. Rusydi and Lamp (1990) indicated that the basic inputs of feed and seed constitute the principal cost of operating a carp farm. According to Pillay (1990 *op.cit*) the economic viability of carp culture has never been in doubt, in areas where there is a market for carp and appropriate technologies are used. Within established systems of polyculture, integration with animals and/or crops, or multi size stocking also contributes to profitability. According to Hoq, Islam and

Hossain (1993) In Indonesia polyculture of grass, silver and mirror carp with (*M. rosenbergii)* is more profitable and the cost associated with prawn production includes only the seed cost.

However, some countries starting carp culture production without basic information, have experienced considerable marketing problems, as Pillay (1990 *op.cit*) noted for silver carp, and it would appear that consumer acceptance and price levels in the market place, are two of the major factors that determine economic viability in many situations. In some carp culture projects costs are often under evaluated, or even omitted.

Economics of scale

According to Cunningham *et al.* (1985 *op.cit*), "economies of scale will confer the benefits of lower-cost production on the larger farm unit. If significant, their presence will call for larger initial capital investments, posing a financial problem for the producer", the principal economies of aquaculture arise from seven sources;

- increased dimensions,
- labour costs,
- specialisation,
- bulk purchasing,
- risk spreading, permit the spreading of risk across a wider range of units,
- advertising, and
- research and development.

For carp culture it is likely that greater efficiency in land and water management will be achieved in larger units, although conversely, though "diseconomies of scale" smaller units may allow easier management and maintenance (Shang, 1981 *op.cit*). Shang, 1981 *op.cit*; Lewis, 1979; Jolly and Clonts, 1993 *op.cit* and Weir, 1979 indicated the effect of scale on increased production per worker. The effect of specialisation on economies of scale may also be relevant (Craknell, 1979; Gerhardsen, 1979). Bjorndal (1987 *op.cit*), citing 1984 data for salmon culture, shows a decline in total costs from an output of 28 t to an output of 141 t. The main causes are saving in variable costs, in particular in costs of labour and in the purchase of smolts.

In salmon farming Shaw (1988) estimated production economies using engineering cost data; assuming constant price for inputs, costs fall from £3.86 kg^{-1} at a size of 50 t to £3.03 kg^{-1} at 200 t to £2.81 kg^{-1} at a plant size of 500 t, with economies mainly in the use of labour and in capital costs. According to Shaw (1988 *op.cit*) economies of scale appear to be more important at the level of the business than at the level of the site. Bjorndal (1987 *op.cit*) suggests that the reduction in smolt cost (salmon) through larger scale buying could be around 25%.

In Iran, a basic constraint on the study of carp culture development is the lack of reliable economic data, based on inputs and outputs at the farm level both in physical and value terms. Since the carp farming is currently the most important sub-sector of aquacultur in Iran and its rapid development has attracted considerable attention for fish protein supply during last decade, though, determinants of its micro-economic structure in different regions and categories are addressed. Therefore, a careful investigation of the economic of carp culture would benefit both producers and policy makers. The following section describes the background characteristics of the sector in Iran.

4.2.2 Production subsectors

It is necessary to identify and distinguish different types of carp farm economies. According to FAO (1992[e] *op.cit*), the characteristics of the carp farming industry in the three main fish farming provinces, Gilan, Mazandran and Khuzestan are quite different. For almost 20 years, carp has been considered a subsistence food, particularly Gilan, but also in Mazandran, and is a preferred food item by a majority of people in these provinces. Induced by the decline of fish availability from the Caspian Sea, and supported by the Government, carp culture initially developed in Gilan, followed by Mazandran during the last decade. The number of farms in the three main provinces, based on size and location are shown in Table 4.1. More than 95% of farms are located in Caspian area, in Gilan 67% of farms are less than 1 ha and 95% are less than 5 ha, while in Mazandran 59% of farms are less than 1 ha and 86% of farms less than 5 ha, and only 1% of farms in the Caspian Sea littoral are larger than 20 ha. In contrast, more than 90% of farms are larger than 5 ha and 33% larger than 20 ha in Khuzestan.

Table 4.1: Percentage share of number of farms in provinces and categories.

Province	<1 ha		1 to 5 ha		5 to 20 ha		20< ha		Total
	% p	% c	% p	% c	% p	% c	% p	% c	
Gilan	80	67	77	28	41	4	24	1	75
Mazandran	20	59	22	27	32	11	26	3	22
Khuzestan	0	0	1	9	27	58	50	33	more than 3
Total	63		27		7		almost 3		100

% p : as % in province, % c : as % in categories,
Source: developed from Salehi, 1997, Aquaculture Department, 1997*op.cit* and CDSD, 1997[a] *op.cit.*

Carp are reared in ponds or open water in the Caspian littoral and river plain, a development initiated in the middle of the last decade.

Production figures

Carp systems can be distinguished according to the fish yield as:

• Extensive, where stocking density is generally low; with no supplementary feeding,

• Semi-intensive, where stocking density is higher, with better management and supplements of daily feed.

The stocking structure can be monoculture or polyculture; in both, the aim of the farmer is to choose fish species utilising natural protein sources. Since the source is limited, fish yield can be increased with inorganic or organic fertiliser and/or supplementary feeding. The quantity, quality and methods of feed used makes a significant difference in efficiency. Polyculture is now the most common practice in carp culture in Iran.

The full operation of carp production can be defined in the following stages:

(1) Hatchery propagation, which starts with the procurement of eggs and ends with feeding fry,

(2) Early fry rearing, which starts with the stocking of feeding fry and ends with one month old, advanced fry,

(3) Fingerling rearing, which starts with the stocking of one-month old fish and ends with the harvesting of fingerlings,

(4) On growing production from the stocking of fingerlings until the end of the second season,

(5) Marketable size fish production from the stocking of one-summer old fish until the end of the two season.

In Iran, carp production is mostly carried out on a two year growing cycle, and carp farms can be defined according to the following categories:

- Fry rearing, including stages (1) and (2),
- Fry rearing and fingerling producers, including stages (1), (2), and (3),
- Fingerling growing, including only stage (3),
- On growing fingerling to marketable size including stages (4) and (5),
- Fry rearing until marketable size, including stages, (1) to (5).

Polyculture of silver, grass and bighead carp with common carp has been practised in fresh water ponds and open waters in Gilan and Mazandran over the last two decades. The rate of growth and the size reached varies considerably between different parts of Iran depending on climatic conditions. Carp grow well in shallow ponds that can warm up quickly in the summer. Otherwise, ponds are usually 2-2.5 m deep, but in Khuzestan, with its hot climate, they are constructed at almost 2.5-3.5 m to prevent water from becoming too warm. Pond sizes are chosen according to the availability of land or other reasons, and can be found from less than few hundred m^2 to more than 10 ha. Ponds for market fish production usually range from < 0.5 ha. to 2-2.5 ha.

The farmers enhance the ability of ponds to generate natural feed by keeping the pond dry for a period of time throughout the year. During this time, organic material usually breaks down and pathogenic bacteria and parasites die off. Drying the pond is considered to be essential in enhancing overall farm production, hence acts to define the length of production cycles.

4.2.3 Study structure and methods

A study of yield production, costs and profitability was carried out to help clarify carp production costs and their difference with location and farm size. Specific objectives are:

(I) To determine the costs and returns to farmers,

(II) To find the cost contribution of the inputs,

(III) To determine the profitability of carp farming by farm size and location,

(IV) To determine the differences in carp culture method by farm size and location.

The study was developed to indicate the following elements:

(I) The characteristics of carp farms in three main provinces of Gilan, Mazandran and Khuzestan, and special cases

(II) Costs: including fixed and indirect operating costs, such as salary[44], insurance[45], maintenance, interest, and depreciation, which are usually independent of the level of production and variable costs[46], such as seed, feed, fertiliser, chemical and drugs, labour, water and energy, harvesting and post-harvest, and miscellaneous costs, which vary with output,

(III) Income: Total production, total cost of production, gross revenue, net return, benefit-cost ratio (net return/ total cost), cost of input per unit of output (kg), value of unit of output, amount of output (kg) per unit of land (ha), and costs of input per unit of land (ha),

(IV) Analysis of the role of external support in carp culture development,

(V) Assessment of key factors affecting carp farm production,

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[44] - Family labour cost, may be one of the major inputs in small scale farm, was not defined directly.
[45] - Until now (1996) there has been no carp stock insurance in Iran, insurance here relates only to health and life insurance for manager and labours, and where exist may include buildings and equipment.
[46] - Imputed opportunity costs of owned inputs, such as family labour and land use are not included, but are discussed relative to comparative returns.

(IV) Analysis of the implications of economic factors on carp culture development.

Attention is also directed to addressing questions such as: which input is significant in explaining outputs from various regions or size categories? Are there economies of scale? If all inputs are changed, will output also changed, more or less? Is carp producers making optimal use of inputs? Are carp culture technically and economically efficient? What constraints inhibit increased productivity and profitability of existing carp culture system?

Study data

The study cover the three main carp culture provinces, Gilan, Mazandran, and Khuzestan, and focuses on pond carp culture in farms. Additional studies were carried out to describe 'special cases', including Kerman and West-Azarbiajan provinces. Data collection, classification, and analysis cover the years 1995-97. In designing the study, two major aspects were combined to provide a comprehensive perspective of recent years and future development. Firstly, to identify a strategy for the sector, it was necessary to define the information available and required in future. From this was developed the study of the carp culture structures, carp culture systems, and micro-economic analysis of farm production.

The methods used were farm surveys, supplemental questionnaires and specific case studies. Two sources of data were used. Primary data were obtained through personal interviews of fish farmers, which were conducted to obtain information on resources used and the quantity of output (details of questionnaire are provided in appendix IV). Much of the secondary data were obtained from a comprehensive census survey conducted by CDSD from April- August 1995. The farms for questionnaire in each province were selected by stratified random sampling, covering the production period March-December 1994. These data were supplemented with other data maintained by Shilat (mostly Aquaculture department), its affiliated provincial offices and its research and training organisation. Wherever core data was not sufficient, additional surveys, face to face interviews with farmers and experts, and other available data was used to ensure a representative perspective on the sector.

A total of 183 farms from the three provinces plus 3 farms from the mountain zone (West- Azarbiajan province) and 2 farms from the desert zone (Kerman province), an overall total of 188 farms, were selected. Of these, 153 farms, 81 from Gilan, 48 from Mazandran and 24 from Khuzestan were classified into four categories, 0.1<<1 ha, 1<<5, 5<<20 and 20<<50 and studied. In addition, 11 farms of less than 1 ha and 6 farms of greater than 50 ha were analysed separately. In Gilan some farmers derived additional income from fry/fingerling sales, and these 13 farms were also analysed separately. The largest number of respondents (94) was from Gilan, followed by Mazandran with 62 respondents, Khuzestan with 27 respondents, W-Azarbiajan (3) and Kerman (2). The farms were thus stratified into six categories[47]:

- Very large (more than 50 ha water surface, coded as >50),
- Large (20 to 50 ha water surface, coded as 20<<50),
- Large medium (5 to 20 ha water surface, coded as 5<<20),
- Medium (1 to 5 ha water surface, coded as 1<<5),
- Small (0.1 to 1 ha water surface, coded as 0.1<<1), and
- Very small (less than 0.1 ha water surface, coded as <0.1).

Data on pond structure, stocking rate, species, labour, fertilisation, feeding, water and energy, transportation, maintenance, facilities on farm, surface area, stocking time, harvesting time, individual production of species, sale price of species, various fish production activities, market channels, and miscellaneous were recorded. Data were entered into a Borland Quattro-Pro for Windows Version 5 spreadsheet and methods for classification, summarising, averaging, and other functions were used for analysis (details are provided in appedix IV).

The primary hypothesis structure for the study was that production costs of carp varies from region to region and within regions, cost varies with culture system, farm size, and management strategy. The following section presents the findings according to this overall structure.

4.3 The role of location

4.3.1 Area and production

There is a significant difference in average area of farms. As Table 4.2 shows, the area of farms averaged almost 6.8 ha, varying from less than 3.4 ha in Gilan to 6.7 ha in Mazandran and 19 ha in Khuzestan. The average yield was 2,873 kg ha^{-1} and there is a marked difference in the provinces. Farmers in Mazandran and Gilan produced an average 2,159 and 2,543 kg ha^{-1} respectively, but farmers in Khuzestan produced 3,572 kg ha^{-1}. In Khuzestan, production (kg ha^{-1}) is higher than the average (+24%), but in Mazandran it is less than the average (-25%).

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[47] - 0.1∈{<0.1}, 1∈{0.1<<1}, 5∈{1<<5}, 20∈{5<<20}, 50∈{20<<50}.

Table 4.2: Number of sampled farms, average area and production of farms in 1994.

Province	Gilan	Mazandran	Khuzestan	Total
Number of sampled farms	81	48	24	153
Average area (ha) [a]	3.35 [50]	6.72 [100]	19 [277]	6.86
Production (kg ha^{-1}) [a]	2543 [89]	2159 [75]	3572 [124]	2873
SD[1]: production (area)	1244 (6)	1719 (52)	1247 (13)	1417 (30)

[a]: As a percent of mean of the three provinces.
[1] - Standard deviation (SD).

4.3.2 Cost structure

Costs per ha

As Table 4.3 shows, total costs for ha were 150% greater in Khuzestan than in Mazandran and 79% more than in Gilan. Costs in Gilan were 40% more than in Mazandran.

Table 4.3: Variable and fixed costs ha^{-1} of sampled farms and their share in the provinces.

Province	Gilan		Mazandran		Khuzestan		All	
	R. 1000	% of total costs	R. 1000	% of total costs	R. 1000	% of total costs	R. 1000,Mean[a]	R. 1000, SD
Seed	153	5	301	14	336	6	278	97
Feed	947	31	443	20	2075	39	1283	836
Chemical fertiliser	147	5	98	5	142	3	130	27
Animal fertiliser	217	7	59	3	518	9.6	299	233
Chemical and Drugs	84	3	19	1	56	1	52	32
Fuel	28	1	35	2	54	1	42	13
Water and electricity	261	9	131	6	288	5	233	84
Harvesting & post harvest	264	9	132	6	511	9.5	331	192
Labour	91	3	89	4	153	3	117	36
Miscellaneous	58	1.9	50	2	79	1	65	15
TVC	2250	74.9	1357	63	4212	78.1	2830	1461
Salary	232	7.9	209	10	324	6	265	61
Maintenance	36	1	89	4	267	5	153	121
Interest	19	0.6	10	0	43	0.9	27	17
Depreciation	469	15.6	482	22	483	9	479	8
Tax	0	0	0	0	0	0	0	0
Insurance	0	0	17	1	44	1	25	22
TFC	756	25.1	807	37	1161	21.9	949	221
TC	3006	100	2164	100	5373	100	3779	1663

[a] - To accounted the mean, the area of farms were also affected. SD: Standard deviation, TVC: Total variable cost, TFC: Total fixed cost, TC: Total cost.

Variable costs averaged 75% of total costs, from 63% in Mazandran to 75% in Gilan and 78% in Khuzestan. As Tables 4.3 and 4.4 show, among the variable costs, feed and fertiliser dominated all other costs averaging 45% of total cost (60% of variable costs), varying from 28% in Mazandran to 43% in Gilan and 52% in Khuzestan (44%, 58%, and 65% of variable costs respectively).

Table 4.4: Percentage of total costs per ha by major* groups of input and as a % of average in the provinces.

Province	Gilan	Mazandran	Khuzestan	Average	SD
Feed and Fertiliser [a]	43 [77]	28 [35]	52 [160]	45 [100]	12
Seed [a]	5 [55]	14 [108]	6 [121]	7 [100]	5
Labour and Salary [a]	11 [85]	14 [78]	9 [125]	10 [100]	3
Water and Energy [a]	10 [105]	8 [60]	6 [124]	7 [100]	2
Harvesting and post harvest [a]	9 [80]	6 [40]	10 [154]	9 [100]	2
Depreciation [a]	16 [98]	22 [101]	9 [101]	13 [100]	7
Others [a]	6 [61]	8 [57]	8 [152]	9 [100]	1

* -On average in aggregate >7% of total costs,
[a]: As a percent of average in the provinces.

Average cost of seed are 7% of total costs (10% of variable costs), varying from 5% in Gilan to 6% in Khuzestan and 14% in Mazandran (7%, 8%, and 22% of variable costs respectively). The other main costs are the cost of 'harvesting and post harvest' and 'water and energy' averaging 8% and 9% of total costs respectively. There is little difference in the cost of hired labour per ha among the locations, which averaged only more than 3% of total costs. Among the fixed costs, the costs of depreciation and 'salary of manager and experts' averaged almost 13% and 7% of total costs respectively.

As Table 4.4 shows, farmers in Khuzestan paid 60% more than the average for feed and fertiliser, while their counterparts in Mazandran paid almost one-third the average. In Mazandran and Khuzestan, farmers paid 8% and 21% more than the average for seed respectively, but their counterparts in Gilan paid 45% less than the average. Cost for labour and salary is also 25% higher than the average in Khuzestan. While cost for harvesting and post harvest in Mazandran and Gilan respectively averaged 60% and 20% less than the average, in Khuzestan is 50% more than the average. All operating costs per ha in Khuzestan are higher than the average, while this is the case only for seed in Mazandran and water and energy in Gilan. Variability of feed and fertiliser is higher than other operation costs, followed by seed.

Costs per kg

As Table 4.5 Shows, the cost per kg of carp production in Khuzestan is higher than in the two other provinces, at R 1,505 kg^{-1} followed by Gilan with R 1,183 kg^{-1}, and only R 1,001 kg^{-1} in Mazandran. Of these costs, feed and fertiliser averaged R 766 kg^{-1} in Khuzestan, R 516 kg^{-1} in Gilan and only R 277 kg^{-1} in Mazandran, while in contrast seed costs amounted to R 139 kg^{-1} in Mazandran followed by Khuzestan and Gilan R 94 kg^{-1} and 60 kg^{-1} respectively.

Table 4.5: Variable and fixed costs (Rial per kg) of carp production in the main provinces.

Province	Mazandran	Khuzestan	Gilan	Mean	SD
Seed	139	94	60	97	40
Feed	205	581	373	447	188
Chemical fertiliser	45	40	58	45	9
Animal fertiliser	27	145	85	104	59
Chemical and Drugs	9	16	33	18	12
Fuel	16	15	11	15	3
Water and electricity	61	81	103	81	21
Harvesting & post harvest	61	143	104	115	41
Labour	41	43	36	41	4
Miscellaneous	23	22	23	23	1
TVC	**627**	**1180**	**886**	**986**	**275**
Salary	97	91	91	92	3
Maintenance	41	75	14	53	31
Interest	5	12	8	9	4
Depreciation	223	135	184	167	44
Tax	0	0	0	0	0
Insurance	8	12	0	9	6
TFC	**374**	**325**	**297**	**330**	**39**
TC	**1001**	**1505**	**1183**	**1316**	**254**

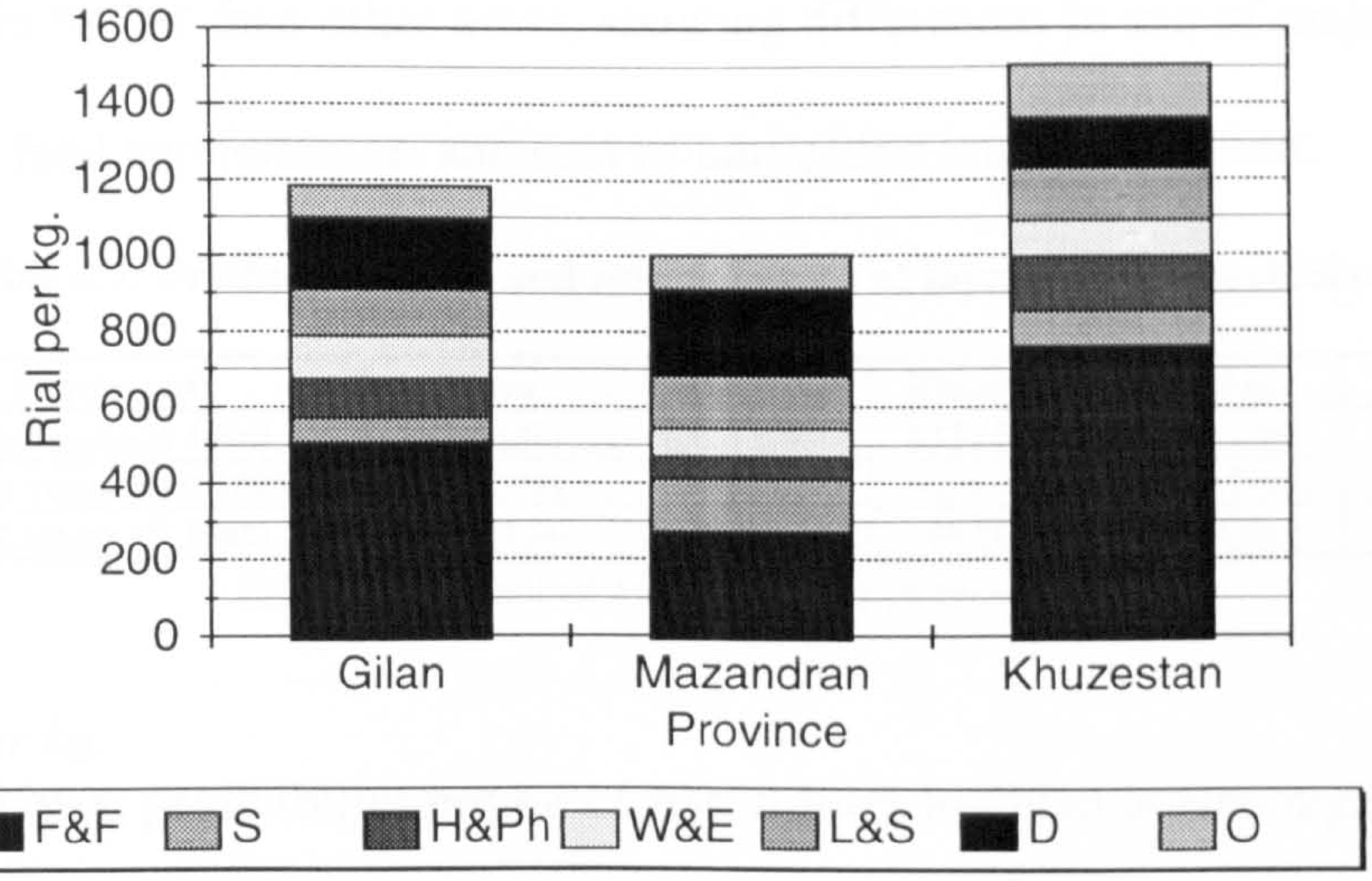
There is little difference in costs per kg of labour and salary. As Figure 4.1 shows, other major inputs costs are 'water and energy' and 'harvesting and post harvest'. Per kg of carp production, in Khuzestan, feed and fertiliser and harvesting and post harvest is much higher than the average, while this was the case only for seed in Mazandran and water and energy in Gilan (Table 4.6). Though, variability of feed is higher than other operation costs, followed by fertiliser, 'harvesting and post harvest' and seed respectively.

Table 4.6: Major costs (Rial per kg) of carp production in the main provinces.

Province [a]	Gilan	Mazandran	Khuzestan	Mean	SD
Seed	60 [62]	139 [143]	94 [97]	97 [100]	40
Feed and fertiliser	516 [87]	277 [46]	766 [129]	596 [100]	245
Water and energy	114 [119]	77 [80]	96 [100]	96 [100]	24
Harvesting & post harvest	104 [90]	61 [53]	143 [124]	115 [100]	41
Labour and salary	127 [95]	138 [104]	134 [101]	133 [100]	6
Depreciation	184 [110]	223 [134]	135 [81]	167 [100]	44

[a]: As a percent of average in the provinces

Figure 4.1: The major costs per kg of carp culture production in the main provinces.



F&F: Feed and fertiliser, S: Seed, H&Ph: Harvesting and post harvest, W&E: Water and energy, L&S: Labour and Salary, D: Depreciation, and O: Others.

4.3.3 Profitability

Profitability per ha.

Table 4.7 summarises the profitability of carp culture farming per ha in the provinces, as defined by following measures:

- Net return, defined as gross revenue minus total costs;
- Benefit-cost ratio, defined as net return for the farm divided by total costs (Shang, 1981 *op.cit*),

- Rate of farm income[48], defined as net return divided by gross revenue, times 100.

Despite a higher cost per ha, the net return per unit of land is higher in Gilan; at R[49] 1,446,000 ha^{-1} compared with R 885,000 ha^{-1} in Mazandran and R 683,000 ha^{-1} in Khuzestan. As Table 4.8 shows, the benefit-cost ratio in Gilan is also higher than elsewhere; at 0.48 compared with 0.41 and 0.13 in Mazandran and Khuzestan respectively. The average rate of farm income for carp rearing is 20%; 32% for Gilan, 29% for Mazandran and only 11% for Khuzestan. Per ha variability of total costs within the Khuzestan is higher than other areas, showing differences in use of major inputs per ha, particularly feed and fertiliser, and cost of harvesting and post harvest.

Table 4.7: Production costs and return per ha of farms in the provinces.

Province [a]	Gilan	Mazandran	Khuzestan	Average	SD
Total costs (R 1000)	3006 [80]	2164 [57]	5373 [142]	3779 [100]	1663
Gross revenue (R 1000)	4452 [94]	3049 [65]	6056 [128]	4719 [100]	1505
Net return (R 1000)	1446 [154]	885 [94]	683 [73]	940 [100]	395

[a]: As a percent of average in the provinces.

Profitability per kg.

As Table 4.8 shows, profitability per kg of fish culture in Gilan is also higher, followed by Mazandran, farmers in Gilan and Mazandran respectively having benefit-cost ratio of 92% and 64% more than the average, in Khuzestan having almost half the average. Total costs' variability per kg production within farms in Mazandran is higher than other areas.

Table 4.8: costs and returns per kg of carp production in the main provinces.

Province [a]	Gilan	Mazandran	Khuzestan	Average	SD
Total costs (R)	1183 [90]	1001 [76]	1505 [114]	1316 [100]	254
Gross revenue (R)	1751[107]	1412 [86]	1695 [103]	1643 [100]	182
Net return[a] (R)	568 [174]	411 [125]	190 [58]	327 [100]	189
Benefit-cost ratio[b]	0.48 [192]	0.41 [164]	0.13 [52]	0.25 [100]	0.2
Rate of farm income[c] (%)	32 [160]	29 [145]	11 [55]	20 [100]	11

[a]: As a percent of average in the provinces.

[48] - The rate of farm income is also an indicator of production efficiency, based on rate of farm income, we can see that the larger the rate of farm income, the greater the production efficiency (Lee, 1981 *op.cit*)
[49] - US$ 1 = R 3,000 at 1997 rates.

[a] Equals gross revenue minus total costs, [b] Equals net return on farm divided by total costs, and [c] Equals net return divided by gross revenue, times 100.

Thus, farmers in Mazandran, although having a lower return per unit of land (ha) and per quantity of fish (kg), can produce carp at least cost. Compared with those in the northern provinces, farmers in Khuzestan produce carp at highest cost, and have the lowest return per ha of farm and per kg of fish.

4.3.4 Share of carp species

Seed used and their cost

As Table 4.9 shows, the average percentage of fry/fingerling of common, silver, grass and bighead carp used was 23%, 57%, 17% and 3% respectively, with little notable difference between the provinces, though farmers in Khuzestan used more grass carp, due to the availability of grass and alfalfa in the province. There is little difference between provinces in the costs of seed. On average, the costs of common, silver, grass and bighead carp averaged 22%, 52%, 23%, and 4% of the total seed costs respectively. Based on availability of seed and 'feed and fertiliser', the major differences occurred in silver and grass carp. As noted earlier, seed was mainly produced in Gilan, though, the price of fry/fingerling was higher in other provinces.

Table 4.9: Number and costs of carp seed used, as percentage of total seed.

Species/Province	Gilan No. (costs)	Mazandran No. (costs)	Khuzestan No. (costs)	Average No. (costs)
CC	24 (21)	20 (24)	22 (20)	23 (22)
SC	55 (48)	62 (57)	56 (53)	57 (52)
GC	17 (26)	15 (17)	20 (25)	17 (23)
BhC	3 (5)	3 (3)	3 (3)	3 (4)

CC: common carp, SC: silver carp, GC: grass carp, and BhC: bighead carp

Production

As Table 4.10 shows, production by species was distributed as common 26%, silver 57%, grass 13% and bighead carp 4%. There is little difference in the production share between the provinces, though higher mortality of grass carp due to the climate was reported in Khuzestan province.

Table 4.10: Distribution of production by species, as percentage of total.

Species/Province	Gilan	Mazandran	Khuzestan	Average
CC	24	27	33	26
SC	58	58	50	57
GC	14	11	14	13
BhC	4	4	3	4

Profitability

Despite a slight difference between costs of seed and amount produced, differences in gross revenue are insignificant between the provinces. Average revenue accounted for common 26%, silver 49%, grass 22%, and bighead carp only 3% respectively, as shown in Tables 4.11. and 4.12, also shows the different shares among the cost, production and revenue. The cost share of grass carp is higher than that of the number of fry used, as these are usually bought at a larger size. The price of market size grass carp is higher than for other species, and so the revenue share of grass carp is notably increased.

Table 4.11: Percentage of carp species revenue in the provinces.

Species/province	Gilan	Mazandran	Khuzestan	Average
CC	26	27	25	26
SC	50	48	49	49
GC	21	22	23	22
BhC	3	3	3	3

Table 4.12: Average percentage of seed and its costs, production and revenue of carp species.

Species	Number of Fry	Fry cost	Production	Revenue
CC	23	22	26	26
SC	57	52	57	49
GC	17	23	13	22
BhC	3	4	4	3

An overall assessment of cost structure and profitability of farms in different locations

The results of the survey showed that the various producer provinces have different cost structures, depending on availability and quality of inputs, farm management, climate, area of farms and other factors. The cost of inputs in Khuzestan (per ha and per kg) were higher than elsewhere, apparently due to higher usage and cost of feed and fertiliser. Overall, the cost per kg of carp production averaged R 1,316, of which feed and fertiliser with the highest level of variation accounted for 45% of total costs (60% of variable costs).

Despite the basic similarities, the majority of farms displayed widely different feed and fertiliser management practices for their production. Thus in Khuzestan use of animal fertiliser in ponds was more than fivefold that in Mazandran. Apart from the absence of a well defined fertilisation programme, in summer, the farmers in Khuzestan flush water through their ponds and as a consequence additional feed and particularly animal fertiliser, has to be applied.

Although farmers apply feed by hand broadcasting, according to FAO (1992[e] *op.cit*) the application frequency varies from 1 to 8 feeds per day, the feeding rate varies from 1 to 40% body weight per day and reported food conversion ratio (FCR) varies from 1.3 to 5. Supplementary feeds are generally applied on one side of the pond, which may be inefficient, particularly in larger ponds. Not only in Khuzestan but also in other regions feed comprises the largest share of costs and reducing feed loss will improve profitability.

In Gilan, where carp culture is longest establishment, and farmers have smaller farms and may manage ponds on an ad hoc basis, they usually use agricultural wastes as feed and fertiliser. The main fry/fingerling producers are also located in this province, and so the price of fry/fingerling is much lower than elsewhere. In Khuzestan seed prices are much higher as most fry/fingerling come from Gilan hatcheries and thus include transport cost, as well as allowing for higher mortality combined with high stocking rate, thus increases the cost. The relatively higher cost of seed in Mazandran is due to the use of larger size seed, mainly coming from Gilan. However, increased hatchery production in Mazandran and Khuzestan may reduce the cost of seed. Labour and salary have the variation averaging R 133 kg^{-1}. This is probably due to smaller farms in Caspian region normally using family labour, while larger farms in Khuzestan have increased human resource productivity, and so differences in cost of human resource are negligible.

Increased cost of harvesting and post harvest in Khuzestan is likely to be due to the greater distance to markets. Overall, it was found that costs per ha of carp production were 150% greater in Khuzestan than that in Mazandran and 80% more than that in Gilan. Comparing the two northern provinces, farmers in Mazandran, although having a lower return per unit of land (ha) and quantity of fish (kg), produced carp at least cost. Compared with those in the N, farmers in Khuzestan produce carp at highest cost (per ha and per kg), and have the lowest return.

Feed and fertiliser productivity is usually considered as important indicator of the level of efficiency of carp farming production. Feed and fertiliser productivity of farms in the N is higher than that in Khuzestan (for feed more than twofold and for fertiliser almost fourfold). This suggests that, the productivity of carp farming in different locations is closely related to feed and fertiliser productivity. Yield averaged 2,873 kg ha^{-1}, ranging from 2,159 kg ha^{-1} in Mazandran to 3,572 kg ha^{-1} in Khuzestan. However, in Khuzestan, climatic conditions and increased feed and fertiliser input as well as larger size increased per ha production. However, additional costs and reduced revenue per kg (due to single harvesting and supplying large quantity of product in markets over short time period) reduced the profitability.

On average, benefit-cost ratio and the rate of farm income was closely related to location. This suggests that farmers practice more efficiently and have better conditions in Gilan, resulting in higher farm income per ha and per kg, followed by Mazandran. The most profitable province is Gilan and the most expensive producer and the least profitable province is Khuzestan. The break-even[50] production point averaged 2.3 t ha^{-1}, ranging from 1.5 t ha^{-1} in Mazandran to 3.2 t ha^{-1} in Khuzestan.

Development objectives of carp production depends on its profitability, and increases in yield, reduction in costs and increases in price of product were the major means of increasing profit in all locations. Reduction in major variable costs, such as feed and fertiliser, seed and labour, harvesting and post harvest and energy, as well as main fixed cost (construction[51]), increase production per unit of land, associated with increased stocking rate, survival rate, good pond management, growth rate, and increased price per quantity of fish by aiming at higher valued production may all increase profit. Despite higher production per unit of land, the present profitability of carp farming in Khuzestan may not be acceptable in the longer term.

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[50] - Break-even analysis defines, the level of price or production at which the project just covers its total costs (Shang, 1981[b] *op.cit*).

[51] - Investment required to establish a carp farm increased from R 5 m in 1992 to R 15-18 m in 1996 (Norbakhsh, 1998).

4.4 Role of farm size

4.4.1 Production

The size of farm may play an important role as it may reflect the availability of capital, access to credit, and managerial ability, and the potential to operate efficiently and use resources efficiently. In the four categories used to define size, there are 58 farms between 0.1 ha to 1 ha, 44 farms from 1 ha to 5 ha, 33 farms of 5 ha to 20 ha, and 18 farms of 20 to 50 ha. As Table 4.13 shows, there is little difference in yield between the four categories.

Table 4.13: Number of sampled farms and their average areas in four categories in the main provinces.

Categories [a]	0.1<<1ha.	1<<5 ha.	5<<20 ha.	20<<50 ha.	Mean	SD
Number of farms.	58	44	33	18	-	-
Average area in category (ha)	0.59	2.71	12.15	27.51	6.8	-
Average production ($kg\ ha^{-1}$)	2668 [93]	2558 [89]	2969 [103]	2883 [100]	2874 [100]	189

[a]: As a percent of average in categories.

4.4.2 Cost structure

Costs per ha.

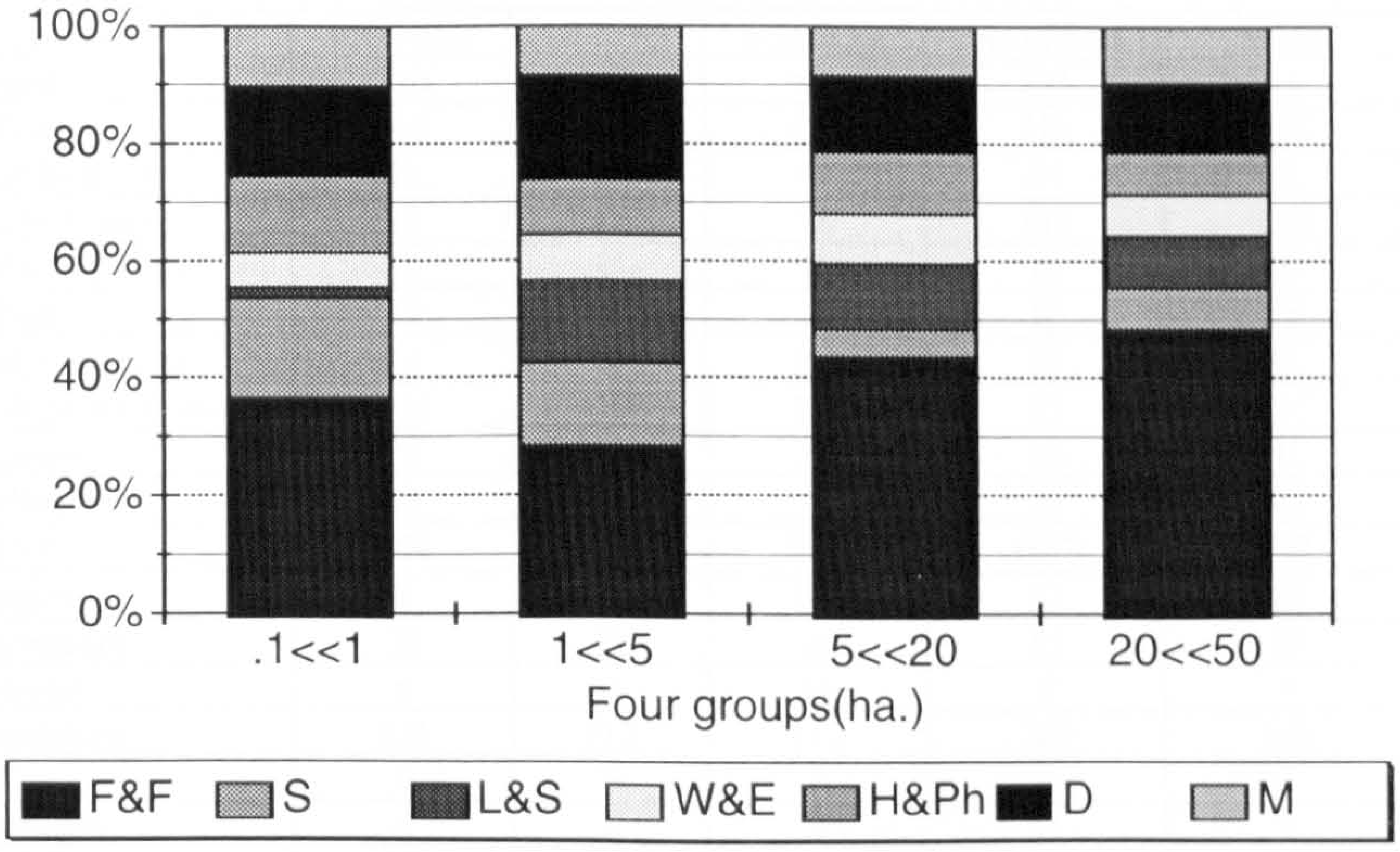
Major operation costs included fry or fingerling, feed and fertiliser, and labour and salaries, and these varied in magnitude between the four categories. Total costs significantly increased while the size of farm increased. As Table 4.14 shows total production costs averaged R 3,782,000 ha^{-1}, varying from R 2,751,000 in the farms between 0.1 to 1 ha, to R 4,039,000 in the farms between 20 to 50 ha. On average, the percentage of feed and fertiliser was highest in the larger groups (> 5 ha), but percentage of seed was the highest in the smaller groups (< 5 ha). For farms of > 5 ha, this is normally due to lower cost supply of fry from their own hatcheries or through buying smaller and bulk fry, but using more feed and fertiliser, while farms of < 5 ha usually buy larger sizes of fingerling and use agricultural waste as feed or fertiliser. Higher fixed costs ha^{-1} for farms 5-20 ha apparently due to higher cost of salary for manager and permanent experts combined with cost of maintenance. The contribution of costs are shown in Figure 4.2.

Table 4.14: Variable and fixed costs per ha in four categories in the main provinces.
Unit: Rial 1,000

Categories	0.1<<1 ha	1<<5 ha.	5<<20 ha	20<<50 ha	Mean	SD
Seed	478	428	191	299	276	129
Feed	698	666	1281	1473	1288	410
Chemical fertiliser	158	128	132	127	130	14
Animal fertiliser	158	105	225	416	301	136
Chemical and Drugs	103	83	50	42	51	28
Fuel	86	51	34	43	42	23
Water and electricity	90	179	273	224	233	77
Harvesting & post harvest	359	262	412	280	331	70
Labour	59	156	95	130	117	41
Miscellaneous	80	36	61	74	65	20
TVC	**2269**	**2094**	**2754**	**3108**	**2834**	**464**
Salary[a]	0	272	304	250	265	139
Maintenance	53	71	177	159	153	62
Interest	15	28	32	22	27	7
Depreciation	414	542	481	467	478	52
Tax	0	0	0	0	0	0
Insurance	0	7	22	33	25	15
TFC	**482**	**920**	**1016**	**931**	**948**	**241**
TC	**2751**	**3014**	**3770**	**4039**	**3782**	**611**

[a] Farms less than 1 ha are located in Gilan and Mazandran provinces and opportunity cost for manager is based on family labour, that was not accounted here.

Figure 4.2: Contribution of costs[52] per ha of carp farms production in four categories.



Costs per kg.

As Table 4.15 shows the major cost in all categories is feed and fertiliser, which averaged R 699 kg^{-1} in the largest group and R 351 kg^{-1} in farms between 1 to 5 ha. Fry/fingerling averaged R 179 kg^{-1} in the small group to R 64 kg^{-1} in farms between 5 to 20 ha. Labour and salary averaged R167 kg^{-1} in the farms between 1 to 5 ha to R 22 kg^{-1} in small farms. The other main costs are 'harvesting and post harvest', ' depreciation' and 'water and energy', which show little differences between the groups.

52 - F&F: Feed and fertiliser, S: Seed, H&Ph: Harvesting and post harvest, W&E: Water and energy, L&S: Labour and Salaries, D: Depreciation, and M: Miscellaneous.

Table 4.15: **Variable and fixed costs per kg of sampled farms in four categories in the main provinces.**
Unit: Rial kg^{-1}

Categories	0.1<<1ha	1<<5 ha	5<<20 ha	20<<50 ha	Mean	SD
Seed	179	167	64	104	96	54
Feed	262	260	431	511	448	126
Chemical fertiliser	59	50	44	44	45	7
Animal fertiliser	59	41	76	144	105	45
Chemical and Drugs	39	32	17	15	18	12
Fuel	33	20	11	15	15	9
Water and electricity	34	70	92	78	81	25
Harvesting & post harvest	134	102	139	97	115	22
Labour	22	61	32	45	41	17
Miscellaneous	30	14	20	26	23	7
TVC	**851**	**817**	**926**	**1079**	**987**	**116**
Salary	0	106	102	87	92	50
Maintenance	20	28	60	55	53	20
Interest	6	11	11	8	9	2
Depreciation	155	212	162	162	166	26
Tax	0	0	0	0	0	0
Insurance	0	3	7	11	9	5
TFC	**181**	**360**	**342**	**323**	**329**	**82**
TC	**1032**	**1177**	**1268**	**1402**	**1316**	**156**

As Table 4.16 shows, cost of feed and fertiliser per kg of production is 17% higher than average in the larger group, while on average in the two smaller groups (<5) it is 40% lower than the average.

Table 4. 16: Inputs as a percent of mean (per kg) in categories.

Categories [a]	0.1<<1ha.	1<<5 ha.	5<<20 ha.	20<<50 ha.	Mean
Feed & fertiliser	[63]	[59]	[92]	[117]	100
Labour & salary	[17]	[129]	[101]	[99]	100
Seed	[186]	[174]	[67]	[108]	100
Water & energy	[69]	[94]	[107]	[97]	100
Harvesting & post harvest	[117]	[89]	[121]	[84]	100
Depreciation	[93]	[128]	[98]	[98]	100
Other costs	[85]	[79]	[103]	[103]	100

[a]: As a percent of mean.

4.4.3 Profitability

The highest cost per ha are found in the largest group, while the smallest group has the highest net return. As shown in Table 4.17, the average net return is R 940,000 per ha, varying from R 2,207,000 in the smallest group to R 587,000 in the largest group.

Table 4.17: Production costs, gross revenue and net return per ha in sampled farms in four categories.
Unit: Rial 1,000

Categories [a]	0.1<<1 ha	1<<5 ha	5<<20 ha	20<<50 ha	Mean	SD
TVC	2269 [80]	2094 [74]	2754 [97]	3108 [110]	2834 [100]	464
TFC	482 [51]	920 [97]	1016 [107]	931 [98]	948 [100]	241
TC	2751 [73]	3014 [80]	3770 [100]	4039 [107]	3782 [100]	611
Gross revenue	4958 [105]	4036 [85]	5017 [106]	4626 [98]	4722 [100]	453
Net return	2207 [235]	1022 [109]	1247 [133]	587 [62]	940 [100]	684

[a]: As a percent of average of categories

Figure 4.3: Cost per kg of carp farms production in four categories.

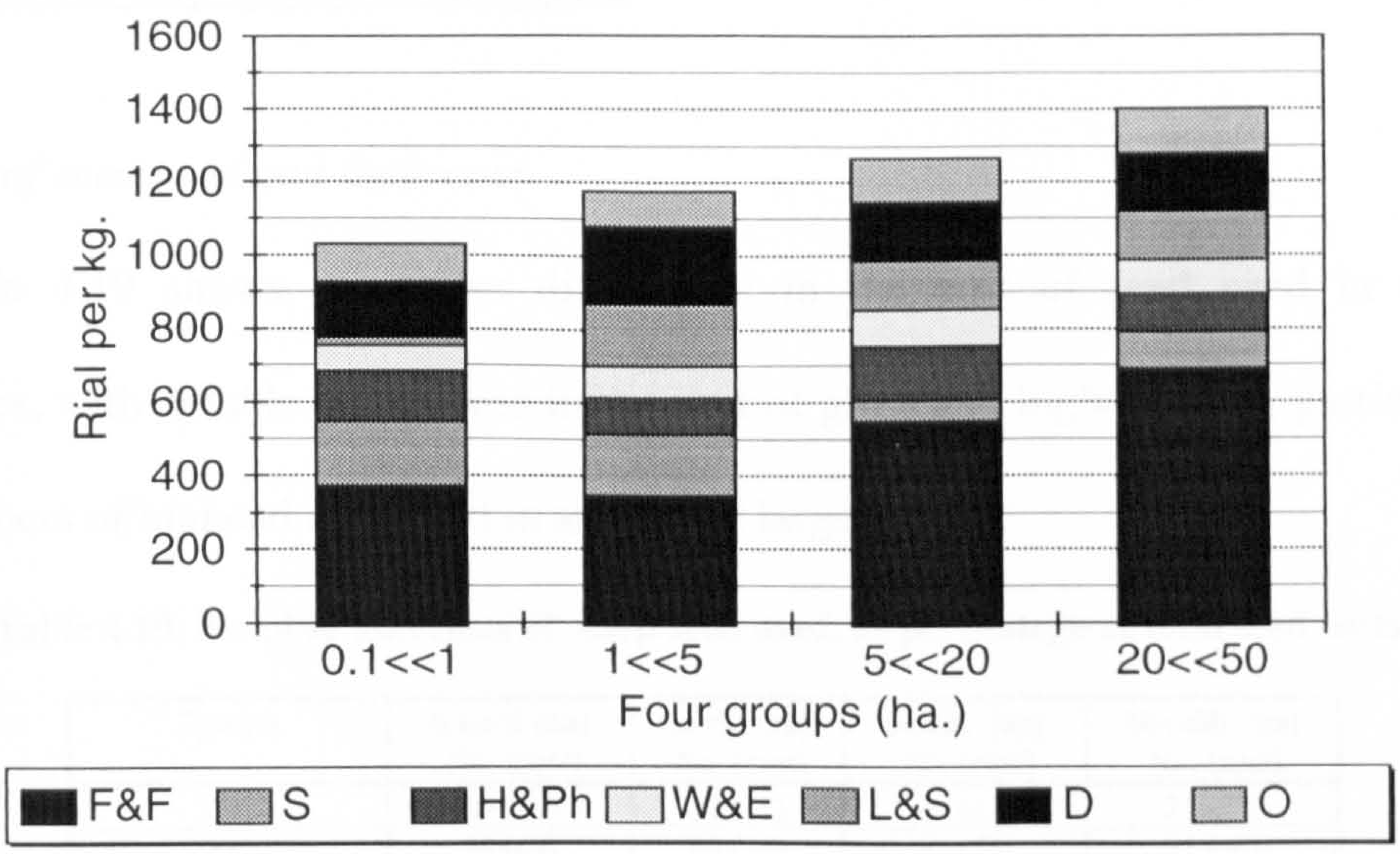


Table 4.18 and shows the cost of inputs in total costs per kg for the four categories. The costs of carp production significantly increased per kg while the size of farms increased. The average net return is R 327 per kg, varying from R 826 per kg in smallest group to R 203 per kg in largest group. The Benefit-Cost ratio and farm income are closely related to farm size (Table 4.18). This means that the small farms practice more effective farming, which result in higher farm income per hectare and per kg. The benefit-cost ratio and rate of farm income decreased as farm sizes grew (the difference between two middle groups are negligible).

Table 4.18: Benefit-costs ratio and rate of farm income per kg of carp production in sampled farms in categories in the main provinces.

Remark/Category [a]	0.1<<1ha	1<<5 ha	5<<20 ha	20<<50 ha	Mean	SD
TC R kg^{-1}	1032 [78]	1177 [89]	1268 [96]	1402 [106]	1316 [100]	156
Gross revenue R kg^{-1}	1858 [113]	1574 [96]	1690 [103]	1605 [98]	1643 [100]	127
Net return R kg^{-1}	826 [253]	397 [122]	422 [129]	203 [62]	327 [100]	262
Benefit-Cost Ratio	0.8 [320]	0.34 [136]	0.33 [132]	0.15 [60]	0.25 [100]	0.3
Rate of farm income (%)	44 [220]	25 [125]	25 [125]	13 [65]	20 [100]	12.8

[a]: As a percent of mean

4.4.4 Share of carp species in categories

Number of seed used and their cost

As Table 4.19 shows, there are differences in the cost of seed used in the four categories, with notable differences in the cost of grass and bighead carp, particularly in the numbers of bighead carp used in small and large groups.

Table 4.19: Number and costs of carp seed used, as percentage of total seed costs.

Species	0.1<<1 (ha) No. (cost)	1<<5 (ha) No. (cost)	5<<20 (ha) No. (cost)	20<<50 (ha) No. (cost)
CC	23 (24)	22 (18)	23 (22)	21 (22)
SC	56 (44)	60 (58)	57 (57)	57 (50)
GC	20 (30)	16 (20)	14 (15)	16 (21)
BhC	1 (2)	2 (4)	6 (6)	6 (7)

Production

The share of production of bighead carp in large farms is three fold that of small farms (Table 4.20), and the share of grass carp in small farms is almost two fold that of large farms, though differences in production of common and silver carp between the groups are slight. This is primarily due to most of the small farms producing only common, grass and silver carp[53].

[53] - The lack of bighead fingerling.

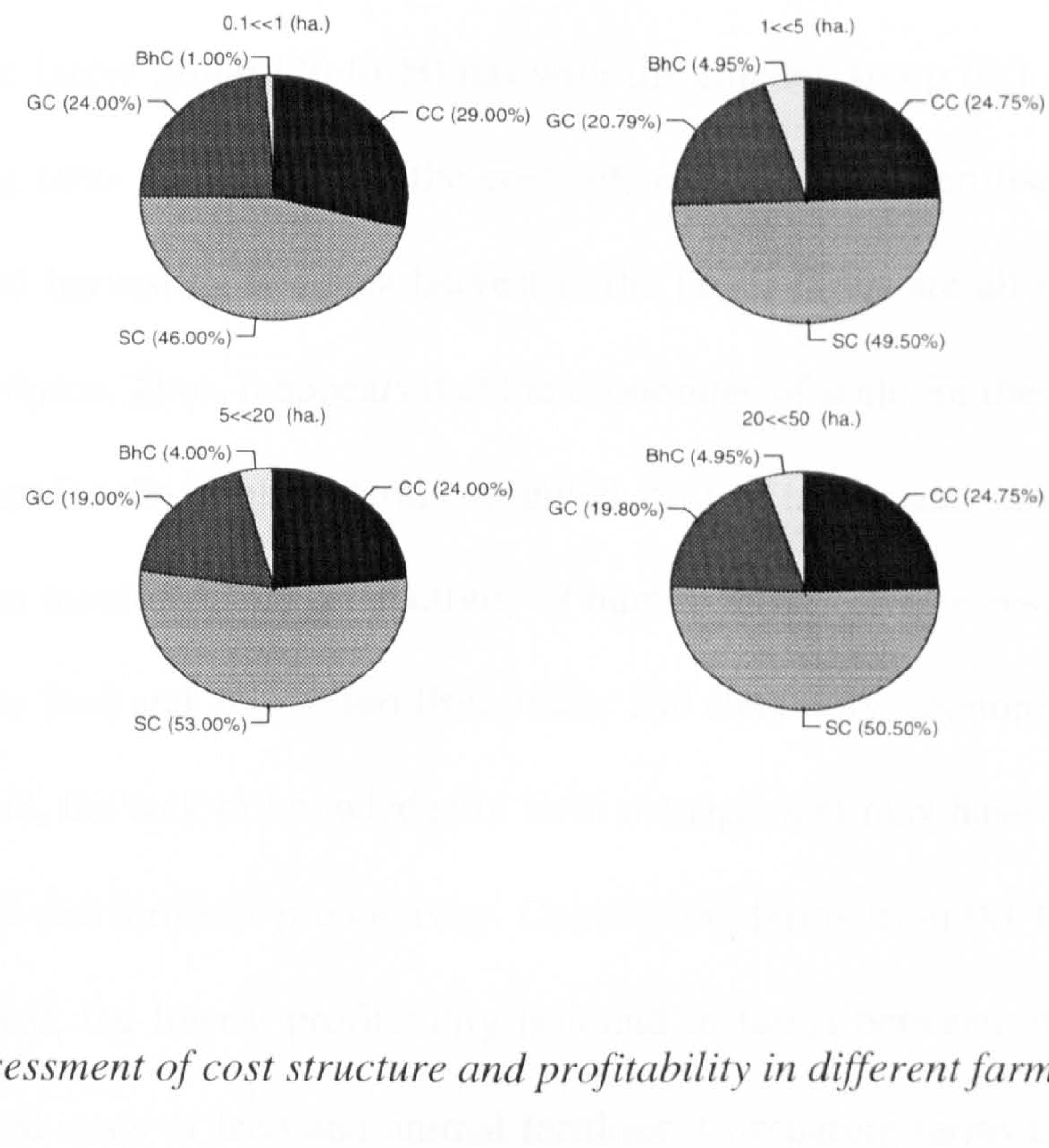
Table: 4.20: Percentage of species of carp production in categories.

Species/ area (ha)	0.1<<1	1<<5	5<<20	20<<50
CC	26	25	27	32
SC	58	58	55	54
GC	15	12	13	9
BhC	2	5	4	6

Profitability

As Figure 4.4 shows and compared with Table 4.20, despite a lower share of grass carp in production, its share in revenue notably increased, due its higher market price.

Figure 4.4: Percentage of carp species revenue in categories.



An overall assessment of cost structure and profitability in different farm sizes

As showed earlier, in Gilan, 65% of farms are <1 ha and 95% are <5 ha, while overall in the Caspian region more than 90% of farms are <5 ha; carp farming in the area is mainly based on family units. In this situation only one farm is operated, on a small scale, with personal control and management by the farmer. An expanded scale of carp culture in Khuzestan is by commercial or/and co-operative firms.

Overall, comparing, farms < 5 ha with farms >5 ha, smaller farms due to their use of agricultural wastes, had smaller costs per unit of land and per quantity of fish. However, these were mainly located in Caspian zone with longer history and experience. Comparing, farms < 5 ha with farms >5 ha, seed cost also declined as farm size increased,. This appears to be mainly due to influence of farms in Mazandran, which had the highest cost. Except the farms between 0.1 to 1 ha which used family labour, the cost of labour and salary declined as the size of farm increased.

Comparing the larger group (20 to 50 ha) with the smaller group (0.1 to 1 ha), on the basis of per kg costs of production, the costs of seed, chemical fertiliser, chemical and drugs, fuel, and harvesting and post harvest in the larger farms are all lower than those in the smaller farms. Thus, it appears that the economies of scale for these inputs may be relevant. Except for the smallest farms, as noted, cost of labour and salary[54] declined as the size of farm increased, and productivity of human resource were positively related to size. Except for feed and animal fertiliser, water and electricity, economies of scale may be relevant, and, the lack of knowledge in farm management may have a more negative impact on feed and fertiliser productivity. Considering farms from 0.1 to 50 ha, despite the highest yield, the lowest profitability is found in farms between 20-50 ha, mainly due to increased costs of feed and animal fertiliser. Comparing farms between 0.1 to 1 ha and 20 to 50 ha, the productivity of feed was doubled in the former.

[5454] - The cost of labour and salary averaged R 149 kg^{-1} in farms of 1 to 50 ha. If this is added the costs of farms <1 ha, per kg costs of production are estimated at R 159 kg^{-1}, very near to those of farms between 1 to 5 ha (average R 167 kg^{-1}).

Comparing, farms <5 ha and farms >5 ha, feed and fertiliser productivity are much higher in the former. It is evident that feed and fertiliser (almost 60% of variable costs) play a very important role in carp production and its profitability, and this has led to the poorer productivity of larger farms. The profitability of farms between 20-50 ha may not be acceptable in present conditions and it may be necessary to increase profitability by increasing feed and fertiliser productivity as well as the skills of the farmer. The effect of farm size in development of carp culture related to different locations and other factors which influence carp supply in the future will be discussed in chapter six.

4.5 Comparative analyses; special cases

4.5.1 Fry/fingerling products

As noted earlier some farmers in Gilan produce their own fry/fingerlings for rearing ponds[55]. A few of these farmers also sell some of the additional fry/fingerling to other farmers locally or in other provinces. A sample of 13 farmers with additional income from fry/fingerling sale were classified by size category and analysed separately. As shown in Table 4.21, except the smallest farms, cost of feed and fertiliser dominated all other costs, while the major cost are seed, followed by feed and harvesting and post harvest in small farms. Total cost averaged R 5,477,000 ha^{-1}, varying from R 2,556,000 ha^{-1} in farms between 1 to 5 ha to R 10,505,000 ha^{-1} in small farms.

Table 4.21: Variable and fixed costs ha^{-1} in categories with fry income.

Categories	with 0.1 to 1 ha		with 1 to 5 ha		with 5 to 20 ha		All	
No. of sample	4		7		2		13	
Average area	0.53		2.56		13.65		3.64	
							Mean	SD
	R. 1,000	% of total costs	R. 1,000	% of total costs	R. 1,000	% of total costs	R. 1,000	R. 1,000
Seed	4927	47	363	14	40	1	1718	2733
Feed	2141	20	686	27	1310	23	1230	730
Chemical fertiliser	118	1	137	5	414	7	174	166
Animal fertiliser	125	1	162	6	695	12	233	319
Chemical and Drugs	225	2	79	3	179	3	139	75
Fuel	128	1	29	1	1	0	55	67
Water and electricity	434	4	81	3	758	13	294	339
Harvesting & post harvest	1165	11	215	8	293	5	519	527
Labour	325	3	108	4	462	8	229	179
Miscellaneous	298	3	27	1	410	7	169	197
TVC	**9887**	**94**	**1888**	**74**	**4561**	**81**	**4760**	**4072**
Salary[a]	0	0	0	0	395	7	61	228
Maintenance	165	2	32	1	220	4	102	97
Interest	37	0	66	3	2	0	47	32
Depreciation	416	4	570	22	470	8	507	78
Tax	0	0	0	0	0	0	0	0
Insurance	0	0	0	0	0	0	0	0
TFC	**618**	**6**	**668**	**26**	**1087**	**19**	**717**	**258**
TC	**10505**	**100**	**2556**	**100**	**5648**	**100**	**5477**	**4007**

[a]- Family labour are not included.

The average production of market-sized fish is 2,479 kg ha^{-1}, below the average in the province, 7 farms having production of less than 2,000 kg ha^{-1}. As shown in Table 4.22 average net income was R 8,487,000 ha^{-1}, compared with R 1,446,000 ha^{-1} as average in the province (almost sixfold increase), and with an average, benefit-cost ratio of 1.3 (0.48 average in the province) and a rate of farm income averaging 52% (32% average in the province), higher in the farms between 5 to 20 ha. Farms between 1 to 5 ha have lower farm income than the two other categories. Overall, this showed that production of fry/fingerling and market-sized carp together had a positive impact on gross revenue and net income.

[55] - Some farmers buy fry and sell both fingerling and market-sized fish.

Table 4.22: Benefit-cost ratio and rate of farm income in categories with fry/fingerling income.

Categories [a]	0.1 to 1 ha	1 to 5 ha	5 to 20 ha	Mean	SD
Total costs (R. 1,000)	10505 [192]	2556 [47]	5648 [103]	5477 [100]	4007
Fish sale receipts (R 1,000)	9810 [190]	2583 [50]	4845 [94]	5155 [100]	3697
Fry income[a] (R 1,000)	17061 [194]	1648 [19]	17370 [197]	8809 [100]	8989
Total revenue (R 1,000)	26871 [192]	4231 [30]	22215 [159]	13964 [100]	11955
Net return (R 1,000)	16366 [193]	1676 [20]	16567 [195]	8487 [100]	8940
Production (kg/ha)	3432 [138]	1750 [71]	3127 [126]	2479 [100]	896
Benefit-cost ratio	**1.56 [101]**	**0.66 [43]**	**2.9 [189]**	**1.55 [100]**	**1.14**
Rate of farm income (%)	**61 [100]**	**40 [66]**	**75 [123]**	**61 [100]**	**18**

[a]: As a percent of mean, [a]- Fry/fingerling income calculated per ha of farms.

4.5.2 Small scale producers

Many farms in the Caspian littoral have an area of less than 1,000 m^2 . Farmers usually have a small pond and produce carp beside their agricultural activity, expending little special time on fish farming, buying large fingerlings for on-growing and using agricultural wastes for carp culture production. Eleven random sampled farms were chosen from Mazandran province, mainly in the centre of the province. The average area of farms is 441 m^2, and these farmers mostly obtained their fingerlings from Gilan province.

Table 4.23 summarise the costs and returns of the farms. The major expense item for the small carp farms operation is feed and fertiliser, comprising about 39% of the total costs. Other major cost items are fingerling, maintenance and depreciation, comprising about 35%, 10%, and 7% respectively. The total operating cost was R 836 kg^{-1}, and average net return generated by the farmer was R 1,180 kg^{-1}. Benefit-cost ratio (benefit/cost) for the farms accounted for 1.5 and the rate of farm income is 59%. The cost for salary and labour due to family labour used was not accounted.

Table 4.23: Benefit-cost ratio in the sampled farms less than 0.1 ha in Mazandran.

Number of sample	11	Range (SD)		
Average area	441 m^2	900 (305)	Mean	
	R. 1000 ha^{-1}.	R. 1000 ha^{-1}.	R. kg^{-1}	% of total cost
Seed	1894	4365 (1405)	292	35
Feed	1598	5548 (1657)	247	30
Chemical fertiliser	275	1000 (288)	43	5
Animal fertiliser	218	875 (263)	34	4
Chemical and Drugs	107	750 (230)	16	2
Fuel	197	812 (248)	30	4
Water and electricity	-	-	-	0
Harvesting & post harvest	-	-	-	0
Labour	-	-	-	0
Miscellaneous	-	-	-	0
TVC	**4485**	**9829 (2823)**	**692**	**83**
Salary	-	-	-	0
Maintenance	561	4666 (1384)	87	10
Interest	-	-	-	0
Depreciation	379	120 (47)	58	7
Tax	-	-	-	0
Insurance	-	-	-	0
TFC	**932**	**4780 (1398)**	**144**	**17**
TC	**5417**	**9829 (3145)**	**836**	**100**
Gross revenue	13064	27179(9156)	2016	
Net return	7648	18571 (6904)	1180	
Production (kg/ha)	6481	9102 (3560)	-	
Benefit-cost ratio	**1.5**	3.7 (1.2)		
Rate of farm income (%)	59	87 (30)		

As shown in Table 4.24, these farms produced common, silver and grass carp. The share of species in production are 30%, 38%, and 32%; however due to the high price of grass carp the share of revenue is 24%, 37% and 39% respectively.

Table 4.24: Percentage of production, revenue, number of fry used and cost of fry based on species.

Species/remark	Production	Revenue	No (cost) of fry used
CC	30	24	34 (29)
SC	38	37	42 (44)
GC	32	39	24 (27)
BhC	0	0	0 (0)

It was found that the farms less than 1,000 m^2 area are most profitable, with an average carp production of 6,481 kg ha^{-1}, significantly higher than the average in the Caspian littoral. Benefit-cost ratio is 1.5, almost three times that of other farms in the Caspian area. The major factors affecting profitability are the reduced in total cost and the increased production per ha.

4.5.3 Carp culture in desert zones

Carp culture in Kerman province has been started recently, where it is practised in fresh water ponds. The number of farms increased from 2 to 5 during the 1989-95 period. Farmers buy their fry/fingerling from Isfahan/Fars or Gilan province. Data from 2 farms were collected and analysed. The areas of the farms are greater than in Gilan and Mazandran, averaging 19 ha, but production averaged only 2,053 kg ha^{-1}, which is lower than the average for the 3 main provinces (2,873 kg ha^{-1}).

Table 4.25 presents the costs and returns per ha and per kg. Among the variable costs, expenses on feed and fertiliser, harvesting and post harvest, water and energy, and fry/fingerling averaged 23%, 8%, 11%, and 9% of the total cost respectively. Depreciation, averaged 20% and labour and salary accounted for 22% of the total cost. Total cost averaged R 1,146 kg^{-1}. Net return accounted for R 480 kg^{-1}. Benefit-cost ratio averaged 0.46 and the rate of farm income was 31%.

Table 4.25: Benefit-cost ratio in the sampled farms in Kerman province.

Area (ha)	24	14	Mean	24	14	Mean	24	14	Mean
			19			19			19
	R. 1000 ha^{-1}.			R. kg^{-1}			% of total cost		
Seed	215	184	203	129	68	107	10	8	9
Feed	463	201	366	278	74	203	22	8	17
Chemical fertiliser	75	121	92	45	45	45	4	5	4
Animal fertiliser	7	157	63	4	58	24	0	6	2
Chemical and Drugs	4	0	2	2	0	1	0	0	0
Fuel	17	21	18	10	8	9	1	1	1
Water and electricity	208	286	237	125	105	118	10	12	11
Harvesting & post harvest	146	214	171	87	79	84	7	9	8
Labour	100	135	113	60	50	56	5	6	5
Miscellaneous	88	96	91	52	36	46	4	4	4
TVC	**1323**	**1417**	**1358**	**794**	**522**	**694**	**62**	**58**	**61**
Salary	300	514	379	180	189	183	14	21	17
Maintenance	58	107	76	35	39	36	3	4	3
Interest	0	0	0	0	0	0	0	0	0
Depreciation	450	450	450	270	166	232	21	19	20
Tax	0	0	0	0	0	0	0	0	0
Insurance	0	0	0	0	0	0	0	0	0
TFC	**808**	**1071**	**905**	**485**	**395**	**452**	**48**	**44**	**40**
TC	**2132**	**2488**	**2263**	**1279**	**917**	**1146**	**100**	**100**	**100**
Gross revenue	2783	4203	3307	1670	1549	1625	-	-	-
Net return	651	1715	1043	391	632	480	-	-	-
Production (kg/ha)	1667	2714	2053	-	-	-	-	-	-
Benefit-cost ratio	0.31	0.69	0.46	-	-	-	-	-	-
Rate of farm income (%)	23	41	31	-	-	-	-	-	-

As Table 4.26 shows, the share of common, silver, grass and bighead carp in production are 19%, 61%, 14%, and 6% respectively. However, the share of these species in number and cost of fry used are different from output. The share of common in production notably decreased, but silver carp increased, due to the lack of feed (mostly concentrate and fishmeal) and its relatively high price, and the greater availability and low price of animal fertiliser. However, the share of number and cost of used fry of silver carp was lower than the average in the 3 main provinces, but its share in production and revenue was greater, and for common carp conversely.

Table 4.26: Percentage of production, revenue, number of fry used and cost of fry based on species in Kerman.

Species	% Production	% Revenue	% No (cost) of fry used
CC	19	19	38 (35)
SC	61	63	27 (30)
GC	14	15	19 (18)
BhC	6	3	16 (17)

Though, yields are lower, benefit-cost ratio is higher than the average for other farms of the same size, even higher than average for the country, due primarily to the availability of low cost fertiliser, alfalfa and by products. Analysis indicates that profitability is closely related to the optimum utility of inputs.

4.5.4 New developments, West-Azarbiajan

Carp culture in fresh water ponds in West-Azarbiajan province has also recently commenced, the number of farms increasing rapidly from 1 to 25 from 1989 to 1995. Farmers buy fry/fingerling from Gilan province, and the culture season is shorter than other areas, though, some farmers produce marketable size over the three years. Data from 3 farms was collected and analysed, though due to management problems, production has failed in one farm. The average area of farms is 2.9 ha and the production averaged 1,859 kg ha^{-1}.

Table 4.27 presents the costs and returns per ha and per kg. Here, variable costs, expenses on 'feed and fertiliser' and fry/fingerling averaged 73%, 48% and 15% of the total cost respectively. Among fixed costs, depreciation and salary averaged 14% and 8% of the total cost respectively.

Table 4.27: Benefit-cost ratio in the three sampled farms in West-Azarbiajan province.

Category	(range)	(range)	
Average area ha.	2.9 (3.8)		
Unit	R. 1000 ha^{-1}.	R. kg^{-1}	% of total cost
Seed	571 (1128)	256 (268)	15
Feed	1401 (1833)	736 (149)	45
Chemical fertiliser	128 (243)	61 (65)	3
Animal fertiliser	4 (12)	2 (6)	0
Chemical and Drugs	119 (227)	57 (65)	3
Fuel	38 (100)	14 (34)	1
Water and electricity	88 (85)	65 (111)	4
Harvesting & post harvest	137 (280)	72 (132)	4
Labour	0	0	0
Miscellaneous	22 (32)	13 (15)	1
TVC	2507 (3636)	1275 (430)	73
Salary	327 (500)	141 (253)	8
Maintenance	250 (750)	66 (257)	5
Interest	0	0	0
Depreciation	372 (110)	250 (256)	14
Tax	0	0	0
Insurance	0	0	0
TFC	948 (1355)	477 (172)	27
TC	3455 (4991)	1752 (563)	100
Gross revenue	3728 (5397)	1854 (777)	
Net return	272 (642)	103 (398)	
Production (kg/ha)	1859 (2157)		
Benefit-cost ratio	0.06		
Rate of farm income (%)	5		

Total cost averaged R 1,752 kg^{-1} and net return averaged only R 103 kg^{-1}. Benefit-cost ratio and the rate of farm income accounted for 0.06 and 5% respectively. As Table 4.28 shows, in contrast other carp farms in the country, the share of common carp and silver carp are 55% and 29% respectively.

Table 4.28: Percentage of production, revenue, number of fry used and fry expenditure based on species in West-Azarbiajan.

Species/remark	Production	Revenue	No (cost) of seed used
CC	55	58	55 (60)
SC	29	21	23 (20)
GC	15	21	15 (15)
BhC	1	1	7 (5)

These results showed that the farmers in this area, have the lowest levels of income, with a negative impact on average net return arising from an increased share of common carp and increased feed costs, and the short season of production. Feed and fertiliser, seed, and salary accounted for 68% of total costs, at R 736 kg^{-1} , R 256 kg^{-1} and R 141 kg^{-1} respectively, and average carp production is low, at 1,859 kg ha^{-1}, compared with 2,873 average in the three main provinces. The benefit-cost ratio of 0.06, compares with an average 0.25 in the main provinces.

4.5.5 Large scale farms

A few farms in Khuzestan and Mazandran provinces have areas of greater than 50 ha. Farms usually produce their own fry/fingerlings, and are usually managed by co-operatives or governmental companies. The area of farms averaged 119 ha and the farms in Mazandran are bigger than those in Khuzestan province.

Table 4.29: Benefit-cost ratio in the sampled farms larger than 50 ha in the country.

Number of sample	6		
Average area	118.5 ha.		
	R. 1000 ha^{-1}.	R. kg^{-1}	% of total cost
Seed	162	126	12
Feed	287	224	17
Chemical fertiliser	57	44	4
Animal fertiliser	67	52	5
Chemical and Drugs	4	3	0
Fuel	13	10	1
Water and electricity	42	33	2
Harvesting & post harvest	99	77	6
Labour	29	23	2
Miscellaneous	73	57	6
TVC	**833**	**649**	**55**
Salary	146	114	10
Maintenance	26	20	2
Interest	15	12	0
Depreciation	440	343	32
Tax	0	0	0
Insurance	15	12	1
TFC	**642**	**501**	**45**
TC	**1475**	**1150**	**100**
Gross revenue	1855	1447	
Net return	380	297	
Production (kg/ha)	1282		
Benefit-cost ratio	0.26		
Rate of farm income (%)	20		

Six farms (3 in Mazandran, and 3 in Khuzestan) were chosen at random. In Mazandran, these large farms are usually in the SE of the Caspian Sea, and in Khuzestan, they are in middle of the province (north of Ahvaz, where the great availability of water and land is suitable for agricultural activity). Table 4.29 summarises the costs and returns of the farms. The major items of expense is depreciation, comprising about 32% of total cost, other major items being 'feed and fertiliser', fry/fingerling, and 'labour and salary', comprising about 26%, 12% and 12% of total costs respectively. Total operating cost amounted to R 1,150 kg^{-1}, but average net return was only R 297 kg^{-1}. Benefit-cost ratio (benefit/cost) for the farms averaged 0.26. The cost for salary and labour averaged R 137 kg^{-1}. As shown in Table 4.30, these farms produced common, silver, grass and bighead carp. The share of species in production are 25%, 68%, 2% and 5%, and the shares of revenue, due to the high price of grass carp were 26%, 64%, 5% and 5% respectively.

Table 4.30: Percentage of production, revenue, number of fry used and fry expenditure based on species in farms larger than 50 ha.

Species/remark	Production	Revenue	No (cost) of fry used
CC	25	26	26 (21)
SC	68	64	64 (69)
GC	2	5	4 (4)
BhC	5	5	6 (6)

It was found that the farms with more than 50 ha area have comparatively low yields and incomes per ha. Average carp production is 1,282 kg ha^{-1}, significantly lower than in other groups. The benefit-cost ratio is 0.26, and on average the rate of farm income is 20%.

An overall assessment of cost structure and profitability of special cases of farms

In Gilan, producers with additional income from sales of fry/fingerling are much more profitable than other farms (with an almost sixfold net return). This is mainly due to reduced costs of seed, transport, labour and salary and miscellaneous items, as well as additional income from sale of seed. The Caspian area appears to have a great potential for this method, but expansion into other regions, where the facilities and experts are available may increase profitability of carp farming, particularly for larger farms, in Khuzestan and in other new development areas.

Farmers with small ponds (<1,000 m^2) producing carp alongside their agricultural activity, expending little special time on fish farming, buying large fingerlings for on-growing and using agricultural wastes for production are more profitable than all other categories. Even, when family labour is added (almost 10%), these farms are more profitable than average. Major factors affecting profitability are; increased yield (mostly using large fingerlings), lower cost per kg of production (mainly using agricultural wastes and with family labour inputs). Where water and fry/fingerling is available, and climate is adequate, it may be possible to establish farms beside agricultural activity and produce carp. The introduction of this practice may also increase farm income and fish consumption for producers and other local community members. If this is carried out in areas where aquaculture is at an early stage of development and demand for fish is low (i.e. almost all rural areas in inland provinces), this could positively affect demand and increase fish consumption. The expansion of carp supply and the use of new technology in larger farms may also reduce production cost and improve opportunities in longer term. Some of these aspects will be discussed later.

In the desert zone (Kerman), costs per kg were almost the same as the average for the main provinces, with feed and fertiliser dominating other costs (but only 23%), followed by labour and salary (22%). The share of common carp in production notably decreased, but silver carp increased, affecting the cost of feed (only 45% of average in the main provinces). Despite the lower yield (almost 71% of average elsewhere), benefit-cost ratio and rate of farm income is higher than average for similar size farms. The availability of low cost by products as feed and fertiliser, as well as climate condition have positively affected profitability. Through the introduction of improved aquaculture in this area, a large quantity of resources previously unemployed and/or under-employed may be shifted to aquaculture. This may also increase farm income and fish consumption in the area. The main problems may occur in marketing for the products, which will be discussed later.

The result of case study in mountain zone (W-Azarbiajan) showed that per kg cost of production averaged almost 50% higher than that of the main provinces, in which cost of feed dominated all other costs, more than double the average for elsewhere. Despite higher costs, yield averaged 1,859 kg ha^{-1} (only 65% of average). Farmers in this area, have the lowest yield and income, negative impacts arising from an increased share of common carp and associated feed costs, as well as the short production season. Profitability of farms in all other regions may be mainly related to the low cost production of silver and bighead carp. The benefit-cost ratio and the rate of farm income is extremely low, averaged only 0.06 and 5% respectively, compared with 0.25 and 20% as an average in the main provinces, and development of carp farming in this area may not be acceptable in present conditions.

A final case study related to farms greater than 50 ha in Khuzestan and Mazandran showed that per kg cost was only 87% of average, in which depreciation dominated all other costs (32%), influenced to some extent by the lower yield. Cost of feed averaged 50% lower than average, though yield was extremely low, averaging 1,282 kg ha^{-1} (only 45% of the average in the country and 36% of the average in the Khuzestan). Profitability decreased due to three major factors:

(1) decrease production per ha due to inadequate management and lower use of feed,

(2) decrease the share of grass carp in the production, and

(3) lower sale price of production, mainly due to the supply of huge quantities of production into the market.

4.6 Overview of cost structure and profitability of carp farming

It was found that the various producer locations, categories and cultured systems have different cost structure and consequently different profitability, depending on availability and quality of inputs, farm management, climate, area of farms, location of production, sell price and other factors. On average, farmers in all locations and categories made a profit (gross revenue minus total costs). However, this aggregate picture includes notable variation as profits of farms <5 ha, and farms in Gilan and Mazandran, as well as Kerman are above the average while farms >5 ha, and farms in W-Azarbiajan showed profits less than average. Special case farms such as those obtaining additional income from seed sales were much more profitable than other systems.

Considering only farms in Khuzestan, on the basis of per kg costs of production, total cost declined as farm size increased, though, economies of scale for this province may be relevant. In the Caspian region, comparing farms between 1 to 5 ha with farms between 5 to 20 ha economies of scale may also be relevant.

The history of carp culture is older in Caspian littoral, and farms of less than 1 ha water surface was only found in this area. Smallholder carp culture, in some cases integrated with agricultural activity, was seen as a simple, low cost and achievable in this area.

Carp farming does not appear to be a particularly attractive investment in West-Azarbiajan, but in Kerman it may be. Factors such as feed and fertiliser, seed, water and energy, labour and salary all influence yield and profitability, but farm management, location, production system and size of farms were also affected. In the Caspian region, in practice, a wide range of plant materials, and other organic by products were used to improve pond productivity and carp growth, either directly as feed or indirectly as fertiliser, and this practice reduced total operating costs and consequently increased profitability. Some farmers in Gilan, based on the price of fish and the price of rice have reported to change from aquaculture to agriculture (rice). However, the analysis suggests that in the present situation, carp farming would bring considerably higher operating returns than rice.

In many cases, especially in Gilan and Mazandran, family labour may be used during the off-agricultural season, in which case there would be minimal costs for pond preparation. It appears that farmers in Gilan and small farms were more profitable because farmers can take advantage of management with reduced cost of inputs especially feed and fertiliser. Even, if family labour (almost 10% of total cost) is added to the cost of farms of less than 1 ha in Gilan, these farms are more profitable than others.

Chapter five

5 Consumer study of cultured carp products

5.1 Introduction

5.1.1 Background

Aquaculture is a relatively new industry in many parts of the world, and according to Jolly and Clonts (1993 *op.cit*) its rapid expansion has been followed by marketing problems in recent years. Pillay (1990 *op.cit*) noted such cases with silver carp, milk fish and mussels in certain countries, while the current situation with Atlantic salmon and Mediterranean seabream is similar (Josupeit, 1995 and Muir, 1998).

To identify the product needs of the consumers who make up the market and to ensure that the products offer the attributes most capable of satisfying their needs is one of the most important issues in developing aquaculture.

According to Lambregts, Capps, and Griffin (1993) consumer and market-related data to develop effective marketing strategies are essential to the growth of the industry. According to Kinsey (1988 *op.cit*) the principles involved in consumer decision-making are;

i) buyer characteristics,

ii) product characteristics,

iii) seller characteristics, and

iv) situational characteristics.

These principles and factors must be understood and applied if markets are to satisfactorily addressed. As Pillay (1990 *op.cit*) indicated, if product is to be sold in domestic markets of many countries, less expensive systems of production may have to be considered. It is clear that the quality and size at harvest, as well as the methods of processing and presentation, depend very much on the market and consumer attitudes.

The purpose of this chapter is to address the demand characteristics for carp product and its influencing factors, and to present an analysis of the various changes which may occur in the markets for cultured carp. The responses of consumers to marketing aspects of carp and its products are analysed and addressed.

5.1.2 Consumer study methods

As noted in chapter 3, to be able to define a marketing strategy for cultured carp a more detailed marketing study was carried out, examining the current structure of carp market, consumer preferences, seasonal purchasing and consumer purchasing behaviour, and determining the type of carp products in the market. In the next section, the methods and kinds of collected data is addressed. Key definition are provided as follows:

Definition

1) Consumer status

SF: Small family (married with less than 3 offspring) group.

LF: Large family (families with 3 and more than 3 offspring).

NC: Married and childless.

S: Single group.

NC+ SF+ LF: Married groups

SF+LF: Family groups.

S+NC: Single/childless.

2) Education level

Below diploma: The respondents who had no higher qualification (including students in secondary and high school, and respondents who did not finish their study or/and abandoned school).

Employees: The people who work for government in a ministry, or other state organisation, even universities and hospitals (usually belong to the state).

Housekeepers: The women who work in home (mostly their home) are known as housekeepers.

Free-job workers: The people who are not working in an office or factory (except farmers) are known as free-job workers (mainly including shopkeepers, private consultant, private technicians and etc.), however, this group usually classifies as middle income groups but includes some of the higher income group as well.

3) Fish species

CC: Common carp, GC: Grass carp, BhC: Bighead, SC: Silver carp.

5.1.3 Survey design

As noted earlier, the diverse structure of the markets for carp products throughout the country and its supplies, are such that extensive primary data would be prohibitively time consuming. The emphasis of consumer survey was therefore focused on selected primary investigations together with secondary data analyses. The consumer survey of cultured carp consumption in Iran was conducted in the winter 1997. A questionnaire was prepared related to the personal information of respondents and their preferences for carp consumption. Details are provided in appendix V.

The selection of respondents was based on random sampling (details are provided in appendix V). A face to face interview was carried out with 357 persons in Tehran province, selected from its two major cities (Karaj and Tehran), in the province accounting for almost 18% of the national population in 1991 (SCI, 1997 *op.cit*). During the last two decades the population of these cities has annually increased by almost 8%, mostly from immigration from other parts of the country. Since the characteristics and lifestyle of people in north, centre and south Tehran and Karaj differ[56], a stratified sample was obtained from consumers in these three areas of the cities[57].

5.1.4 Sample characteristics

1) Age: 22% of the respondents[58], are between 11 to 18 years old, 63% between 19 to 50 years old and 15% are older than 50. According to the Iran Statistical Yearbook (SCI, 1995 *op.cit*) in 1991, 23% of national population were 11-20 years old, 31% were 21-50 and 13% were >50 years old, and so the sample is similar to the overall population distribution over 11 years.

The study showed that more than 61% of the youngest group were born out of Tehran, showing the importance of migration over the last two decades. Almost 99% of the youngest group were below diploma level, amongst age groups >18 years old, diploma

[56] - In broad terms may be classified as high income, middle income and low income respectively (Shilat, 1996[b] *op.cit*).
[57] - According to Shilat (1996[b] *op.cit*) 23% of population live in N, 43% in C and 34% in S Tehran in 1996.
[58] - These 22% were students and were selected by stratified random from secondary and high schools in Karaj.

and graduate degree declined as age grew, suggesting that educational levels had increased recently. Between 19-50 years old, the share of employees increased and that of free-jobs worker decreased with age. Overall, the share of employees has declined, but free-job workers have increased. After the revolution, the share of housekeepers initially increased, but later declined. The relation between age and number of children is significant and positive, indicating that older groups have more family members and that the birth-rate has declined recently.

2) Birthplace: as earlier noted, groups from throughout the country have been selected in Tehran province. 10% of respondents were born in the coastal areas (the N and S of the country), 42% in Tehran province and 48% were born in other inland provinces. This is broadly in line with the overall population distribution, though the share of Tehran respondents is higher in the sample (Table 5.1).

Table 5.1: Birthplace of population in the sample.

Value	Frequency	Percent	Percent (ISY)*
Northern coast	27	8	13
Southern coast	8	2	9
Tehran	149	42	18
Other Provinces	173	48	60
Total	357	100	100

*- Distribution of national population, Iran Statistical Yearbook (SCI, 1995 *op.cit*)

There are no significant difference between birthplace groups for age distribution. Diploma and bachelor levels were higher in respondents born in coastal areas, followed by Tehran and inland provinces, while postgraduate level were higher in respondents born in inland provinces, followed by Tehran, suggesting the importance of migration of more highly educated people from other provinces. Almost 60% of coastal area respondents living in Tehran were employees, compared with 35% from inland provinces, 20% housekeepers compared with 14% from other areas, The share of free-job workers from other provinces was higher than those from Tehran. Respondents born outside Tehran province were mostly in the SF.

3) Occupation: among the sample population 41% were office employees or worked in factories, 23% were students in secondary and high schools, 16% were housekeepers, and 19% were free-job workers. The Iran Statistical Yearbook (SCI, 1995 *op.cit*) records 8% employees, almost 20% housekeepers and 24% students in secondary and high schools with little information available on free-job workers and so the share of employees in the sample is dissimilar to the overall population distribution. With in the total population, 30% were <11 years old in 1991, and would not usually make purchasing decisions.

Sample data showed that 60% of employees, 70% of free-job workers and 74% of housekeepers were in the 26-50 years group. While 43% of employees, 34% of free-job workers and 49% of housekeepers were born in Tehran province, 66% of free-job workers were born outside, suggesting a degree of migration for jobs in the capital. Compared with 79% of employees with diploma and bachelor degree, 82% of free-job workers and 84% of housekeepers were below diploma and diploma level. While 12% of employees have postgraduate qualifications, only 5% of free-job workers and none of the housekeepers do so.

There is a significant difference between N and S Tehran in job distribution; 36% of the employees lived in N, compared with 26% in S, free-job workers rose from 21% in the N to 56% in the S and the share of housekeepers rose from 28% in the N to 41% in the S of Tehran. The relationship between job groups and family status is also significant; 60% of employees are in the SF category, declining to 51% of free-job workers and 33%

of housekeepers, but only 27% in the LF category, increasing to 33% of free-job workers and 61% of housekeepers.

4) Educational level: in the sample, 69% had no higher qualification, of which 29% had diploma, 38% were at below diploma level and less than 2% were illiterate. At higher education levels, 25% had bachelor degrees, and 6% had postgraduate qualifications. There is no information relating to the educational levels of overall population in the country, though in 1991, more than 25% of the population >6 years old were recorded as illiterate (SCI, 1995 *op.cit*). Here 15% of >50 years old were at diploma level increasing to 51% of the 37-50 years old group and declining to 28% of the 26-36 years group while 80% of the graduate groups were at the 26-50 years range, declining to 19% of the >50 group.

The share of sub diploma and postgraduate levels was much higher in respondents born outside Tehran, suggesting the importance of migration for these two groups, for better job opportunities at their respective levels. There was a significant difference between education levels and number of offspring, which declined with rising education level.

5) Household status: among the sample population 52% were SF, 35% LF, 7% were single (excluding students who usually live with their families) and only 6% NC. According to Iran Statistical Yearbook (SCI, 1995 *op.cit*) in 1991, out of 10.8 million households, the average household has almost 5 members, ranging from almost 0.5 million single [~5%], 1.1 million NC [~10%], 3.1 million SF [29%] and the balance (6.1 million [56%]) LF. The national policy is to reduce birth-rate and though the population has increased due to rising life expectancy, childbirth has declined from 1.6 to 1.2 million in 1995. The average age of marriage has also increased from <22 to >25

years over last decade. The share of married groups in the sample is similar to the overall population distribution.

As might be expected, there is a significant difference in family status with age; 90% of the single group were 19-25 years old, 47% of the NC group were 26-36 years old {overall, 77% of NC were 19-36 years old}, 54% of the SF group were 37-50 years old and 29% are 26-36 {overall, 83% of SF were 26-50 years old} and 57% of LF were 37-50 years old {overall, 85% of LF were >36 years old}, The number of family members and age is positively related, and there is evidence of reduced family size or later children in recent decades. Family status is also negatively related to educational level. At below-degree level the share of LF is much higher than SF, which in turn is higher than NC, while at graduate level and above the order is reversed. The NC group declined from 47% in N Tehran to 23% in S, while LF group increased from 30% to 44% correspondingly. According to Shilat (1996[b]), family status from almost 3.9 in N increased to 4.6 in S, while in graduate level and income this is reversed.

5.1.5 Organisation of outputs

Consumer investigation covered buyer behaviour and studied the social and economic influences affecting purchase decisions for carp products, considering both aggregate responses and the characteristics of specific sub-groups. In aggregate responses factors investigated included; familiarity[59], seasonality of fish consumption, priority consumption, and preferred form of cultured carp for consumption. Consumer attitude issues included; the effect of supply increase, income rise and price decline on carp

[59] - Based on the question' are you familiar with fish species such as Caspian fish, Persian Gulf species, Trout and carp species, or product form of carp such as fillet, smoked, frozen, etc., general knowledge of fish.

consumption, attitudes in purchasing cultured carp and reasons for negative preferences for carp. Details of the questionnaire are in appendix V.

These factors were also examined with respect to sub groupings by age, job, family status, location, birthplace and educational level. For questions such as priority factors for carp consumption, appreciated forms of carp products, purchasing attitudes and reasons for negative responses to purchasing carp, respondents were allowed single or multiple[60] responses. Where useful to explain preferences, the two response types were separated.

5.2 Aggregate responses

5.2.1 Fish consumption behaviour

1) Familiarity with type of fish species: responses are presented in Table 5.2. showing that Caspian Sea species, with a long history of use in the country, are familiar to most, followed by southern species. Grass carp is equivalent to kutum[61], so is more familiar than other carp species. Due to lack of bighead carp in the market, only 5% were familiar with it. 76% were familiar with multiple species, indicating 24% were familiar with only one group.

Table 5.2: Familiarity and consumed species (%) by the sample population.

Value	Familiar	Served	Served share as a % of familiarity
CC	50	34	68
GC	56	42	75
SC	44	33	75
BhC	5	1	20
Trout	56	38	68
Caspian fish species	68	58	85
Southern fish species[1]	61	52	85

[1] - The Persian Gulf and Oman Sea species

[60] - i.e. respondents could either give one response only, or several.
[61] - In local markets, grass carp is known Cultured kutum.

2) Type of fish consumed; responses are presented in Table 5.2. Almost 69% of the sample population consumed multiple species, with 31% consumed only one. As with familiarity, the Caspian Sea species were most commonly consumed, followed by southern species, and then grass, common and silver carp. Combining the two results shows some additional features; Broadly, familiarity with species, increased consumption.

Familiarity: while the ratio of consumption for capture species was 85%, this reduced to 75% and 68% for 'grass and silver' and 'common carp and trout' respectively, while that for bighead carp is only 20%. It appears that capture species with their long history were widely adopted, followed by grass and silver carp which are similar to the two Caspian species, kutum and Caspian salmon, and are known as cultured kutum and cultured salmon respectively. The lower uptake of common carp appears to be a result of poor handling and possibly be due to its smell. The low uptake of trout may be due to its level of publicity, price or market being unmatched by its availability.

5.2.2 Species preferences

1) Key reasons for consumption: responses are presented in Table 5.3. from 29% (trout) to 39% (S species) offered multiple reasons for their priorities. Except for silver carp, taste and flavour appears to be the chief reason for choice.

Table 5.3: The priority on type of species (%) in the sample population.

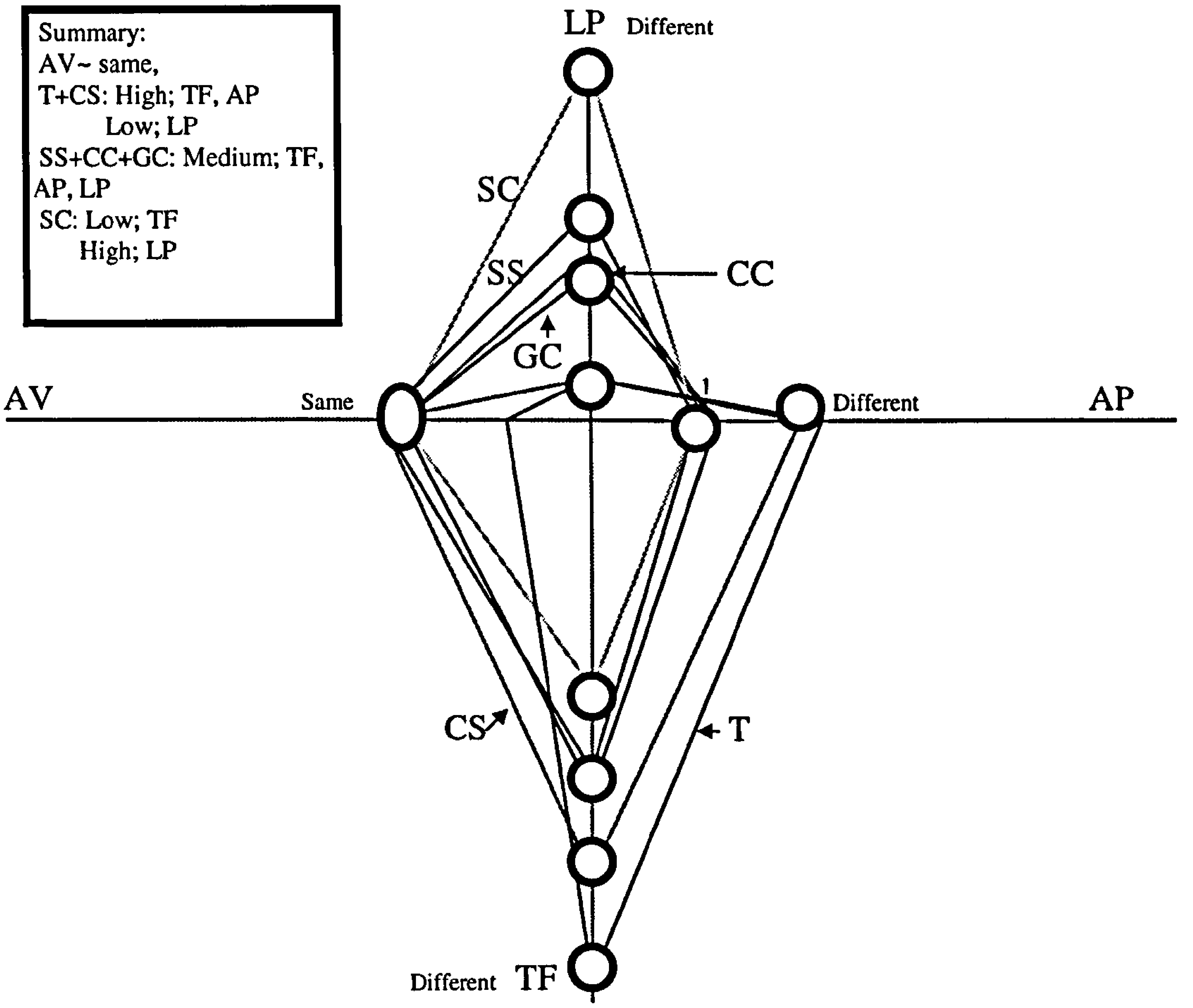
Value	CC	GC	SC	Trout	Caspian fish	Southern fish	Average carp	Average capture
Offered reason	M (S[1])	M (S)	M (S)	M (S)	M (S)	M (S)	M (S)	M (S)
Lower price	34 (13)	30 (18)	62 (37)	7 (4)	8 (0)	33 (11)	42 (23)	21 (5)
Taste and flavour	76 (67)	69 (68)	52 (50)	92 (88)	84 (75)	77 (73)	66 (62)	81 (74)
Availability	25 (15)	24 (8)	29 (10)	9 (4)	28 (17)	31 (8)	26 (11)	30 (13)
Appearance	19 (5)	19 (6)	14 (3)	25 (5)	26 (8)	15(8)	17 (4)	21 (8)
M (S) reasons	30 (70)	33 (67)	36 (64)	29 (71)	37 (63)	39 (61)	33 (67)	38 (62)

1- M (S): Multiple choice (only single choice)

Other responses indicated: lower price; maximum for silver carp (37%) and minimum for Caspian species (0%)), taste and flavour; maximum for trout (88%) and minimum for silver carp (50%)), availability; maximum for Caspian species (17%) and minimum for trout (4%), and appearance; maximum for capture species (8%) and minimum for silver carp (3%). The different attributes based on Multiple Correspondence Analysis[62] (MCA) are shown in Figure 5.1, indicating the similarity and differences between consumer attributes for different species.

62 - Greenacre M. (1984) as shown in Figures 5.1 & 5.2.

Figure 5. 1: Priority attributes for species.



CC: Common carp, GC: Grass carp, SC: Silver carp, T: Trout,
SS: Southern species and CS: Caspian species
1= 10%, LP: Lower price, TF: Taste and flavour,
AV: Availability and AP: Appearance

2) preferred form of consumption for cultured carp: 97% replied, with the responses shown in Table 5.4. Almost 23% gave multiple responses. It is clear that fresh fish (whole and gutted) is most liked, followed by fillet. Comparing Table 5.4 with delivery form of carp in the market in 1996, as showed in Figure 3.8, indicates, sampled responses is more diverse. Very low preference for whole frozen may possibly be due to poor handling and quality issues, and better rolling of gutted frozen appears to be due to better presentation and higher quality.

Table 5.4: preferred form of cultured carp for consumption in sample population.

Value	Multiple choice (%)	Single choice (%)
Whole fresh	36	36
Gutted fresh	45	39
Whole frozen	1	1
Gutted frozen	10	6
Fillet	21	14
Smoked	9	3
Salted	4	1
% multiple /single response	23	77

3) Seasonality of fish consumption: 98% replied, with the following responses: all year round (37%), during a particular season (55%), on special occasions (8%). Thus, almost 63% consumed fish only periodically. As noted before, with a high preference for fresh consumption is seasonally linked to capture periods in winter and autumn. The Caspian fishery starts at the end of September and continues to March, and except for some parts in the S, there is usually no fresh fish in spring and summer. Thus, seasonal fishing, limited supply, inadequate handling and marketing facilities, traditional consumption forms and lack of processed fish have been important factors and continue to affect demand.

5.2.3 Consumer attitude response

A series of questions focused on specific aspects of consumer attitudes to carp, the first considering the negative[63] views of carp as a preferred meat. Three other questions focused on the effect of supply increase, income rise and price decline in carp consumption and the final question focused on attitudes in purchasing cultured carp.

[63] - E.g. the negative views of carp compared with related protein foods, such as capture fish, red meat and poultry.

1) Why is cultured carp not a top priority in protein consumption ?: 88% replied, 73% with single and 27% with multiple responses, with the following results (%single/%multiple):

- taste (50/57),
- lack of access to safe and suitable carp in markets (18/29),
- Inadequate familiarity with carp (17/23),
- relatively high price than other sorts of flesh (7/13),
- cooking problems (4/9), and
- other reasons (3/6).

Results showed the pattern for single and multiple respondents is almost the same. Taste appears to be the chief reason for the negative views of carp. It seems, this may possibly be due to supply forms (whole fresh and/or frozen) and poor handling, and inadequate presentation in the market (mostly without ice and/or refrigerator), though, need to find the way to provide fish more acceptable with high quality to the market. access and familiarity are also important and need to increase and expand carp products in market.

2) When asked to identify 'to what extent has the supply increase of cultured carp influenced the increase in your consumption', 93% replied with the following result given.

- very little increase (22%),
- moderate increase (35%),
- great increase (30%), and
- very great increase (13%).

Thus, some 78% of respondents would be ready to increase consumption with an increased supply and though, the extent can not be fully defined, this suggests a very positive response. As almost 50% of respondents claimed inadequate familiarity with carp and the lack of safe and suitable fish in the market, expanded supply and improved handling and marketing facilities may positively affect consumption.

3) When asked to identify 'to what extent has income rise influenced the increase in your consumption of cultured carp', 97% replied, with 59% ready to increase consumption, of which 19% would increase this very much. However, 41% would not change. These basic results suggest that income rise may positively affect demand for carp products, though the extent of income rise and consumption change has not been specified.

4) When asked to identify 'the effect of price decline on consumption, 97% replied, with 68% ready to increase consumption, of which 30% would increase this very much. However, 32% would not change consumption. It appears that price decline may increase demand slightly more than income rise, though, as specific values of change were not recorded, it is difficult to define this further, in terms of elasticity of demand.

5) When asked to identify 'which aspect do you take into consideration while purchasing cultured carp', 97% of the sample replied, with responses shown in Table 5.5. Quality of fish appears to be significantly the priority factor, for both single and multiple preference respondents, followed by price and trust in the seller. 48% of respondents consider multiple aspect, though, fish appearance affect 13% of respondents as well, while single respondents consider other aspects for purchasing.

Table 5.6: Factors in purchasing cultured carp.

value	Multiple (%)	Single (%)
Fish price	32	7
Fish delivery form	20	7
Fish appearance	13	1
Fish quality	84	76
Trust in the seller	28	9

5.3 Responses by sub-group

5.3.1 Location of respondents (income groups)

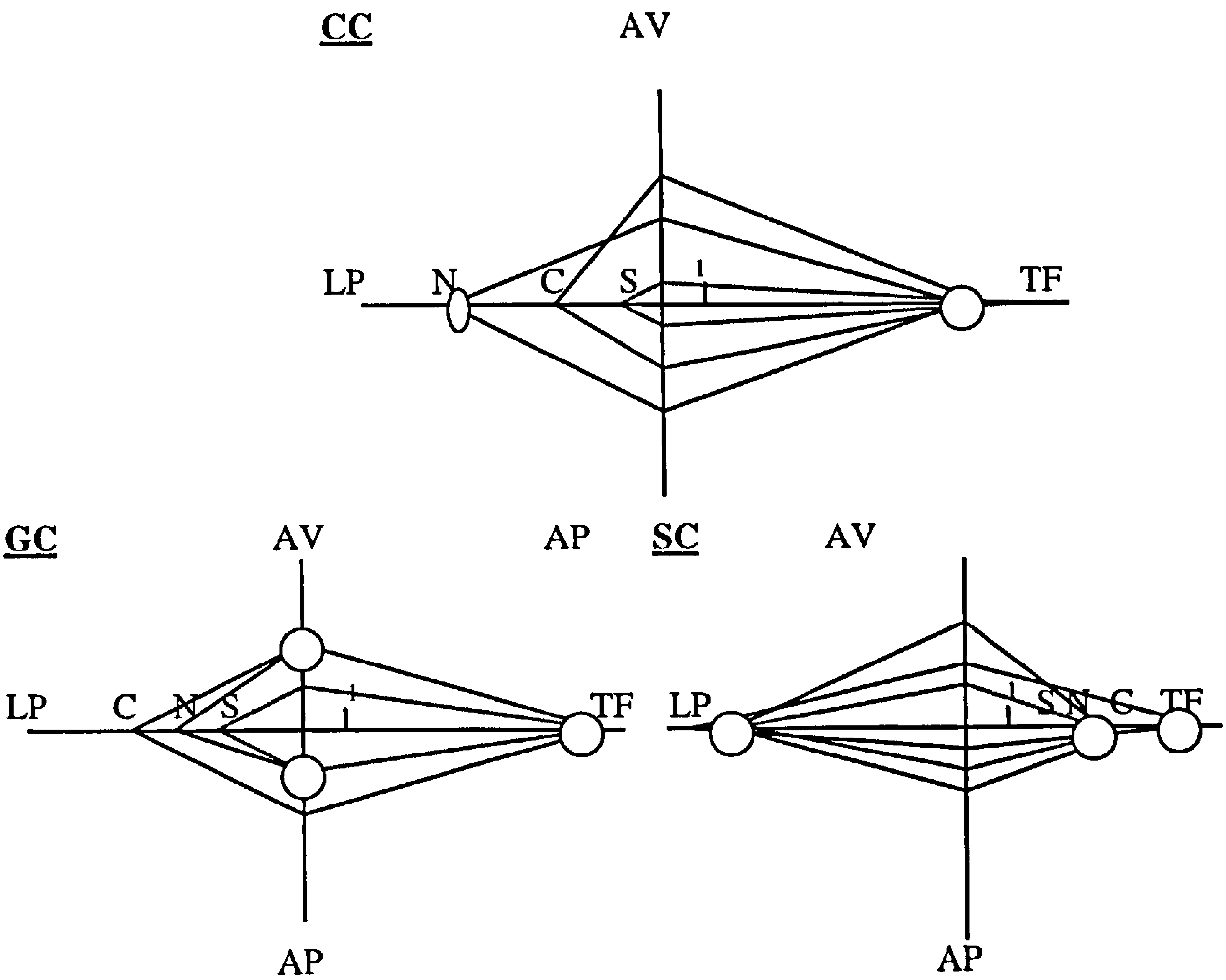
As noted before, the sample was obtained from consumers in the north, centre and south of the cities of Tehran and Karaj, Corresponding broadly to high, middle and low income groups respectively, with differences in educational level, marital status and disposable income (Shilat, 1996[b] *op.cit*)[64].

Priority factors of cultured carp for consumption

As shown in Figure 5.2, primary analysis of responses to the question ' to determine consumer's priority for common, silver, and grass carp consumption' indicates that consumers in all areas identify taste and flavour as the most important factors in consuming common, grass, and silver carp. Except for silver carp this factor is significantly more important than others. Between the groups the lower price of silver carp is more important for central part than elsewhere. An average of 43% (N), 42% (C) and 17% (S) offered multiple priorities.

[64] - In a study by Shilat (1996[b]) there is a significant difference between households related to income, education level and other socio-economic aspects in different areas of Tehran, in north Tehran monthly income averaged almost 100% higher than centre Tehran and 230% higher than south Tehran, as well as the number of family members and per capita per year fish consumption from 4.8 persons and 5.7 kg in N decline to 5.2 persons and 3.9 kg in centre and 6.2 persons and 2.2 kg in S Tehran.

Figure 5.2: Priority factors in carp consumption by location.



TF: generally similar, except for SC, and CC>GC>SC,
CC+ GC: generally similar, SC: different,
LP: for SC similar, for CC and GC different,
AV+ AP: different,

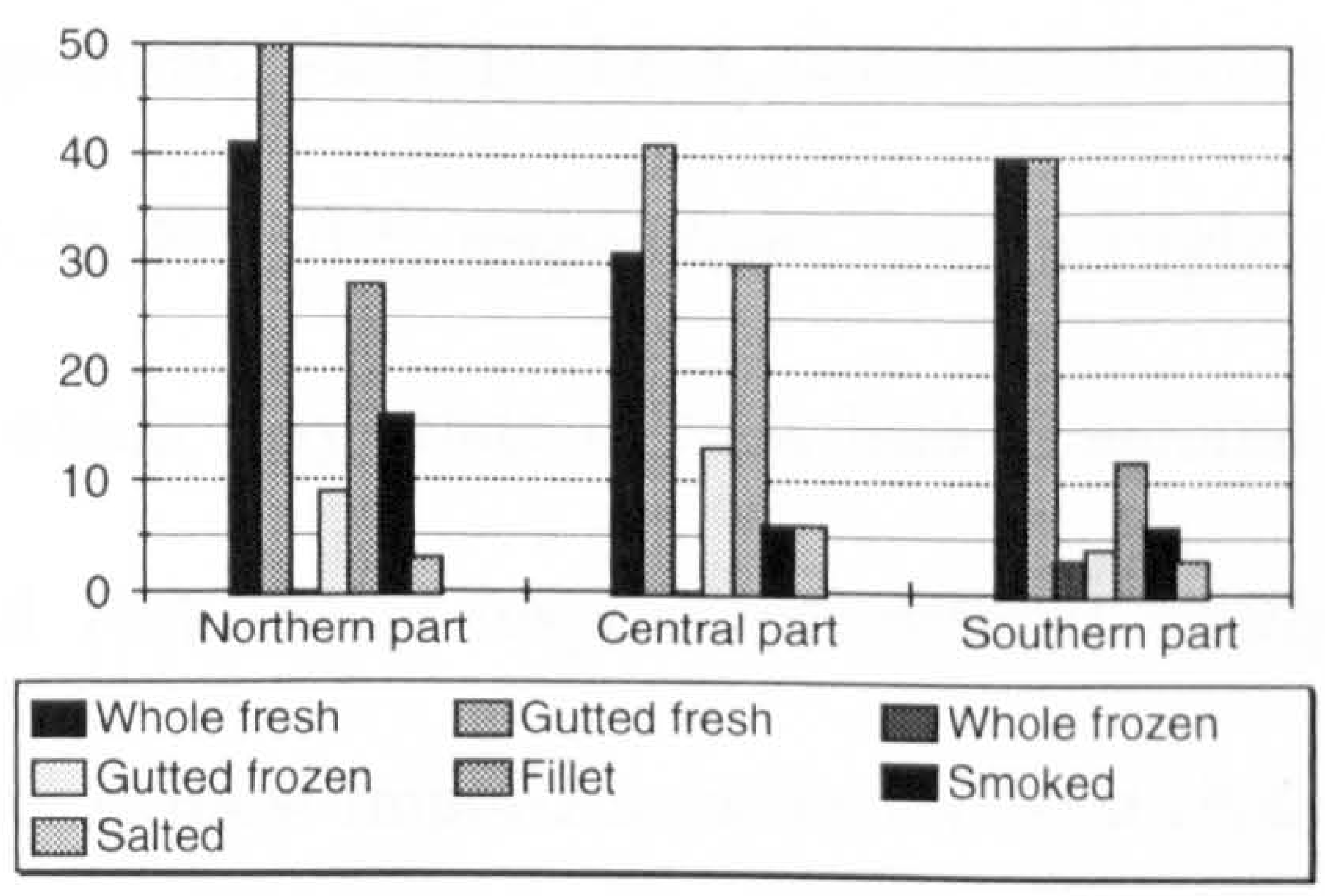
LP: Lower price, AP: Appearance, TF: Taste and flavour, AV: Availability
N: North, C: Centre, S: South Tehran and Karaj,

For common carp; the importance of lower price and appearance factors declined from N to S, comparing with other species, common carp is one of the cheapest species in N, though, if they want to choice common carp, lower price appears to be most important, For grass carp; appearance and lower price seems to be the priority in C, while for SC; lower price more important for all, while taste varies more than grass and common carp, taste appears to be the priority in C, but appearance do not. Availability was more important for N and C, this appears to be mainly due to a little supply, particularly in N.

Form of cultured carp

Fresh fish is significantly preferred over other forms, at 91%, 72%, and 80% for N, C and S areas respectively, and gutted fresh is liked over whole fresh fish in N and C areas. While on average 29% liked fillet in N and C areas, only 12% do so in S. Apart from 3% of the sample in S, nobody likes whole frozen product as presently available, and only 2-4% liked salted or smoked forms, declining from S to N (Figure 5.3). An average 37% (N), 27% (C), and 11% (S) expressed multiple preferences, suggesting that higher income groups consider diversity of product, and a rise in income might shift demand towards a variety of products.

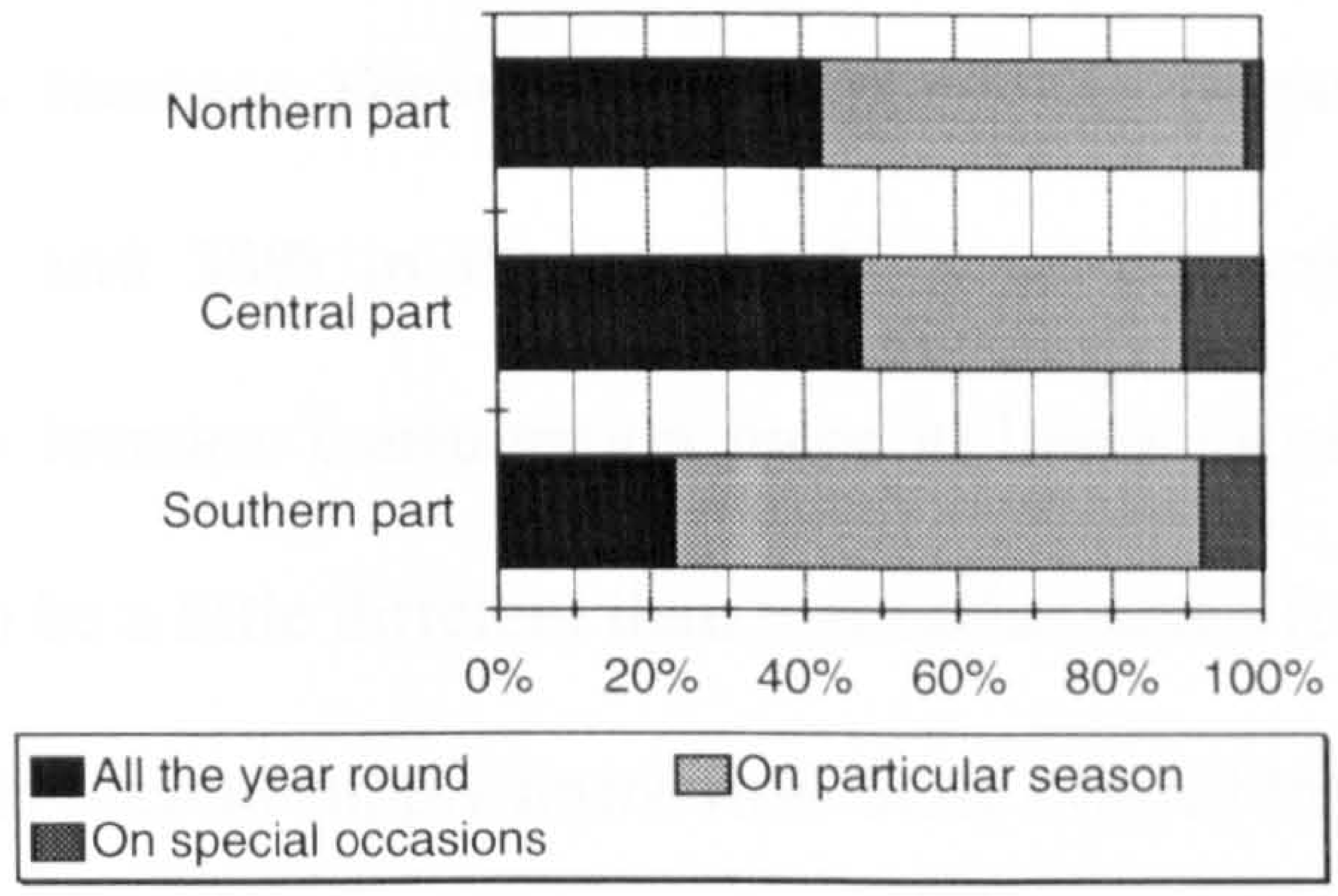
Figure 5.3: Consumption form of cultured carp in different areas (%).



Seasonality

While more than 40% of respondents consume fish all year round in C and N areas, only 23% do so in the S (Figure 5.4). Factors behind this seasonality have been noted earlier, but in differences may also be related to factors such as educational level, job, income and marital status (see later).

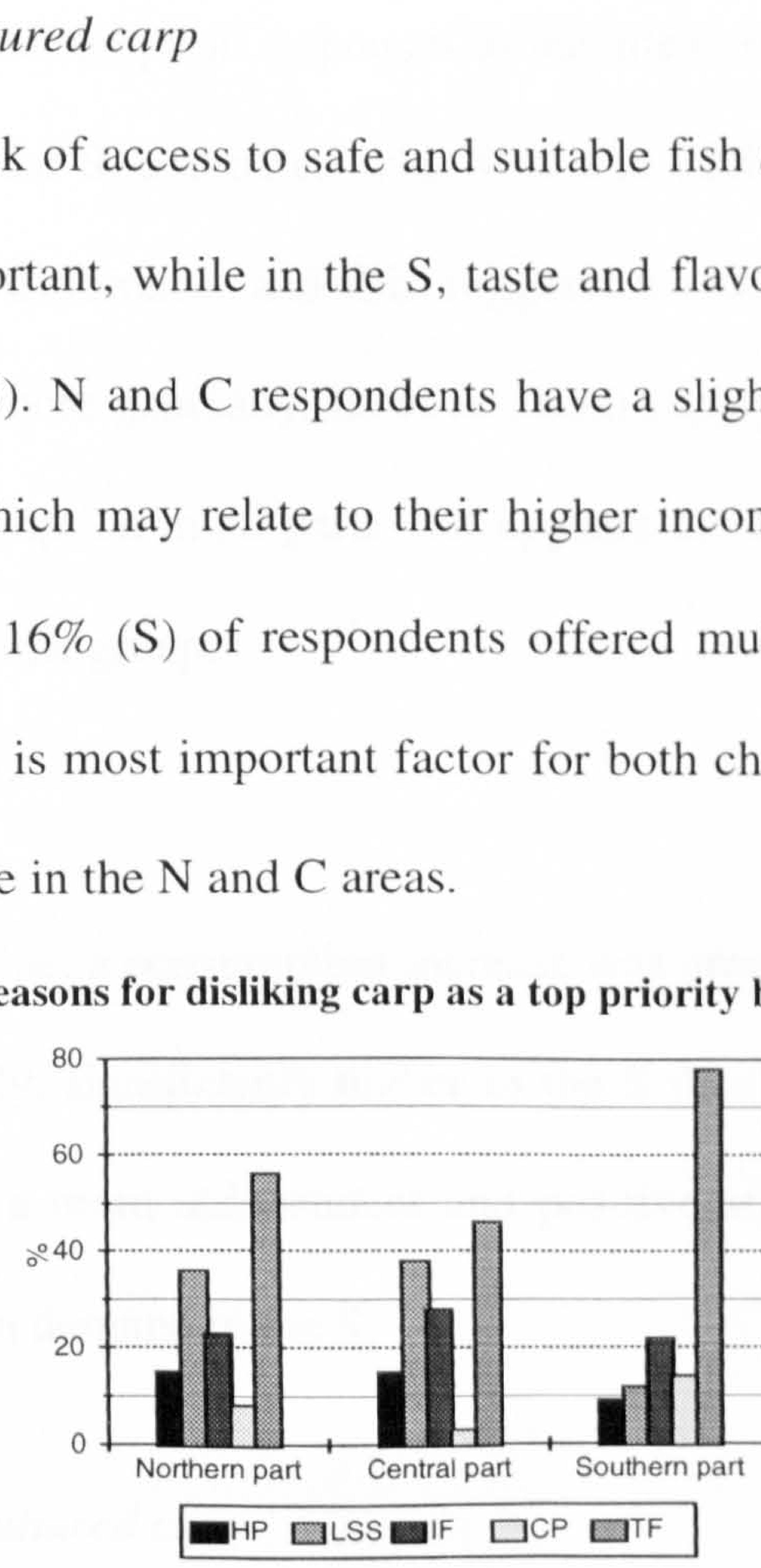
Figure 5.4: Seasonality of fish consumption in difference locations.



Negative features of cultured carp

In the N and C areas, lack of access to safe and suitable fish and inadequate familiarity with carp are more important, while in the S, taste and flavour and cooking problems have priority (Figure 5.5). N and C respondents have a slightly great concern for safe and healthier product which may relate to their higher income and educational status. 40% (N), 27% (C) and 16% (S) of respondents offered multiple reasons. Comparing with earlier results, taste is most important factor for both choice and negative features in the S areas, while price in the N and C areas.

Figure 5.5: Reasons for disliking carp as a top priority by location (%).



HP: Relatively high price, LSS: Lack of access to safe and suitable fish,
IF: Inadequate familiarity with carp, CP: cooking problems, and
TF: Taste and flavour

Role of supply increase

In response to supply increase, consumption increase was proposed by 51% in the S areas, but only 39% and 38% in the N and C areas respectively, suggesting that increased supply may increase consumption more in lower income group than others. This result, appears to be a little different than that earlier noted for availability, it looks, this might be related to present supply forms than those offered by the respondents.

Role of income rise

When asked to identify consumption responses to income rise, 58% proposed a possible effect of income rise in the S, compared with 49% and 52% in the N and C. Though, this is not a significant difference, and this suggests a reduced response with higher income in the N and C, more generally, however, both supply increase and income rise may increase carp consumption in all parts, but appears the effect of a rise income is a little higher in lower income group.

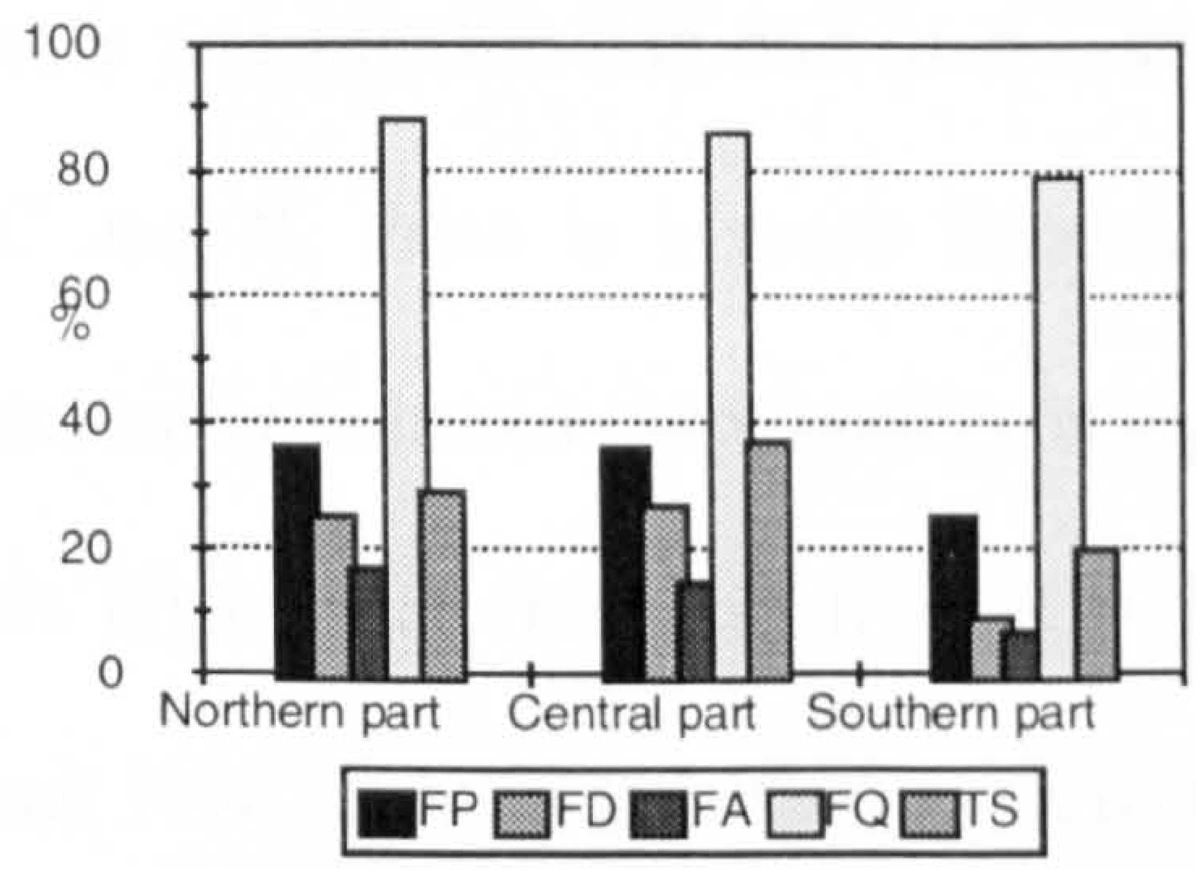
Role of price decline

In response to price decline, a consumption increase was proposed in 68% (S), 56% (C) and 60% (N) respectively, significantly higher in the S than elsewhere. This response, though appears to have a more independent and positive affect on carp consumption, with a notable increase in demand in the S.

Factors in purchasing cultured carp

With regard to the final question "what factors do you take into consideration while purchasing cultured carp?", it appears that relative fish quality is significantly more important than other factors, and this factor increases from S to N (Figure 5.6). Price is the second factor influencing purchasing, followed by trust in the seller. Fish appearance and form also influenced purchasing, these factors declining from N and C to S parts, though differences in purchasing decisions between N and C parts is negligible. Carp supplied with cheaper and lower quality, this is particularly more important in the S. This result suggests, for market development, increased quality might be expected to have a positive response to carp products, particularly in the N.

Figure 5.6: Difference in carp purchasing factors among locations.



FP: Fish price, FD: Fish delivery form, FA: Fish appearance,
FQ: Fish quality, and TS: Trust in the seller

Overall assessment of relationships between consumer responses and location/social group

There is a notable difference between carp consumption behaviour and the location of respondents, including factors such as seasonality of fish consumption, and greater preference for added-value products such as fillet and gutted fresh in the N and C. Though, N and C respondents have a slightly great concern for safe and healthier product which may relate to their higher income and educational status.

However, all locations showed a preference for taste and flavour, which is significantly more important than other factors (except for SC which lower price is more important). High income groups might be expected to consider more aspects in their priorities. In all locations, price decline creates a more positive response to consumption than income rise, in turn more than supply increase. There is a significant difference between location for the effect of price decline and income rise. Since the effect of both are more important in the S, the policy may be expected to direct expansion of lower price product in the S.

Considering views against carp consumption, dislike of taste is more important in the S than elsewhere, supplied with lower quality of carp appears to have a positive effect, which lack of access to safe and suitable fish and inadequate familiarity with carp are more important in the C and N. Price is a more important in the C, and cooking problems in the S. In purchasing cultured carp, quality is significantly more important than other factors and this importance increases from S to the N. Overall, differences occur significantly between N+C and the S, reflecting possible impacts of educational level, job, and disposable income, which will be examined further. Key strategic issues to develop the market in each group are as follows:

- N: improve quality, better presentation, widest range of products, value added, and healthier supply,
- C: lower price (particularly for grass and silver carp), value added, healthier supply and safety products,
- S: expanded supply with better quality, year round supply, income rise.

It appears that a different policy is required to increase carp consumption in different social groups, particularly related to the noted aspects, which will be discussed further.

5.3.2 The role of age

As noted before, 22% of the sample population is between 11-18 years old, 63% between 19-50 and the balance are older than 50. However, the national population is very young and in 1991, more than 55% were < 20 years old, 30% were < 10 years old and the latter would not really make purchasing decisions. The role of age on consumer behaviour is addressed in this section.

Priority factors of cultured carp for consumption

As Table 5.8 shows, consumers in all age groups identify taste and flavour as a priority consumption factor. This is significantly more important than other factors (except SC in >25 groups) and there are notable differences for other factors. On average, price gains in significance with consumer age, particularly for silver carp, and so lower price is the chief reason for eating silver carp in the >25 years old group, and this factor may strongly influence further marketing development for these groups.

Table 5.8: Priority attributes for carp species by age group (%).

Value	CC					GC					SC				
	<19	19-25	26-36	36-50	>50	<19	19-25	26-36	36-50	>50	<19	19-25	26-36	36-50	>50
LP	5	50	44	45	33	17	13	32	38	37	28	57	58	70	77
TF	76	50	69	82	83	80	63	55	72	63	56	71	47	48	38
AV	24	33	13	29	25	27	25	18	28	16	28	14	21	33	31
AP	5	33	19	21	25	10	13	27	19	21	0	29	16	10	23
M	5	33	38	47	42	23	13	27	47	32	11	71	26	45	38

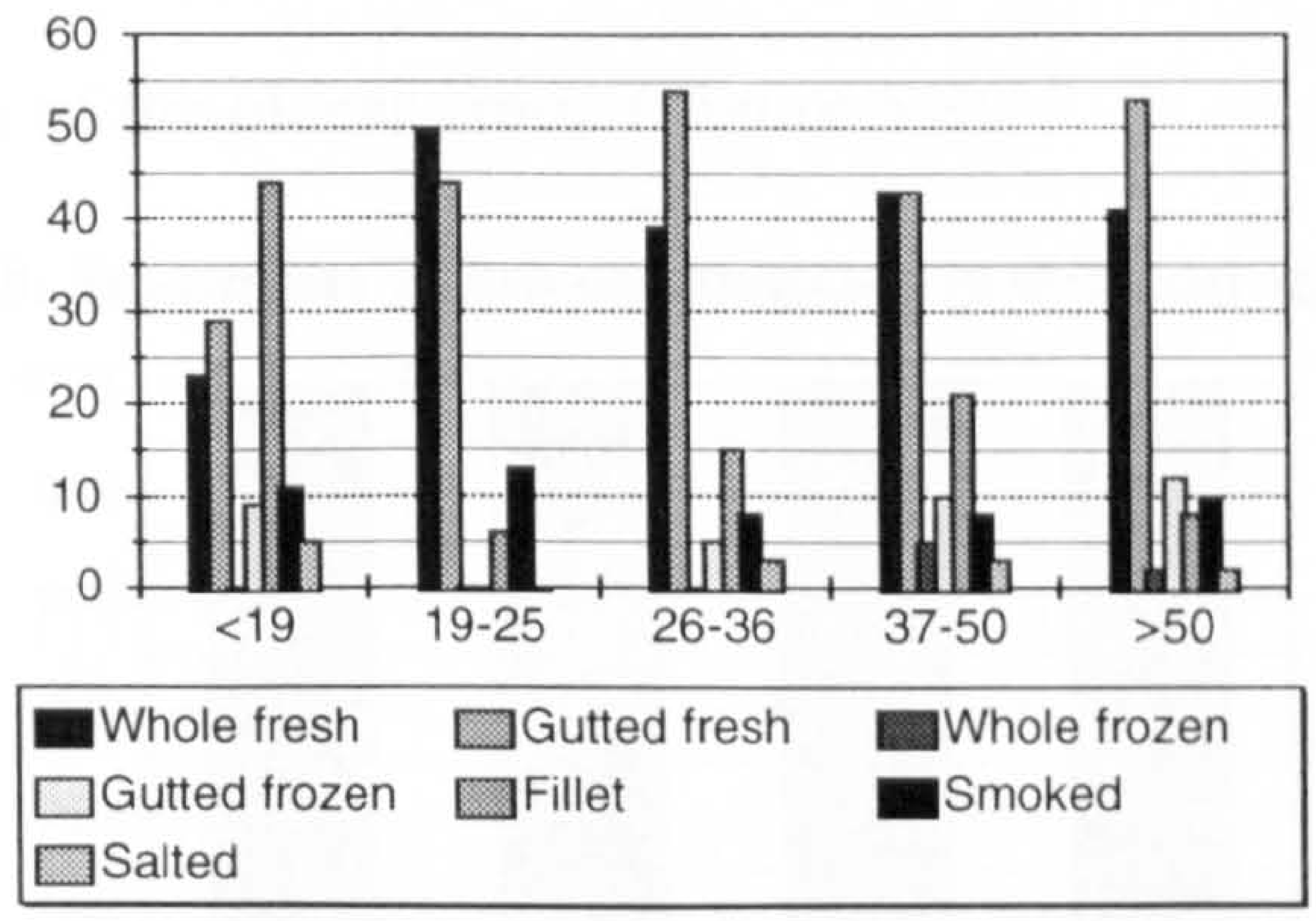
Value	Average carp				
	<19	19-25	26-36	36-50	>50
LP	17	40	45	51	49
TF	71	61	57	67	61
AV	26	24	17	30	24
AP	5	25	21	17	23
M	13	39	30	46	37

LP: Lower price, TF: Taste and flavour, AV: Availability,
AP: Appearance, and M: Multiple respondents

Form of cultured carp

While primary analysis indicates that consumers prefer fresh fish, differences occur between the youngest group and others.

Figure 5.7: Preference of carp product by age group (%).

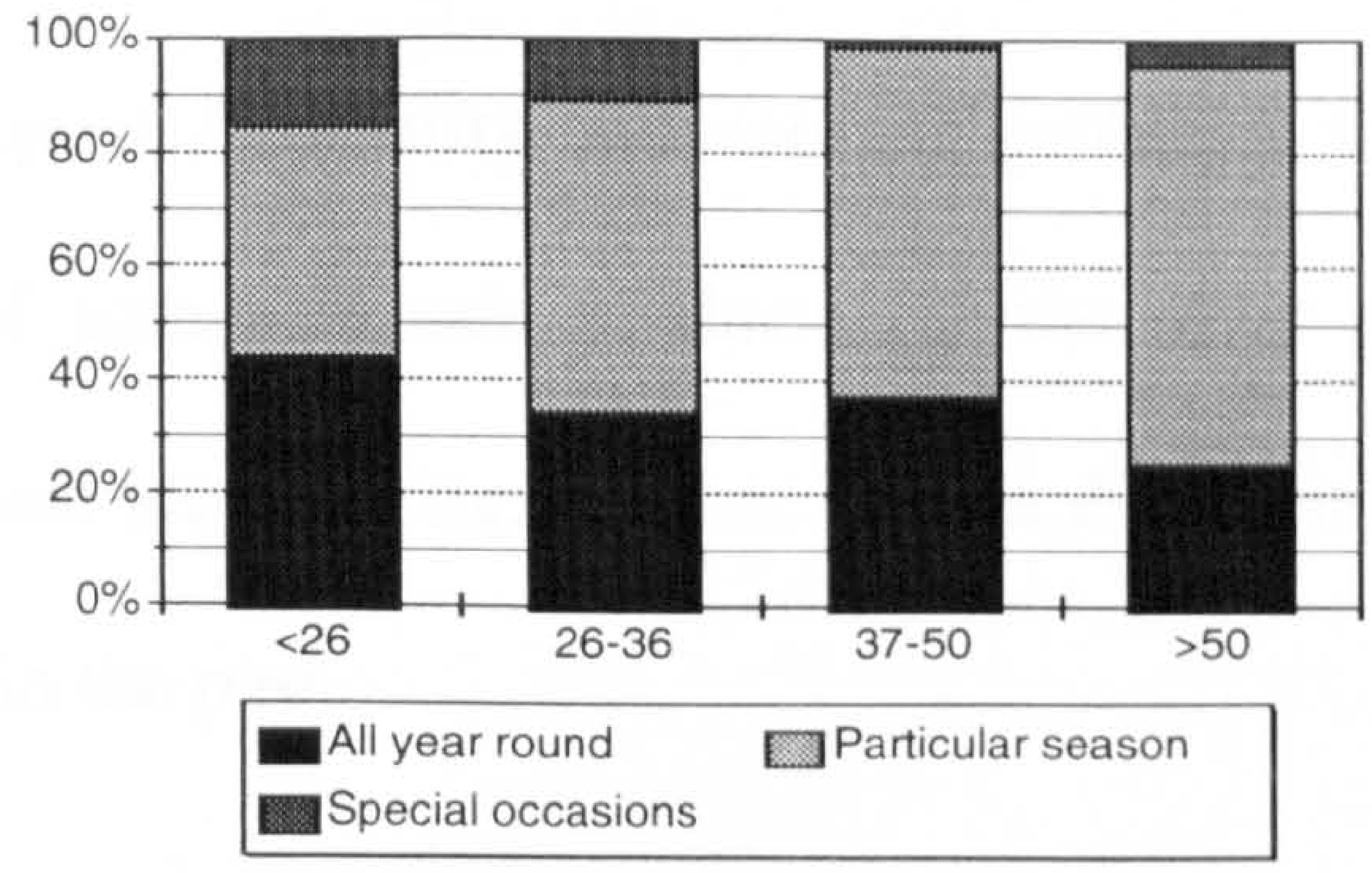


Except the 19-25 group, all others prefer gutted fresh over whole fresh. Except for an average 4% in groups of >36 years old, nobody likes whole frozen fish as presently available. 44% of the youngest respondents like fillet, declining to less than 20% of others. (Figure 5.7). Between 13% of group 19-25 years old and 27% of >50 years expressed multiple preferences. It appears that the younger generation likes easily prepared fish. Among those preferring only one form, 48% of the youngest group liked fresh fish (both gutted and whole), this average increasing to almost 85% in others. Preference for the fillet form decreases from 38% of the youngest group to almost 4% of the 19-50 groups and nobody >50. That for gutted frozen form decreases from 8% of the 37-50 group to almost 2% of the others. preference for forms such as whole frozen. smoked and salted is negligible.

Seasonality

While 50% of the sampled population of < 19 years consume fish all year round, only 26% of the > 50 years old and on average 37% of the 25-50 years group do so. There is a little difference across the 25-50 range. Thus, the proportion of all year round fish consumption decreases with respondents age. Only 3% of people older than 36 years consume fish on special occasions, but this increases to 15% for those less than 25 years old. As age increases, seasonal fish consumption also increases, from 40% of the youngest group to 70% of the oldest group (Figure 5.8).

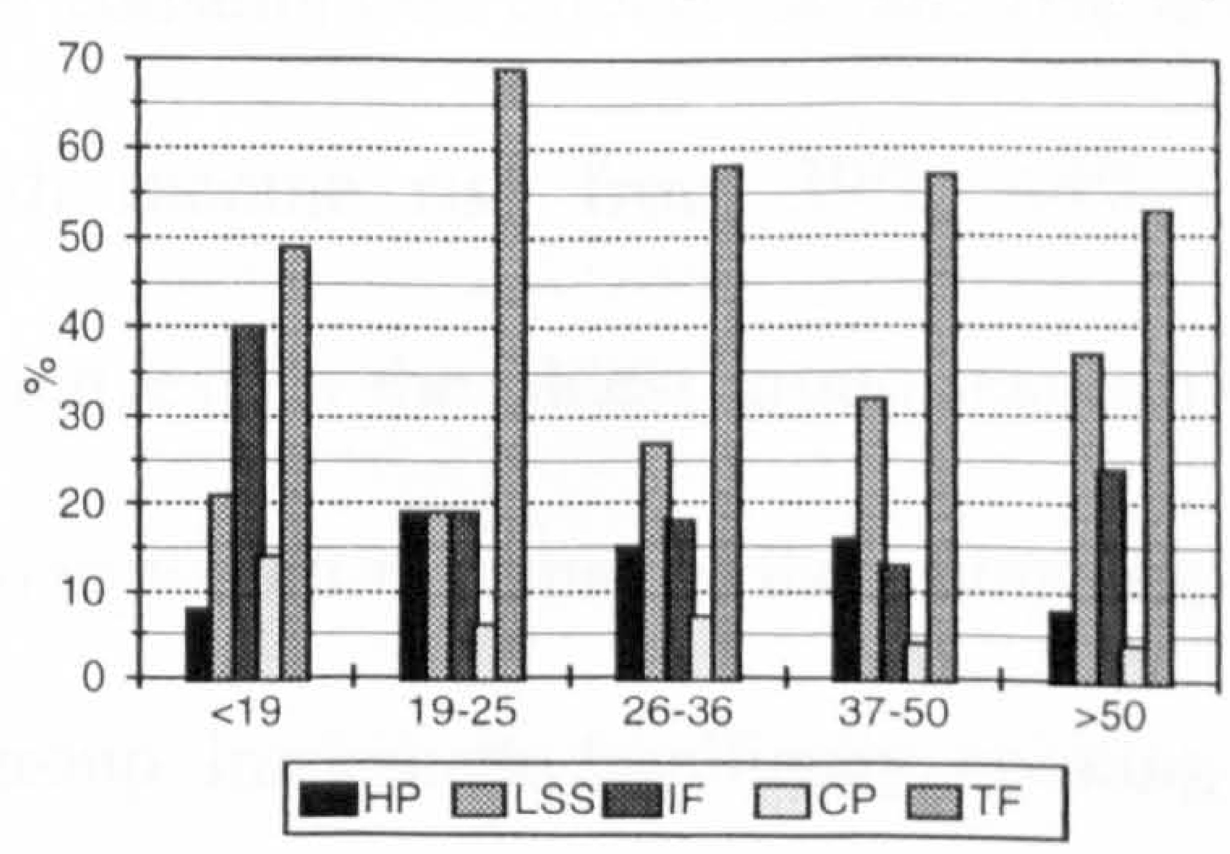
Figure 5.8: Seasonality of fish consumption in different age groups.



Negative features of cultured carp

A minimum 49% in the youngest group and maximum 69% in the 19-25 group do not like the taste and flavour of carp, as do on average 57% of the >25 years group. The importance claimed for lack of access to safe and suitable fish increased with age (from 20% of the <25 group to 38% of the >50 group), but cooking problems declined conversely. (Figure 5.9).

Figure 5.9: Negative perceptions of carp as top priority by age group (%).



HP: Relatively high price, LSS: Lack of access to safe and suitable fish,
IF: Inadequate familiarity with carp, CP: Cooking problems, and TF: Taste and flavour

As shown in Figure 5.9, among respondents claiming only one reason, 67% of the 19-25 group claimed taste, compared with only 39% of the youngest group; the difference between other groups is negligible. Lack of access to safe and suitable fish is claimed by 8% of the 19-25 group, compared with 28% for the oldest group, with a little difference among the others. On average 9% of the 19-25 and 37-50 groups claimed inadequate familiarity with carp, as opposed to 29% of the youngest group, with little difference for others, though inadequate familiarity and cooking problems in the youngest group is also notable. Lack of access to safe products for the older group is notable, which suggests that inadequate handling facilities as well as damaged fish product has created negative perceptions in the past.

Role of supply increase

The relation between age and the response to supply increase is significantly positive. Increased carp consumption is proposed by 26%, 32%, 39%, 49%, to 59% of the youngest group to the oldest group respectively and so increased supply would increase consumption in all groups, but more so as age increases. However, the limited response of younger groups, who will increasingly form the potential market, is of concern.

Role of income rise

The relationship between consumption effects income rise and, age is also significantly positive, increasing with income rise from 39%, 44%, 56%, 57%, to 64% for respondents from the youngest to the oldest group respectively. With an income rise 53% of the youngest group would not change their consumption habit, compared with only 33% of the oldest group. Inadequate familiarity, cooking problems and whole fresh and/or frozen supply of carp appears to have this negative response.

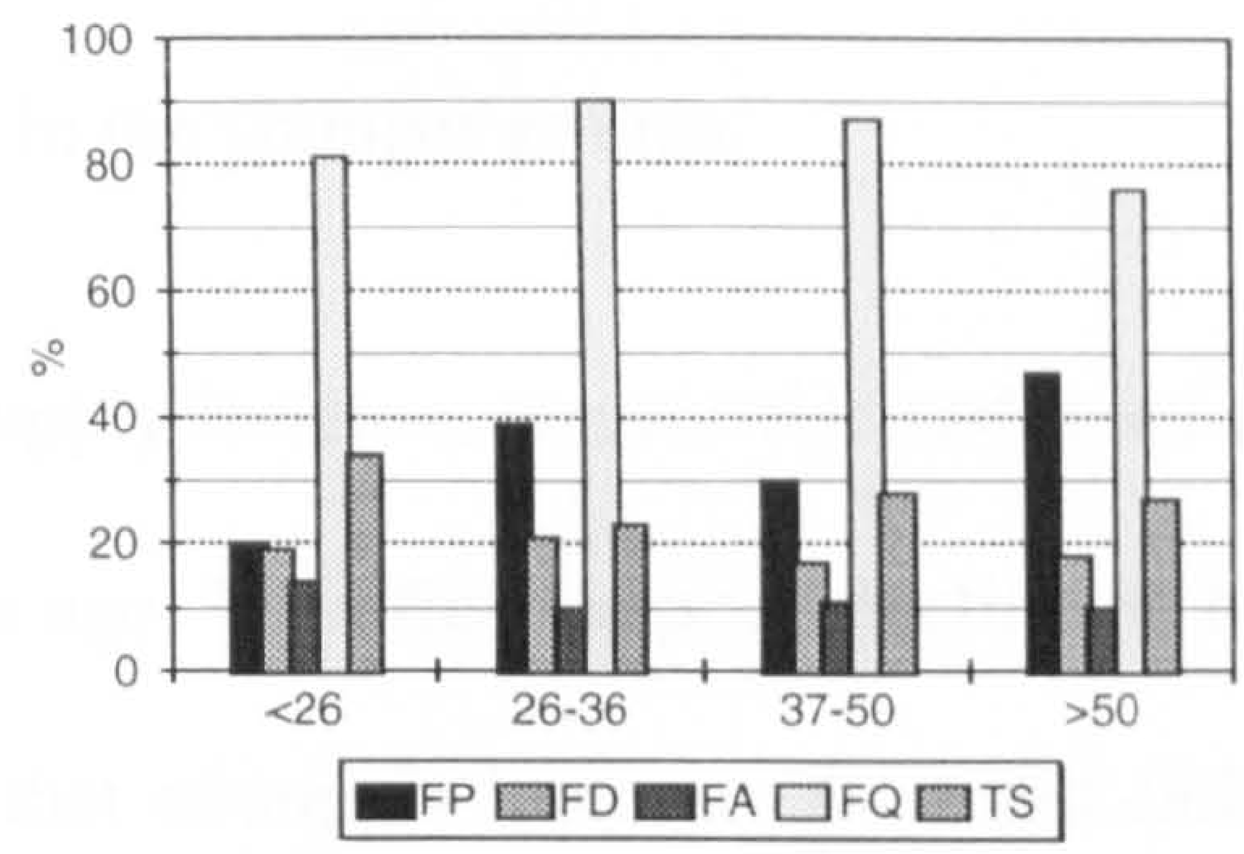
Role of price decline

Increased carp consumption as a response to price decline grows from 41%, 51%, 61%, 67% to 78% of the youngest to oldest group respectively. As with supply increase and income rise, price decline may positively influence demand in all groups, this effect significantly increasing with age, much higher for those >25 years who are usually responsible for family earning. The key difference between income rise and price decline appears to be a greater effect of price decline on consumption, and the consumption effect of price decline is higher than that of income rise, which in turn is higher than that of supply increase. This result suggests, price elasticity might be expected to be more for older groups, both price decline and supply increase may create a notable change on carp consumption.

Factors in purchasing cultured carp

The final question was "what factors do you take into consideration while purchasing cultured carp?". Here the importance of the relative fish quality is significantly higher than other factors in all age groups, from an average almost 89% in the 25-50 groups, to 81% in the youngest group, and 76% in the oldest group. Price of fish is more important in the oldest group than that in other groups, but trust in the seller and fish appearance are more important in the youngest group (Figure 5.10). Between 42% of younger group to 53% of older respondents consider multiple aspects while purchasing cultured carp. The contribution of older groups who paid attention to different aspects on purchasing decisions may be reflected by their experience.

Figure 5.10: Difference in carp purchasing factors among age groups.



FP: Fish price, FD: Fish delivery form, FA: Fish appearance,
FQ: Fish quality, and TS: Trust in the seller

Results are broadly similar between single and multiple respondents, though, fish quality is more important for <50 groups (especially 26-50) than the oldest group, and fish price more so for >50 group.

An overall assessment of relationships between consumer responses and age

A range of age related patterns could be observed. Age and seasonal consumption are positively related. Over the last decade, with increased production and improved marketing facilities, year round consumption has generally grown, this change mostly affecting younger groups, suggesting that continued improvement in handling and marketing facilities and an increased variety of products may positively influence year round consumption.

Consumers in all age groups identify taste and flavour as a priority factor, but lower price is more important for the >18 years group and positively related to age. Availability is more important for the >37 years group (especially for common and silver carp), and though taste may influence all groups, decline in price and supply increase may be particularly important for increasing consumption in older groups. There is a significant difference in preferred forms, fresh fish (whole and gutted) are preferred in groups >18 years old, fillets in the youngest group, pointing up the potential for value-added products in the younger groups.

The linked factors of "supply increase, income rise and price decline" all show positive response, increasing with age. The effect of price decline is higher than that of income rise, in turn higher than that of supply increase. As noted earlier, the number of family members increases with age, associated in turn with busy families located in S, classified as low income groups, all of which factors may result in both income rise and price decline increasing demand. However the >25 years groups paid more attention on price.

5.3.3 The role of birthplace[65]

There is a significant difference between coastal areas and inland provinces in per capita fish consumption and expenditure on fishery products. Differences in fish consumption behaviour might also be significant, as examined in the following section.

Priority of cultured carp for consumption

Overall, 60% of inland group respondents and 68% of the Caspian and Tehran consumers identify taste and flavour as a priority consumption for carp. Except for silver carp this factor is significantly more important than others.

Table 5.7: Priority factors in carp consumption by birthplace location (%).

Value	CC			GC			SC			Average carp		
	C	T	O	C	T	O	C	T	O	C	T	O
Lower price	63	33	33	40	34	27	17	61	59	40	43	40
Taste and flavour	63	83	72	70	72	64	67	50	45	67	68	60
Availability	25	21	28	10	24	24	17	26	30	17	24	27
Appearance	0	19	21	0	18	23	17	9	18	6	15	21
Multiple reason	38	19	33	20	40	30	17	41	34	25	33	32

C: Caspian area, T: Tehran province, O: Other inland provinces except Tehran.

As Table 5.7 shows differences occur as follows: On average, 43% of the Tehran group and 40% of the others identified lower price. Availability was noted by 17% of the Caspian group, increasing to 26% of the others, and 6% of the Caspian group choose appearance, increasing to 18% of the other groups. Overall, priorities for carp consumption are similar between inland provinces but differ for Caspian respondents. These preferences may in part be explained by the apparent equivalence between cultured species and others which are known in the locations concerned. Thus, common carp and Caspian carp are equivalent, and cultured carp are known, especially in the Caspian littoral, where the price of Caspian carp is usually higher than that for cultured carp. As noted earlier, grass carp is equivalent to kutum (the most preferred fish in the region). Silver carp is also equivalent to Caspian Salmon (mahi aazad). Though, the price of kutum and Caspian salmon are higher than those for grass and silver carp, the three carp species are highly substitutable with Caspian species.

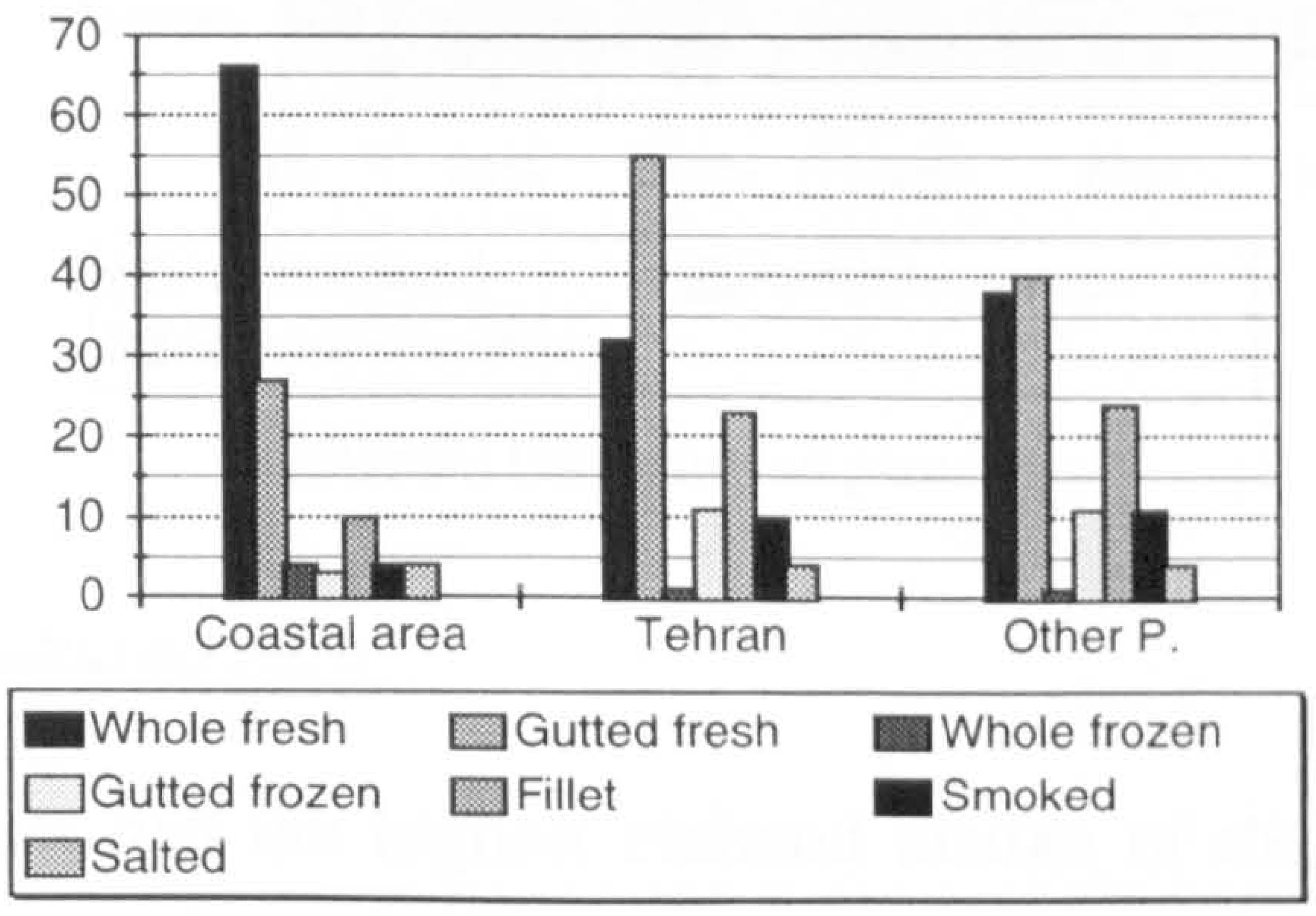
Form of cultured carp

The preference for fresh fish is significant but differs with birthplace location. Thus, 65-75% of the N and S coast respondents choose whole fresh respectively, declining to 32-38% of Tehran and other provinces respectively. On average 26% of the coastal respondents liked gutted fresh, increasing to 55-40% for Tehran and the other provinces respectively. Only 8% of the N coast respondents liked fillet, increasing to almost 24% in other areas. Smoked fish and gutted frozen is also chosen more in Tehran than others, but there is no difference in preference for salted form (Figure 5.11). This appears to confirm that the availability of whole fresh fish in the Caspian area has affected choice

[65] - Within Tehran province, respondents born in the Tehran, S coast, N coast and other inland provinces of the country.

and continued consumption habit, while poor transport, handling and quality control of whole fish in inland markets have influenced preference for gutted fresh and other added-value products.

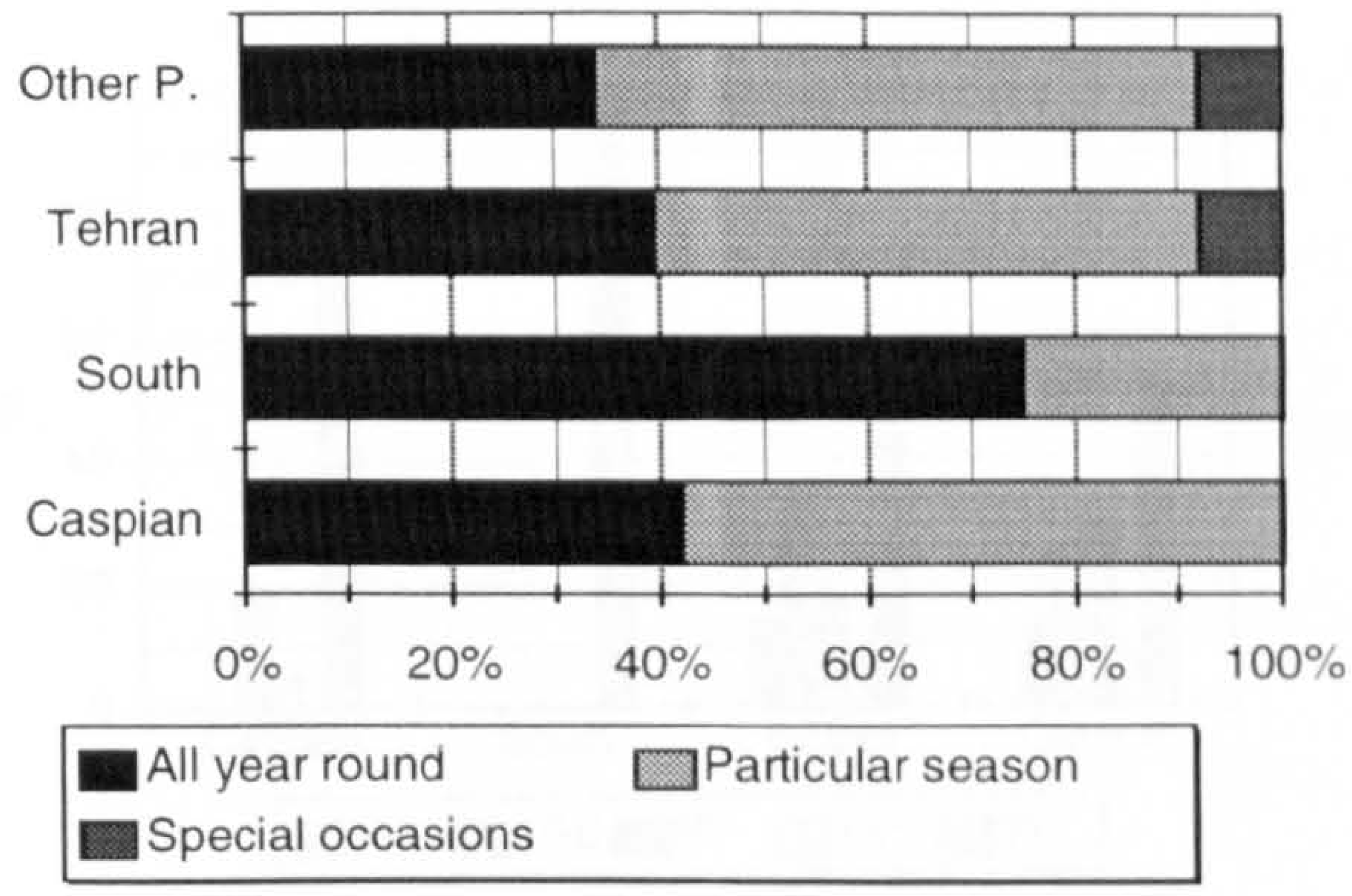
Figure 5.11: Processed culture carp consumption in difference areas.



Seasonality

As Figure 5.12 shows, 75%, 42%, 40% and 34% of the sampled population in the S coast, N coast ,Tehran and other inland provinces respectively consume fish all year round. In the coastal areas, nobody consume fish on special occasions, whereas 8% of Tehran and other province respondents do so. While only 25% of the S coast respondents consume fish during particular season, between 53-58% of respondents in other areas do so. In the Caspian littoral, both culture and capture harvesting start in the early autumn, though that for cultured carp usually finishes by the middle or end of the fall, while capture fisheries continue until end of March. This is probably the main case for seasonal consumption in the Caspian area and in Tehran. Respondents born in coastal areas appears to have a tendency to consume all year round.

Figure 5.12: Seasonality of fish consumption in different areas.



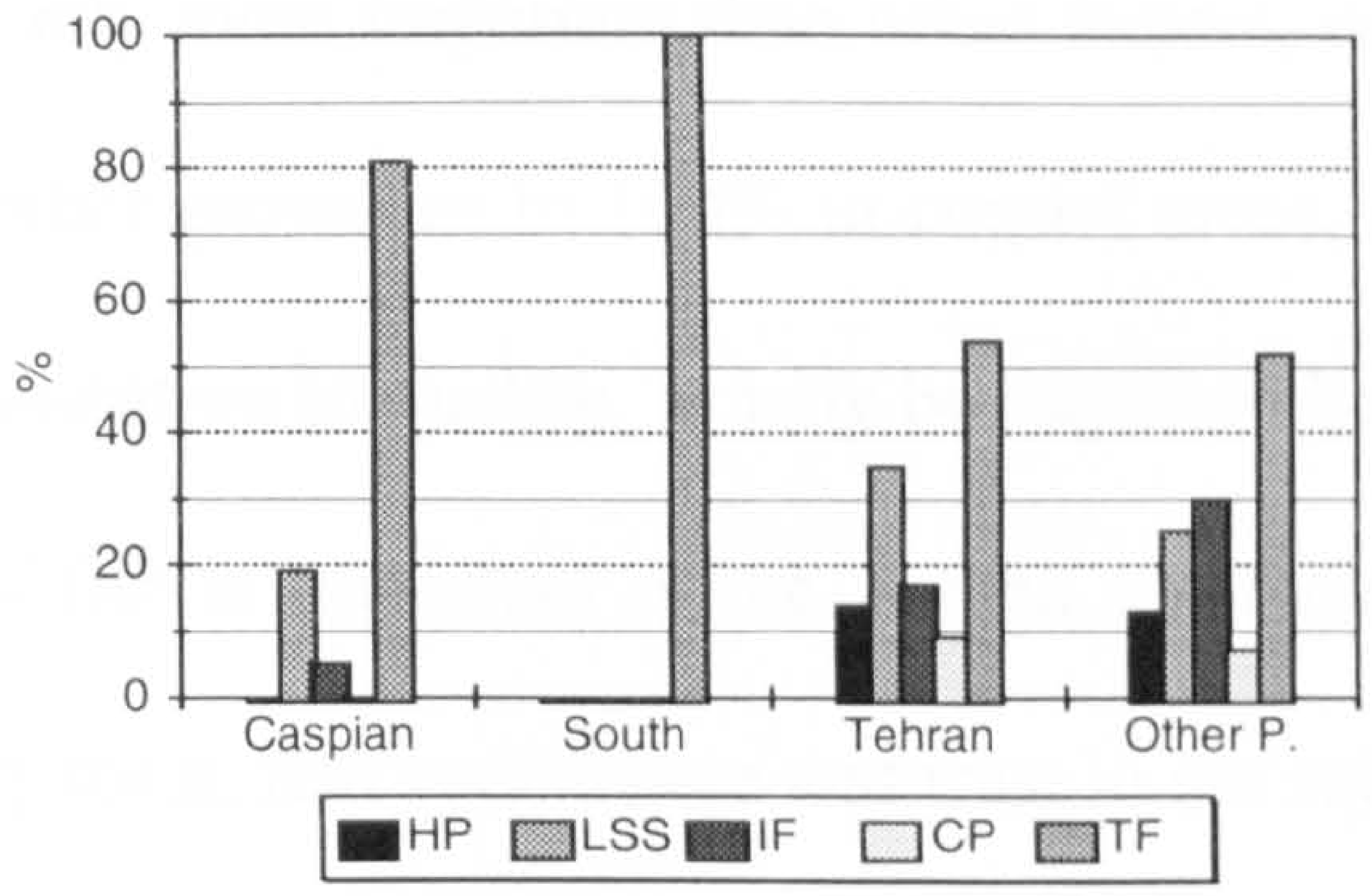
Other P.: Other inland provinces

Negative features of cultured carp

South coast respondents had the highest claimed dislike of the taste of cultured carp, declining to 81%, 54% and 52% in the N coast, Tehran and other inland provinces respectively. On average, 14% of inland province respondents claimed to be deterred by relatively high price but this was not claimed in coastal areas. Since, N coast respondents usually compare cultured carp with its Caspian equivalent, price has not been important. While 30% of all inland provinces respondents claimed lack of access to safe and suitable fish, only 19% claimed this factor in the N coast and nobody claimed this in the S coast.

In other inland provinces 30% of the respondents claimed inadequate familiarity with carp, but this declined to 17% and 5% of the Tehran and N coast respondents respectively. On average, 8% of the all inland province respondents claimed cooking problems, while nobody claimed this in coastal areas (Figure 5.13). These findings would seem to suggest that increase handling, processing and marketing facilities in inland provinces may increase carp consumption in this area. Unfamiliarity, poor quality, lack of processed forms appear to affect responses in inland provinces, which might be expected to be changed in the future. However, reduced supply of capture fish in Caspian area may affect perceptions and acceptance.

Figure 5.13: Negative attributes for carp by location.



HP: Relatively high price, LSS: Lack of access to safe and suitable fish,
IF: Inadequate familiarity with carp, CP: Cooking problems, and TF: Taste and flavour

Role of supply increase

This showed that: in the S coast, consumption would increase with only 25% of respondents, changing to 38% in the N coast and on average 44% in all inland provinces. This suggests the importance of improving supply to inland markets, though all markets would appear to benefit.

Role of income rise

Differences in response between areas (except the S coast) were negligible, in the N coast, 48% of sample respondents said that their consumption would increase, increasing to an average 54% in inland provinces. Consequently, however, a rise in income may increase carp consumption in all areas, but its effect is higher in inland provinces.

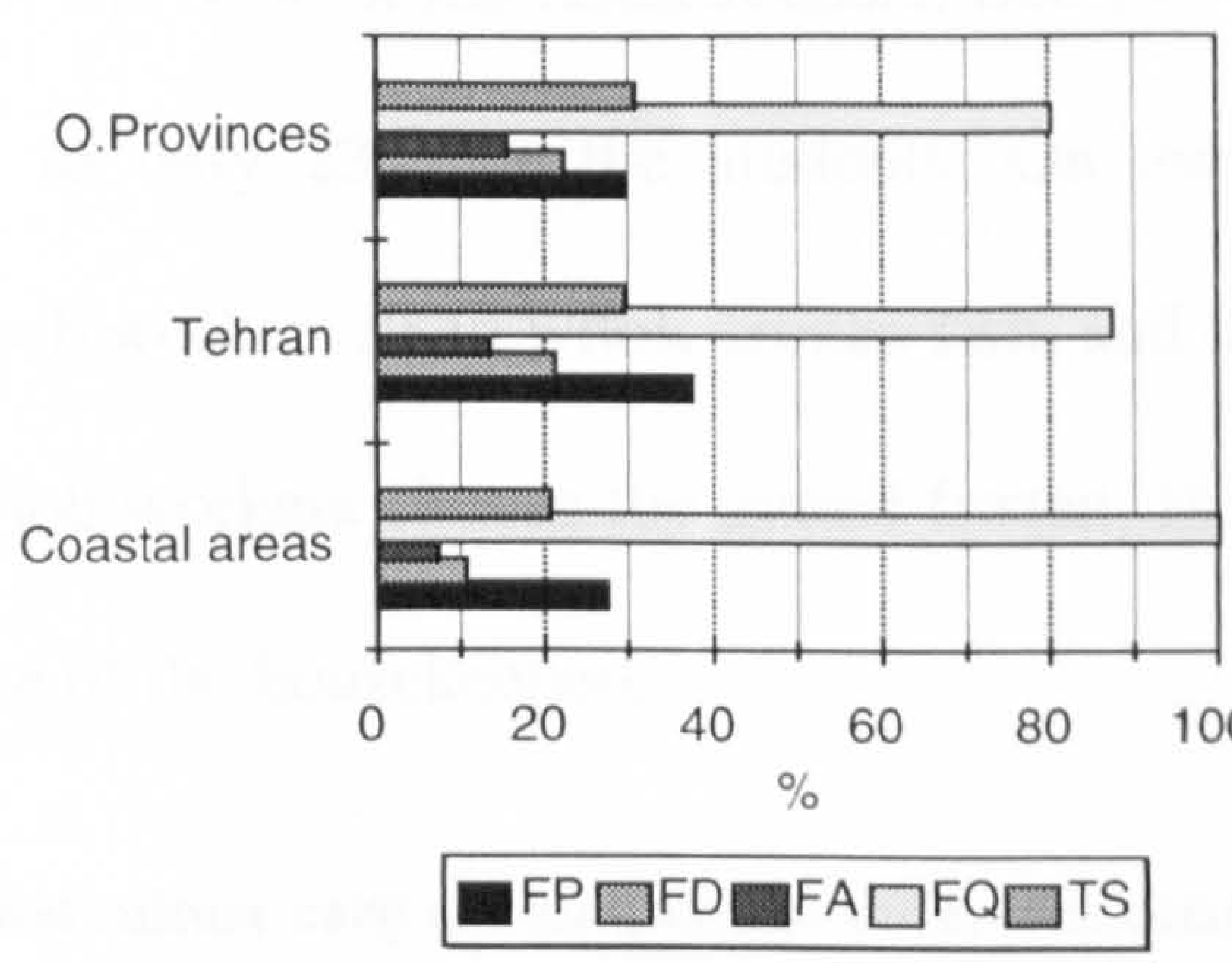
Role of price decline

With price decline, consumption would increase with 56% of respondents, in the N coast, increasing to an average 62% in all inland provinces. Since the price of carp is higher in areas far from production sites, it would appear that expanded carp production in inland provinces, and/or new or improved technology and management to reduce costs of production may positively influence demand, especially in inland provinces.

Factors in purchasing cultured carp

Fish quality is significantly more important than other factors, ranging from an average of almost 80% in the other provinces to 100% in coastal areas, confirming that coastal respondents pay more attention to quality, as may be expected because of availability of fresh fish. The price of fish is important of the Tehran respondents, followed by other provinces. Fish delivery form, fish appearance and trust in the seller are important of the other provinces, followed by the Tehran respondents (Figure 5.14). The contribution of respondents identifying multiple factors in purchasing carp is higher in Tehran than elsewhere.

Figure 5.14: Difference in carp purchasing factors among the locations.



FP: Fish price, FD: Fish delivery form, FA: Fish appearance,
FQ: Fish quality, and TS: Trust in the seller

An overall assessment of relationships between consumer birthplace and their responses

The study confirmed differences, especially between coastal area and inland provinces. Bringing all these findings together, there appears to be a favourable market for carp and its products, particularly in inland provinces, and especially for processed products. Though transport and handling facilities are being improved, constraints may remain over the coming years. The static or declining position of capture fish supplies not only may increase these feature in inland provinces but also in coastal areas.

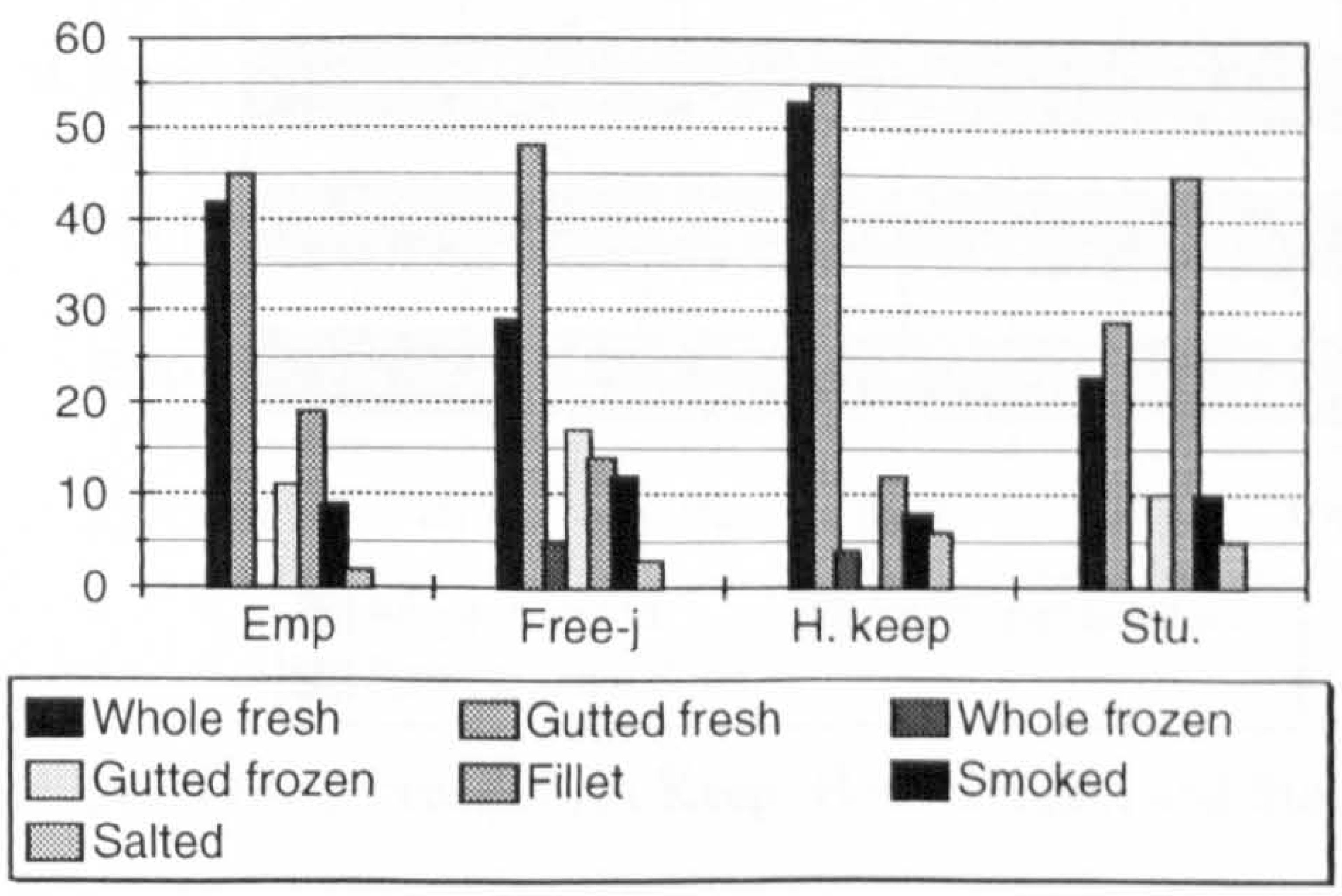
5.3.4 The role of occupation

Since there are differences between job groups on disposable income, educational level, family status and location, might be expected, the consumption behaviour of job respondents may also be different, this is examined below.

Form of cultured carp

Fresh fish is preferred, gutted more so than whole fresh fish. As Figure 5.15 shows, on average, 45%, 48% and 54% of the employees, free-job workers, and housekeepers liked gutted fresh respectively, declining to only 29% of the students[66]. Whole fresh fish was liked by 53%, 29%, and 42% of the housekeepers, free-job workers and employees respectively, declining to only 23% of the students. On average, only 4% of the housekeepers and free-job workers liked whole frozen fish, and none of the other groups do so. 17% of the free-job workers choose the gutted frozen, as do 10% of the students and employees, but none of the housekeepers.

Figure 5.15: Processed culture carp consumption at difference occupational groups (%).



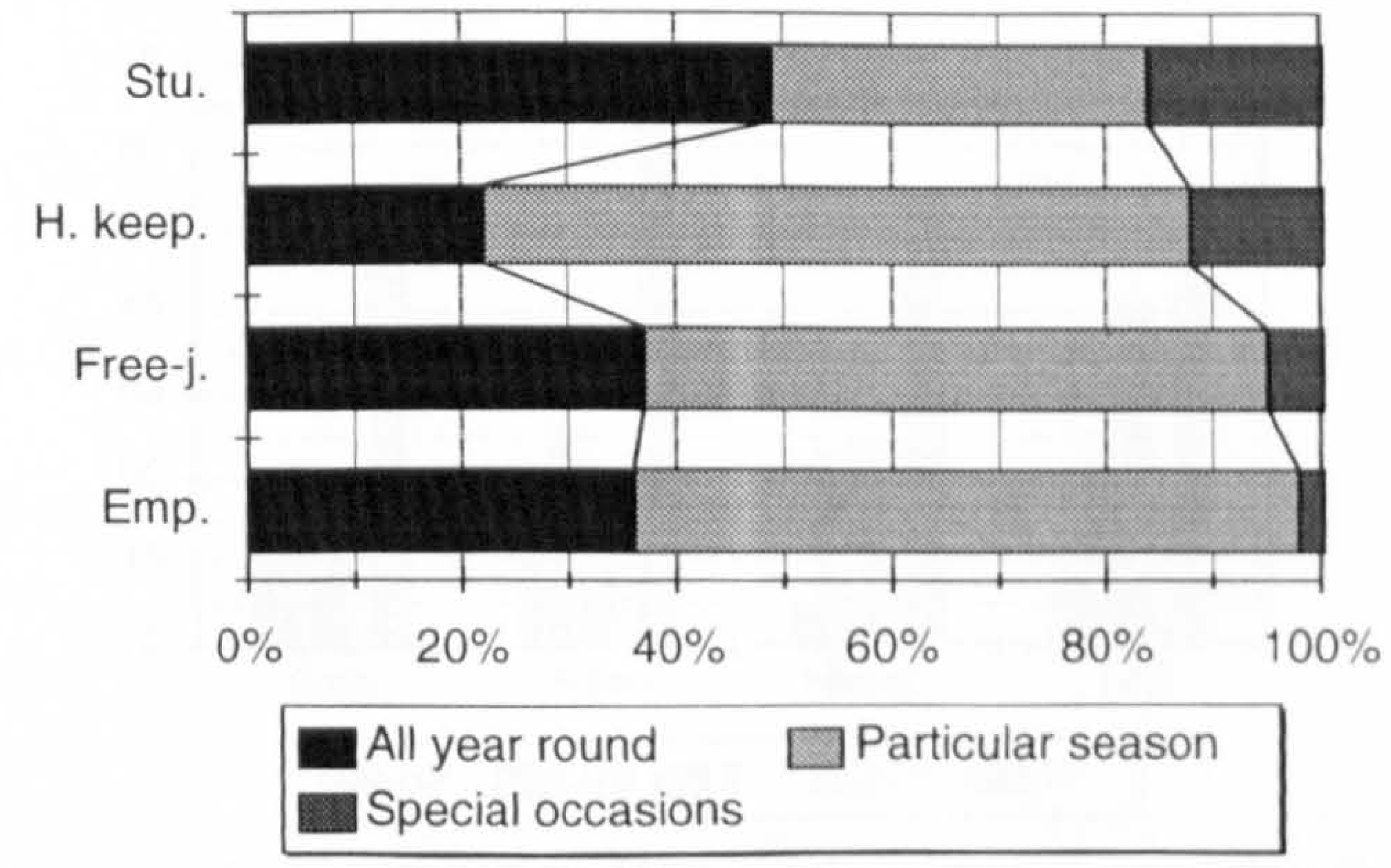
Emp: Employee, Free-j: Free-job, H.Keep: Housekeeper, and Stu: Student.

A significant difference occurs in preferences for fillet, in that while 45% of students liked fillet, more important than other forms, respectively only 19%, 14% and 12% of the employees, free-job workers and housekeepers do so. The difference in response for smoked form between job groups is negligible. A maximum of 6% of housekeepers choose the salted form, declining to only 2% of employees. Overall, the study showed, the difference between students and job workers on forms of carp consumption is significant, and those between housekeepers and other two job groups is also notable.

Seasonality

As Figure 5.16 shows, 49% of the students consume fish all year round, but on average 36% of employees and free-job respondents do so, declining to only 22% of housekeepers. There is no a notable difference between employees and free-job respondents on seasonality. While only 2% of employees consume fish on special occasions, this increases to 16% of the students. Though, this may be affected by both their birthplaces and residences. Except for students, between 58-66% of the all groups consume fish on particular seasons.

Figure 5.16: Seasonality of fish consumption at different occupational groups.



Emp: Employee, Free-j: Free-job, H.Keep: Housekeeper, and Stu.: Student.

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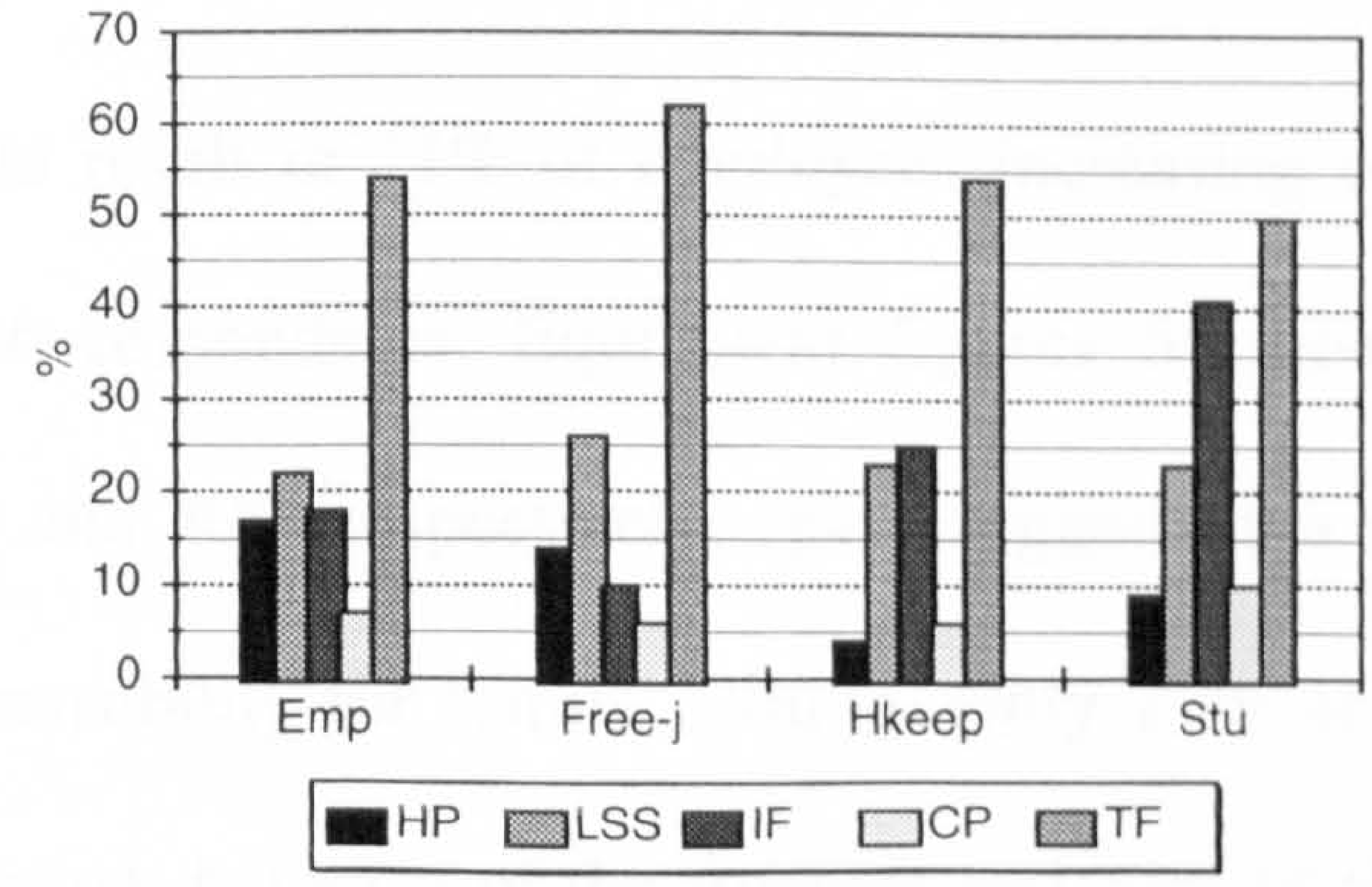
[66] - Almost one-third of the population are students, so the situation of this group is explained separately.

Negative features of cultured carp

62% of the free-job respondents do not like the taste and flavour of cultured carp, declining to 54% and 50% of the other groups and students respectively, with no notable difference between employees and housekeepers. While 17% and 14% of employees and free-job respondents claimed to be deterred by the relatively high price of carp respectively, only 4% of the housekeepers do so. Since housekeepers have not direct responsibility for family earnings, from which it appears that they are less concerned by price. There is no a notable difference between groups concerning the lack of access to safe and suitable fish. While 41% and 25% of the students and housekeepers claimed inadequate familiarity with carp, only 18% and 10% of employees and free-job respondents did so respectively, suggesting that increased familiarity may positively influence demand, especially for students and housekeepers. 10% of the students claimed cooking problems, compared with an average of only 6% of the other groups (Figure 5.17).

Figure 5.17: Reasons for disliking carp as a top priority among occupational groups.



Emp: Employee, Free-j: Free-job, HKeep: Housekeeper, and Stu: Student.
HP: Relatively high price, LSS: Lack of access to safe and suitable fish,
IF: Inadequate familiarity with carp, CP: cooking problems, and
TF: Taste and flavour

Role of supply increase

Some 48% of employees and housekeepers would increase consumption, compared with 37% of free-job respondents, and 25% for students. The effect of supply increase is more important for employees and housekeepers, followed by the free-job respondents. Since the students usually do not engage in buying, the effect of supply increase on proposed cultured carp consumption appears not to be important as other job groups.

Role of income rise

Here, 60% of employee and free-job respondents would increase consumption, compared with 45% and 42% of housekeeper and student respondents respectively. Only 36% of employees and free-job respondents do not change their consumption, but 43% and 53% of the housekeepers and students do so respectively. It appears that the effect is higher for groups who have direct responsibility for family earning, however, all of them usually do not make purchases[67].

Role of price decline

A price decline would result in 71% of employees increasing consumption compared with 63% of free-job respondents. Equivalent figures for housekeeper and student respondents are 55% and 40% respectively, again suggesting a strong effect for those who have direct responsibility for family earning. Only 24% of employees would not change their consumption, but 47% of the students and 33% of the other groups would do. Thus, except students, on average, more than 60% of other groups are ready to increase their consumption with price decline. The effect is higher than income rise and supply increase in all job groups.

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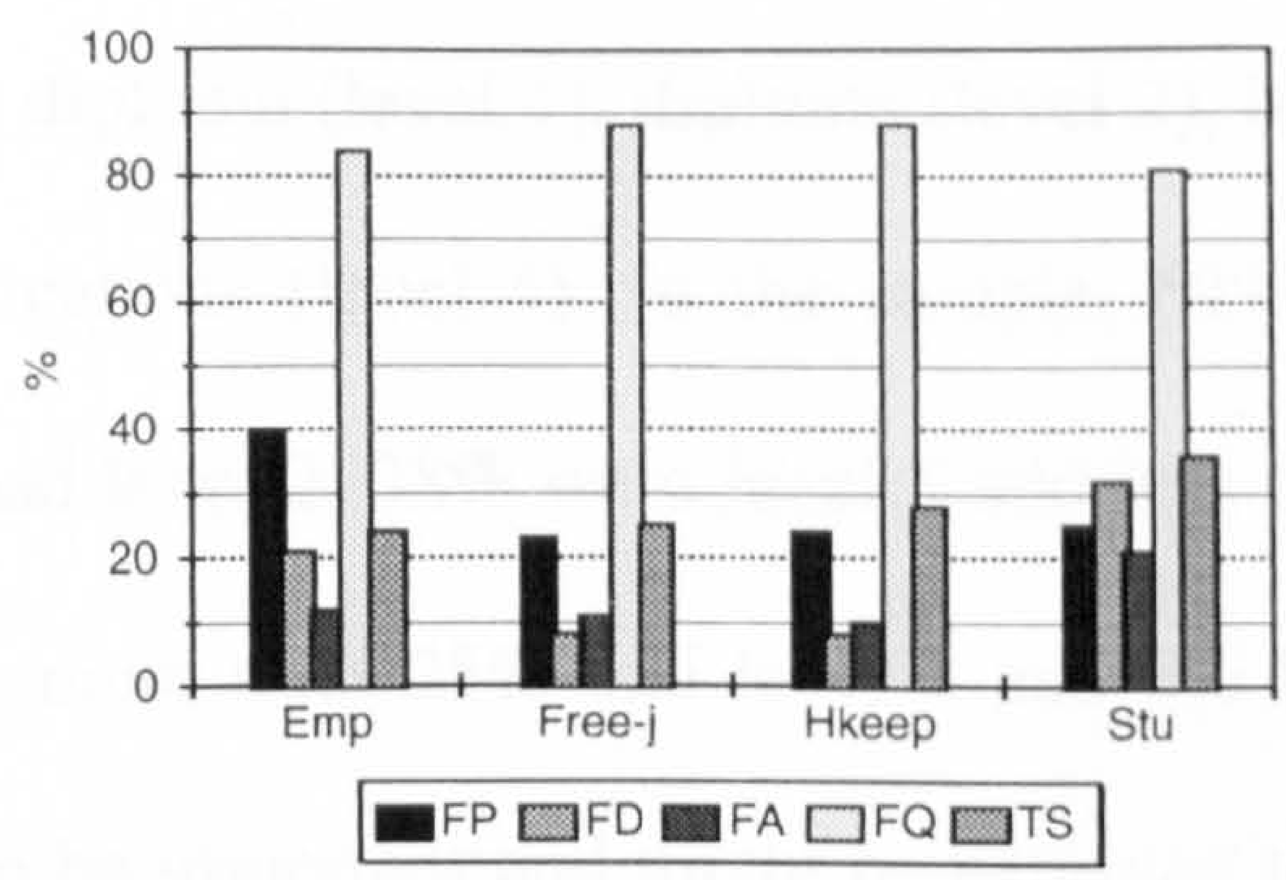
[67] - In a study by Shilat (1996[b] *op.cit*) it was found purchases are doing by men (55%), women (33), both 12%.

Factors in purchasing cultured carp

As Figure 5.18 shows, fish quality is significantly more important than other factors in all job groups, though 40% of employee respondents consider price compared with only 23% of the free-job respondents. This may reflect the importance of lower salary levels (in real terms) of employees on their purchasing decisions. Students, followed by employees, note delivery form and appearance more importantly than other groups. Trust in the seller is more important for student respondents, followed by housekeepers. Only 33% of free-job respondents consider multiple factors in purchasing carp, compared with almost 50% of other groups.

Figure 5.18: Percentage difference in purchasing carp among occupational groups.



Emp: Employee, Free-j: Free-job, HKeep: Housekeeper, and Stu: Student.
FP: Fish price, FD: Fish delivery form, FA: Fish appearance,
FQ: Fish quality, and TS: Trust in the seller

An overall assessment of relationships between consumer responses and occupation

As the biggest groups are students and all year round fish consumption is higher for them than other groups, while for housekeepers, one of the most important groups, the level is less than half of that for students. Overall, all year round fish consumption of students is more than the national average, in employees and free-job workers it is similar, but for housekeepers it is almost two-thirds of the national average. Since housekeepers mostly have low educational level and are more significant in S Tehran, these factors may affect seasonal consumption.

Since students liked fillet and claimed for inadequate familiarity, suggesting that demand for these groups may increase over coming years. Income rise and price decline might be expected to affect demand more positively for employees than for other groups. Overall, the relationships between job and carp consumption with response to increase supply, income rise and price decline is insignificant, and so these will have a negligible effect across categories.

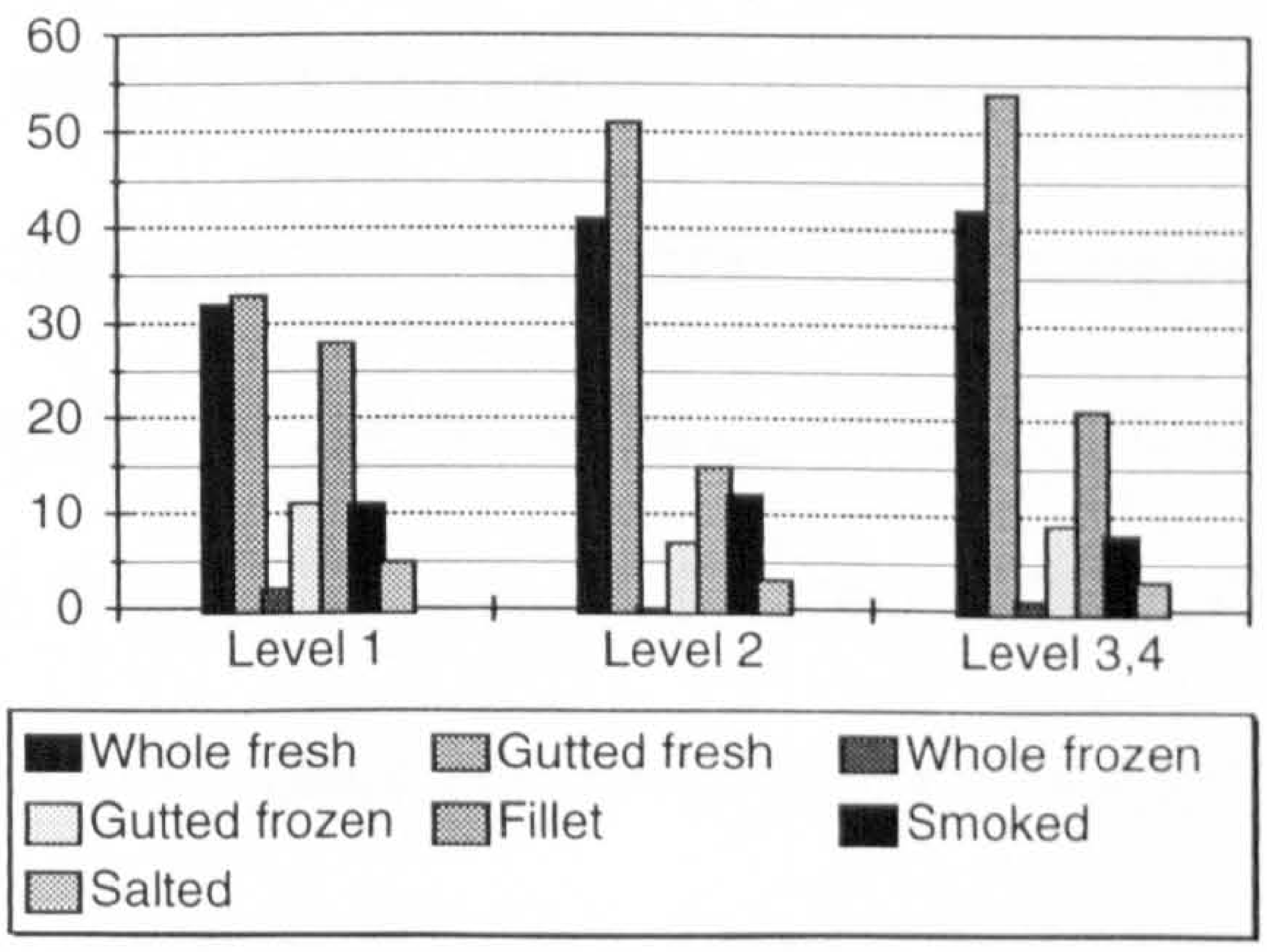
5.3.5 The role of educational level

Five categories were used; illiterate (level 0), students or those who did not finish high school, known as below diploma (level 1), diploma (level 2), bachelor degrees (level 3) and postgraduate qualifications (level 4). In the sample, 69% had less than bachelor degree, of which 29% had level 2, 38% were level 1 and less than 2% were level 0. At higher education levels, more than 25% had level 3 and 6% had level 4. Educational level analyses appears to be important and might be expected to have a notable impact, though, there are may linkages between levels 3+4, employment, and living in N of Tehran, which will be discussed later. However, upper levels (3+4) might be expected to increase in coming years and may positively affect demand.

Form of cultured carp

As in other analyses, all categories[68] show a great preference for fresh fish and all liked gutted fresh over whole fresh (Figure 5.19). With increased educational level the percentage share of both whole fresh and gutted fresh increases, the standard error of a proportion (SE_p)[69], for whole fresh in level 2 and 3+4 is 4.9% and for gutted fresh in both groups are 4.8%. Level 1 group liked whole frozen and fillet forms more than other groups. There is a little difference in smoked form consumption among the groups, though it was better liked by levels 1 and 2. Choice for salted form declines as educational level increases. Overall, in literate groups, there is a significant relationship between educational level and chosen forms of carp products. Between 16% to 29% of the respondents liked multiple forms of cultured carp. 40%, 40% and 20% of level 0 respondents liked whole fresh, gutted fresh and whole frozen fish respectively.

Figure 5.19: Processed cultured carp consumption at difference educational levels (%).

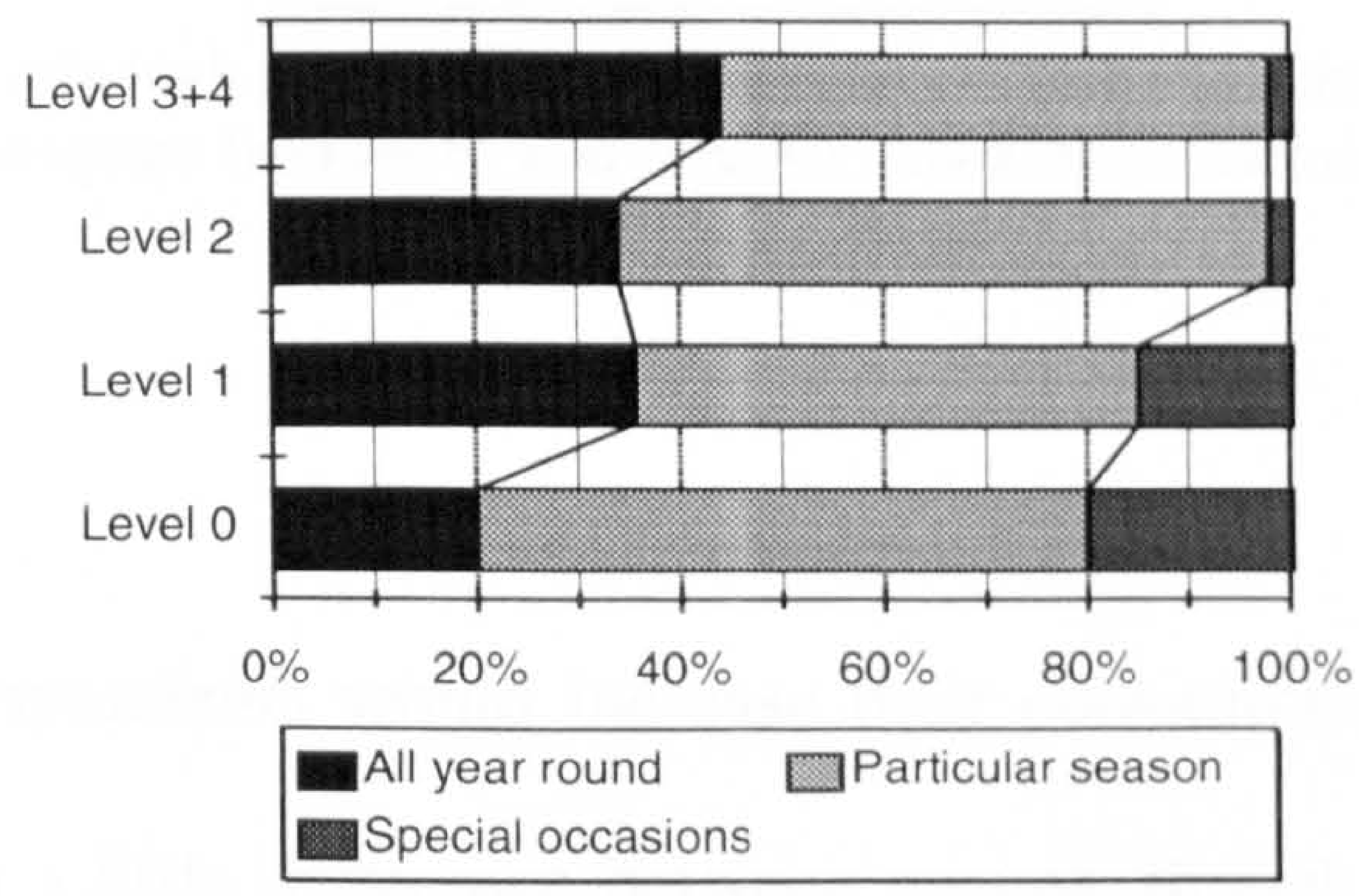


Seasonality

There is a notable difference between educational level fish consumption period. 62% of the group level 4 consume fish all year round, compared with an average of 35% for levels 1 and 2 respondents, declining to only 20% for level 0. While only 2 % of levels

2, 3 and 4 consume fish on special occasions, 15% of the level 1 and 20% of the level 0 do so (Figure 5.20). Since more than 55% of national population is <25 years old and students contain almost one-third of the population, and the share of educated level is increasing, this suggests that year round fish consumption may be increased in future.

Figure 5.20: Seasonality of fish consumption in different educational levels.



Negative features of cultured carp

Some 63% of level 2 respondents dislike taste of cultured carp, declining to 48% and 57% for level 1 and levels 3+4 respectively. As the level of education increase the importance of lack of access to safe and suitable fish also increases (from 0% at level 0 to 37% at level 3, and 50% at level 4). Inadequate familiarity with carp declines, with educational level (from 50% at level 0 to 14% for the others); with no notable difference between levels 2, 3 and 4. Cooking problems were a factor for 10% of level 1, but on average only 4% for levels 2, 3 and 4 (Figure 5.21). Among the four illiterate respondents 50% claimed taste and flavour and 50% claimed inadequate familiarity with carp. As educational level are increasing in Iran, reduced prices and improved handling and marketing facilities may positively affect demand for carp products in future.

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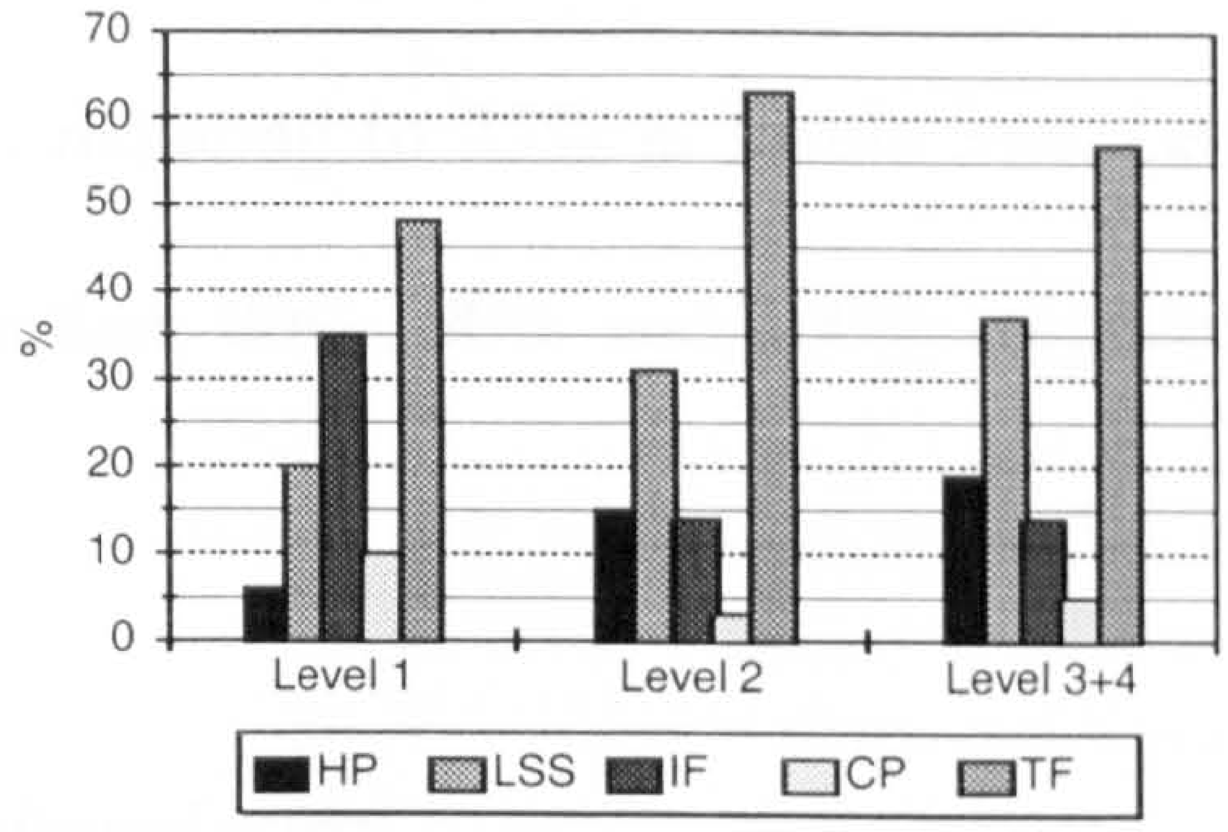
[68] - The number of illiterate respondents are few, so the situation of this group is discussed separately.
[69] - p: Percentage of respondents who choose fresh fish.

Figure 5.21: Reasons against carp as a top priority by educational levels (%).



HP: Relatively high price, LSS: Lack of access to safe and suitable fish,
IF: Inadequate familiarity with carp, CP: cooking problems, and
TF: Taste and flavour

Role of supply increase

Level 1, 2 and 3+4 respondents would increase their consumption by 36%, 44% and 48% respectively, with a little difference between groups, though, the effect is slightly positive with increasing educational level.

Role of income rise

Levels 1, 2 and 3+4 respondents would increase their consumption 51%, 52%, and 56% respectively, positive with increasing educational level, but with negligible difference between groups. The effect of income rise in increased consumption is greater than supply increase in all educational groups. Only 37% at levels 3+4 would not change their consumption habit, increasing to 43% and 47% for levels 1 and 2 respectively. Here it appears that income rise especially for educated groups may increase carp consumption over coming years.

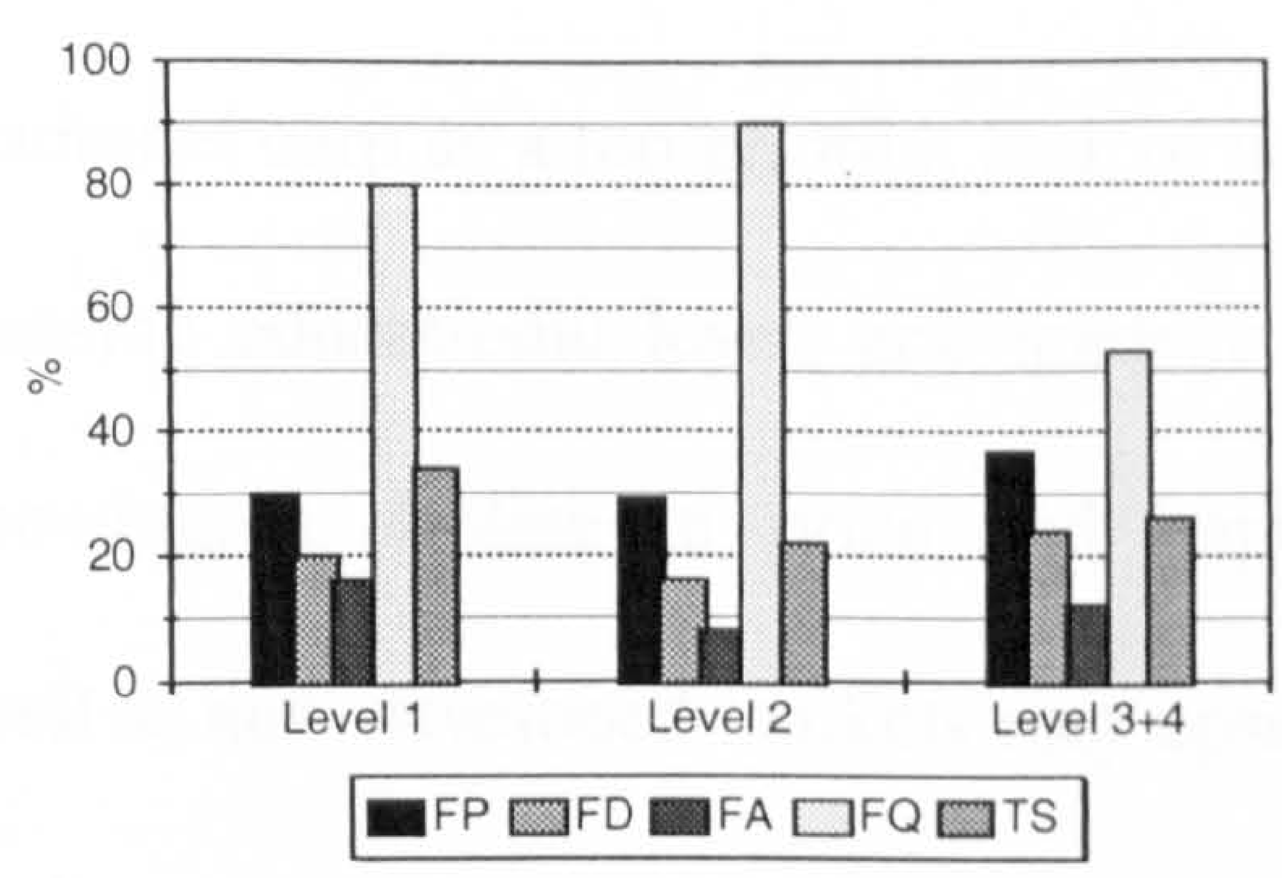
Role of price decline

Levels 1, 2 and 3+4 respondents would increase their consumption by 54%, 61% and 68% respectively, showing a positive though, statistically insignificant affect with increasing educational level. The effect is greater than income rise and supply increase in all educational groups. On average 35% of levels 1 and 2 groups would not change their consumption habit , reducing to 25% at levels 3+4. Level 0 for supply increase, income rise and price decline, 80%, 80% and 100% respectively would increase their consumption.

Factors in purchasing cultured carp

As in other groupings fish quality is a significant factor, from almost 53% at levels 3+4 to 90% at level 2. 37% of the levels 3+4 respondents consider price of fish, but this declines on average to almost 30% for levels 1 and 2 groups.

Figure 5.22: Factors in purchasing carp with educational levels (%).



FP: Fish price, FD: Fish delivery form, FA: Fish appearance,
FQ: Fish quality, and TS: Trust in the seller

As shown in Figure 5.22, level 1 respondents consider fish appearance more than other groups, followed by levels 3 and 4 who note fish delivery more than others, followed by level 1 groups. Level 1 respondents consider trust in the seller more than others, followed by levels 3 and 4 respondents. On average, only 46% of level 1 and 2 respondents offer multiple reasons, but this increases to 84% at levels 3 and 4 groups. The contribution of educated groups who consider more than one factor in purchasing decisions is higher than other levels. At level 0, 80%, 40% and 20% identify quality, price and trust in the seller, but none consider appearance or delivery forms.

An overall assessment of relationships between carp consumption behaviour and educational level

Year round fish consumption for level 4 group is double that for national average consumption, but for levels 1 and 2 are similar to national average. The figure for the illiterate group is almost half of that for national average, indicating significant increases with increasing educational levels. However, this is almost conversely related to age and relates to the employee' class mostly similar to levels 2 and 3. Since, Iran is developing and educational level will be increased over coming years, might be expected, year round consumption might also be increased in future.

In negative response to cultured carp as a top priority, lack of access to safe and suitable fish increases with increasing educational level, and inadequate familiarity with carp declines conversely, showing, a decline in price and improvement handling and marketing facilities, as well as new developed markets may upset these negative aspects, particularly for upper levels.

It was found, with increased educational level, the percentage share of both whole and gutted fresh increases, and choice of salted form declines, suggesting, potential demand for added-value products.

The effect of supply increase, income rise and price decline are positively related with increasing educational level. The relationships between educational levels and "supply increase, income rise" to increase carp consumption, is found insignificant, but price decline is significant. This suggests that economic growth which increase per capita earning, new production technologies which increase supply and reduce production costs may all contribute to expanded future demand.

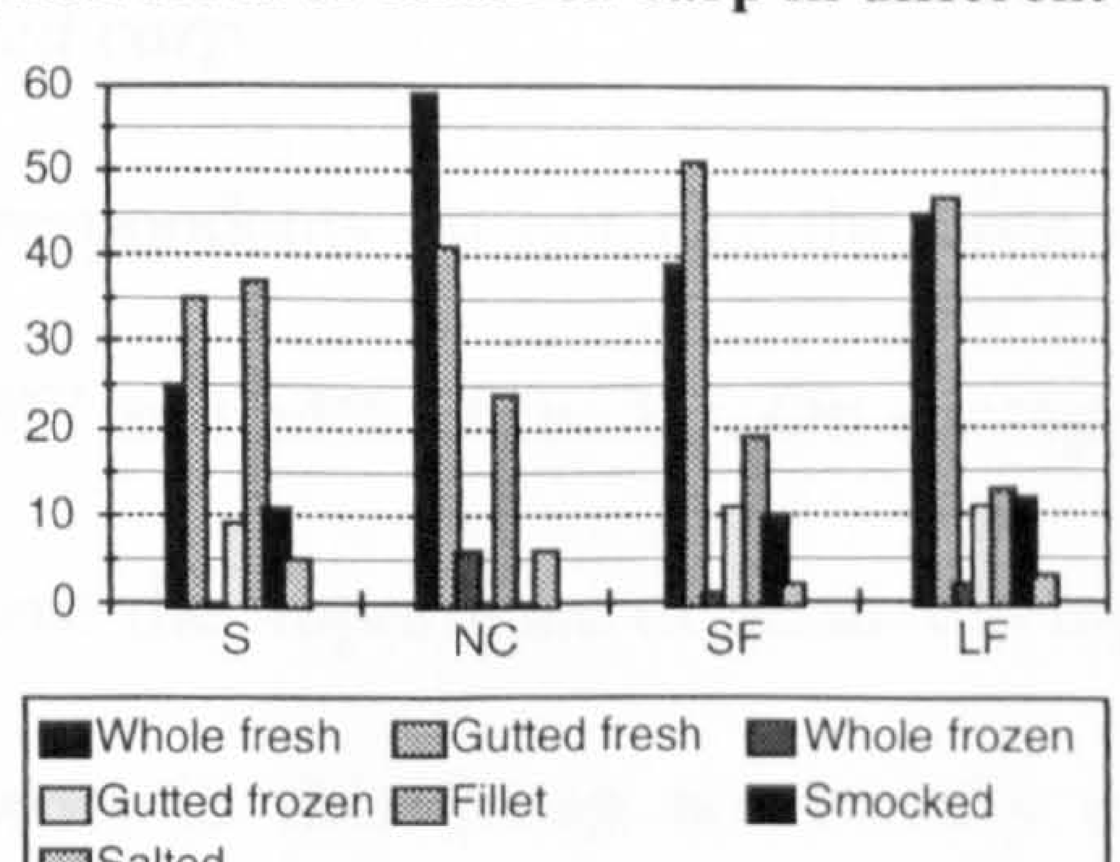
5.3.6 The role of family status

The sampled population included 52% married with SF, 35% LF, 7% single (excluding students who usually live with their families) and 6% NC. The relationships between consumer responses in carp consumption behaviour and household status are as follows.

Form of cultured carp

All consumers have a significant preference for fresh fish, and except for the NC, gutted fresh is preferred. As Figure 5.23 shows, 41%, 51%, and 47% of the NC, SF, and LF like gutted fresh respectively, increasing to 60% of the single[70] group. Thus compares with a preference for whole fresh by 59%, 39%, and 45% of the NC, SF, and LF respectively, declining to 30% of the single group. only 6% of the NC and 1% of the SF like whole frozen, and none of the others, while 24% of the NC and 19% of the SF respondents like filleted product, declining to 12% in other groups. Except for single respondents, as household size increases, preference for filleted product decreases. On average, 10% of SF and LF respondents like gutted frozen; 5% of the single group and none of NC do so. Except for NC respondents, 10% of other groups like the smoked form.

Figure 5.23: Consumption form of cultured carp in different household groups (%).



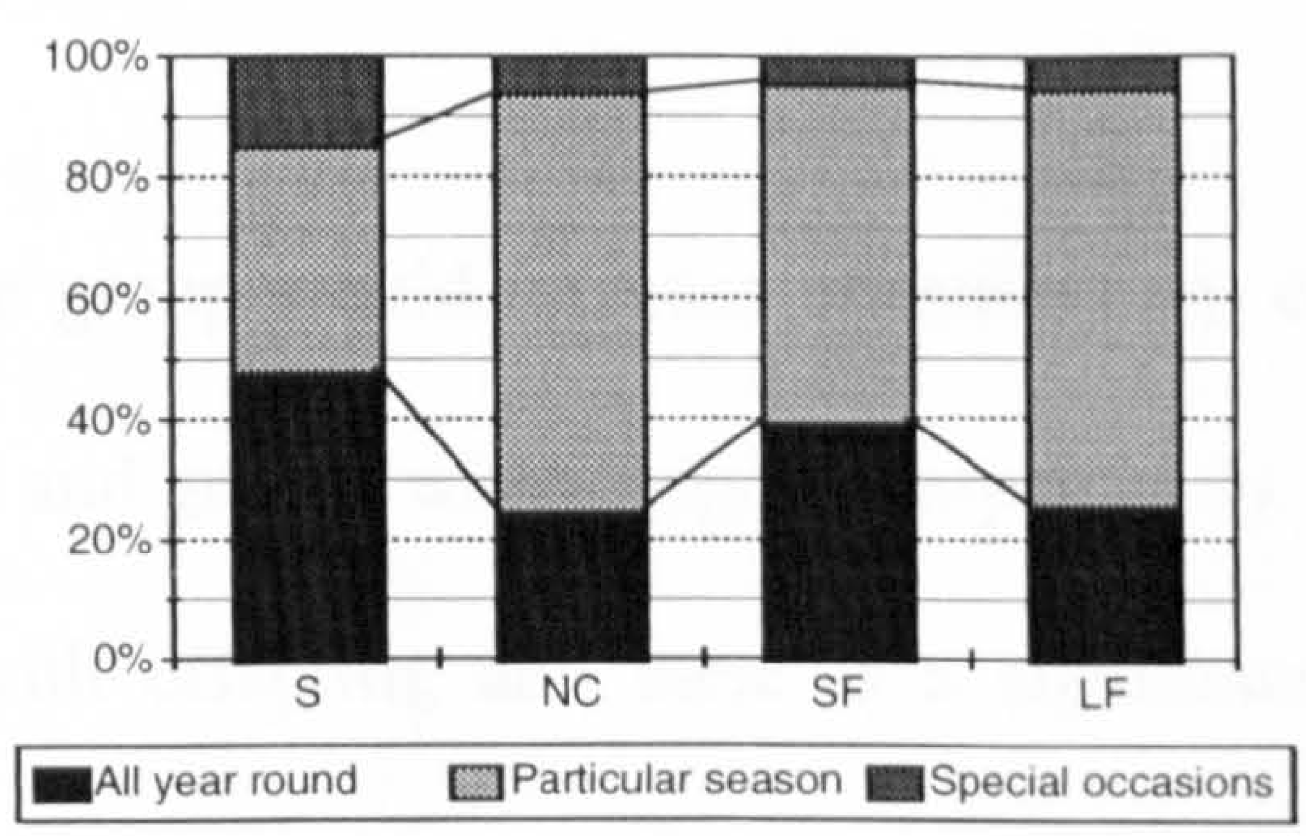
S: Single, NC: No children, SF: Small family, and LF: Large family.

[70] - Single group excluding students, because students usually live with their families.

Seasonality

As Figure 5.24 shows, 47% of single respondents and 40% of the SF consume fish all year round, declining to an average ~25% of the other groups. 47% of the single respondents consume fish in particular seasons, increasing to 56%, 69% and 69% of the SF, NC and LF groups respectively. A notable difference occurs between the two SF and LF groups; when the number of children increases, all year round consumption decreases and seasonal use increases. This result might be expected to relate with educational level and location, in which LF are less educated and more likely to be living in S Tehran.

Figure 5.24: Seasonality of fish consumption in different household groups.

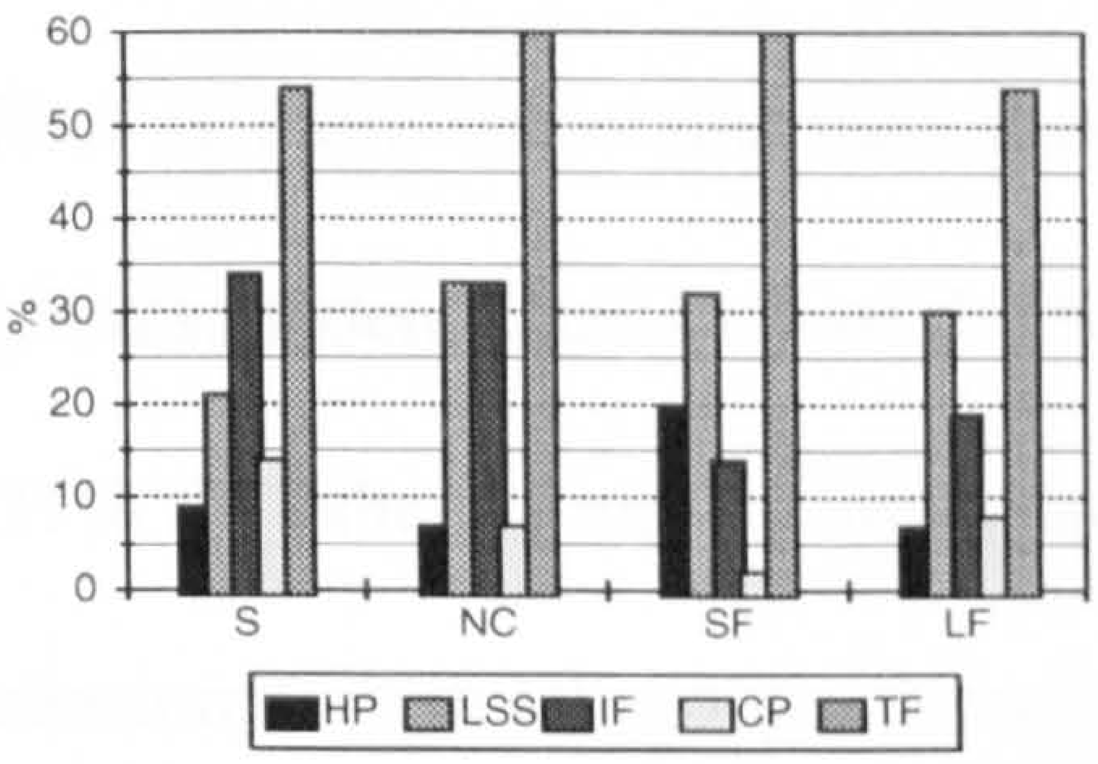


S: Single, NC: Married childless, SF: Married with less than 3 offspring, and LF: Married with 3 and more offspring.

Negative features of cultured carp

A total of 71% of single respondents do not like the taste of cultured carp, compared with 60% of the 'NC and SF' and 54% of the LF. On average, 10% of the 'single group, NC and LF' respondents note the importance of relatively high price, increasing to 20% of the SF (most respondents in this group are usually employees). 24% of single respondents claimed lack of access to safe and suitable fish, increasing to an average 32% for the others. Inadequate familiarity with fish decreases from 34% of the NC groups to 16% of groups with offspring and 4% of the single respondents. 12% of single respondents claimed cooking problems, compared with only 2% of the SF group (Figure 5.25).

Figure 5.25: Reasons for disliking carp as a top priority among household groups.



S: Single, NC: No children, SF: Small family,
and LF: Large family.
HP: Relatively high price, LSS: Lack of access to safe and suitable fish,
IF: Inadequate familiarity with carp, CP: cooking problems, and
TF: Taste and flavour

Role of supply increase

Here, 30% of the single group would increase consumption, compared with 32% and 51% of NC respondents and groups with offspring respectively. Thus, the effect is more important for groups with offspring and there is a significant relationships between family status and consumption response. It is expected that the expansion of carp markets will positively influence demand, especially for families with offspring.

Role of income rise

In this case, 50% of the single group would increase consumption, compared with 41% and 59% of NC and groups with offspring respectively, showing the greater importance in increasing carp consumption amongst groups with offspring. Only 37% of groups with offspring would not change their consumption, increasing to almost 47% of the two other groups. A rise in income may affect carp consumption in all family status levels, especially households with offspring, almost 85% of the national population.

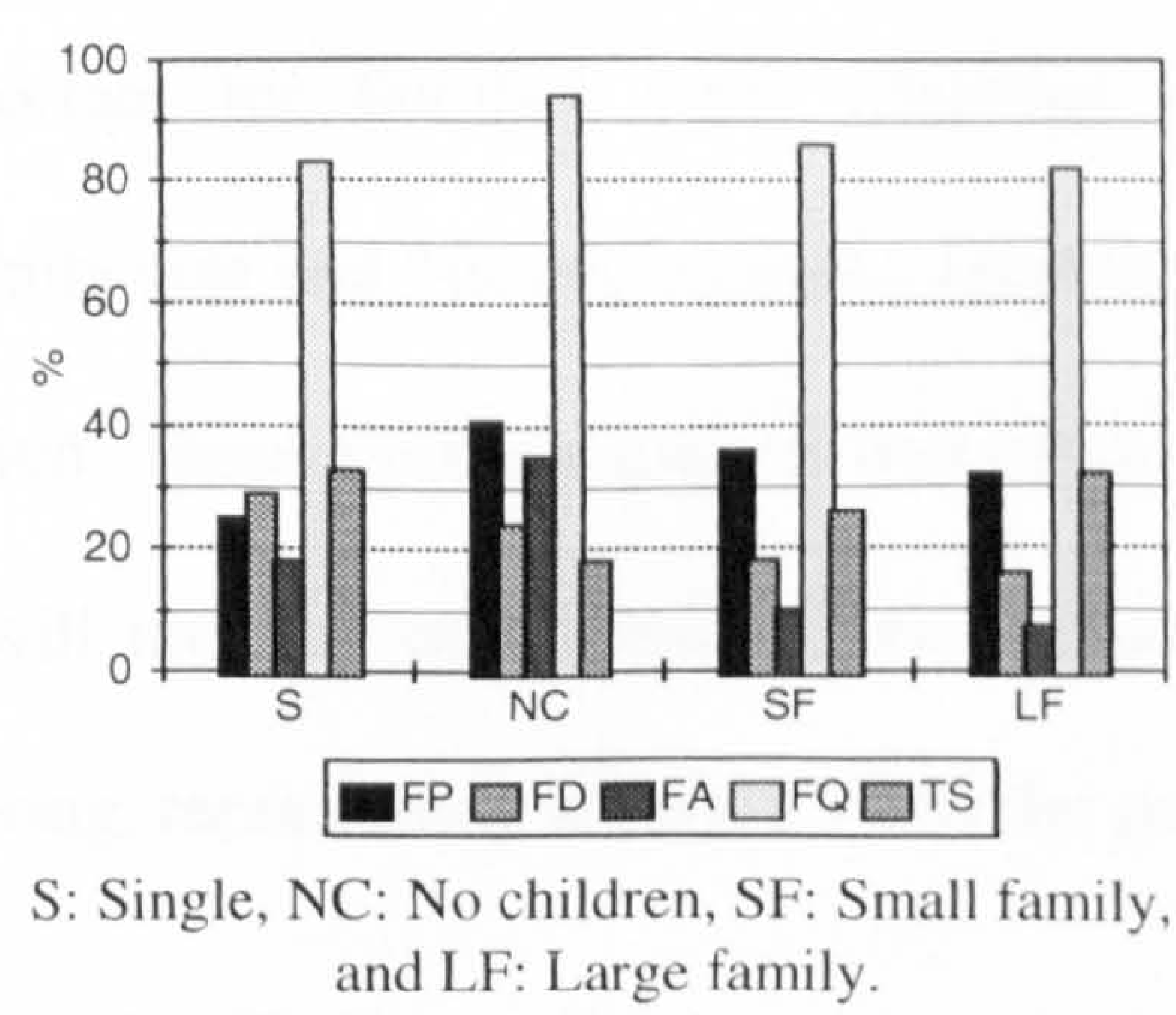
Role of price decline

Of the single group 60% would increase consumption, compared with 47% and 69% of NC respondents and groups with offspring respectively. The effect of price decline is more important for groups with offspring, there is a significant relationship with family status, and the potential effect is more important than that of income rise or supply increase. Some 30% of single respondents and 41% of the NC group would not change consumption, declining to 27% for other groups. A reduction in price would appear to significantly increase carp consumption in all groups, especially families with offspring, 70% of whom are ready to increase their consumption.

Factors in purchasing cultured carp

As before fish quality is most significant at an average of almost 82% of the LF group, increasing to 94% of the NC. Except for single respondents, price, delivery form, appearance and quality factors decline in importance as the number of family increases. Except for single respondents, trust in the seller as a factor increases in importance with household size. Overall, the difference between households with offspring on purchasing decisions is negligible (Figure 5.26).

Figure 5.26: Factors in purchasing carp with household status.



S: Single, NC: No children, SF: Small family, and LF: Large family.
FP: Fish price, FD: Fish delivery form, FA: Fish appearance, FQ: Fish quality, and TS: Trust in the seller

An overall assessment of relationships between consumer responses and family status

Year round fish consumption for single group is more than national average, for NC and LF less than national average, but for SF similar to national average. As the number of children increases, year round consumption decreases and seasonal use increases, which appears to be related to more supply, cheaper and traditional purchasing in seasonal for LF. As noted before, respondents with LF were mainly older, less well educated and lived in S Tehran, though it seems all these factors affected on all year round consumption in this group.

All married groups were found to have a significant preference for fresh fish, and as household size increases, the share of filleted product decreases. This appears to be related to age, education and location, where LF are mainly older, less educated and live in the S. However, the difference between LF and SF for gutted fresh is negligible.

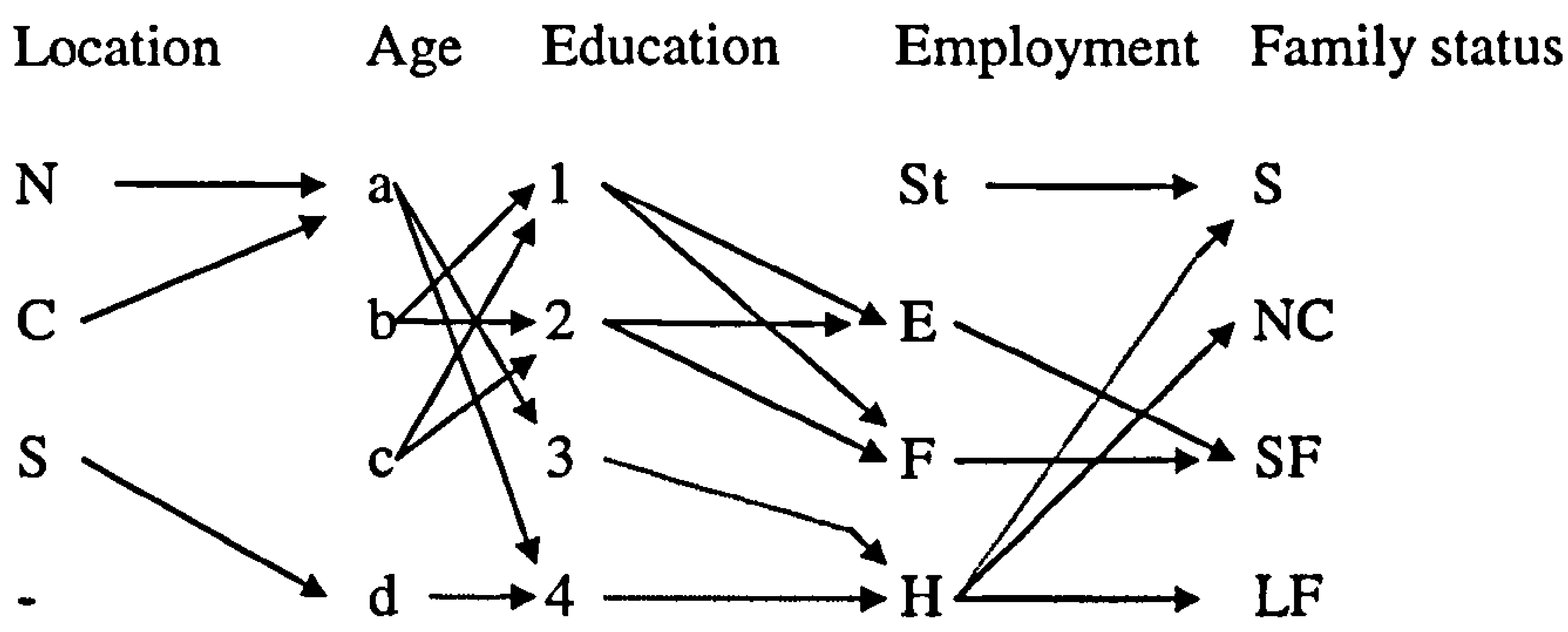
In terms of choice against carp, the factor of taste, declines as household size increases. this may be related to traditional serving, single respondents claiming cooking problems, however, the difference between LF and SF is negligible.

Among the married groups, the potential effect of supply increase, income rise and price decline are more important for families with offspring, and there is a positive relationship between family size and "supply increase, income rise and price decline" to increase carp consumption. These findings suggest that expanding supply and reducing the real price of carp will increase consumption, and decline in price will especially affect groups with offspring, representing almost 85% of the population.

5.4 Overview of relationships between consumer characteristics and carp consumption behaviour

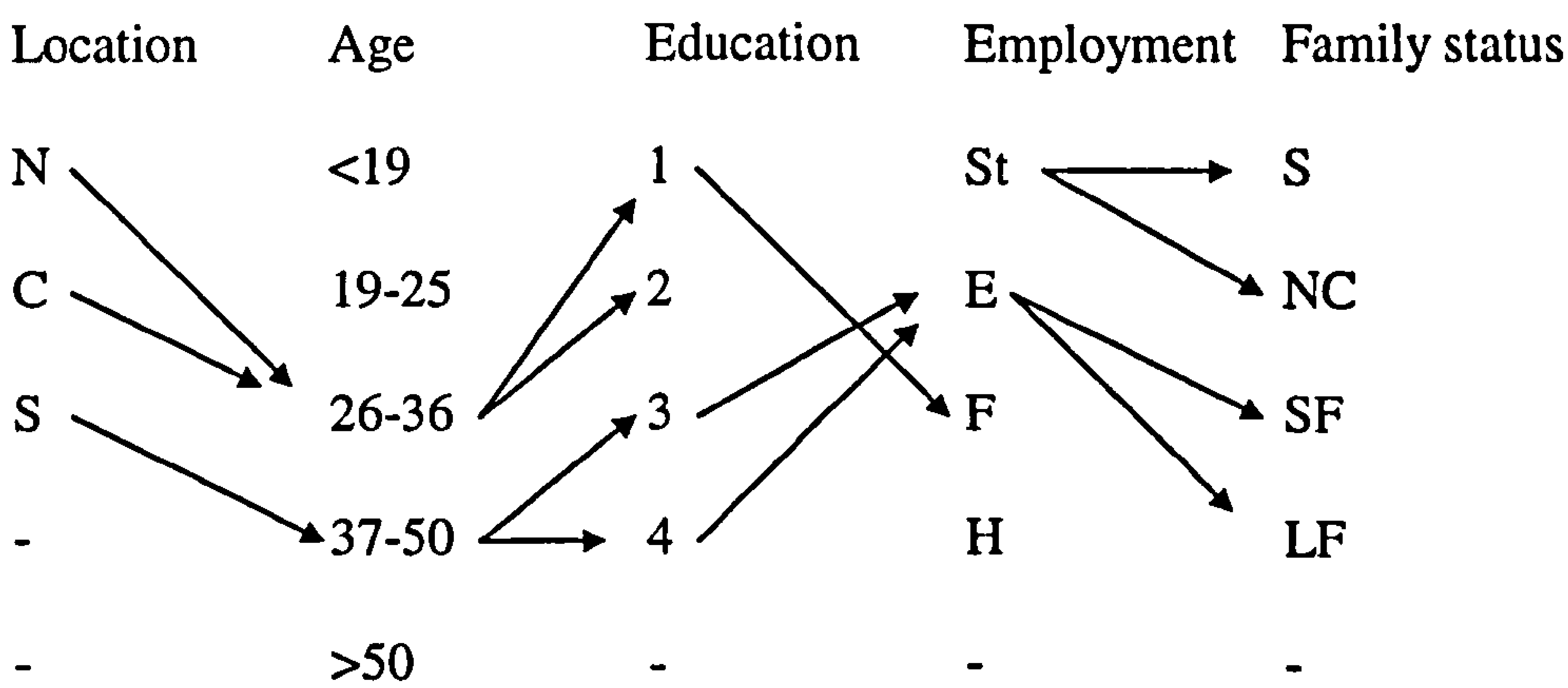
The relationships between consumer characteristics and carp consumption behaviour were analysed in this chapter. In this last section overall result is briefly addressed.

(1) Positive linkages on year round consumption between groups



a: <25, b: 26-36, c: 37-50, d: >50 and St: student, E: employee,
F: free-job, H: housekeeper

(2) Positive linkages on supply increase, income rise and price decline between groups



(3) Key features of preferences

Major groups	Prefer	% of population
young, single	fillet, ready meal	~>50% (~25% <10 years old)
educated, middle age, small family	lower price, safety products, high quality	~<35%
old, large family	lower price, fresh, increased supply	except children ~15%

As shown, the younger group is the largest, with preferences for ready meals and demand for a variety of products. In coming years, the education level of this group will increase, and increased supply and improved quality of products appears to be more attractive for this group. To increase carp consumption a rise in income and decline in price of carp product will affect more older groups, larger sized families and educated people. The study also showed, that in present conditions, with only supply increase to increase consumption, the difference between educational levels, family status, job groups, and location is insignificant. Except for students, it was found, the effect of job on consumption behaviour is also insignificant. The difference between locations (which related to social-economic, different aspects such as income, educational level, job and family status) is significant, though, this difference may be expected to affect seasonality of consumption and increased consumption with a rise in income and price decline. Overall, increases the variety of product in markets, a rise in income and price decline may increase all year round fish consumption.

Chapter six

6. Development prospects of carp farming industry: A sector perspective

6.1 Introduction

As noted earlier, the share of aquaculture and inland fisheries (of which carp represents more than 95%) to total fishery production increased from 8% in 1982 to almost 15% in 1995. As a result, apparent aquaculture consumption increased from 0.15 kg head^{-1} yr^{-1} to 0.83 kg and its share in total aquatic food consumption increased from 6.5% to 19%. The extent to which carp culture in Iran will meet the demand for low cost produce, and be able to expand into larger markets is a critical issue for development. If carp culture is to develop, and meet market demands, the underlying features of production and consumption need to be understood in conjunction.

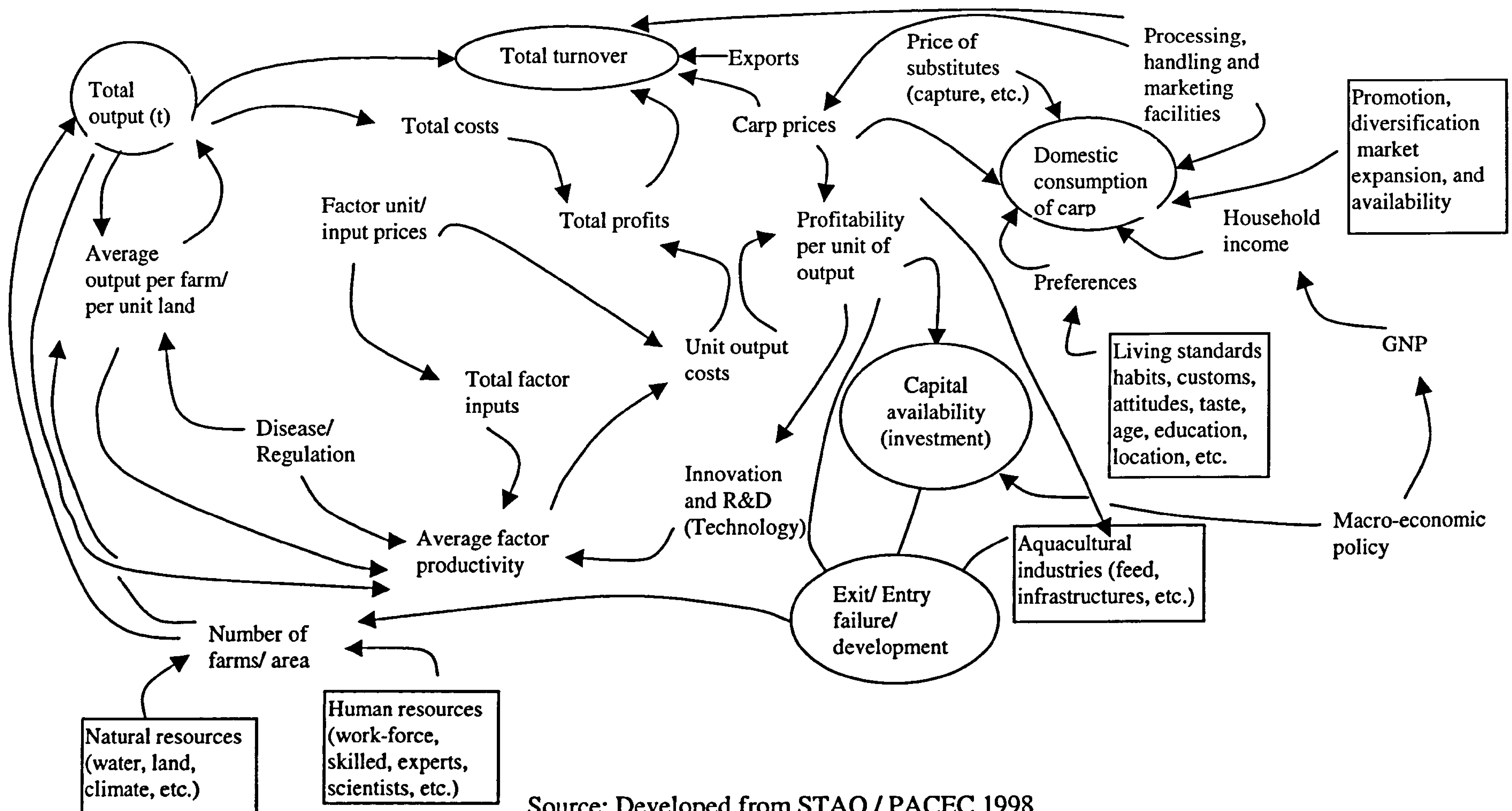
As for any other aquacultural activity, to produce carp requires primary resources including; land, water, ecosystem, capital and human resources, secondary resources including; feed and fertiliser, seed, energy (fuel-based) and technology products and tertiary resources including developed science and technology. Where natural resources are available, the role of investment in construction and early operational needs is significant, though for future develop, investment for support facilities and infrastructure for activities such as training, extension services and R&D is also important.

Opportunities for investment will depend basically on the margins available between production costs and market prices. Thus, if there is a sufficient market for carp products, offering sufficient margins to offset risks of production will encourage investment and accommodate resources within the sector. However, though such opportunities are a primary requirement for further development, there must be investment available to respond to these opportunities, which depends on economic growth, as well as policy support to provide investment security to reduce various risks and to provide sectoral capacity for evolution and further improvement. The strength of this system, together with national resources might also be an important indicator of the potential for the development of carp aquaculture.

Macro-economic factors such as demographic change, economic growth, disposable income and its distribution will affect the market for carp and its future development. A conceptual framework for the carp culture sector is shown in Figure 6.1, linking the cost of production and its inputs, market margins, market expansion and domestic demand. It appears that existing markets for carp products currently provide a certain trend of expansion, with suitable natural conditions in many areas. As chapter 4 suggests, existing levels of production also appear to be profitable. However, future expansion will depend on market demand and its market margin, which will enable the industry to develop and compete with other activities.

The primary basis for increased demand is associated with population and economic growth, while other factors such as the growth in urbanisation will affect market forms and product distribution. However, as noted in chapter 5, the specific capacity for markets to be developed is related to the purchasing power of different society groups, their preferences, and their purchasing behaviour in response to features such as availability, quality, price, and the extent of product diversification. Purchasing power will depend on the national income or *per capita* income, income distribution and the cost of other essential needs.

Figure 6.1: Conceptual framework for the carp farming sector, in Iran.



Source: Developed from STAQ / PACEC 1998

As noted in chapter 1, *per capita* income is growing and expenditure on fish products has changed. The Gini coefficient declined from 0.65 in 1982 to 0.48 in 1993 in urban areas and from 0.46 to 0.33 in rural areas, over the same period (SCI, 1996 *op.cit*). The contribution of fish products to animal and total proteins consumption has also increased, particularly in urban areas.

While market demand needs to be defined, the selection of suitable locations and technologies, the use of economies of scale, and technical change may lead to significant change in resource use efficiency, and the control or reduction of production cost. In particular, cost of production could be reduced significantly if prices of feed were reduced and/or if labour could be more effectively utilised. The impact of such technical change would need to be understood.

The main aim of this chapter is therefore been to derive a general perspective on cultured carp production activity in Iran, and in particular to:

1 - consider the strategic determinants of demand and identify the possible range of demand based on demographic and economic projections.

2 - review the cultured carp production sector and its support, and determine potential costs of production with respect to expanding output.

3 - combine the results of marketing analysis and farming system survey to determine the potential characteristics and directions of the future development and to consider how, production and markets might be most efficiently developed.

4 - based on market preference data, to identify where and how the carp products, may be positioned, and how product attributes, including price of the carp products might be placed.

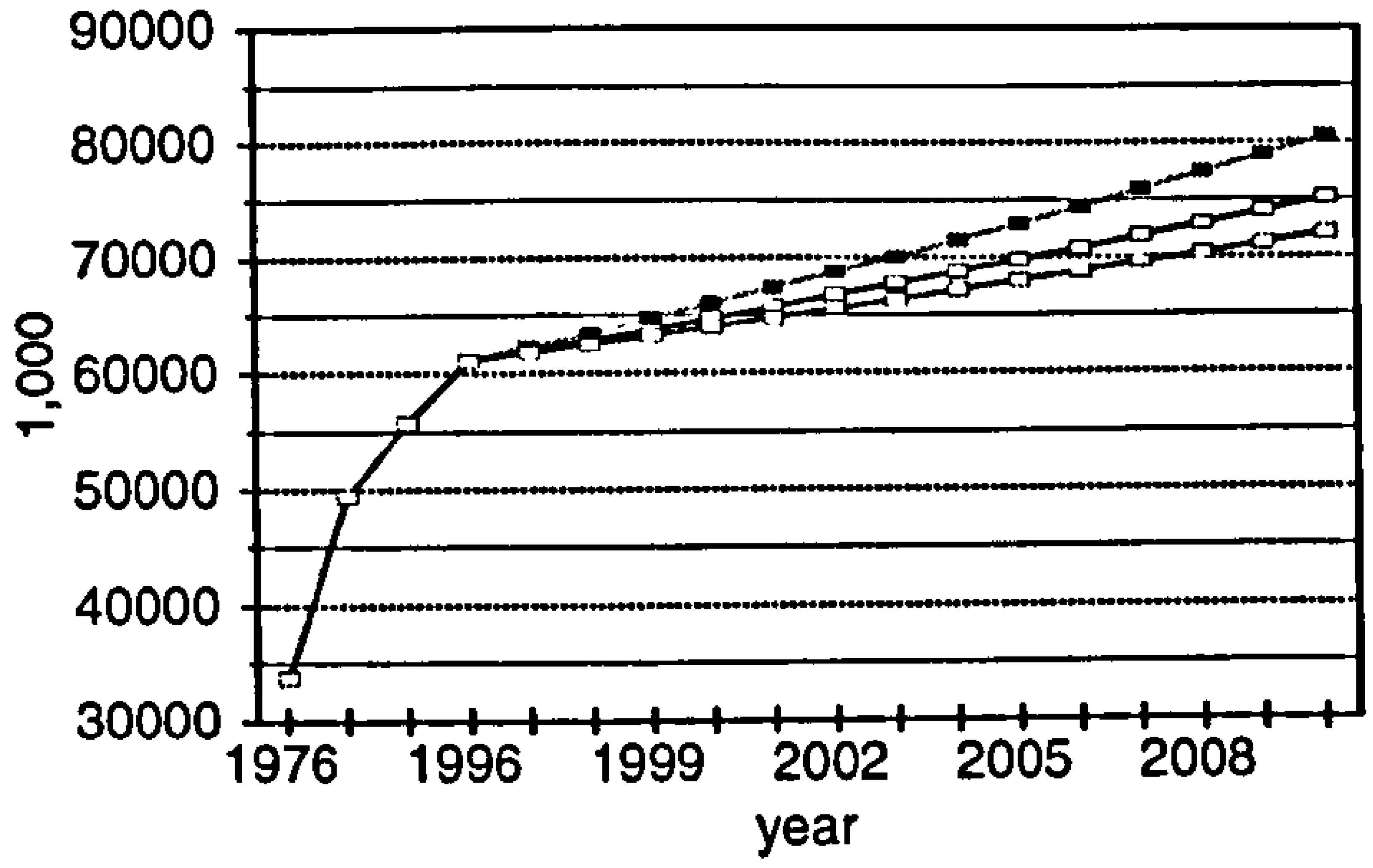
6.2 Strategic issues

This section contains a brief description of strategic issues related to demand of carp products including population estimates, fish demand based on present consumption and changing patterns of fish consumption. The potential effect of income growth and potential implications with differing regional population are also addressed. A series of scenarios is developed to present the potential impact of various changes in demographic and economic factors on the potential level of demand for carp.

Population trends

Iran has a population of about 61 million in 1996, of which 61% had, lived in urban areas, with a significant migration to urban areas over the last decade. Key social developments have been rapid urbanisation, changing (and increasing) job opportunities, and better living standards and facilities in urban areas, which have caused a strong migration, especially to Tehran and its surrounding cities. Though UNDP (1994 *op.cit*) estimate a 3% annual population growth rate, Haghy (1997 *op.cit*) notes a decline in 1996 to almost 1.5%, from 3.8% in 1993 (World Bank, 1995 *op.cit*). Projections for year 2010 suggest a population of some 73 to 81 million, of which, urban population may be estimated at 53-59 million (developed from SCI, 1997 *op.cit*). Based on the results of the FFYDP and SFYDP (Akbary, 1997, SCI, 1997 *op.cit* and Haghy 1997, *op.cit*), three alternatives of population growth (based on an average 1.2%, 1.5% and 2% annual growth rate) are shown in Figure 6.2.

Figure 6.2: Alternative population growth scenarios by 2010 in Iran.



Source: developed from SCI, 1997 *op.cit*, Akbary, 1997 *op.cit* and Haghy, 1997 *op.cit.*

Demand based on present fish consumption

As noted in chapter 3, in 1993, fishery products represented 26% of total meat production, a gradually rising trend. However, for expansion red meat and poultry production, options are rather limited, and so overall supply from fisheries may become more important. The supply of fishery products mainly comes from domestic[71] production (382,000 t in 1995), of which the Persian Gulf and Oman Sea accounted for 63%, the Caspian Sea 15%, aquaculture and inland fisheries ~15% with the balance from international waters[72]. Only three strategies might be directly feasible for expanding edible fish supply from capture fisheries.

[71] - According to Shilat (1999), total domestic production was ~400,000 t by 1997, of which aquaculture and inland fisheries represent 16%, the Caspian Sea 19% , the Persian Gulf and Sea of Oman 60% and the balance from international waters.

[72] - In 1995, total Caspian Sea supply was estimated at 58,300 t, of which 27% were bony fish, more than 70% kilka (of which almost 95% were used for fishmeal), and the balance sturgeon. Except for kilka and other low value species, no significant increases are expected in the future. In the Persian Gulf and Sea of Oman, total fish and shellfish supply was estimated at 265,000 t, of which 40% were demersal fish, 22% other fish (such as cuttlefish, shark, hair tail, etc.), 34% large pelagic, and the balance 'small pelagic and mesopelagic' (mainly used for fishmeal)'; except the last two groups no significant increases are anticipated in the future.

• increased fishing effort on under-utilised stocks such as kilka and small pelagics, currently used for fishmeal, with a target share of human consumption growing by almost 15-25,000 t by 2010 (~ 2,500 t in 1995).

• improved management of existing stocks, particularly for demersal fish in the Persian Gulf and sturgeon and bony fish in the Caspian Sea, and to improve management, modernisation of fleet in the Sea of Oman and increase catch for large pelagic tuna.

• increase productivity of existing capture supply (mostly at the post-harvest level), especially in the South.

However, even if these measures are effective, their effect in meeting increasing demand would be negligible, and aquaculture may need to become a significant additional source of supplies.

As noted earlier, in 1995, apparent fish consumption was estimated at 4.5 kg head^{-1} yr^{-1}, of which almost 0.9 kg came from culture-based carp products, which increased 7% annually[73] over the 1988-95 period.

[73] - As noted earlier, in 1995, domestic production from aquaculture and inland fisheries (mostly culture-based production of carp) is estimated at 52,980 t, of which 47% derives from open-water bodies and 51% from carp farming, the balance being rainbow trout farming (Aquaculture Department, 1997 *op.cit*). The annual growth rate of the sub-sector was < 3% over the FFYDP (1988-93), (based on effects of privatisation, subsidy elimination, input cost inflation and a decline in the real wholesale price of carp). However, based on governmental investment in the sector over the FFYDP, average annual growth rate of

Table 6.1: Apparent fish and carp demand based on present consumption level by 2010.

Factor	1995	2010
Per capita demand (kg)	4.5	
Estimated population (m)	60	73 - 81
Therefore total edible fish demand (t)	270,000	328,500 - 364,500
Expected supply from capture sector (t)	217,000	250,000
Therefore potential demand for aquaculture (t)	~53,000	78,500 - 114,500
Expected demand for carp (98% of present aquaculture production) (t)	~52,000	76,900 - 112,200 (or 85,750 t based on 75 m population)
Expected *per capita* carp consumption (kg)	~ 0.9	1.05 - 1.35

Source: production; developed from CDSD, 1997[a] *op.cit*), population; Figure 6.2.

Table 6.1 provides an outline of potential demand for carp based on current consumption levels and continuing similar % levels of carp production in total aquaculture production. As shows, demand for carp is estimated at 76,900-112,200 t by 2010. Though, based on this trend, total demand for carp product may be estimated at ~85,750 or 1.14 kg head^{-1} yr^{-1} by 2010, based on 75 m population. However, fish consumption patterns may also change over the coming years, and may in turn affect future consumption levels and potential demand for carp.

Demand based on changing patterns of fish consumption

Differences in consumption patterns between regions, educational levels, age groups, family status, and social traditions have an impact not only on total demand, but also on *per capita* demand. In Iran, markets for carp products are still seasonal, partly reflecting traditional availability, and may impose important production constraints. However, an increasing number of products may be supplied in different forms throughout a wider period of the year, and the effect of the younger generation, increasing educational

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the sub-sector was increased at ~10% over the 1994-95 period, and elementary result show that, average annual growth rate of the sub-sector increased at almost 9% over the 1995-98 period (Shilat 1999, *op.cit*).

levels, product diversification, market development and expansion, technology effects, increased quality and performance, and an increase in convenience products may offset such constraints.

It may also establish or develop in inland provinces, where latent demand exists, even if only as occasional items of consumption. The increased role of women in the work force and the general trends of urbanisation (particularly, as most if not all the expanded population is expected to be in urban areas) may also increase demand for carp and its products, in traditional domestic supply, in convenience foods and in the catering sector.

As Table 6.2 shows, *per capita* carp consumption has increased[74] on average by 7% per annum over the 1988-95 period, and if this rate of change continues in coming years, total carp production might be expected to increase to ~144,000 t by 2010 (1.9 kg head^{-1} yr^{-1}). However, based on the above mentioned trends *per capita* demand for carp product may be conservatively estimated at around 2.2-2.9 kg head^{-1} yr^{-1} by 2010, and based on 75 m population, a quantity of 165,000 - 217,000 t yr^{-1}.

Table 6.2: General pattern of carp consumption development.

	1974	1982	1986	1995	average estimation by 2010
Population (m)	32	43	49	60	75
Carp production (%age of total fishery products)	1,600 (5%)	6,000 (7%)	11,500 (9%)	52,000 (14%)	165,000 -217,000 (40-46%)
Consumption kg head^{-1} yr^{-1} (%age of total edible fish)	0.05 (2.6%)	0.14 (6.3%)	0.23 (8%)	0.9 (19%)	2.2-2.9 (40-46%)

Potential implications of differing regional populations

Fish consumption has been found earlier to range widely between as little as 0.2 kg in W-Azarbiajan to 35.5 kg head^{-1} yr^{-1} in Hormozgan province, with consumption in the N

[74] - Increased 180% over the years 1974-82, 64% over the 1982-86, 291% over the 1986-95 (overall, 15% annual growth over the 1974-95), and ~4% growth over the FFYDP and 12% growth in 1995, (overall, 7% annual growth over the 1988-95, and 9% over the 1995-98) though it seems, 8-10% annual growth over the coming years is potentially achievable.

and S coastal regions above average. This consumption has also affected expenditure, in which 64% of expenditure on fishery product was incurred in the six coastal provinces, with almost 20% of national population. Coastal fish markets were found to receive almost two-thirds of their supplies from fisheries sources. The relative under-consumption in other areas may be due to combination of traditional market condition, lack of onshore facilities and processing units, and inadequate handling and marketing infrastructures, all of which could be subject to change in future years.

As developed from Abzigostar, 1996 *op.*cit, Mosanejad, 1995[a], 1995[b] *op.cit* and Khalatbari, 1996 *op.cit*, and based on the results of this study, market characteristics for different societal and regional groups may be distinguished as follows:

- (I) All inland populations living in rural areas and small urban cities, classified as societies with negligible interest or experience with fishery products; consumption levels are minimal - typically < 1kg cap^{-1} yr^{-1}, and often associated poorer quality, simply preserved products and occasional purchasing,

- (II) Larger cities in inland provinces such as Tehran, Isfahan, Shiraz, Mashhad, Kerman and Karaj, and also most Caspian areas, particularly areas far from the coast; classified as societies with a moderate degree of traditional, often seasonal consumption; with varying degrees of access or partially developed trade in fishery products; traditional seasonal preferences may be common, with a wider range involved, including fresh and lightly preserved products; consumption levels are typically 1-6 kg cap^{-1} yr^{-1}.

- (III) Most of the S coastal populations and a few areas on the N coast can be classified as societies with high degree of access to fishery products, but with diverse alternative opportunities; consumption is often seasonal; with moderate consumption - perhaps 4-15 kg cap^{-1} yr^{-1}; of a range of fresh and traditional preserved product forms; markets can be developed, but are commonly very competitive especially over seasonal fishing, provided traditional supplies continue, additional demand for carp in this area may well be negligible.

- (IV) Cities and their surroundings in the south of Iran located near coastal areas of the Persian Gulf and the Oman Sea, and a few cities such as Anzali in the north can be classified as societies with a very high level of access to fishery products; with an active and competitive preferences for fresh fish, usually throughout the year; with high levels of consumption - typically 8-30 kg cap^{-1} yr^{1}; of a diverse range of species. At present, there is a little demand for carp products in this area (except cities in the north) and assuming continued access to traditional capture products, this will be unchanged over the coming years.

Overall, ~80% of national population is located in groups (I & II) and carp consumption would typically bc targeted for these areas, particularly in larger cities. As noted earlier, average annual *per capita* carp consumption is currently estimated at ~1 kg for these two groups and as showed in Table 6.2, 40-46% of total fish consumption might come from carp products by 2010.

As the earlier carp consumption survey showed, demand for cultured carp product would be highest in the Caspian region and its neighbouring provinces, though provinces with a degree of demand from open-water bodies could also be included. Most areas in the N, NW, NE and the central part of the country which are familiar with Caspian bony fish would have targeted potential, while at present, the potential demand for carp product in the S, SE and SW is negligible. The approximately level of carp demand based on Table 6.2 (8% annual growth) in main areas is shown in Table 6.3.

Table 6.3: Approximate carp demand for different regional groups by 2010.

Group	Population in 1995 (10^6)	Approximate population in 2010 (10^6)	Approximate carp demand (t) by 2010
I	28	35	89,000
II	18	23	58,000
III	8	9.5	10.000
IV	6	7.5	8,000
Total	60	75	165.000

Potential effect of income growth

Beyond population growth, national economic growth may also increase fish consumption. However, this may differ between different income and social groups. In general, Muir (1995, *op.cit*) provided the following distribution:

- For low disposable income: the primary concern is usually price if basic quality features are satisfied; consumption will vary with availability; except for festive or other reason, response to price increase may be to substitute,

- For moderate disposable incomes: choice becomes rather wider, and regular consumption of preferred products, if at modest price, becomes feasible, while occasional purchases of more desirable, highly priced products become possible, and quality become more important,

- For high income levels: choice is increasingly unrestricted, and issues of basic consumption become far less critical; quality and image are more important, diversity and variety are also significant, and new product development and presentation becomes more essential in maintaining interest and developing market opportunity.

The process of economic transition, towards a more market oriented economic structure has resulted in an annual real GDP growth rate of about 7% during the years 1988-95, and a corresponding *per capita* real income increase of 2.9% annually, while *per capita* fish consumption has grown from 2.5 to 4.5 kg yr^{-1} from 1987 to 1995 (CDSD, 1997[a] *op.cit*), a change of ~5% per year, greater than 2.9% income change.

As Table 6.4 shows, though, GNP $head^{-1}$ is relatively high, *per capita* fish supply is at almost the lowest level, amongst countries with equivalent GNP ranges of $US 2,000 to 4,000, which shows a *per capita* fish supply ranging from 3 kg to 43 kg with average 14.5 kg per year (see Appendix VI, Table VI. 1). Though, as Table 6.5 shows, consumption would have to increase ~3 times to reach average for GNP group.

Table 6.4: Fish consumption in regional and GNP comparative countries (GNP per head US$ 2,000-4,000 by 1991).

Year	1991	1992	1992	1990		
country/region	GNP/head	Pop (10^6)	Urban Pop %	Fish supply kg head^{-1} yr^{-1}	fish protein gr head^{-1} day^{-1}	Fish/animal proteins %
Chile	2360	13.5	85	25.5	5.9	19.4
Venezuela	2720	20.2	91	14.6	4.1	14.8
Malaysia	2520	18.8	45	26.2	7.1	27.9
Iran	2410	61.6	58	4.8	1.4	8.7
South Africa	2540	39.9	50	9.3	2.9	10.7
Argentina	3790	33.1	87	6.1	1.7	2.7
Mexico	3080	88.2	74	10.8	2.8	8.8
Brazil	2920	154	77	5.6	1.6	5.9
Czechoslovakia	2700	15.7	76	7.7	2.8	4.6
Hungary	2750	10.5	66	4	1.2	2.2
Pakistan*	400	124.9	33	2	0.6	3.5
Turkey*	1790	58.4	64	4.6	1.4	8.6
Iraq*	..	19.3	73	0.7	0.2	1.7
All developing countries	880	4240	35	9.4	2.7	19.2
Industrial countries	14920	1210	74	26.1	8.2	13.8
World	4160	5450	44	13.3	4	16.1
Developing continent (near-East)	--	--	--	4.3	1.2	7
Asia continental	--	--	--	9.7	2.8	22.6

Sources: UNDP, 1994 *op.cit*, FAO, 1992[d] *op.cit* and Muir, 1995 *op.cit*
*: Three neighbouring countries (with GNP *per capita* less than 2,000).

Different consumption behaviour has been observed, in which coastal area consumption is above the national average, but all inland provinces are less than average. Lower income groups consume ~33% of the average and the higher income groups spend twice the national average. Though, future economic growth may still remain dependent on oil exports and its products. Over the 1992-98 period, an average annual GNP growth rate increased ~3% (UNIDO, 1999 & Mehnatfar, 1999, *op.cit*). If GNP growth rate continues at the same percentage over the coming years, and if fish consumption increases at the same percentage, *per capita* fish consumption would be projected at ~7 kg head^{-1} yr^{-1} by 2010, and based on Table 6.2 (250,000 t capture supply), with 90% of total aquaculture supply would be from carp products, with total carp supply estimated at ~247,500 t (Table 6.6).

Table 6.5: Approximate carp demand based on average for groups by 2010.

	An average *per capita* fish supply (kg yr^{-1})	Approximate population (10^6)	Total fish supply (t)	Estimated capture fishery supply (t)	demand for carp (expected 90% of aquaculture production) (t) by 2010
Iran (1990)	4.8	49.5	266,240	---	---
Iran (2010)	14.5	75	1,087,500	250,000	753,750

Table 6.6: Carp demand based on consumption increased at same as GNP change by 2010.

	An average *per capita* fish supply (kg head^{-1} yr^{-1})	Approximate population (10^6)	Total fish supply (t)	Estimated capture fishery supply (t)	demand for carp (expected 90% of aquaculture production) (t) by 2010
Iran (1990)	4.8	49.5	266,240	---	---
Iran (2010)	7	75	525,000	250,000	247,500

Demand elasticities for fish products

The previous sections have used general assumptions about the response of consumer demand to varying changes. A more specific assumption can be developed by considering varying elasticity features. Where a given change in an independent variable (such as product price, price of substitutes, *per capita* income) brings about a more than proportionate change in the quantity demanded, then demand is said to be elastic with respect to that variable, and where the change in quantity is less than proportionate, demand is said to be inelastic (Cunningham, *et al.* 1985 *op.cit*). There are many other determinants of demand but probably the most frequently examined has been the effect of changes in consumer incomes and spending power (Shaw and Muir, 1987 *op.cit*) using the income[75] elasticity of demand. It is not easy to compare elasticity data for fishery products, as they differ in the time period covered, the country or region, the species and product, the technique used. However, price elasticities for fish products are generally negative (Bell, 1978; Buchanan and Nicholson, 1977, Young, 1977; Tsoa, Schrank and Roy, 1982, Cunningham, *et al.*, 1985, Muir and Shaw, 1987 *op.cit*; Herrmann and Lin, 1988; Singh, 1988; De Vorets and Salvanes, 1990; Bjorndal, 1990 *op.cit*; Jolly and Clonts, 1993 *op.cit*), while with some exceptions (catfish in USA and west African countries) (Jolly and Clonts, 1993 *op.cit*) income elasticities appear to be positive. Some products have also been shown to have a positive cross-price elasticity of demand with other fish or food items, demonstrates that demand is dependent upon the prices of these substitute goods.

In Iran, Mehraban (1996 *op.cit*) used 1994 household expenditure data on fishery product related to various income groups, indicating that with income rise, the quantity of fish demand increased and this rise was higher in urban areas (1.14 income elasticity) than in rural areas (1.008). It is difficult with available information to make significant comments on price elasticity and/or income elasticity for carp and its products in Iran, but it appears that income and demand are positively related, an increase in income typically shifting the demand curve to the right. Thus as noted in chapter 5, almost 54% of respondents will increase carp consumption with income rise, while 41% would not change, and 61% will increase with price decline, while 32% would not change. The effect of both income rise and price decline was also higher in low income groups. It appears that both income rise, and price decline of carp products may be positively related with demand, and so differences may mainly occur in terms of form of products. A response of >1 is likely occur for whole fresh and/or frozen products for lower income, and value-added products for moderate and higher income, educated groups and younger consumers.

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[75] - Income elasticity of demand = % change in quantity demanded / % change in incomes, the higher the value of this coefficient, the greater increase in demand brought about by a change in incomes (Shaw & Muir, 1987 *op.cit*).

Different demand scenarios

To compare the implications of the different strategic features, Table 6.7 provides an overview. As expected there are differences between the projected scenarios, depending on the linkages between *per capita* consumption, population growth rate, economic growth, urbanisation and other changing patterns. As shown, key factors affecting carp consumption are population growth, urbanisation, income rise, improvement in handling and marketing infrastructures, market expansion and distribution of varying products. It also summarise the effects of other factors in modifying this trend. These issues will be discussed later.

Table 6.7: Key factors which may affect carp demand in Iran.

Variable	Effect
Carp price	Higher prices reduce demand and vice versa
Price of other fish (mostly Caspian bony-fish)	Increasing relative price of substitutes increase carp demand and vice versa
Supply increase	increase carp demand
Real income	Increasing real income increase demand
Improved quality	increase demand
Diversified product	increase demand
Competitive market	increase demand
New product development	increase demand
Advertising	increase demand
Changes in consumer preferences	increase or reduce demand
Expansion market over the year	increase demand
Expansion market over the country	increase demand
Market development (modern market establishment)	increase demand
Increase catering markets (Hospitals, factories, armies, Universities, ...)	increase demand

Source: developed from previous chapters

On the basis of 1974-95 trends, *per capita* apparent fish consumption might be expected to increase between[76] 6 kg to 10 kg head^{-1} yr^{-1}, with average food fish demand at around 8 kg head^{-1} yr^{-1} by 2010.

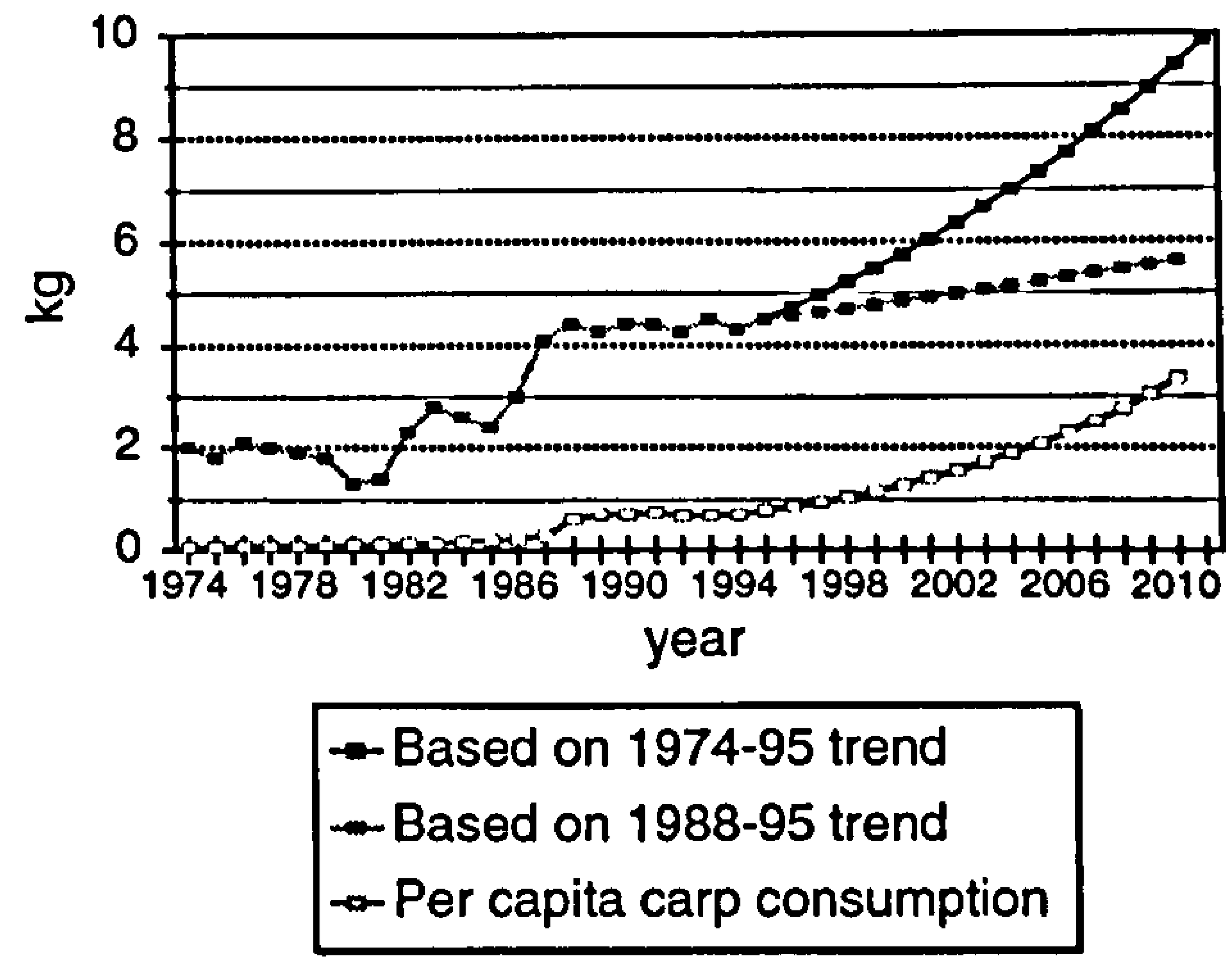
The primary expectation is that the bulk of additional production will be distributed into urban areas, with inland fresh water aquaculture (mainly carp) likely to provide a major share of output. This is likely to be particularly important for middle and low income groups, and populations located in inland provinces, though, added-value carp products may also be attractive for high income groups, educated people and younger consumers. Assuming other strategies are employed to maintain or enhance capture fishery[77] and post-harvest supply, edible fish supply is unlikely to increase more than 250,000 t by 2010, and so only aquaculture may meet demand. Consequently, as Table 6.8 shows, at lowest *per capita* fish consumption and lowest population growth rate, the total demand from aquaculture production may be some 138,000 t and at highest *per capita* fish consumption, and highest population growth rate, it could reach 510,000 t. An intermediate estimate may be based on 1.5% population growth rate (as expected in the most recent on 3-5 years (SCI, 1997 *op.cit*)), with a real increase in GDP and *per capita* income, but slowing down; subsequently, as the effects of reduced oil dependence are felt. Compared with 1988-95, on average, a conservative estimation may be <3% annual growth for *per capita* income, with all added population living in urban areas, estimated urban population > 55 m by 2010) and the rural population remaining stable or even declining.

It might be also expected that a rise in supply and the effects of technology may affect the price of carp products, where price will decline in real terms. All these factors will affect demand and the annual growth rate of fish consumption may be estimated at between 2-4% with a realistic estimation of around 8 kg $head^{-1}$ yr^{-1} by 2010 for all fishery product. As a result, by 2010, total fish demand may be estimated at about 600,000 t, and so aquacultural products, of which a significant part would be carp, may

[76] - On average between 1.5% and 5% annual growth rate based on past situation (1988-95 and 1974-95 trend).
[77] - In Hormozgan, capture wastage were estimated at between 8-18%, and on average, buyers consider a 12% loss in their purchasing (Mosanejad, 1995[b], *op.cit*).

be estimated at some 300,000 t. Over the 1996-2010 period, fish consumption growth rate are annually estimated at 5% and 1.5% based on average growth rate over 1974-95 and 1988-95 respectively. A scenario based on the previous trend is shown in Figure 6.3.

Figure 6.3: Estimated *per capita* fish consumption by 2010.



Note: *Per capita* carp consumption are estimated based on 10% annual growth rate.

Table 6.8: Demand projections in the year 2010.

Per capita apparent fish consumption	Lowest	Middle	Highest
kg	6	8	10
Population	Low , High	Low , High	Low , High
million	73 , 81	73 , 81	73 , 81
Total demanded fish food (1,000 t)	460 , 486	584 , 648	730 , 810
Total estimated capture fish and other cultured fish food (1,000 t)	300	300	300
estimated aquaculture supply needs (1,000 t)	138 , 186	284 , 348	430 , 510

Note: Excluding export and import effect.

6.3 Supply and production cost

6.3.1 Introduction

The previous section has suggested target levels of 284,000-348,000 t which represent growth rate of 13-15% per year respectively from the present levels of 7% over the 1988-95, and 9% over the 1995-98 period. The purpose of this section is to consider how in practice such supply might be developed, and based on the present production profiles, the potential patterns of production and cost of supply.

The efficiency of resource allocation, and micro-economic analysis of existing cultured carp production will help in the successful establishment and development of future industry enterprises. The costs, returns, and yields of various farm sizes in different locations measure the success and failure of the farm business. The results provide a basis for decision-making among producers and policy makers. Attention can be directed to addressing such questions as; the share of which inputs are significant in costs of production? Are there economies of scale in carp culture? Is profitability acceptable? Are farmers making optimal use of inputs? What constraints inhibit increased productivity and profitability of existing carp culture systems? What is the effect of increases in cost of inputs? Linked in with there would also be the potential for investment and hence expansion of the sector.

These analyses are based on the micro-economic evaluation carried out in the three main provinces; Gilan, Mazandran and Khuzestan, together with supplementary data on specialised systems and locations outside these three provinces. The three provinces, together accounted for 87% of farm area, 92% of farms, 91% of production, and 72% of the total aquaculture and inland open-water bodies production.

6.3.2 Supply scenarios

If the perspective is to be formed for carp culture development and its potential in meeting various objectives, particularly market demand, it is useful to consider the underlying relationships for its growth to date and emerging factors which may occur in the coming years. Muir (1995 *op.cit*) noted three primary development factors can be considered to apply for aquaculture:

- demand; its effect on price, preference and perceived investment opportunity,
- production; the emerging technical capacity, and the resources required and available,
- the development model; the political, economic, social, environment and legal context.

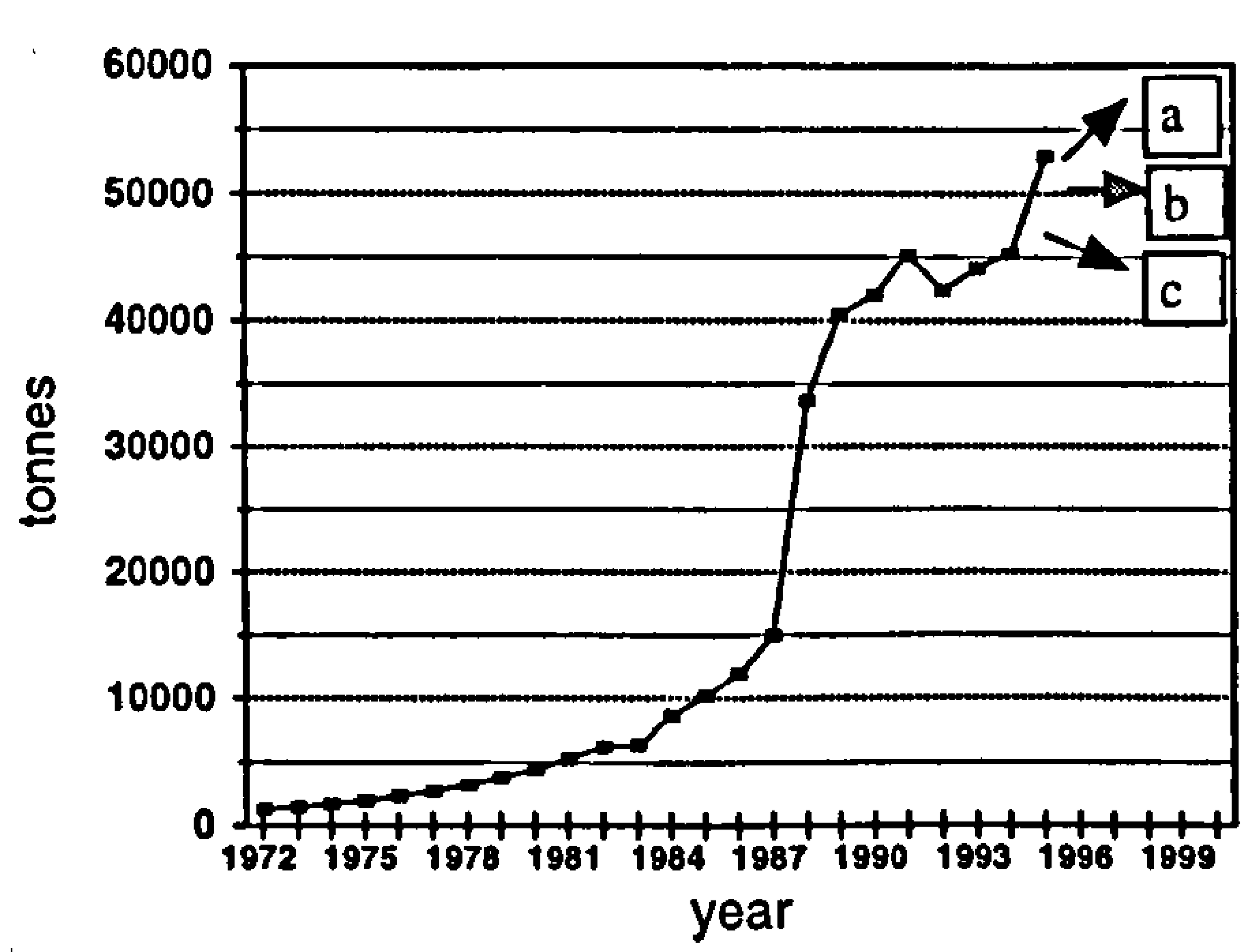
The previous section dealt with the potential demand under various strategic scenarios. This section investigates production scenarios for meeting those requirements, and hence determines the prospect for carp production to achieve its objectives. However, carp culture may have to compete with other users for primary resources, particularly water and land, and though these resources may not be problematic in the short term, they may need to be considered for longer term change.

The first step has been to project the average annual percentage growth of carp production for 1986-95 period, to the year 2010. The second step has been to consider various factors which may affect future supply based on previous trends, including;

population growth, economic growth, urbanisation, industrialisation, using new technology to manufacture input facilities, and particularly, production and processing (e.g. diversification), infrastructure and transport expansion.

The previous pattern of carp culture development and its growth is shown in Figure 6.4. Over the 1972-95 period it can be classified into four stages; during the early development stage (1972-80), production slowly increased, particularly in the Caspian area, but over the 1980s, especially since 1986, with better profitability, production and hatchery technology, government investment and subsidy support, as well as population growth rate and a decline in Caspian bony fish, carp production increased to more than 40,000 t. Since the FFYDP, economic transition and lower margin for producers reduced growth, but since 1994 this has increased.

Figure 6.4: Carp production growth patterns in the past and its future perspectives in Iran.



[a]: new technology, new market development, increases profits, increases purchasing power, hence growth potential.
[b]: Profits diminish as markets decline, investment reduces, growth slows down.
[c]: Increased competition, increasing costs of production, reduces potential, consumer prefer other species, companies leave business, etc.

Since carp culture development is widely different within Iran, its future development curve may comprise a series of smaller and/or short-run curves, each representing a specific event, in specific location, and system and technology change may take place across a broad range, from small family unit production to industrial vertical integrated scale with various intensities. As shown earlier, factors such as preferences, economical policy, demand, investment and competition with other sectors (e.g. resource use) may positively or negatively influence its growth.

As Figures 6.4 shows, the main underlying trend of carp production in Iran has been a steady if not dramatic growth rate.

However, over the coming years, growth may occur as described by 'scenario I', which may be affected by new technology[78] (increasing yield and decreasing costs of production), new market development, diversification of products, improved handling, processing and marketing facilities and increased margin. With expected population growth, urbanisation, decline in capture fisheries, reduced cost per unit production, developing facilities and infrastructures, together with good resource potential, and other positive factors, an optimistic perspective may consider, production to increase an average by 10% annually over the 1996-2010 period (Table 6.9).

At the moderate perspective 'scenario II', which on average, may be similar to the FFYDP and the SFYDP, with cost of inputs increased, price diminished in real terms, purchasing power declining, and private investment moving into trade. However, government investment, credit and extension support over the period has positively affected growth in production since 1994. Since such support, particularly related to basic infrastructure and credit is difficult to assess[79] over coming years, this uncertainty may influence carp production. In this moderate scenario 'II' carp production is not expected to exceed more than 160.000 t by 2010.

[78] - The adoption of technology may be regarded as new, not so much because it is genuinely innovative, but rather because it is new to the market in Iran. Introduction of new technology may bring about improvements in production efficiency and other measures but, there can be no guarantee that this will be so. Indeed quite the opposite might also occur.

The pessimistic scenario 'III' will happen as a result of a combination of negative factors including, increased price of inputs and decline in profit, increased performance of other species such as trout, inadequate investment (national, local or private) for related industries (such as hatchery production, feeds, processing and marketing), poor market demand and a decline in purchasing power. In these circumstances carp production may not increase more than 122,000 t (Table 6.9).

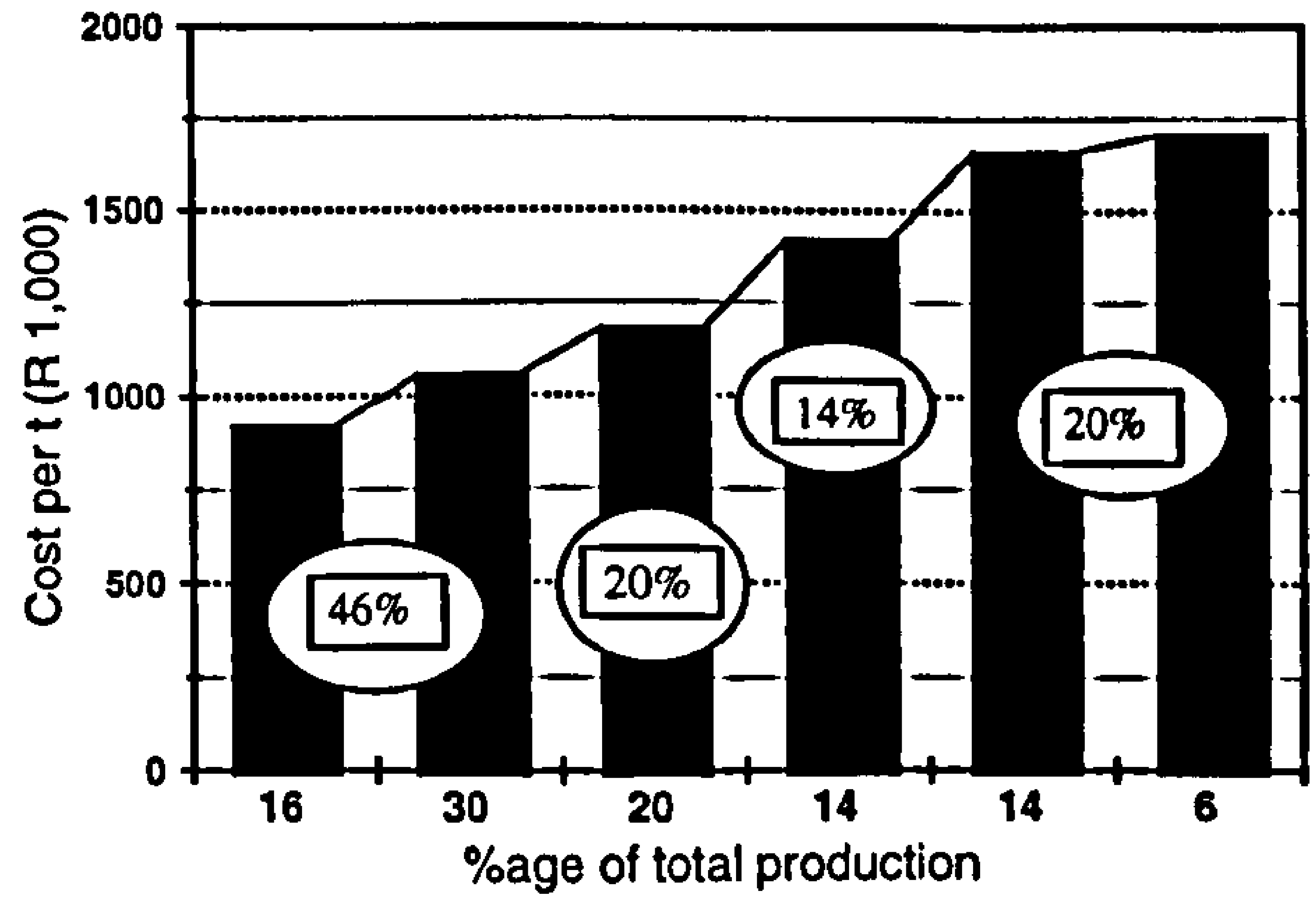
Table 6.9: Carp production scenarios by 2010.

Scenario	1986	1995	2010	% annual growth 1995-2010
Optimistic (I) (1,000 t)	12	51	210	10
Moderate (II) (1,000 t)	12	51	162	8
Pessimistic (III) (1,000 t)	12	51	122	6

6.3.3 Production cost

As Figure 6.5 shows, the cost of production in 1995 varies between R 920-1706 kg^{-1}, depending on availability and quality of inputs, farm management, climate, area of farms and other factors.

Figure 6.5: The cost of carp farming per unit output.



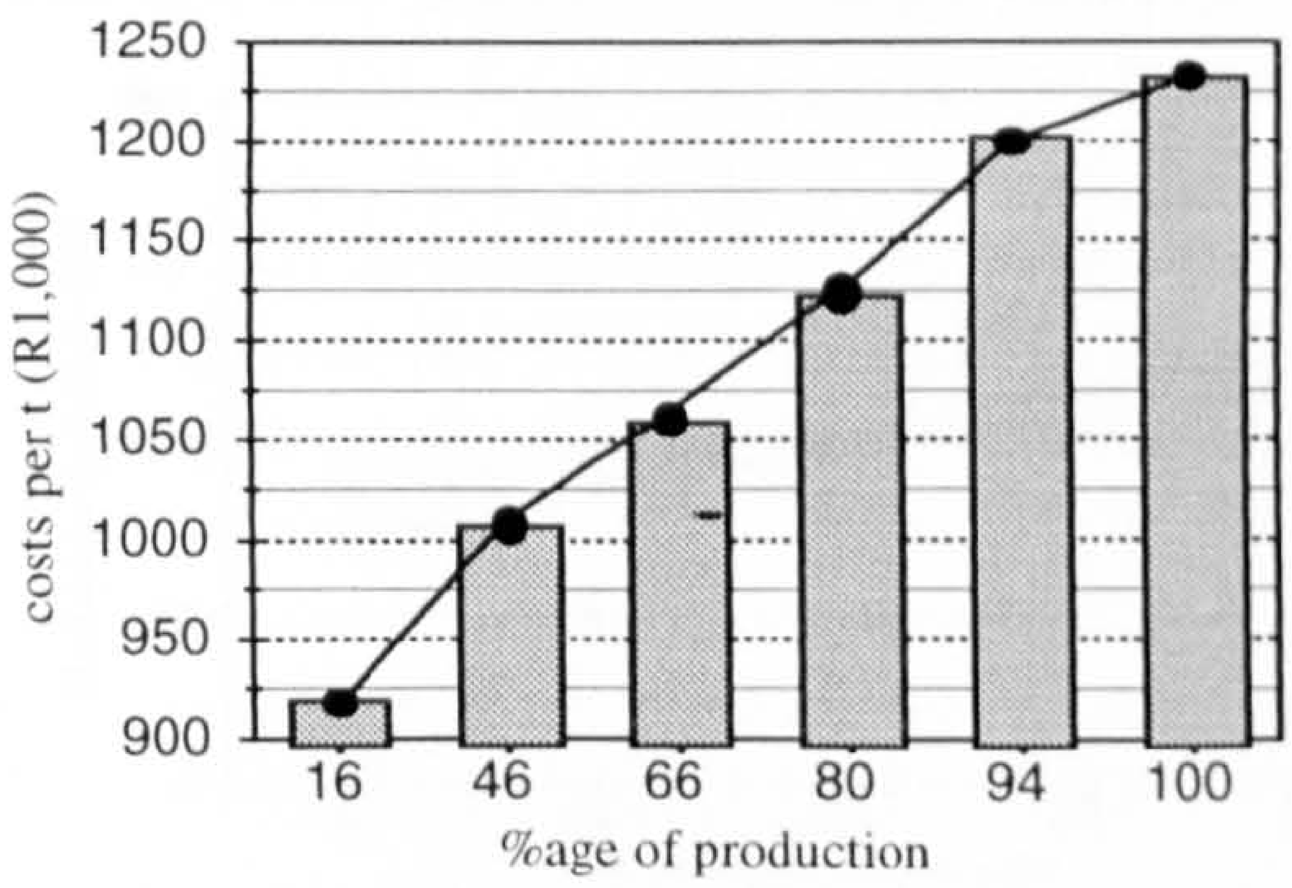
Source: Farms survey

The lowest cost producers are at an average R $9.2*10^5$ t^{-1} in Mazandran, with farms of <20 ha, representing 16% of production, followed by farms in Gilan of <1 and between

[79] - Strongly related to price of oil, as well as may investment move towards shrimp production for export.

5-20 ha, some 30%. These two groups, accounting for 46% of total production surveyed, had a weighted mean cost of production of R10^6 t^{-1}. Medium cost producers represent a range of provinces and categories, including Gilan (1-5 ha, 15%), Mazandran (20-50 ha, 2%) and Khuzestan (>50 ha, 3%), whose weighted mean cost for 20% of production was R$11.8*10^5$ t^{-1}, while upper medium cost producers are in Khuzestan (5-20 ha, 14%), with a weighted mean cost of production of R$14.2*10^5$ t^{-1}. Higher cost producers are also in Khuzestan (1-5 ha, 1% and 20-50 ha, 14%) and in farms of >20 ha in Gilan (5%), whose weighted mean cost, for 20% of production, amounted to R$16.7*10^5$ t^{-1}. The cumulative production in different categories is shown in Figure 6.6.

Figure 6.6: Cost of cumulative production in different categories.



The cost sensitivity of carp farming in different categories and locations is shown in Figures 6.7- 6.13, relating to changes in key variables of feed and fertiliser (F&F), labour, seed, and harvesting and post-harvest (H&ph). As noted before, production costs are dominated in all groups by operating inputs[80] at 77-93% of the total cost, of which feed and fertiliser is the most important item. As Figures 6.7... 6.13 show, cost of feed and fertiliser is the most sensitive in Khuzestan and farms of 20.0-50 ha, followed by

[80] - Here, defined as total cost excluding depreciation and interest (TC-D-I).

farms in Gilan and farms of 5.0-20 ha, and the lowest sensitive farms are in Mazandran and farms of 1.0-5 ha.

Figure 6.7: The cost sensitivity of carp farming in Gilan.

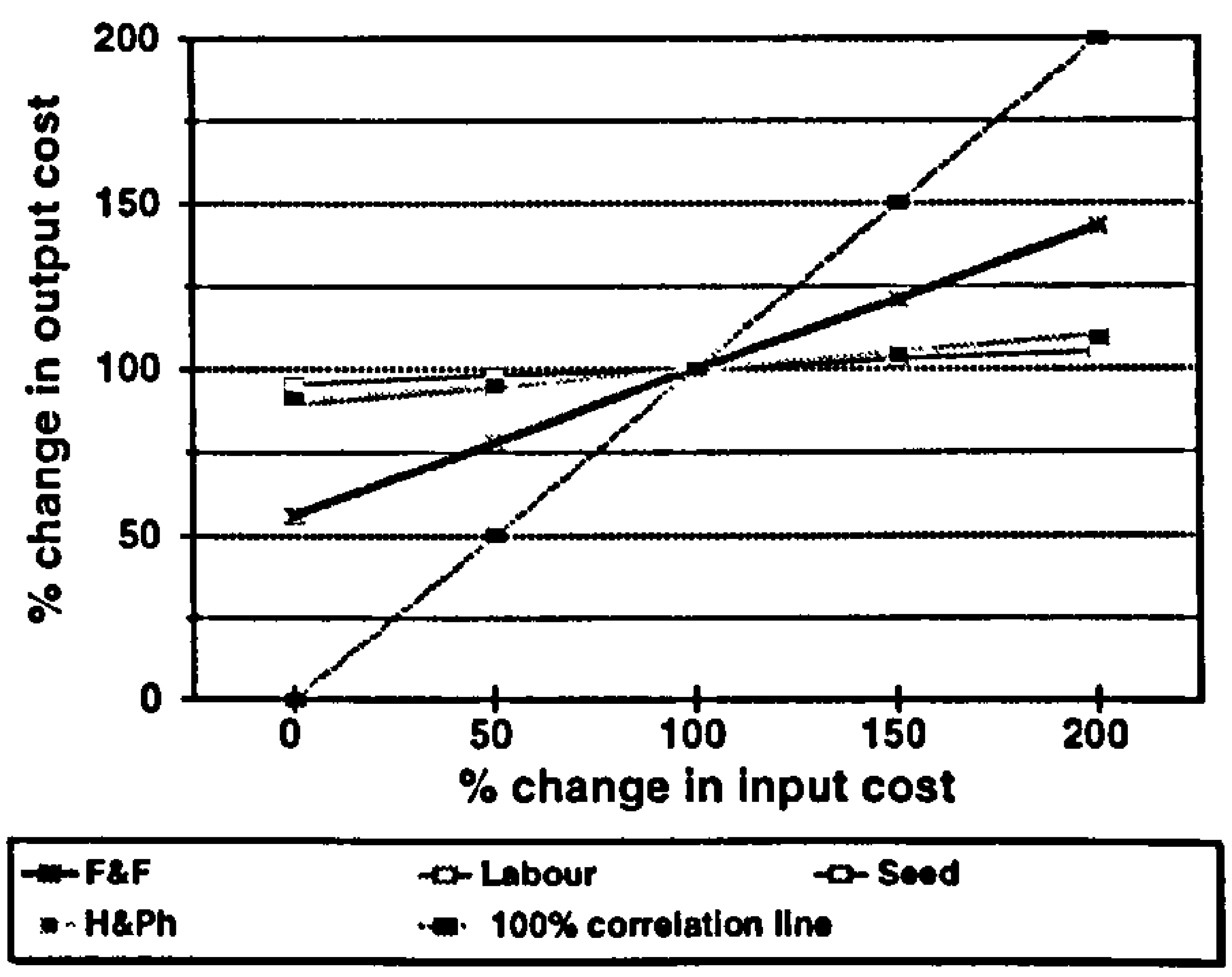


Figure 6.8: The cost sensitivity of carp farming in Mazandran.

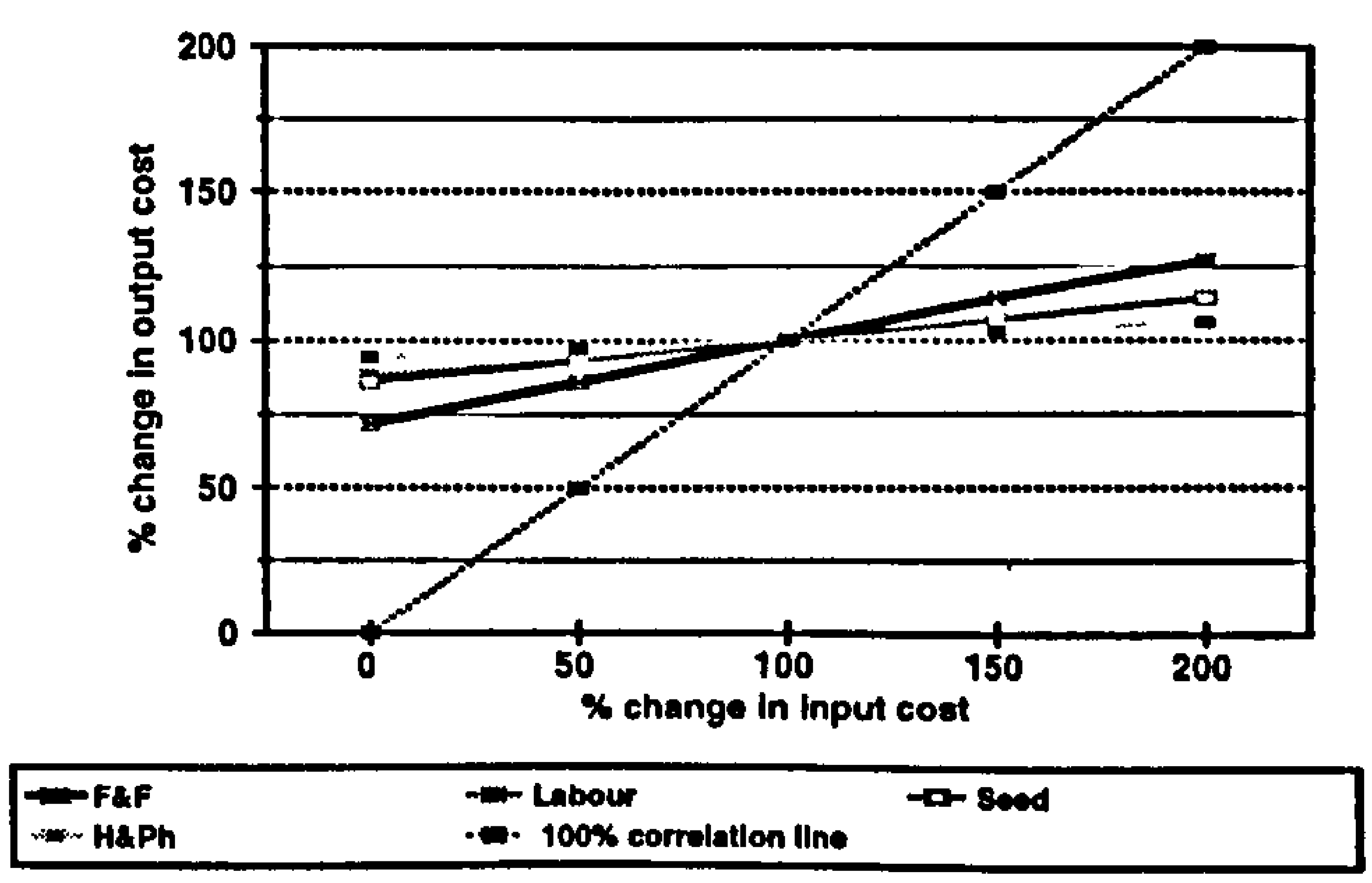


Figure 6.9: The cost sensitivity of carp farming in Khuzestan.

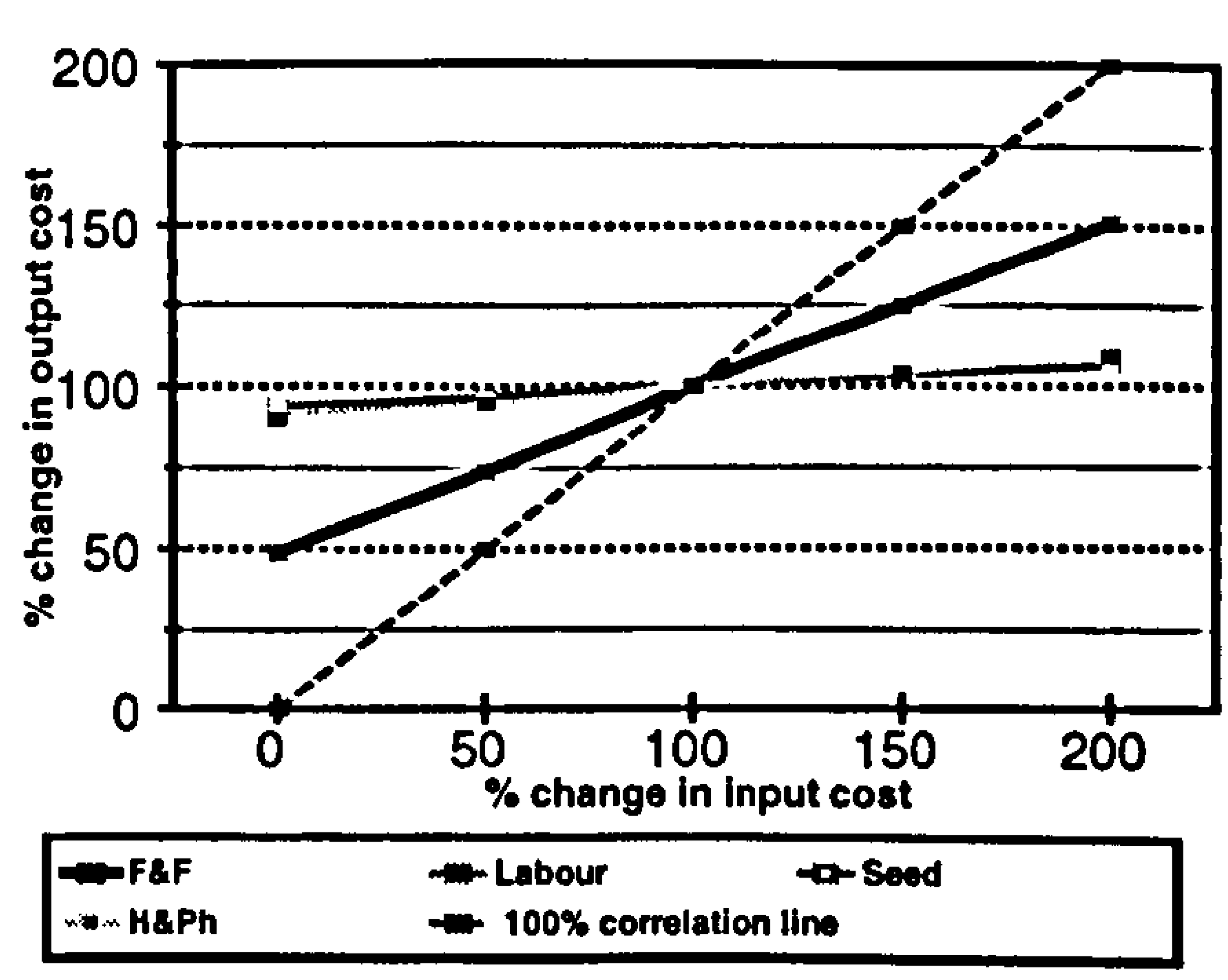


Figure 6.10: The cost sensitivity of carp farming <1ha.

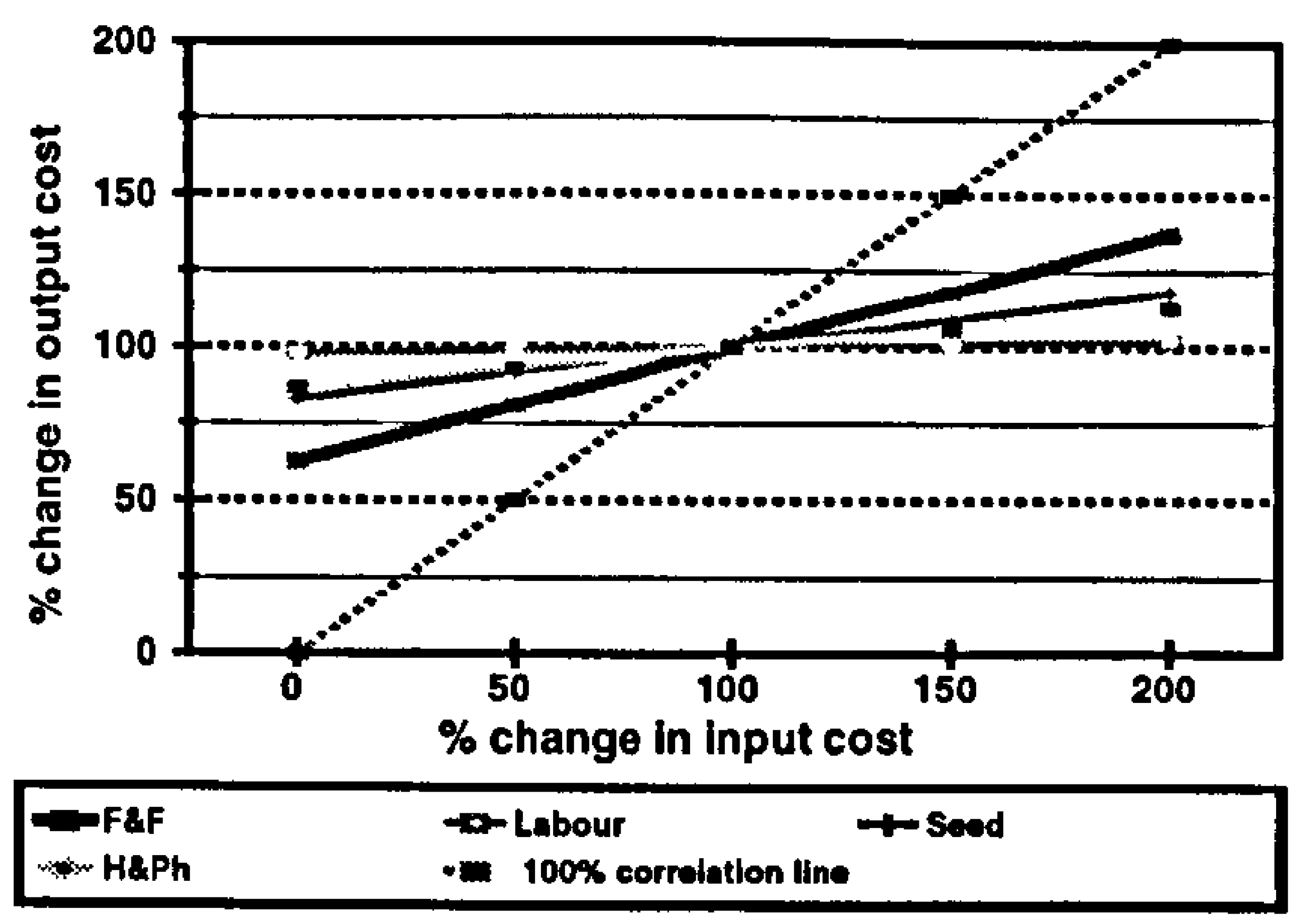


Figure 6.11: The cost sensitivity of carp farming 1-5 ha.

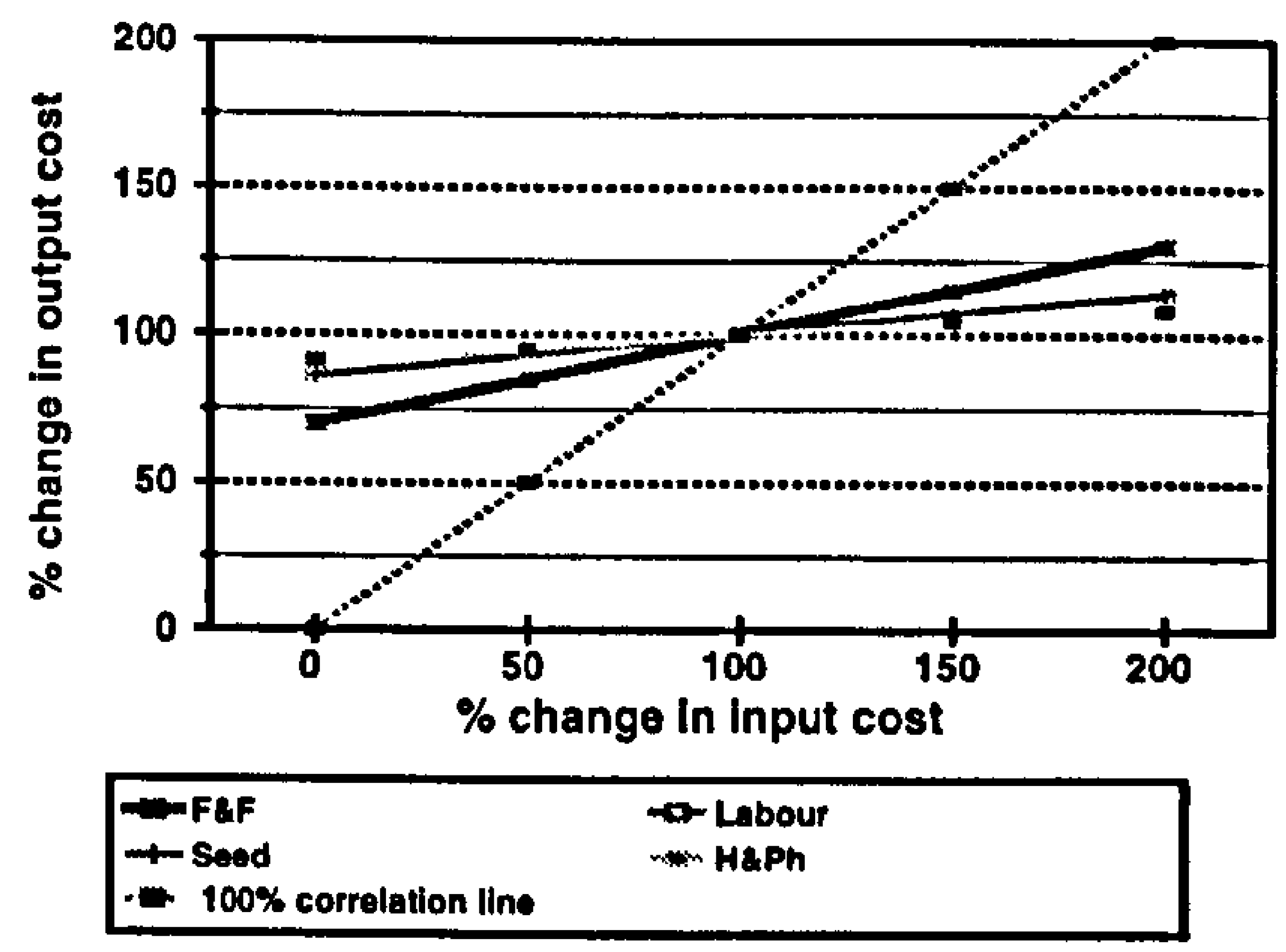


Figure 6.12: The cost sensitivity of carp farming 5-20 ha.

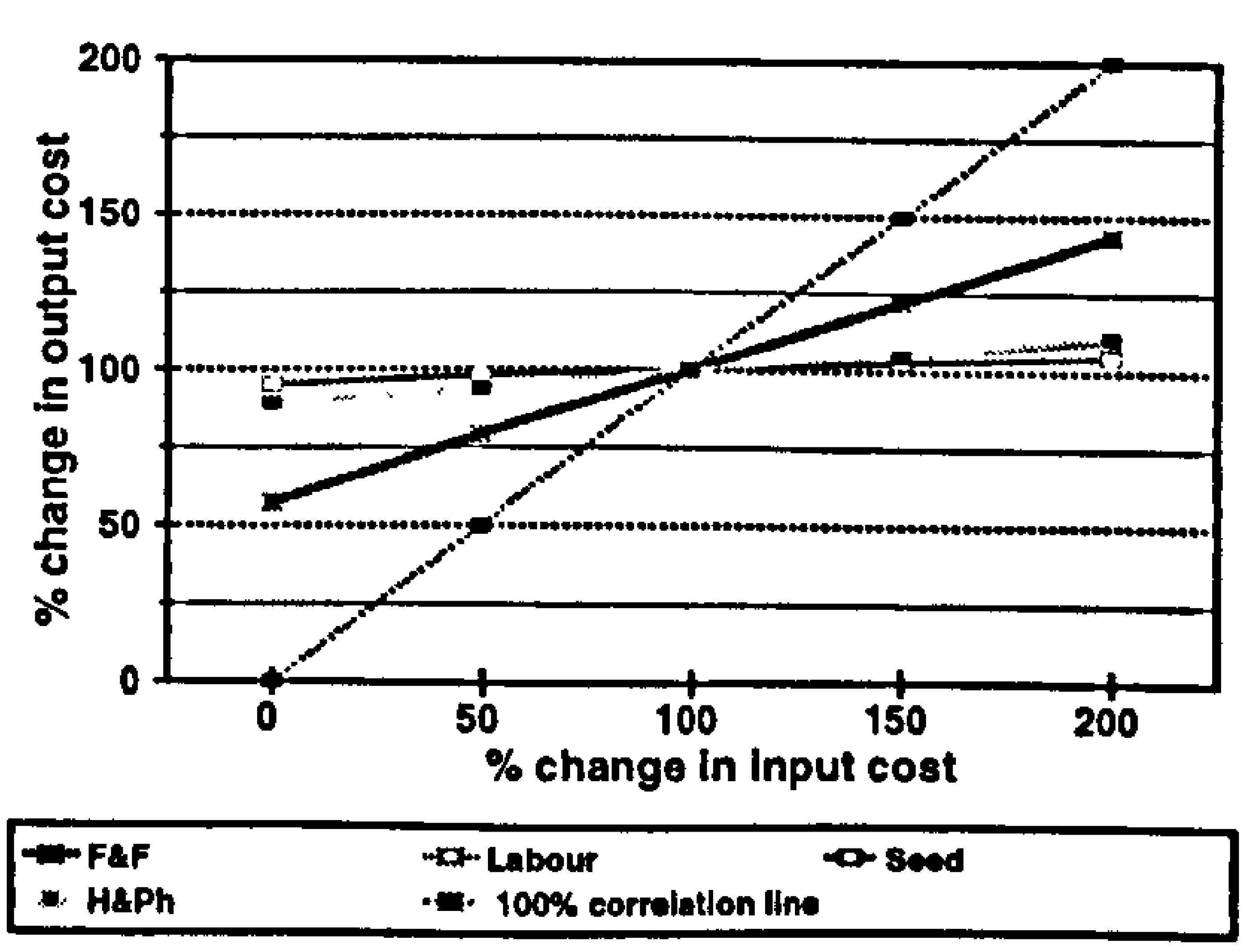
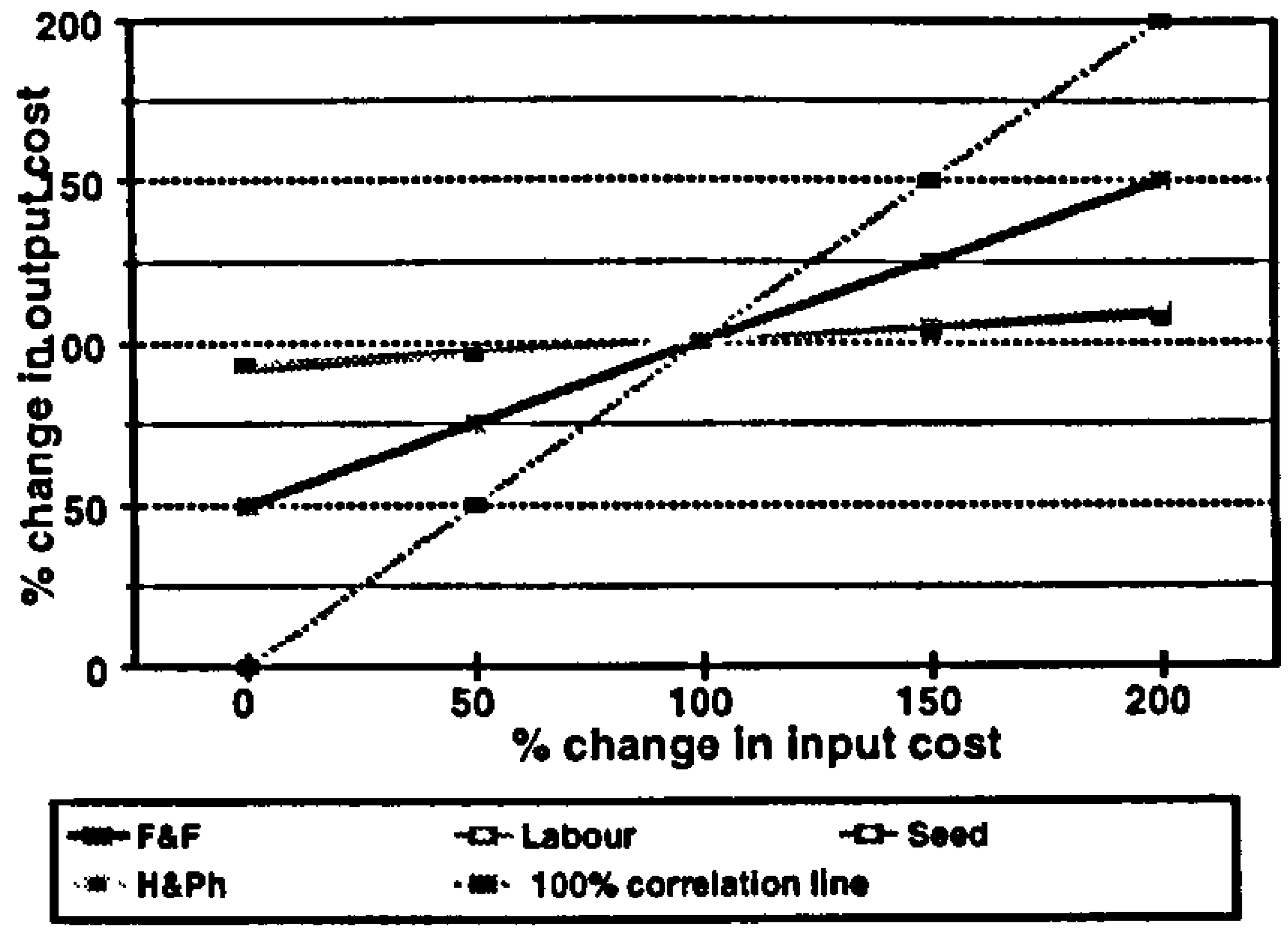


Figure 6.13: The cost sensitivity of carp farming 20-50 ha.



This item also represents the chief difference between locations and area categories (ranging from 28-51%), and dominates the cost sensitivity of all categories and locations; a 50% increase in the cost of this item increases the total cost by 14-25%, while an equivalent change in other inputs, such as seed, labour and harvesting and post harvest account for less than 9% change in total cost (except the case < 0.1 ha) (Table 6.10).

Table 6.10: % increases in cost resulting from a 50% increase in cost item.

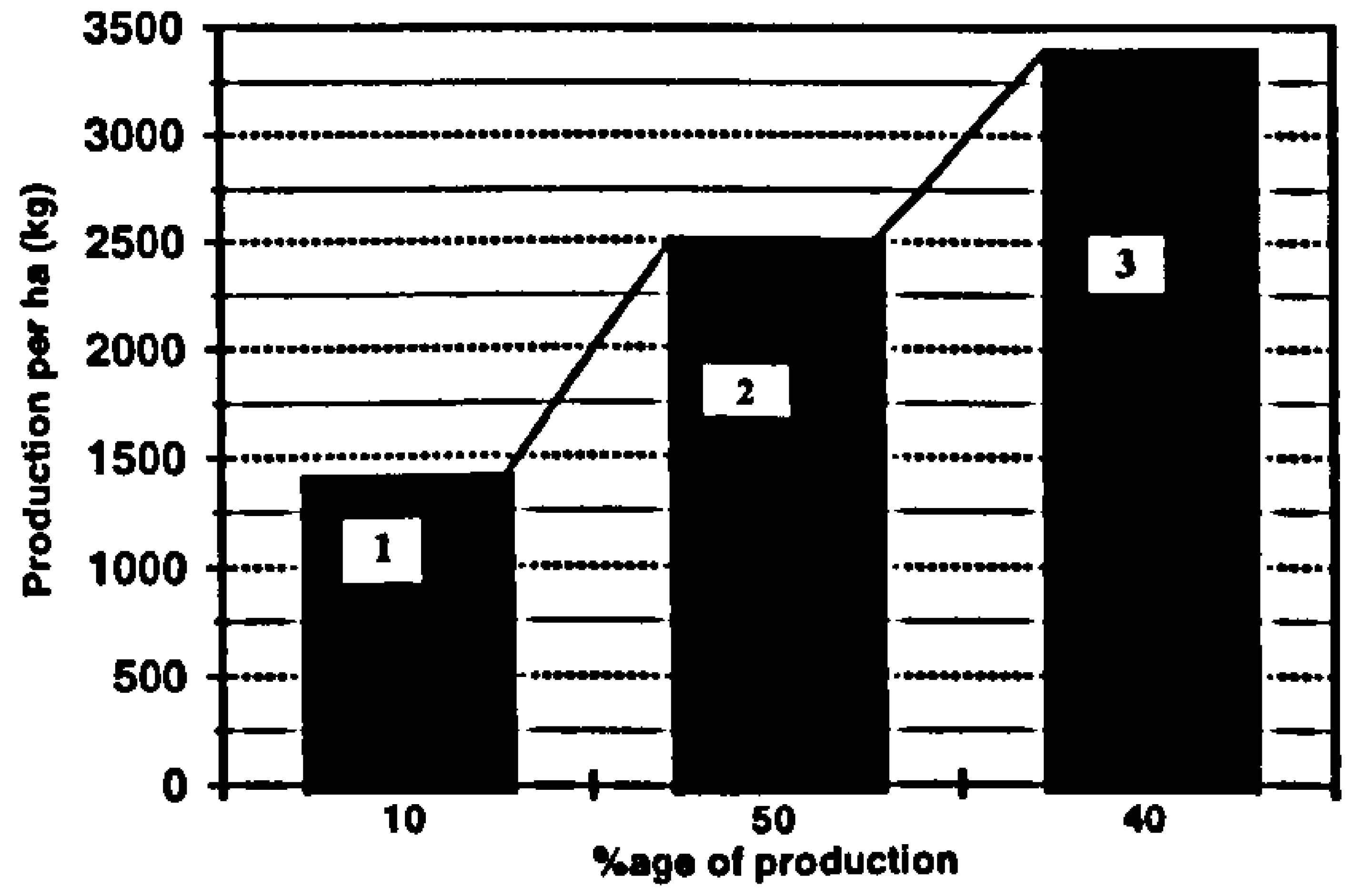
Category	Feed and fertiliser	Labour	Seed	Harvesting and post harvest
Mazandran	14	7	7	3
Gilan	22	5	3	4
Khuzestan	25	4	3	5
< 1.0 ha	18	1	9	6
1.0-5 ha	15	7	7	4
5.0-20 ha	22	5	3	5
20.0-50 ha	25	5	4	3
< 1,001 m^2	19	n	17	n

Farms <20 ha in Mazandran have the lowest cost/t of production, with their key factor being feed and fertiliser used, though they usually use agricultural wastes, and farm productivity is closely related to feed and fertiliser productivity. Though, these smaller scale family units only represents 16% of total products, and as small scale family units may not get projected demand levels, the policy might be expected to direct increase in number of family unit farms in the Caspian area, or other aquaculture systems such as medium cost producers, represent a range of provinces and categories. Since, feed and fertiliser productivity is considered as important indicator of efficiency, particularly for medium and larger farms, key strategy for increased production might be expected related to increase productivity of feed and fertiliser and the skill of farmers, and though, it appears bulk of future production could be established in the medium cost range, representing ~70% of production, which may possible to reduce feed and fertiliser cost of these categories.

6.3.4 Productivity

There may be potential to increase productivity, particularly for medium and larger farms, but may not be enough for future demand, and new areas may have to be established. According to (Salehi, 1997 *op.cit*) and based on the result of this study (Figure 6.14), ~10% of total output in 1995 was in group 1 (<1.5 t ha^{-1}), 50% in group 2 (~2.5 t ha^{-1}) and the balance in group 3 (>3 t ha^{-1}).

Figure 6.14: Carp production per ha (kg).



[1]: Mazandran >20 ha, Khuzestan >50 ha, and W-Azarbiajan.
[2]: Gilan 1-50 ha and Mazandran <20 ha, Kerman also located in this group.
[3]: Khuzestan <50 ha and Gilan <1 ha.

Based on the result of this study, in the Caspian area, overall, farm productivity (t ha^{-1}) negatively, and in Khuzestan positively related to production cost t^{-1}. Considering feed and fertiliser productivity, overall, productivity of this item negatively related to production cost t^{-1}. The condition of each category is explained as follows:

[1]: there is a good potential to expand carp production, particularly for larger farms, increased yield may strongly increase profitability, as the extremely low productivity at present may not be acceptable,

[2]: there is a potential to increase yield (with larger seed size, increased organic fertiliser and effective management), and good potential for additional profit, particularly for additional production of fry/fingerling for farms >5 ha in the Caspian area,

[3]: increased feed and fertiliser productivity and skill of farmers may strongly increase profit.

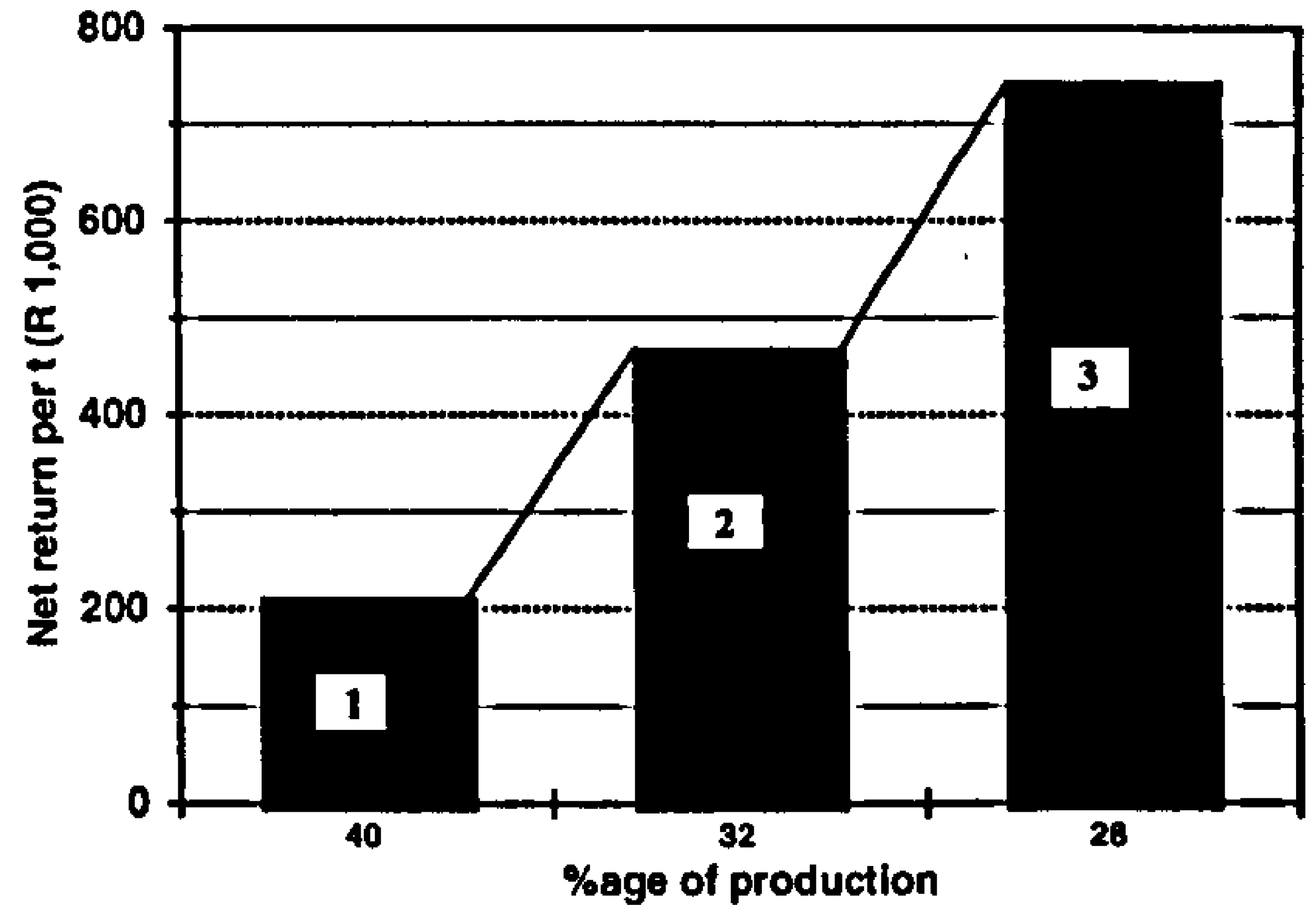
Questions then arise concerning whether the additional returns involved in using various inputs and/or techniques offset the additional costs. Though, feed and fertiliser productivity in the Caspian area is higher than that in Khuzestan (for feed more than twofold and for fertiliser almost fourfold), considering size of farms, economies of scale for feed and fertiliser may not be relevant, but productivity of human resources may be more important.

For larger farms, the lack of knowledge in farm management may have a more negative impact on feed and fertiliser productivity, as for water and electricity. Comparing farms between 0.1-1 ha and 20-50 ha, the productivity of feed almost doubled in the former, and comparing farms <5 ha and >5 ha, feed and fertiliser productivity are much higher in the former.

6.3.5 Profitability

The development of carp farming production depends on its profitability, and increases in yield, reduction in cost/t and increases in price of product were major means of increasing profit in all locations and categories. The break-even production point averaged, 2.3 t ha^{-1}, from 1.5 t ha^{-1} in Mazandran to 3.2 t ha^{-1} in Khuzestan. Not all least cost producers are the most profitable, as they have lower output, or lower market prices. Where feed and fertiliser (~60% of variable costs) play a very important role, it may be necessary to increase farm profitability by increasing feed and fertiliser productivity and the skill of the farmers. Though, production per ha and cost of production are higher in Khuzestan, so profitability may not be acceptable in the longer term, as for farms between 20-50 ha. However, increased productivity, particularly of feed and fertiliser, and the establishment of local hatcheries may improve profitability of almost 30% of carp production located in Khuzestan province. In contrast, in Mazandran farms of <20 ha used lowest levels of feed and fertiliser and have lowest yield, but compared with the smaller sized farms in other provinces profitability is lower. Profitability of different producers are shown in Figure 6.15. The profitability of 40% of production is extremely low, and it with 20% increase in unit cost of production (others constant) 34% of producers (Farms <50 ha in Khuzestan and >20 ha in Gilan) will become unprofitable.

Figure 6.15: Net return per t of production (R 1,000).



[1]: Mazandran and Gilan >20 ha and Khuzestan 1-50 ha, and W-Azarbiajan.
[2]: Mazandran and Gilan 1-5 ha, Mazandran 5-20 ha and Khuzestan >50 ha, Kerman also located in this group
[3]: Mazandran and Gilan 0.1-1 ha and Gilan 5-20 ha.

Analyses of data from Gilan province indicate that profitability of different sized carp farms is closely related to optimum utility of inputs, and for farms of <20 ha has grown remarkably due to three major factors;

(1) increased production per ha,

(2) decreased inputs costs, mainly by increasing feed and fertiliser productivity, and using agricultural waste, as well as seed, and

(3) increased market price (high demand within province and near Tehran).

An important issue for future consideration might be the effect of a change in price of key inputs. For example, in Khuzestan a 20% increase in the price of feed will reduce rate of farm income[81] from 11% to 4%, while a 20% decrease in feed price will increase this to 18%, and profitability change by 80%. The condition of each profitability category is explained as follows:

[81] - Rate of farm income; defined as net return divided by gross revenue, times 100.

[1]: for Caspian area, increased fertiliser use, larger seed size, additional profit from seed sale, and for Khuzestan additional activity such as hatchery production, and reduced feed and fertiliser may strongly increase profitability.

[2]: for farms in the Caspian area the same as those in category [1], for Khuzestan and Kerman increased yield may increase profitability, and there is a potential to expand new area ,

[3]: there is potential to increase yield per unit area, particularly in the Caspian area, as it is less likely that there is additional area for expansion.

6.3.6 Implication for carp culture

According to Shang (1990 *op.cit*) three major elements may influence aquaculture development in a country:

- the relative economics of rearing and marketing various species,
- the comparative advantages, and
- the relative economics of aquaculture versus other economic activities.

At the project level, several conditions may facilitate successful implementation of carp culture including:

1. a favourable market and a positive attitude regarding carp products,
2. a positive policy at governmental level to support carp culture and enable farmers to receive basic resources such as land, water and credit to establish a farm,

3. availability of basic feedstuff, equipment, materials, skill of managers research into improved seed production, institutional, training and extension services, which enable farmers to increase productivity,

4. profitability of existing carp farming, though it may be improved, some of this issue is addressed in next sections.

This analysis has shown that, maximising productivity (i.e. t per ha) does not maximise profits, nor it appears does increased farm size, reduce cost and increase profitability, though farms of between 20 to 50 ha had highest productions. Efficiency of the key inputs feed and fertiliser and farm productivity were positively related, feed and fertiliser cost contributing significantly to variable operating costs. Effective management would aim to maintain the lowest FCR consistent with growth, which may require considerable changes in feed quality, which have yet to come about. Quality control in particular should be improved to the point where feed performance can be better standardised. It is likely that greater efficiency[82] in land use and other inputs may be achieved through increased size of farms, although conversely smaller units may allow easier management. Larger farms, may improve efficiency through vertical integration, involving activity such as feedstuff production, hatcheries, and possibly processing, distribution and marketing.

6.3.7 Supply expansion

Overall, the factors influencing the supply of cultured carp may be represented as follow;

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[82] - The quantity of labour per unit produced will almost certainly decline, the result of farm study showed, on average, the number of used labourers per ha in carp farming declined from almost 137

- changes in sales value of carp,
- changes in price of production factors (inputs),
- changes in profitability of other crop farming,
- changes in profitability of poultry production,
- changes in production and marketing technology,
- changes in prices of joint products with carp, (such as other fish or shellfish, and integrated commodities),
- environmental changes,
- institutional changes such as national policy, state or government programmes.

It is expected that production of carp in Caspian area will become more intensive and will increase in the next few years, particularly in Gilan, where there is a good demand for carp products, farm profitability is higher than elsewhere, and there is a limitation for land to expand carp area. Other areas are also likely to commence production, but production growth in Khuzestan will depends on productivity growth of feed and fertiliser. The availability of natural resources in Khuzestan are most attractive for future expansion, and a development strategy may be focused here, the main constraint being the higher cost of production and low profitability of farms.

If the cost of feed and fertiliser can be reduced through improved feed quality and farm management, Khuzestan and the largest farms in Gilan may become more attractive. With moderate natural resources and profitability, development is also suitable in Mazandran. The choice of development strategy will depend on both location and profitability.

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man/day/ha in farms between 1 to 5 ha, to 63 in farms between 20 to 50 ha and productivity of labour

Changes in the price of production factors

An increase in the price of fry/fingerling, feed and other inputs may result in decreased output, and vice versa. Over the FFYDP, increased prices of feed, labour, energy, and pond construction have had a negative impact on carp production, and the price of basic inputs may steadily increase over coming years. If all other factors remain constant, only increased productivity of inputs may help farmers to continue, and /or establish new farms.

Changes in profitability of other crop farming

In areas where carp culture can compete for primary resources with other crops, farmers are likely to allocate more resources to more profitable competing enterprises. In Gilan province over the 1984-87 period, farmers have increased the area devoted to carp culture while decreasing rice production area and conversely by 1991. Competition between rice and carp culture will continue in Caspian area, however, new technology and better forms of integration may make these sections more complementary.

Change in production and marketing technology

Over the last decade changes in technology have brought rapid gains to the aquaculture industry world-wide. Recently, developments in fingerling production and hatching techniques have resulted in some farmers in Gilan producing on-farm stock instead of depending on a central source. New methods of aeration, feed quality, harvesting, processing and handling have also resulted in increased supply of fish, and improvements of these methods, and factors of production and marketing may increase the quantity and quality of fish available year round throughout the country.

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increased from 20 kg to 47 kg respectively.

Institutional and legal issues

Since 1984, with Governmental programmes including; availability of credit, and subsidy inputs (such as fingerling, feed and fertiliser and energy) have had a positive impact on fish supply. However, In 1991, with the decline of rice production, the State Governor limited the rise of carp farming in the province of Gilan, with a negative impact on carp supply. Expansion of Shilat's regional offices have started since 1992 in inland provinces, and these may help local people and other investors to establish aquaculture and improve productivity of open-water bodies. In 1996, the Shilat's law was approved by Parliament and additional regulation subsequently approved by the national Cabinet, which will positively influence carp production. Increased credit access to low interest, insurance of products and availability of basic inputs such as land and energy, improved and better supplies of feed and other required equipment will also positively influence supply. Regulations such as tax exemptions for production and export will also increase supply, especially at earlier development stages, by attracting investors.

6.4 Market development

6.4.1 Introduction

As earlier noted, over the 1982-93 period, the share of household expenditure on fishery products to total animal protein (TAP) increased from 7% to 11% in urban areas, and remained stable in rural areas. According to Abzigostar (1996 *op.cit*) the lower income group consume approximately 34% of average levels (~1.5 kg capita^{-1} yr^{-1}), whilst the higher income group consume twice the national average (~9 kg capita^{-1} yr^{-1}). The major markets for carp products were found in the Caspian area and Tehran province, though with whole fresh and whole frozen product the respective preferences. Over the past decade, urbanisation, an increased awareness of health and an increase *per capita* income appear to have led to greater demand for fishery product and for carp in areas where capture fish are less available in particular. A *per capita* decline of other animal meat supply may also have contributed to this trend.

Demand for processed carp such as gutted fresh and/or frozen fish, fillet and smoked forms appears to be increasing in larger cities in general and in Tehran in particular, and recently such high-valued product (HVP) of processed carp were successfully supplied in food chain supermarkets (Beheshty, 1998 *op.cit*). However, traditional markets, which represent the bulk of fishery product remain focused on whole fresh and/or frozen fish. The potential for carp to meet increased demand has already been noted, whether for higher value markets, or as a more staple sources of protein. On the basis of the market and consumer data developed in chapters 3 and 5 and in the light of supply and production cost projections of the previous sections, the purpose of this section is to attempt to identify key aspects related to market development for carp and its products. The analysis starts with market margins, followed by general variation related to fish consumption. Current trends in competitive products, followed by market potential and potential for future market development for carp product are also to be addressed. Overall, the main objectives are to assess whether cultured carp have a significant place in these markets, what quantities might be appropriate to supply, where and when it might be supplied, which form might be supplied and what price levels might hold?

6.4.2 Retail prices and market margins[83]

The purpose of this section is to consider the potential retail price levels of expanded carp supply. Market margins of various carp species are different, grass carp sells at higher prices than silver carp which in turn is higher than common carp. These differences appear to be related to taste preferences, texture/bones, convenience, image, and tradition. However, positions and movements in demand for carp and its price cannot be understood without reference to the capture fish market, particularly for Caspian bony fish. In the Rasht market, over the peak of kutum fishing, the price of all cultured carp species declined. As shows in Table 6.11, market location is also important; the price of carp is usually higher in Tehran than producer provinces at all levels of sale. On average, over the 1996-97 period, in Tehran retail prices of common carp were 38%, silver carp 19% and grass carp ~5% higher than in Gilan. The small price differences for grass carp are due to its relative importance in Gilan.

Table 6.11: Retail price (R kg^{-1}) of carp species in Gilan and Tehran over 1996-97.

	Gilan (Tehran)		
Season/Species	CC	SC	GC[a]
May-Aug	3078 (4036)	3811 (4477)	6467 (5722)
Sep-Dec	3116 (4979)	3814 (5604)	6067 (7503)
Jan-March	3498 (4165)	4192 (4180)	6507 (6787)
Apr-Jun	3122 (4517)	4147 (4499)	6232 (6627)
Average[b]	3174 (4389)	3950 (4703)	6328 (6561)
Average Tehran of Gilan (%)	38	19	~5

[a]: Demand for grass carp is very high in Gilan, particularly over the off season of kutum. Gilan is a tourist area over this time and the quantity contribution of grass carp to total carp production is also low, suggesting the higher demand in Gilan province.
[b]: weekly average over the May 1996- June 1997.
Note: Since September demand is starting to grow, however, over the Jan-March both demand and supply do so in Tehran. The quantity contribution of common carp declined over the last decade, whilst its demand increased, suggesting the relatively higher price in Tehran market.

[83] - Market margins are the differences in price, and margins can occur at various points. E.g. according to Lee, 1981 and Smith, 1981, the difference between consumer and farm-gate prices, known as the marketing margins.

Over the Jan-March 1997 period, on average, farm-gate[84] prices were 20% (CC), 23% (GC) and 21% (SC) higher in Gilan than those in Khuzestan, while differences between Mazandran and Khuzestan are negligible.

The output from producers moves through marketing channels, representing product flows, though the length of channels may strongly affect margins. There is usually some means of price exchange with which these points are linked together, and varying level of price corresponding broadly to the levels of risk taken by the intermediate.

Table 6.12: Margins in distribution of whole fresh carp (Jan-march 1996) in Gilan.

Price[a] (R kg^{-1})	Level	% change
3600	Farm-gate price	--
3780	Wholesaler buying price	5%
	Wholesaler margin	10%
4158	Retailer buying price	--
	Retailer margin	15-25% of cost
4782-5198	Retailer selling price	--
	Total margins	30-40%
	Retailer price in Tehran	15-25% higher than those in Gilan
5499-5978	Retailer selling price in Tehran	--
	Total margins	45-65%

[a]: Average CC, GC, and SC. sources: CDSD, 1997[a] *op.cit* and 1997[b]; (Modiry, pers. com. 1998).

Table 6.13: Margins in distribution of gutted frozen carp (in 1995) in Tehran[a].

Price (R kg^{-1})	Level	% change
2196	Farm-gate price in Mazandran	--
	Wholesaler margin	50% of cost
3294	Retailer buying price	--
	Retailer margin	15-30% of cost
3788	Retailer selling price	--
	Total margins	65-80%

[a]: Average CC, GC, and SC, source: (Modiry, 1998, Pers. com. *op.cit*).

[84] - farm-gate sales might be at higher prices than would be gained by selling through wholesalers.

Table 6.14: Margins in distribution of fillet of silver carp (in 1995) in Tehran.

Price (R kg^{-1})	Level	% change
2400	Farm-gate price in Mazandran	--
	Wholesaler margin	60% of cost
3840	Retailer (supermarkets) buying price	--
	Retailer margin	15-30% of cost
4416	Retailer selling price	--
	Total margins	75-90%

Source: (Beheshty, Pers. com. 1997).

In Tehran, the margins were higher than those in Gilan, where the supply of capture fish strongly affect carp prices. As Table 6.12 shows, for whole fresh carp, in Gilan a margin applied at each point, ranging from ~5% at farm- wholesale level, ~10% at wholesale-retail level and 15-25% at retail-consumer level, and final sales price in Tehran is typically at a 45-65% margin above paid to the producer. As Tables 6.13 and 6.14 show, respectively, final sales price for gutted frozen and fillet are typically at 65-80% and 75-90% margin above the price paid to the farmer. Overall, final sales price in Tehran is typically at a 45-90% margin above the price paid to the producer, while that in the Caspian area, usually based on whole fresh fish, is typically less than 50%. As shown in chapter 3, 10-20% of products were direct farmer-retailer sales; though, there is no data available on margins, some evidence suggests that this would be less than 20% (Kazerony, 1998 *op.cit*).

Consequently, the standard margin which the wholesaler in Rasht[85] would have received is 10%, but in Tehran the fillet and gutted frozen were sold comparatively higher with highly marginal (50-70%) yield and costs to cover. Retailers within the sector may operate on margins of 20-50%. As showed, cheaper fish (CC) are often subject to a higher margin than those bought at a higher price (GC). At present, demand for carp is modest, and the extent to which this might increase would be critically dependent on the ability of producers to reduce production costs and on additional marketing efforts to be undertaken. The latter might be achieved through developed marketing channels such as supermarket chains and new expanded markets, which might be expected to increase in coming years.

In Tehran, the number of intermediates increased, together with marketing margins. At present, processing activities are not important in most markets, as only 6% of carp is sold in processed form. However, variations in quality between supplies affect prices received, and with the average trends, there are often special price features for different sizes of fish, where in general, larger sizes command higher prices. It also appears that various species and product form have different margins.

The future development of market infrastructures, transportation, standardisation and market intelligence may affect marketing margins. In other inland provinces, despite a decline in quality of carp product (mainly frozen, but thawed and sold as fresh) marketing margin increases. However, the development of carp culture in new areas may change these margins.

As shown in section 6.3, cost of production varies between location and categories, and farmers need an acceptable level of profitability to continue and develop. Consequently, the final sale price is typically almost 50-100% above the price paid to the producer, though, added-value products may increase this margin. As the consumer study showed, lower prices would play an important role in increasing carp consumption. As Figure 6.16 and Table 6.15 shows, over the 1993-96 period, price of carp species declined in

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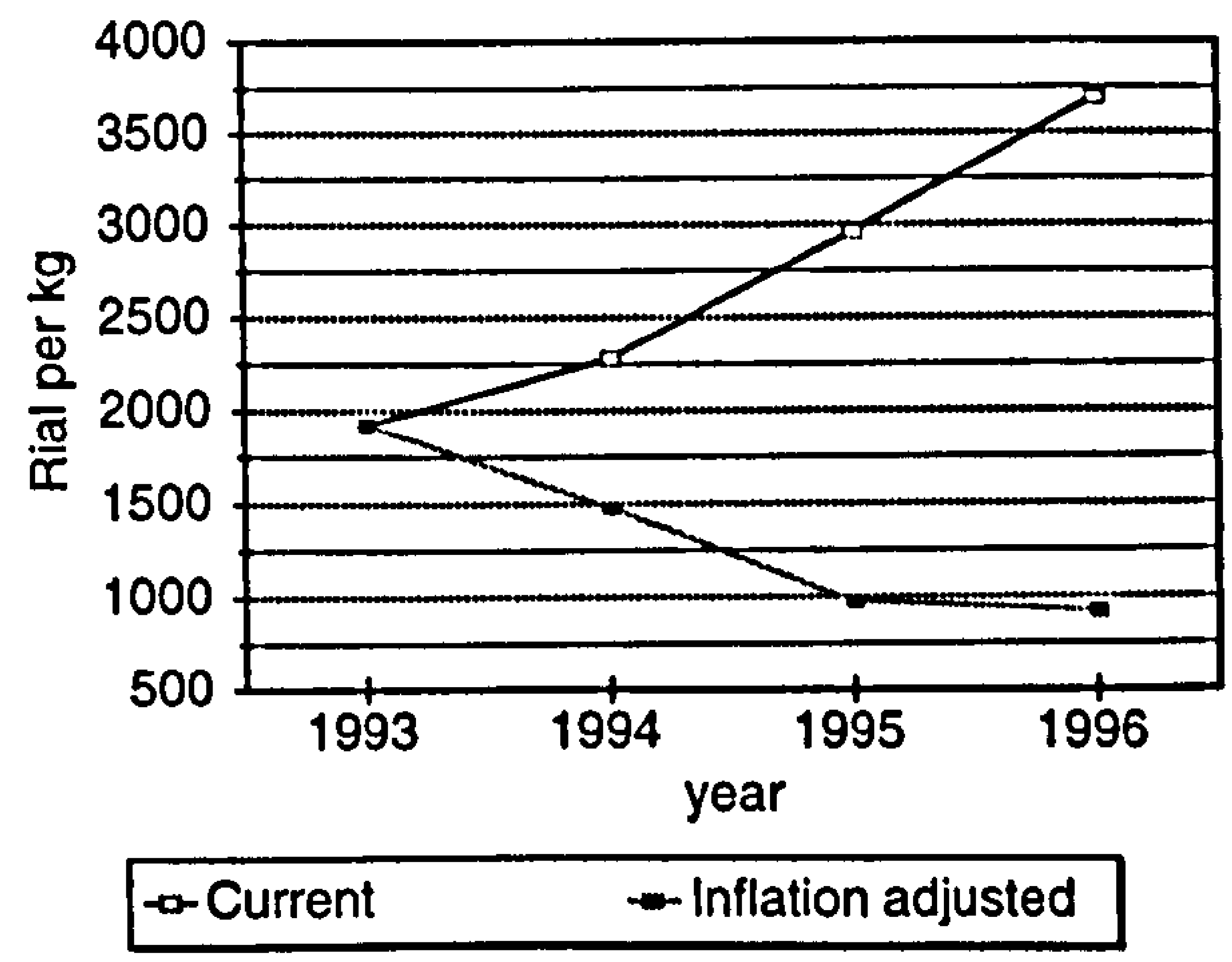
[85] - Centre of Gilan province.

real terms[86]. Though since 1995, inflation declined, and demand increased, and these two factors had a positive effect on the price of carp. Over the 1993-95 period, on average, the real price of Caspian bony fish declined (a little more than that for carp, except kutum). This appears to have been mainly due to increased supply and high competition between carp and Caspian bony fish. Prices of Persian Gulf and Oman Sea species remained almost stable, probably due to increased post harvesting facilities in the S, illegal exports of high-valued species to neighbouring countries, as well as a decline of demersal species. Consequently, average annual percentage price increase for carp species was lower than that for inflation rate.

Figure 6.16: Current and inflation adjusted wholesale prices for carp 1993-96*.



*: Based on average wholesale prices of CC, SC and GC in the Caspian area.

Table 6.15 : Wholesale price of carp species (R kg^{-1}) in the northern provinces.

Category (R)	1993	1994	1995	1996	Current average annual growth (%)	%age change[b] over the 1993-96
CC	1392 [100][a]	[110]	[155]	[195]	26	-37
GC	2833 [100]	[116]	[151]	[180]	22	-47
SC	1543 [100]	[130]	[162]	[212]	28	-25
Inflation	[100]	[135]	[201]	[250]	35	

[a]: [1993=100], [b]: compared with inflation growth rate.

86 - In 1995, compared with average price of almost 30 dominant species from the Caspian Sea, the Persian Gulf and the Sea of Oman, average is unweighted (consider 30 species=100, CC=57, SC=66 and GC=112).

6.4.3 Positioning of carp products in the markets

The principal consideration in positioning carp and its products in the market is the requirement to achieve an acceptable price for potential consumers at the scale of supply intended. Positioning will be affected by high demand, traditional consumption and unavailability of year round supply. Different species and products may be positioned in different points of the market. As can be seen from the price data presented in Table 6.16, the current price of carp is almost lower than that for Caspian bony fish, where relatively high prices are associated with unavailability on a year round basis. In the Persian Gulf area illegal export to the Arabian countries of key demersal species such as white and black pomfret may also be a factor. However, scarcity and unpredictability of supply may contribute to the relatively high demand and corresponding high prices for Caspian bony fish. With expected increase in supply for carp, as well as decreased supply of the Caspian bony fish, price differences between carp and the Caspian bony fish might be expected to increase over coming years.

Table 6.16: Wholesale prices (R/kg) of Caspian bony fish and carp species in Caspian area.

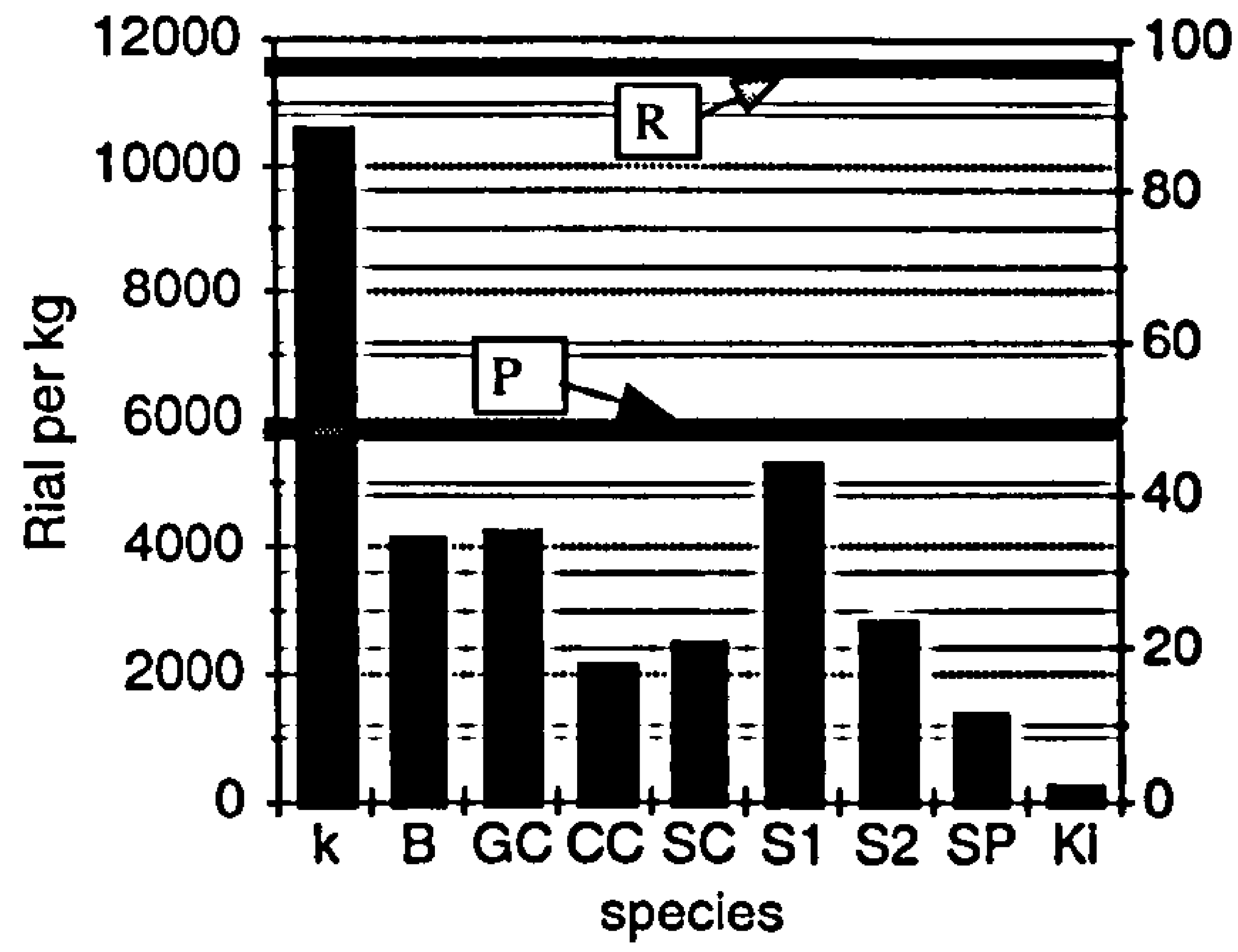
	1993	1995	% change over the 1993-95 (current price)	%age of average price of all species[b] in 1995
kutum	6164	10589	72	276
mullet	2993	5078	70	132
Sea carp	2560	3113	22	81
bream	3685	4067	10	106
perch	3436	5565	62	145
roach	3058	4574	50	119
kilka[a]	115	257	123	7
shad	1258	1384	10	36
pike	2085	2496	20	65
CC	1392	2155	55	56
SC	1543	2497	62	65
GC	2833	4269	51	111
Average	2594	3837	48	100

Source: CDSD, 1997[a] *op.cit.*

[a]: Due to increased demand for fishmeal the price of kilka increased higher than that for other species, as well as demand for its human consumption is also growing.

[b]: Assume average price of all species noted above is [100]; average is unweighted.

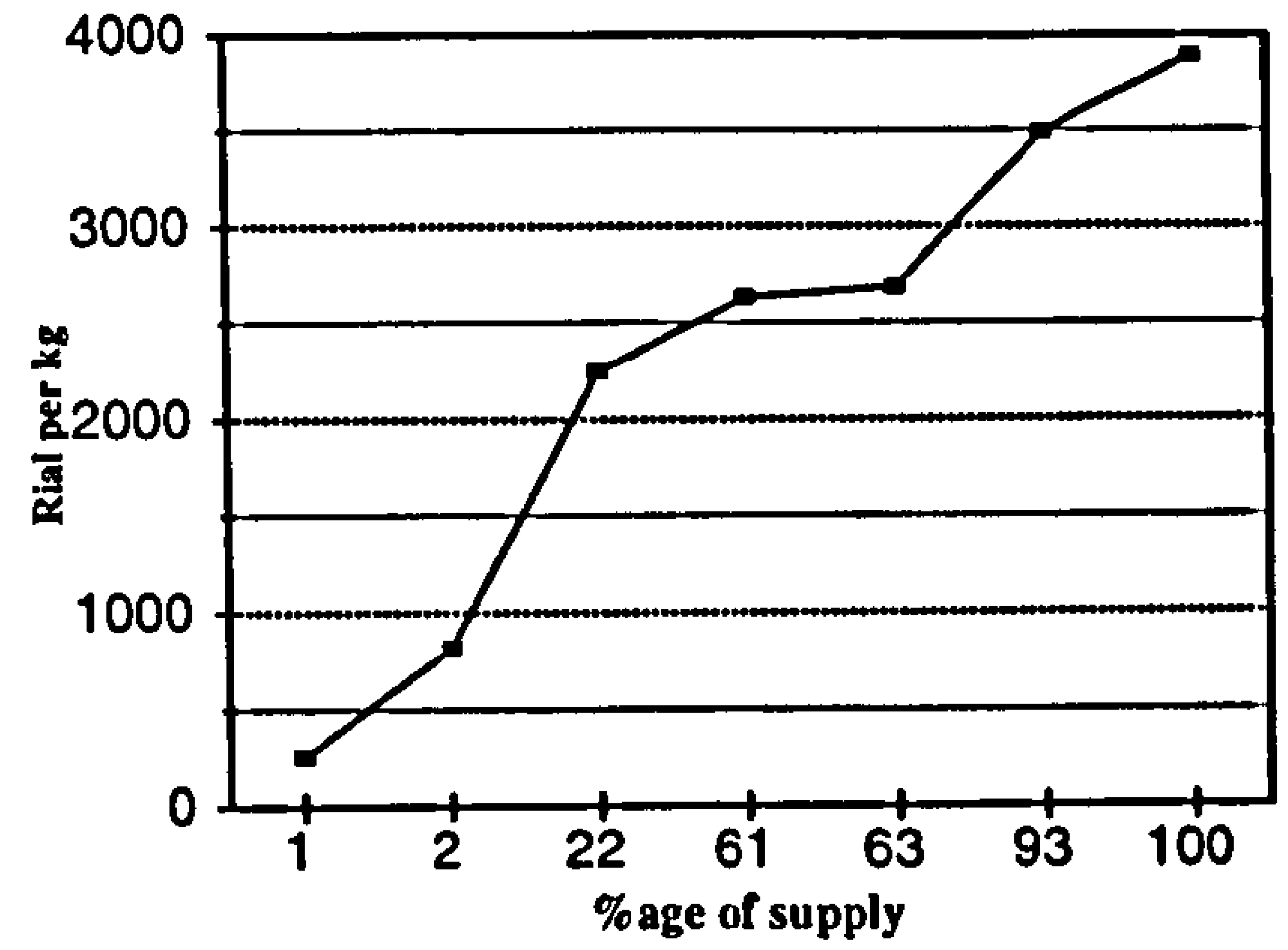
Figure 6.17: The price of fish species in 1995



R: red meat, P: poultry, K: kutum (~ 8,000 t), B: other Caspian bony fish (~ 7,000 t), GC: grass carp (~ 6,000 t), CC: common carp (~14,000 t), SC: silver carp (~30,000 t), S1: Southern high price species and tuna for export or canning, S2: Southern mid and low price species- more than 50% consumed in S coastal provinces, SP: small pelagic species- human share ~ 2,000 and Ki: kilka- human share 2,000.

As shown in Figure 6.17 the price of different carp species also varies. Due to traditional preference and high demand for red meat and poultry, and insufficient supply, their price rate increase was higher than for fish (on average 3-4 times and 2 times as high as for fish), suggesting that the growth of fishery product supply has reduced its price gain. As Figure 6.18 shows, the price of 37% of capture species were higher than that for carp and except for grass carp, this may be increased to more than 50%. Overall, due to reduced supply of high and middle high price capture species and improved handling for these groups, the price of carp species might be expected to stay at the same position over the next few years. or possibly improve.

Figure 6.18: Cumulative %age of supplied species and their prices in 1995.



Highest price includes kutum, white pomfret and threadfin (7%), other Caspian bony fish, other southern higher and middle high price species and tuna groups (30%), grass carp (2%), southern middle and middle low price species (39%), common and silver carp (20%), lowest price includes kilka and small pelagic (~2%), excluding other groups such as shrimp, cuttle fish and lobster, mostly exported.

6.4.4 Target prices, margins and retail costs

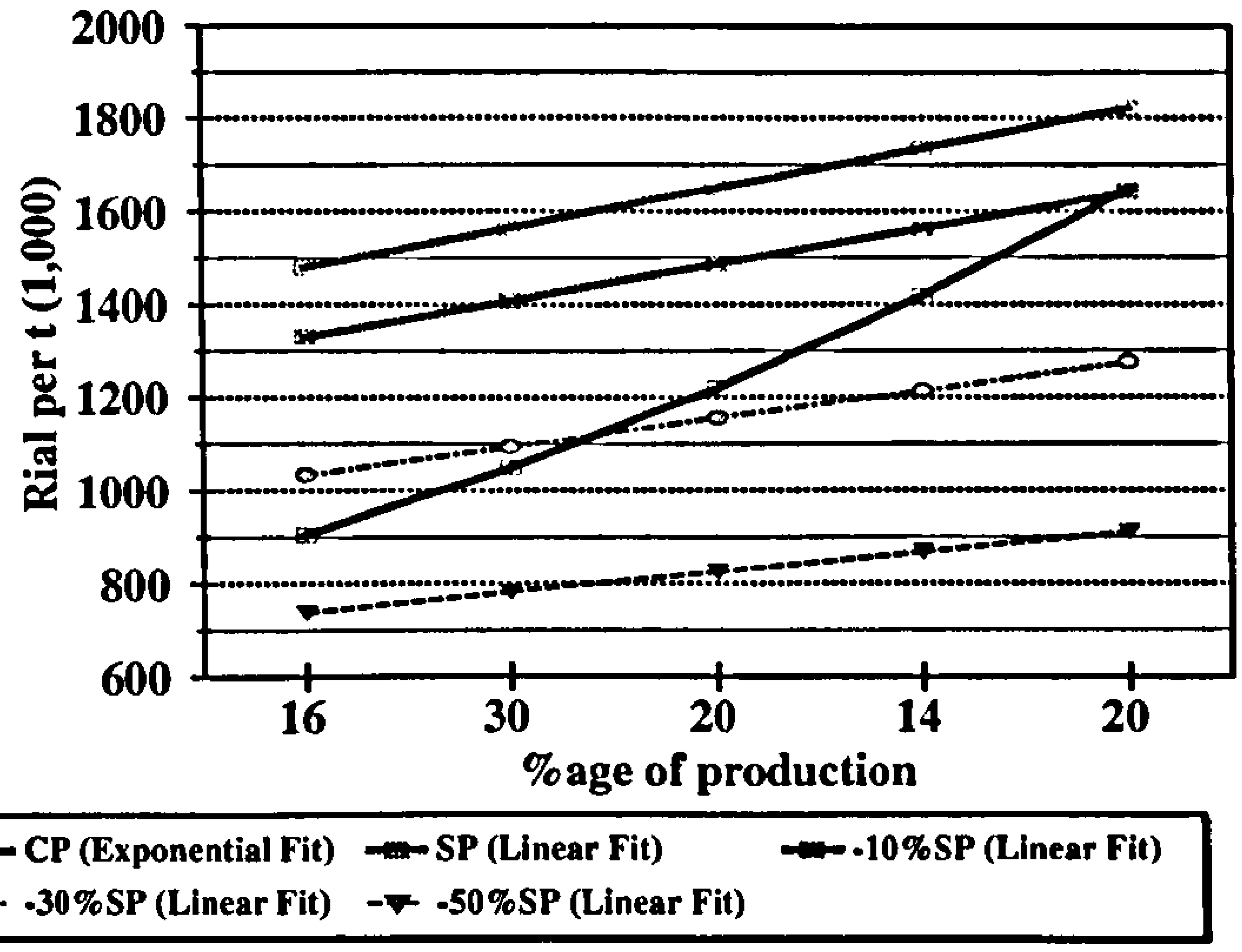
Table 6.17: Production Cost and selling price (farm-gate) for different categories (R/kg).

%age of production	16	30	20	14	20
Cost of production (R/kg)	919	1054	1177	1419	1672
Selling price (R/kg)	1401	1712	1652	1594	1889
Margin (%)	52	62	40	12	13

Source: Chapter 4

As Table 6.17 shows, 16% of carp production has a substantially lower production cost than other categories. Although their profit margin is not very great, it allows adequate returns to producers (52%). Margins for efficient producers (30% of production) appears favourable (62%) and for 20% are still adequate (40%), 34% of production on the other hand are currently faced with lower margins (~13%), and are more vulnerable.

Figure 6.19: Projected market price for carp.



CP: Cost of production, SP: Selling price, and -10%SP: -10% reduction in selling price

As Figure 6.19 shows, with a 10% reduction in selling price, the margin for this group (34% of the supply) will reduce to an unattractive level of <2%, but for 66% of the supply, conditions may still be attractive. For a 30% decline in selling price only 46% of supply will remain profitable (30% of this only marginally). However, by changing species mix and increasing contribution of grass carp better market prices might be attained. It may also be useful to attempt to add-value to meet changing demands.

As Table 6.18 shows, the projected price for the consumer is estimated at between R 1,655 kg^{-1} and R 4,012 kg^{-1}. The final price for almost 34% of production would be relatively high and for last 20% of production, even with 50% margin, is extremely high. Some 66% of production may have an acceptable market within or out of the producing province, with a price which would be attractive for low and middle income groups, employees and inland populations.

Table 6.18: Cost of production and margins for different categories (R/kg) of carp farming.

%age of production	16	30	20	14	20
Cost of production (R/kg)	919	1054	1177	1419	1672
+20% producer profit	1103	1265	1412	1703	2006
+50% cost+margin	1655	1898	2118	2555	3009
+100% cost+margin	2206	2530	2824	3406	4012

6.4.5 Market development

As shown in chapter 5, at present, on average, only one-third of the population consume fish all year round, though with a significant variations within different subsectors, with income, coastal birthplace, youth and education having a positive impact on year round fish consumption.

For the two-thirds who consume less regularly, this pattern may initially be related to fishing season, inadequate marketing facilities and a lack of supply, particularly for inland population, and expanding consumer preferences and changing attitudes to choosing fish protein will be the strategy to develop the market. The development of marketing infrastructures such as storage, improved transportation, processing plant, supermarkets together with factors such as market intelligence, product quality standards and greater product range, may also be important for market development. Extending the period of availability and expanding new markets, particularly in larger cities, is likely to increase year round demand. All the above noted items have started to improve, particularly since the FFYDP, might be expected to develop and extend in coming years. Thus, a variety of products supplied year round may be expected to positively affect demand. Younger consumers and urbanisation, increased educational levels, rising *per capita* income and declining price may also increase year round consumption. However, while this perspective is quite clear, much depends on developing, year round supply with high quality and diversified products. This will be particularly important, where the majority of farms harvest only annually per pond, or even per farm in the autumn or early winter, a bulk of production entering the market in a short period.

Prices and availability of substitutes

In general, the demand for a commodity is affected not only by its own price, but by prices of many other commodities and services. However, Gordon, Salvanes and Atkins (1993) determined that price variations for farmed salmon do not determine or influence price variations in wild-caught fish, indicating that strategic pricing and marketing of farmed salmon need not be restricted by variation in supply of either a high-valued turbot or a low-valued cod. As noted in chapter 3, in Iran, when the price of red meat and poultry increased the demand for fish also increased and inversely. In the Caspian area over the peak of capture fishery, increased supply affected not only the Gilan market but also that of Tehran, and demand for cultured carp decreased.

An overall assessment of market development for carp and its products

In broad terms it might be anticipated that consumption of carp and its products would be inversely related to its price, positively related to the price of competing products (mainly fishery products and particularly Caspian bony fish) and *per capita* income, as well as being affected plethora of influences that dictate the individual's preference for the product. Considering present trends, urbanisation, expanded and developed market structures, increased income and educational level will increase future consumption.

Existing opinion within the market and the evidence of the study, suggests that the carp will need to compete with, and on average be priced at a level some below Caspian bony fish. However, in Tehran and other larger cities in inland provinces it might also compete with demersal and large pelagic species of Persian Gulf. Dramatic increases in the supply of these wild species are unlikely to occur. Thus, regarding marketing price, compared with cost of production, the general reaction to carp and its products appears favourable. The extent to which market share might be increased would be critically dependent upon additional marketing efforts and a decline in cost of production.

6.5 Development perspectives

6.5.1 Introduction

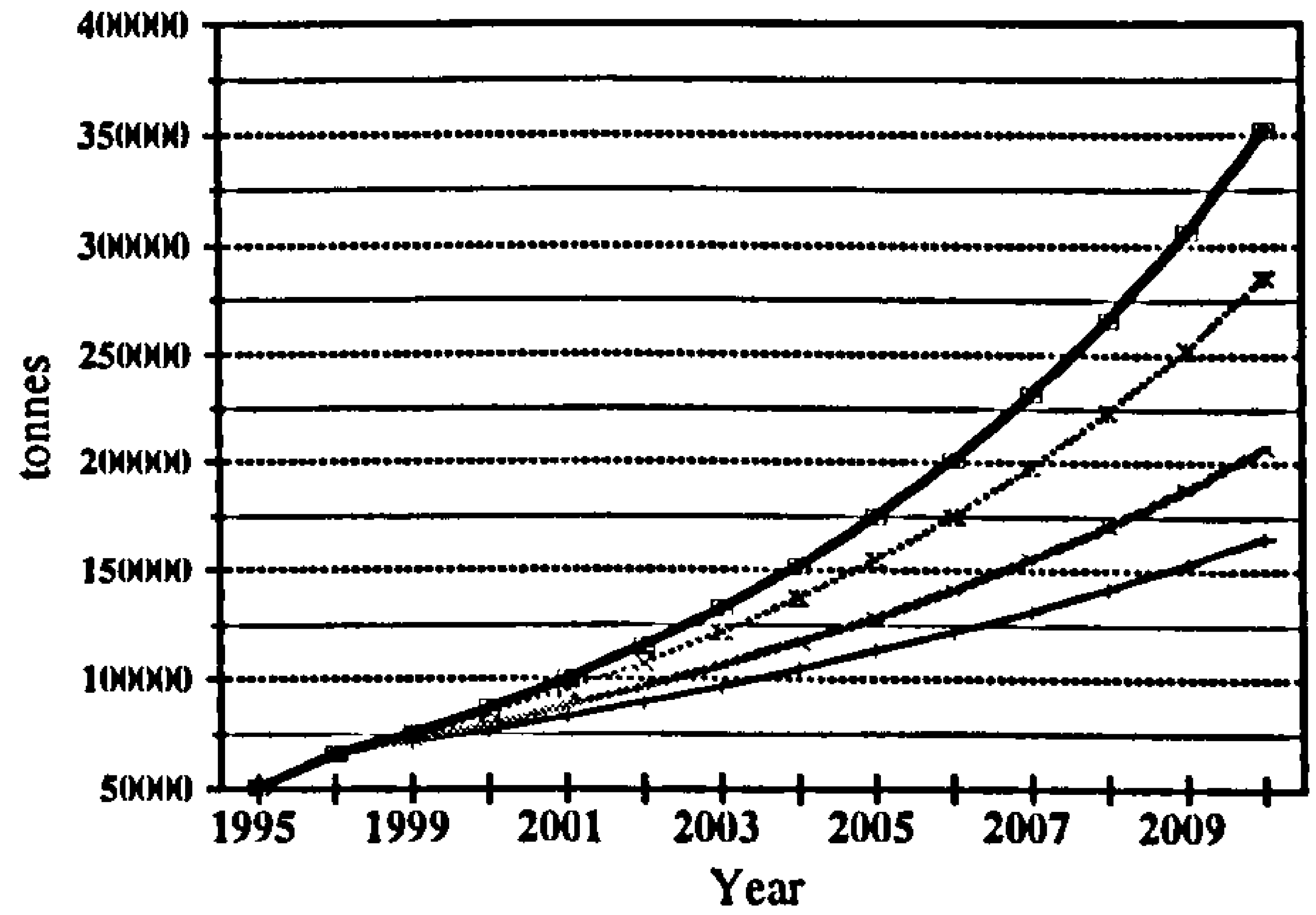
To provide a practical perspective on implications of carp culture development in Iran, a range of supply/demand scenarios have been presented, offering projections for the year 2010. Actual production/consumption is likely to vary around such projections, but those figures may be used as a framework for future development decisions, and to judge priorities for policies. These possible outline of key 'dimensions' of findings and projections have been based on survey data for producers and consumers, and have used selected growth rates, based in turn on assumption made from the production/consumption trends.

For a development strategy in support of cultured carp, much would depend on the potential scale of supply and the potential demand, which would be created to absorb such supplied quantities. The relatively undeveloped market in most areas may offer acceptable but not generous prices for local supplies. This may be useful for smaller scale units in local areas, but would require larger units to distribute products to a number of outlets, particularly in larger cities, based on a lower price level.

6.5.2 Production strategies

Opportunities exist for increasing carp production, mainly by increasing yields in existing farms and open-water units, expansion into new areas, and integration with other agricultural activities. However, as noted, the creation of new markets and the stimulation of additional demands will be more important. Any significant increase in new areas primarily depends on availability of land and water resources. Based on primary study by the Aquaculture Department for the year 2020, at least 50,000 ha is available throughout the country and could potentially be used for polyculture based carp farming. Production scenarios based on current trend productions increase (8%), accelerated productivity (10%), expanded area + base productivity (13%) and expanded area + higher productivity (15%) is shown in Figure 6.20.

Figure 6.20: Production scenarios based on 8%, 10%, 13% and 15% annual growth rate in 2010.



In addition, soil-dam, integrated with agricultural activities, open-water-bodies such as Horol-Azim, Hor-e-Shadegan, Hamon Lake and a lot of other small natural water-bodies may also be used to increase production.

The culture of carp is technically possible in a variety of conditions within the country. Newly developing producer provinces might be Khuzestan, E-Mazandran, Ilam, Kermanshah, W-Azarbiajan and Sistan, which the water and climate is suitable and 5-6 t ha^{-1} production may be attainable. However, if present conditions continue, profitability in some areas may be questionable.

A useful strategy may be to integrate with other agricultural activities and intensify smaller farms in the Caspian area, for which there is adequate input resource but a greater land constraint. However, while many rural people could receive economic benefits, employment would be relatively small, and production could be undertaken as a part time activity. Since there is a huge potential of natural resources, particularly, land, water, climate and agricultural wastes in Khuzestan, the strategy for this province could be based on larger-scale commercial production (at least >5 ha). However, the profitability of carp farming might be questionable, particularly related to cost of feed and fertiliser, and at present, a greater constraint of lack of skilled staff and inadequate supply of fry/fingerling. Recent investments in hatchery production and training might be expected to solve these constraints in the province.

Overall, the potential for year round production of at least on adequate quality, with a range of products, might be expected to permit significant changes in the way in which consumer demand in different groups is met. Additional production at similar (real) levels of production cost as at present might be attainable, particularly by improving productivity, and the difference between categories might be expected to reduce if all subsectors reach similar levels of productivity. Levels of production involved will have a substantial effect on supply, which will have to be co-ordinated with market expansion and diversification of products.

Credit for farm establishment and operational production, and a strategy to improving and expanding extension services, fish breeding and hatchery management practices for mass and safe fingerling production, fish nutrition, and feed development and feeding practices may be needed.

Implementation

The province of Gilan, and farms <5 ha, particularly in Gilan, are the most profitable with the following factors;

1 the background of cultured carp in Gilan with environmental and topographic sustainability,

2 availability of aquacultural experts in Gilan,

3 local markets,

4 governmental supports in the form of credit, subsidy inputs such as fry/fingerling, chemical fertiliser, and feed,

5 the effect of training, research and extension services from Shilat to farmer in Gilan over the last 4-5 years,

6 availability of fingerling at different size and species, from Shilat and private hatcheries,

8 better management within smaller farms,

9 use always of larger fingerling, which reduces mortality and results in a larger market size with higher prices,

10 use of agricultural wastes as feed and fertiliser, which reduces the costs of production, and may improve productivity, and

11 operation of aquaculture as a part time adjunct to agriculture activity, thereby reducing the price of labour.

Most of the above noted factors, may be possible to apply to varying degrees regarding location and categories to increase profitability of farms in other areas, particularly Mazandran, followed by other provinces. However, this will strongly depend on the availability of inputs, particularly natural and human resource.

As noted earlier, the real scope for supply will depend on the potential margins for the farmer, and the success of carp farming depends on its profitability. As there is as yet very little carp culture production in inland provinces, the development of a significant production sector if viable, may take more time, even if infrastructure, legal and market factors are positive. However, in new production areas, progress might be made if small-scale farmers can significantly manage their own farms, after which market potential might be the most critical indicator. The highest priority for increased and sustainable profitability might be to develop consumer confidence and satisfaction in products.

In broad terms the policy for carp production might be directed towards the following objectives in order of priority:

- improving productivity from existing farms through creating effective extension services, developing a strategy for cost-effective use of feed and fertiliser for improving per ha production, and reducing cost of production per kg, integration (vertically, particularly with fry and fingerling and/or horizontally with animal husbandry, multiple use of irrigation water and other agricultural activities such as rice) and improving and expanding fish breeding. Based on annual growth rate of 10% or target production of 210,000 t, total production might be estimated at ~45,000 t.

- expanding the areas under carp culture where land and water are available and climatic conditions are favourable (such as Khuzestan, Ilam, Kermanshah, E-Mazandran, Sistan and W-Azarbiajan). Based on target production of 210,000 t, total production might be estimated at ~115,000 t.

- increasing the productivity of natural and semi-natural water bodies by mass propagation of carp fingerling, improving management, using cage or/and pen culture. Based on target production of 210,000 t, total production might be estimated at ~50,000 t.

- considering the main three provinces; the priorities of expanding new areas will focus on small scale integrated carp farming in the Caspian area and large scale commercial farms in Khuzestan and E-Mazandran (expanded large scale carp farming mainly depends on reducing the cost of feed and fertiliser).

Short term production potential

In the short term, in order to expand cultured carp production, it may be necessary to increase technology and/or improve the management skills, developing and applying methods that can cope with restrictions of reduced resources, increased quality control and reduced resource quantity. An increase in management input to improve feeding and fertiliser strategies, reduce stress and increase productivity might be expected to increase production.

In the next few years, several projects which have been initiated throughout the country may gradually become available for production, and it is expected that Shilat will try to help new co-operatives and investors to expand the number and area of farms. Progress may be made in establishing credit facilities for carp farming enterprises through Agricultural Bank and/or other Banks, but the problem of uncertainty of sufficient credit may remain.

Mass propagation stocking in open water bodies may also improve productivity of this large potential, while existing farms may double through improved productivity as has been initiated over the last 2-3 years. Through such means a doubling of yield, particularly in those that may use processed feed and/or aeration may be possible in next few years. However, costs of input might be expected to differ in categories and locations.

6.5.3 Marketing strategies

The survey concluded that carp is more likely to attain a position in the processed form (mainly gutted fresh and/or frozen, fillet and others). This is particularly the case in inland provinces, apparently due to inadequate handling facilities from farmers to customers, which in turn caused inadequate and unacceptable quality. To develop markets beyond the present level of supply, particularly to expand sales outside the current ranges, would require a far more developed and organised approach to marketing. Where market structures are themselves more organised (particularly Rasht in Gilan and Sarcheshmeh in Tehran, both with longer background, mass distribution and better infrastructures), this may not be so much of a problem, but where this is lacking, (all inland provinces, particularly larger cities) buildings are not really available and *per capita* consumption is low. In the shorter term, the case for such market development may be difficult to justify, and it would be unlikely to make much impact unless it were part of a much larger market development.

If it is assumed that cultured carp has become established as a meat protein with high quality and that a level of awareness and product recognition has been generated for its higher valued products, the obvious route to further development is to supply more into the retail sector, with variety of quality products. The supermarket chains, such as Qods, Etteka, Shahr-o-rosta, Shahrwand, Farhangian co-operatives and other retail markets may presently be confined to higher quality specialist products. The volume that can be traded through such outlets is finite however, and beyond some point a larger market of consumers oriented to quality but not luxury needs to be targeted. This consumer group is readily reachable within the all supermarkets and other modern retail outlets and requires a suitable and consistent quality range of products. While the above noted supermarket chains are usually supplied from large producers, other supermarkets can be supplied from wholesalers, other distributors or even producers.

A critical point is to provide a solution to a number of consumer's traditional negative attitudes associated with fish, for example, can avoiding the smell (especially common carp), wetness and sliminess often associated with fish, and enabling the product to be treated much in the same way as any other meat. Development of the catering sector such as universities, army garrisons, hospitals, schools, snack shops, fish and chip shops, and etc. are another aspects which could be considered. In the longer term there are many opportunities to add value; fillets, smoked product, vacuum skin packs, boneless, even gutted fresh fish represent potential means of extending the product range. However, at present, existing producers and processors do not generally do this.

Further expansion would also be conceivable by developing more sophisticated products such as prepared convenience dishes, and also a variety of packaging options. A higher volume standard item outlet, such as cannery product may also provide stability and a constant market and may be targeted as a staple, or even as a specialist sector- e.g. in sauces, smoked, etc. The potential for such new products are unknown, though, market study could establish to know about potential consumer acceptance.

Consumer preferences may also be influenced by the actions of the suppliers and distributors, and there are various ways in which such activities could be organised. For instance, work on quality control, product diversification and new product development is particularly important since it contributes directly to making carp products more attractive for various consumer groups. Improved post-harvest and handling standards may also influence the market. Promotion is other major way in which farmers and distributors could help to stimulate demand for the products.

The result of market surveys and exhibitions by Shilat in some provinces suggest that opening and expanding new markets in concert with steady and constant increases in production could stimulate and maintain demand. It might also be expected that expanding cultured carp supply during the off-season for the Caspian bony fish (March-September) would increase overall demand, as there would be no significant fish competition for cultured carp. In the areas where consumers eat considerably more chicken, as a result of a move towards healthier sources of protein and away from red meat, similar health advantages may be prepared for cultured carp. While, market gains are available to cultured carp through direct competition with other protein sources, trends to increase consumption of low cholesterol foods may well add to the carp products.

As noted in sections 6.1- 6.4, the growth in positive factors affecting consumer demand may be expected, demand is not yet saturated, and potential demand might be expected to increase more than supply, and so future prospects for growth of demand are good. The main threat, to the ability of carp to exploit this growing market share and its profitability lies in the dangers of poor quality and unreliable supply, and in an excessive increase in supplying without diversification of products and a lack of new expanded markets.

Distribution strategies

As in developing markets elsewhere, the traditional wholesale sector can be expected to lose its position as the industry transforms towards contemporary consumer demands. Those firms, which remain can be expected to be more active in satisfying the increasingly specific demands of the markets, improving their own marketing facilities and source product on an ever-widening scale. At the same time, the investment in new plant may encourage other wholesalers to seek alternative ways of adding value by becoming involved in yet more advanced and processed products, at which point the distinction between wholesalers and processors might be expected to decline.

It might be expected that integrated (multiple) retailers and supermarket chains may become increasingly important outlets for processed carp products over coming years. The additional supply and the product range typically stocked as whole frozen would also suggest scope for further market expansion. The growing willingness to buy new processed product forms might be expected to increase overall demands, and within the retail sector there is evidence than Iran is beginning to change and adapt its traditional forms of fish retailing. Comparing existing ranges with the typical product availability in developed countries, quite substantive change in both fresh and frozen forms may therefore be expected, and the role of supermarket chains might be expected to grow. It is also expected that contract sales between producers and modern distribution chains will also develop.

Within the rural areas and smaller cities, it might be expected that where carp culture may be feasible to develop, consumers may increase their ability to buy fresh fish at the farm gate or from local outlets. More modern factories might become established, particularly for processing fish products.

6.5.4 Development strategies

Demand for carp product is projected to remain relatively high because landing from capture fisheries do not appear to be likely to meet increased demand. Even if carp culture production continues the relatively high rate of growth it has achieved annually over the last decade, it will still fall short of projected demands for aquatic products by 2010. The first basic requirements is to ensure that the potential production can meet demand growth in the future, the second requirement is to assist the cultured carp industry to become significantly more efficient and the third is to bring greater market competition through improved handling, processing and marketing techniques.

Shilat may has an important role, though research and development in all noted aspects in supporting the production, distribution, processing and marketing sub-sectors. Support could involve the enhancement of the domestic market, through the creation of an efficient market, the physical construction of new markets in urban areas, appropriate marketing infrastructure and creating value-added products, as well as the development of export opportunities. The expansion of production in new areas where appropriate, and the production of integrated methods could ensure access to low-priced fish by lower income groups and rural areas and smaller urban centres. Increasing efficiency and competition will play an important role in the development of the sector.

A related issues, subject to similar criteria as these discussed earlier, would be a potential strategy for development of other exotic species such as other Chinese and Indian major carps. With readily available culture technology approaches may be made to diversify carp products and to provide farmers with alternative species of better market value. A major screening parameter for these species might be the potential for their culture and locally available inputs, however, this species for introduction would need to be totally evaluated with regard to their utility for aquaculture development and their appropriate for the production and market conditions of the areas concerned.

Longer term prospects

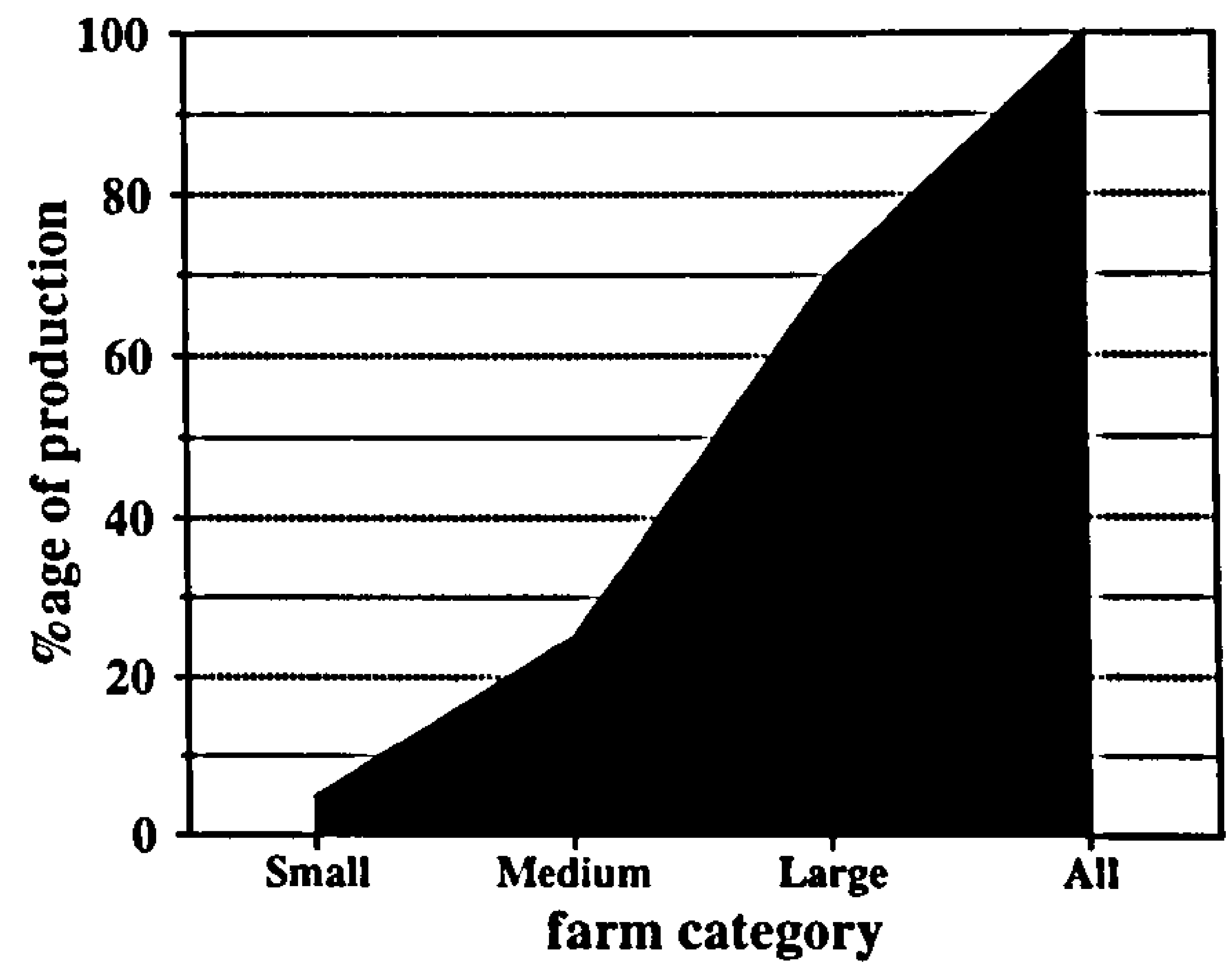
In broad terms, the carp industry might be expected to develop further under two types of concept;

(i) integration and marginal gain, based on modified natural systems and mostly focused on small-scale, family operations, potentially saving local markets and/or specialist retailers,

(ii) economic return, based on commercialised systems and vertical integration, potentially saving larger markets and urban centres.

The former should be developed under the principle of integration with agriculture and animal husbandry in rural and agricultural lifestyle areas (mainly in inland provinces which classifies with low demand), the latter should be developed under intensive methods with vertical integration. The balance of each is given in Figure 6.21. Larger farms might be expected produce 70% of production, while small farms may produce only 5% of production, the balance may provide by medium farms.

Figure 6.21: The balance of each category of farms production in 2010.



Since most small-scale carp farmers are also part-time agriculturists, the integration with agriculture and animal husbandry have special importance and many farmers who keep a few animals could also manage a small carp farm. In the Caspian area, most rice-fields could be utilised for fish culture in a combined system. There are 456,000 rice farmers with 516,000 ha farms, and on average each farmer has 1.1 ha of farm area, some of which could be used for integrated production. There are mainly in the Caspian area, with a tradition and longer background on carp farming.

At present, except for one firm in Gilan, which belongs to the Agriculture Ministry, there is no commercialised carp culture in the country, though, increased demand and specialisation may lead new enterprises to establish vertical integrated firms. However, might be expected these investor groups will belong to the larger co-operatives and joint companies and/or governmental organisations (such as army and other organisation) to produce their own food stuff. At present, rate of farm income (net profit/gross revenue) are estimated at 20%, though, with higher productivity this profitability might be expected to increase and may be attracted new investors. Potential interest for investment in processing and distribution based on present condition might also be acceptable.

Chapter Seven

7. Conclusions and recommendations

The benefits of increased fishery products in the diet of the people are fully recognised by the Government of Iran. Fishery products are also becoming increasingly popular, particularly in urban areas, for high and middle income groups and the younger generations. Fish is frequently less costly than alternative animal proteins, particularly lamb and beef, and suitable natural resources are also available to support aquaculture development. Thus, where and when fishery products are readily available, and/or it may be possible to produce these at acceptable price, they can also become a major protein source for average income and poorer communities.

Faced with static and even declining output of some major capture species, Shilat is increasingly considering aquaculture as an alternative source of fish and shellfish products, and as a contributor of animal protein to food security through raising fish consumption towards the world average. Shilat's goal might be possible to reach through a combination of an increase in area of farms, increased yield per unit area, and through maximum utilisation of the country's varied open water resources. Different climatic conditions and differing availability of natural resources within the country will permit a diversity of production. However, efficiency, acceptable cost of production, market acceptability and demand appears to have an important affect.

The importance of aquaculture in general and carp culture in particular as a means of supplying protein and as a source of economic activity has been addressed in this study. Current production of carp and its growth suggests that this sector might be expected to become increasingly important in coming years, contributing to the local and national economy in a range of ways.

The aim of the thesis has been to consider the nature of carp culture in Iran, its market potential and future perspective for its development, particularly with respect to its possible implications for supply of carp and its product to meet demand. In broad terms, the expansion of aquacultural production has more generally been associated with improvement in hatchery techniques, nutrition, disease management, engineering, and an improved understanding of fish genetics and aquatic ecology. It has also been clearly linked with market development. In Iran, it appears that over the last decade demand for carp products is initially increasing as a result of a relative decline of Caspian bony fish, and increasing in urbanisation, population and economic growth. Nash (1997 *op.cit*) noted bony fish production appears to be levelling off and according to (Shehadeh, 1996 *op.cit*; Nash, 1997 *op.cit* and FAO, 1992[e] *op.cit*) aquaculture is a key factor in the national strategy for increasing fish production in Iran. Overall, aquaculture industry may benefit from research aimed at developing technically viable production systems as did before, improved nutrition, species selection, disease presentation, and water quality management will allow not only widespread establishment of pond facilities, but also the emergence of high production systems.

The study has reviewed a range of carp production systems, from semi-intensive to extensive and from <1 ha to >50 ha in a range of location and production conditions. Yields average 2,784 kg ha^{-1} typically using polyculture system, involving common, silver, grass and bighead carp species. The result from data obtained from the three main provinces and special cases quite clearly demonstrate that carp farming is a profitable activity with an average of 20% rate of farm income. However, the cost of feed and fertiliser dominated all other costs averaging 60% of variable costs, seed 10%, harvesting and post harvest 9%, and water and energy 8%. The present level of using feed and fertiliser seems to be extremely high and it may need to be reduced (or product in kg ha^{-1} increased) in coming years, and with restricted resources of fresh water, development of carp culture may have limited negative impacts on the environment.

An important implication of the cases studies suggest that combined fingerling and grow-out production may make a notable profit for the farmers. Hence, policy makers and managers should place more attention on how the farms with large size can be more profitable, particularly in Khuzestan, where local supply of fingerling may be helped.

Improvement in production efficiency through technical development may have an excellent potential to reduce production costs. According to (FAO, 1992[c] *op.cit*) the cost of feed and fertiliser in Khuzestan could easily be reduced through improved management, and carp farming could be more profitable when the farmer is made aware of certain simple management techniques. Though these suggestions were made based on some personal observations, it should be possible to increase feed efficiency if the knowledge of farmers increase and feed processing plant are established. Considering the suitability of climatic condition and availability of natural resources in Khuzestan, it might be expected that carp farming can be developed if the management techniques improve and if fry/fingerling become locally available.

As noted in chapter 6 estimates of future production vary widely and will be to a large extent dependent on the ability of producers to reduce production costs and on the potential for markets to be developed, as has been the case elsewhere, where development has arisen through on acceptable of market opportunities and technical feasibility (Muir, 1995 *op.cit*; Roberts and Muir, 1994; Muir, Young and Smith, 1995 *op.cit*). It might be expected real price of carp will decline if demand grows at a slower pace than supply. A further constraint may also be seasonality of supply. At present, with declining real prices of carp further investment in carp farming may become less attractive, but increased demand may create a more positive effect in the future.

Most of the grow-out producers are concerned about availability of adequate fingerling at demanded size and species, and some fingerling producers are concerned about the availability of pure seedstock (Kazerony, pers. com., 1997 *op.cit*). The establishment of hatchery production in provinces, based on needs, with an adequate and stable supply of fry at a reasonable price, as well as pure seedstock is a critical factor for development. Most large carp farms are, in general, operated at far below their maximum potential, and the costs for carp farming can be reduced if good management is applied, especially for fertiliser and supplementary feeds, and for proper stocking. It would not be desirable for carp to be produced using high costs systems. The trend might be toward the development of intensive and/or semi-intensive culture system with improved management.

Overall, the perspective for carp farming industry in the supply aspect might be expected to improve through improved productivity. The trends suggest, over the last decade, higher price of fodder, cereals and feed decreased the share of common and grass carp but notably increased silver carp, whose feeding on phytoplankton benefits directly from the availability and cheaper price of fertiliser. However, the development of carp culture has also been influenced by the aquatic resources of the principal areas, particularly the provinces of Gilan, Mazandran and Khuzestan. The expanded production, small reservoirs, earth ponds and tanks which have been constructed in all provinces to conserve water for irrigated agriculture are also targeted. As noted in chapter 6 total carp production through increased productivity of unit area, extended areas of production and increased production in open water bodies might be expected to reach 122-210,000 t by 2010, compared with levels of ~65,000 t in 1998 (42% farms production) (Shilat, 1999 *op.cit*). Though, considering past trends, it appears, the lowest cost producers might be in Caspian area, followed by Khuzestan province, and these two traditional producers might be expected to produce more than 70% of total farming production. The possibilities of extending supply outside the traditional seasonal period appears not to be too big, however, some potential may be created in larger cities and Caspian area.

Over the last decade, areas under carp farming have expanded and improved management in some farms made it possible to intensify production to obtain higher yields. Over the coming years, three main strategies might be considered, including;

- increasing the number of farms, particularly those larger sizes which have constructed by Shilat (chapter 2),
- increase productivity of existing farms, mainly those located in the three main provinces, which might be expected to be profitable and there is a possibility to use new technology such as processing feed and aeration, particularly larger farms, especially in Khuzestan, and
- increase productivity of open water bodies through increasing selected inputs and improved stock management.

Mass propagation stocking in open water bodies may also improve productivity of this large potential, while existing farms may double through improved productivity as has been initiated over the last 2-3 years. Though such means a possible doubling of yield in farms, may be possible in next few years. However, costs of input might be expected to differ in categories and locations.

In the short term, in order to expand cultured carp production, it may be necessary to increase technology and/or improve the management skills, developing and applying methods that can cope with restrictions of reduced resources, increased quality control and reduced resource quantity. An increase in management input to improve feeding and fertiliser strategies, reduce stress and increase productivity might be expected to increase production. As noted in chapter 5, at present, the share of out of season production appears to be <10%, but might be expected to targeted by 20% in coming years and 30-40% by 2010, these targets for out of season supply may be reached by high quality freezing infrastructures, better handling channels and improved distribution systems.

Despite the transfer of most of the processing and distribution enterprises from Shilat to the private and co-operative sectors, the domestic market appears to be characterised by inefficiencies and weak competition. Though there appears to be adequate supply of fresh and frozen carp over January-March in the main markets, here is a lack of supply in other markets, and a lack of other product forms, and year round supplies, more generally.

As in the production sub-sector, a lack of knowledge or of an information network appear to be contribute to this situation, though capital investment, relating to commercial management, and to modern marketing practice also appears to be deficient. To create demand for carp and its products consumer preferences need to be well understood, particularly in the growing market in urban areas. Producers and market chains need to directed towards these demands. Demand from the rural areas is also likely to increase where the cultured carp is known and appears as a preferable substitute in the diet. It appears demand from elsewhere in rural areas also may increase through improve local and other marketing systems opportunities, improved product/post-harvest quality, human/social development to improve living standards, as well as market/economic power.

Overall, it appears that the natural resources available to develop carp farming are considerable, and so the development of the industry in practice is likely to be demand rather than resource limited. Present increases planned in carp farming are considerable, and the study suggests that there may be have to supply be accompanied by strenuous efforts to create demand through promotion, new market expansion and new products development.

As incomes are expected to grow, handling and marketing facilities are expected to improve, and major markets may become better supported, so future prospects for growth in demand are good. The role of technical change in the processing and marketing sector may be significant, and improvements in the methods of processing fresh or fresh products and other added-value forms may be expected to be crucial in the expansion of markets, particularly for younger consumers, educated people and higher and middle income groups, as well as inland population in larger cities. This may also have significant effects on the supply and quality requirements for harvested primary carp products, which may some cases lead to vertical integration from supply through to distribution, processing and marketing.

At optimistic scenarios, on average, between 280-350,000 t of aquacultural products will be potentially demanded by the year 2010, of which 250-320,000 t could be carp and its products. A more conservative demand may be expected to be about 200,000 t most of which will be absorbed by larger cities which should be targeted.

There might be opportunities to increase carp consumption, where there is obviously an existing supply network, particularly in the N and larger cities, and where some degree of demand might be anticipated such as urban areas. Increased carp supply through open-water bodies or farms might increase consumption in other inland provinces. Though, capture fishery products appear to be most strongly appreciated particularly in the S provinces and some larger cities in inland provinces such as Tehran, Fars, Kerman and Isfahan, the potential for expanding carp supply will depend on the availability of capture fishery supplies.

The question also arises of the potential for exporting carp products elsewhere, in practice the central Asia and the Arabian countries, which could be the most likely target markets for exporters and the distributors. In both the N and S there is a supply network, and in the N, some degree of demand where carp is known and markets may be more easily developed under the Economic Co-operative Organisation (ECO) agreement. Price and quality are the most significant aspects, and a future marketing strategy would depend on year round markets throughout the country, diversified products and potential scale of supply.

The significant expansion and increasing intensification in aquaculture raises questions concerning the industry's future viability in the condition of increasingly limited resources (such as water, area and feed) and great concern for sustainable development

(Reinersen and Haaland, 1995; Pillay, 1992 *op.cit*; Bagarinao and Flores, 1995; Chamberlain and Rosenthal, 1995, Muir, 1995 *op.cit*; New, 1991; Pullin *et al.*, 1993; Dolapsakis, 1996 *op.cit*; De Saram and Singh, 1992). According to New and Csavas (1995 *op.cit*) as population increases and develops, so does aquaculture production. Aquaculture expansion in developed countries has been quite high and was an apparent response to a market demand, the increase in quantity and value is broadly in accordance with if not higher than their economic growth (World Bank, 1992; UNEP, 1993), but much slower than SE Asian countries. Clearly all kind of aquaculture as well as carp is very dependent on the natural environment. The expansion of the aquaculture sector not only has increased its resource consumption' but also competition for resources within the wide and increasingly demanding external system (Ackefors and Osen, 1979, Csavas, 1994 *op.cit*).

Trends in urbanisation closely follow population expansion and development, in turn leading to large demands in food, industrial activity, mega-services, waste disposal and resources (UN, 1992 cited in Kuroda, 1993). According to Stolman (1987) urbanisation has been strong for socia-cultural economic resources and as noted by Lai and Yu, (1995); Kutty, (1995), development in the SE Asian region has already placed stress on resource acquisition and use by aquaculture. According to (Laureti, 1991, New and Csavas, 1995 *op.cit*) growth in food and aquaculture production has resulted from population expansion and its social and scientific development, higher quality diets have become nutritional habits and resulted in demand for higher outputs and intensification. Intensification has resulted from the fall in real prices and therefore fall in farm incomes and uncertainty in future prices (OECD, 1991) and the displacement of traditional methods (Biswas, 1994). However, according to Pierce and Furuseth, 1986; OECD, 1991; Biswas, 1994 *op.cit*; and Kendall and Pimental, 1994, along with predictable climates and favourable credit conditions, increased production has resulted for high-yielding varieties, cheap energy, mechanisation, irrigation and chemicals. The resulting intensification has caused management, pollution and pathology problems (such as in shrimp farming in Taiwan, China, and India) (Lin, 1986; Josupeit, 1995 *op.cit*; Csavas, 1990 *op.cit*, Csavas, 1996; Macintosh and Phillips, 1992).

In most cases there has been an increasing demand on aquaculture activities to relocate and change their production methods, and loss of the ecology that supplies pristine environment (Dolapsakis, 1996 *op.cit*). In the SE Asia, around half of the freshwater aquaculture production derives from integrated/or polyculture methods (Tacon, 1996; Csavas, 1993 *op.cit*).

The ability to pay for resources, technology or pollution discharge will increasingly play key roles (Dolapsakis, 1996 *op.cit*). The primary objectives of mass production aquaculture is to keep the price of products low without hindering product quality, in order to secure market. According to Dolapsakis (1996 *op.cit*) prices must remain at least as low as fisheries catch prices, or at a price ratio of fish: animal proteins that does not exceed the present. This might only be achieved through further intensification, however, Kungvankij and Kongkeo, (1988); Edwards, (1993); Posadas, (1988), Sarig, (1988 *op.cit*); Phillips, (1995 *op.cit*); Hirasawa, (1985); Collins, (1993 *op.cit*) believed that there are more advantages in producing semi-intensively.

The global conditions of intensification, population growth, economic growth, increasing larger cities, technical development and integration vertically and/or horizontally might also be expected to appear in Iran these factors may also influence positively and/or negatively its carp culture sectors.

As Muir (1995 *op.cit*) noted, the primary point for aquaculture development must concern the need for improved approaches for developing and maintaining an awareness of the features and characteristics of the sector, and of the implications of changing trends. The thesis has attempted to obtain, analyse and develop data related to the carp sector and though has aimed to understand the current status of the sector, it is clear that continuing attention will require to be paid to strategic issues in different regions, particularly resource use, efficiency and margins, consumer trends and preferences, new products taste, and expanded markets. With the prospects of improved data-management systems for all related aspects, it will become feasible to develop such exercises at each appropriate level, using quantitative and analytical methods. Studies could be considered on aspects related to the sector, such as characteristics of fry/fingerling supply, feed production systems, Research and Development (R&D), and with particular focus on resource availability and regional priorities. Combined with tools such as Geographical Information Systems (GIS), this could provide a representational outputs to demonstrate potential choices and priorities in different provinces. These might be associated with planning and development workshops in which participants of other organisations involved in planning and budget, particularly Ministries of Aquaculture, Co-operative, and Energy, as well as other related organisation and groups involved in constructing sector to making a feasible choices.

The following recommendations deal more particularly with the development of carp culture in Iran and its role to gain the growth fish demand.

Production

With regard to the government policy toward carp farms, the government should assist farmers, especially those in Khuzestan province and larger farms in Gilan and Mazandran, with high operating costs, particularly feed and fertiliser costs, insufficient knowledge and inadequate management. Appropriate short-term credit[87] schemes, applied research, an effective extension services related to the problems of share of each species for production, size and amount of seed per unit area, methods of rearing, feed and fertiliser use, farm preparation, diseases control and water management are initially necessary.

It might be necessary to promote low-cost technologies for carp production as well as to provide institutional and policy support to enable poor households to gain access to resources and adopt carp culture. This would be significantly important for small-scale production in most of the rural areas.

Establishment of a carp farmers association might also play an important role in developing communication, research and development and marketing. It may also provide marketing support activities, which include generic promotion, quality control programmes, and marketing intelligence activities.

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87 - According to PBO (1999 *op.cit*) national policy will help new co-operative and investors to expand the number and area of farms. Considering financial conditions of co-operatives and other investors, particularly younger co-operatives and those small-scale operation in rural areas, based on Shilat suggestion government was establishing credit facilities for carp farming enterprises through Governmental banks. However, at present, carp farming is profitable, but additional credit may still be required and this policy may help new enterprises to operate, particularly in the short term. Though, Government has made provision for loan funding by annual Plans under particular Articles with low interest rates. This policy may also be necessary to enable existing carp farming to increase production and become more efficient.

Marketing

Any marketing strategy adopted by carp producers or others should consider the importance of factors detailed in this thesis, particularly in chapter 6 and should further investigate preferences in Iranian households, and demand for carp by species, location and product form. The obvious route to market development is to supply more into the retail sector, with variety of quality and higher valued products. A key point to consider would be diversification, particularly value-addition and quality control over the product chain from harvesting to final consumer. Developed markets, expanded new markets, year round supply, quality and diversification of products should be considered as a critical points.

Future development

Applied research, extension services and the training of core personnel for development may need to be given particular attention, considering existing technology, the transfer, adaptation and development of new technology. Considering the lack of information services among producers, distributors and marketing agencies, as well as development institution, the establishment of an information network needs to be given attention. The absence of a legal basis for the sector as a whole and affiliated sub-sector is also a critical need to be addressed. Though the Shilat law provides a framework for this sector, additional legislation is also required.

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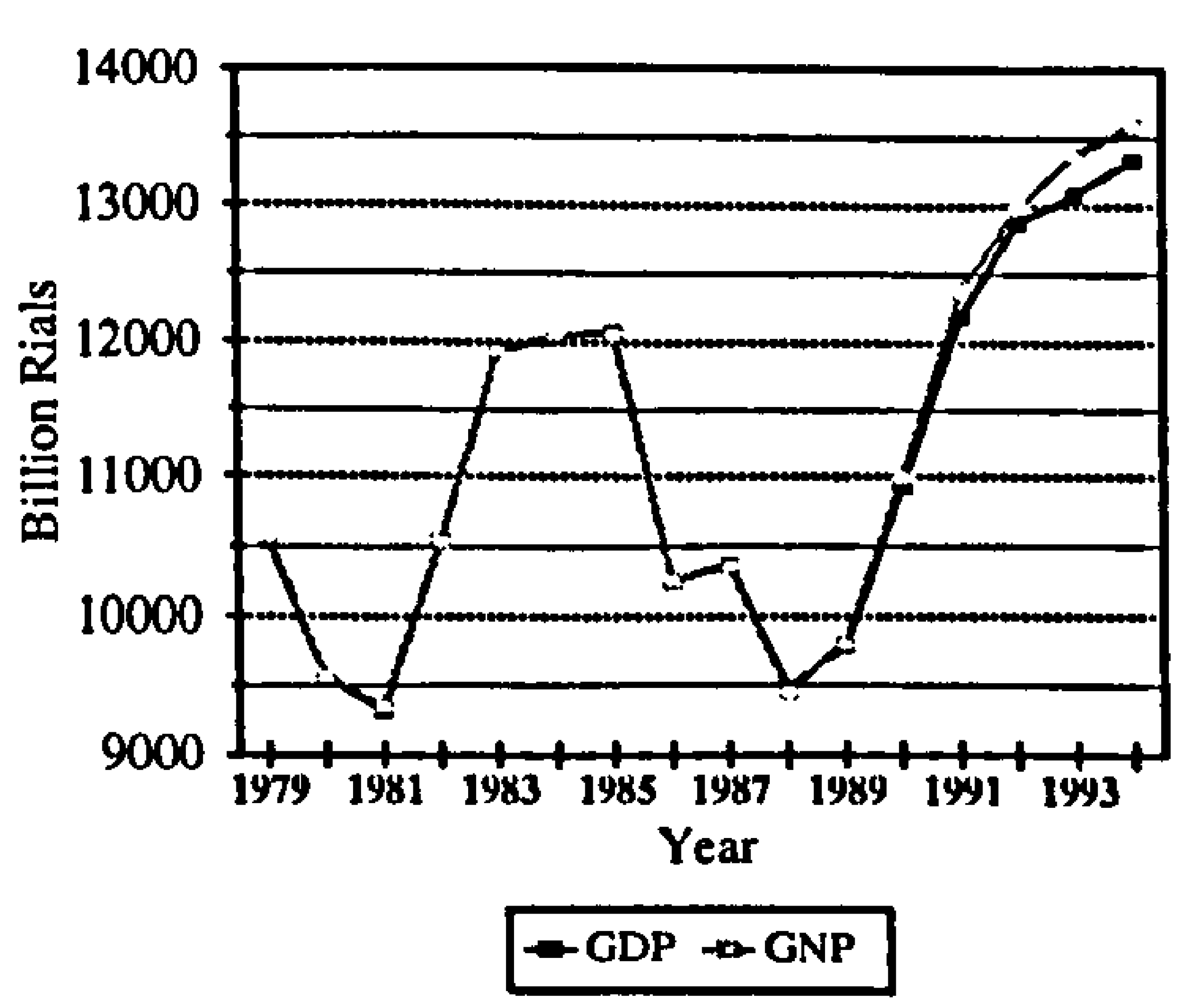
Appendix I

Table I.1: Population, area, and density of population in provinces in 1991.

province	Population (000)	Area (km^2)	Density per km^2
East- Azarbiajan (including Ardabil)	4420	63218	70
West- Azarbiajan	2284	37599	61
Isfahan	3683	105805	35
Iylam	441	19086	23
Boushehr	694	25360	27
Tehran	9982	40836	244
Chahar mahal & Baghtiary	747	14820	50
Khorasan	6013	315687	19
Khuzestan	3176	66532	48
Zangan (including Qazvin)	1776	23767	75
Semnan	458	91544	5
Sistan-Baluchestan	1455	181471	8
Fars	3544	120006	30
Kurdestan	1234	27858	44
Kerman	1863	185675	10
Kermanshah	1622	23622	69
Kohkiloeyeh & Boerahmad	497	13699	36
Gilan	2204	14820	149
Lorestan	1502	28560	53
Mazandran	3793	46645	81
Markazy	1183	29530	40
Hormozgan	924	65379	14
Hamadan	1651	19445	85
Yazd	691	69605	10
Total	55837	1630569	34

Source: Statistical Centre of Iran (SCI), 1994 *op.cit.*

Figure I.1: GNP and GDP (constant 1982 price).



Source: Central Bank of Iran (CBI), 1992...1996.

Appendix II

Table II.1: The number of farms, farms area, and production per unit area in provinces, 1994-95.

Year	1994				1995			
Province	farms (n)	area (ha)	production (t)	unit (t/ha)	farms (n)	area (ha)	production (t)	unit (t/ha)
E. Azarbaiejan	15	80	216	2.7	19	64.7	144.7	2.2
W. Azarbaiejan	11	87	200	2.3	35	102	284.5	2.8
Isfehan	21	45	104	2.3	12	30	90	3
ILam	5	10	30	3	3	6	17	2.8
Tehran	36	329	1085	3.3	18	222.5	469	2.1
Khorasan	25	225	450	2	16	181.5	433.5	2.4
Khuzestan	70	1761	5634	3.2	74	1932	6464	3.3
Zanjan	0	0	0	na	1	5.5	14	2.5
Semnan	1	1	3	3	5	13	32	2.5
Sistan-B	35	98	216	2.2	26	42	72	1.7
Fars	9	69	186	2.7	2	20	28	1.4
Ghazvin	7	26	60	2.3	7	40	120.5	3
Kordestan	9	16	36	2.3	1	2.2	7	3.2
Kerman	4	109	250	2.3	5	102	220	2.2
Kerman shah	6	37	82	2.2	8	38.3	75.5	2
Gilan	1890	3624	11959	3.3	1983	3789	13700	3.6
Lorestan	5	39	117	3	5	42	126	3
Mazandaran	413	1290	3624	2.8	392	1352	4200	3.1
Markazi	8	13	34	2.6	12	25	74.5	3
Hamedan	10	100	273	2.7	11	90	236	2.6
Yazd	2	25	55	2.2	4	8	21.5	2.7
Total	2582	7984	24614	3.1	2639	8107.7	26811.7	3.3

Source: Aquaculture department, 1997, *op.cit.*

Table II.2: The number and area of farms in Iran 1989-1995.

	Carp farms		Trout farms		Total farms	
Year	(n)	(ha)	(n)	(ha)	(n)	(ha)
1989	2210	6916	19	4.81	2229	6920.81
1990	2346	7281	24	5.6	2370	7286.6
1991	2216	8205	29	6.41	2245	8211.41
1992	2432	7648	28	8.01	2460	7656.01
1993	2440	7095	31	8.96	2471	7103.96
1994	2582	7984	39	11.94	2621	7995.94
1995	2636	8108	69	12.6	2705	8120.6
% average annually growth 1989-95	**3.1**	**3**	**26.2**	**17.8**	**3.4**	**3**

Source: CDSD, 1997[a] *op.cit*, and Aquaculture Department for 1995, 1997 *op.cit.*

Table II.3: Carp farming production in Iran, 1989-1995.
Unit: tonnes

Province/Year	1989	1990	1991	1992	1993	1994	1995
E-Azarbaiejan	75	221	221	158.5	143	216	144.7
W-Azarbaiejan	5	15	83	248	160	200	284.5
Isfehan	48	137	133	219	104.5	104	90
ILam	0	11	50	45	30	30	17
Tehran	886	946	1012	1042	1067	1085	469
Chahar mahal	0	0	0	0	0	0	n
Khorasan	298	312	328	410	380	450	432.5
Khuzestan	2401	3255	3731	4309	4118	5634	6464
Zanjan	5	6	12	n	n	n	14
Semnan	13.5	14	16	3	3	3	32
Sistan-B	1	10	17	13.58	20	216	72
Fars	55	64	64	128.5	156	186	28
Ghazvin	160	154	201	186	54.5	60	120.5
Ghom	73	76	32	26	n	n	n
Kordestan	4	9	9	20.5	16	36	7
Kerman	30	32	94	140	171	250	220
Kerman shah	44	50	60	81	82	82	75.5
Kohkiloyeh	0	0	0	0	0	0	0
Gilan	9813	8509	9377	9900	10848	11959	13700
Lorestan	84	86	86	107.5	99	117	126
Mazandaran	4177	4324	4033	4225.5	3272[88]	3624	4182
Markazi	30	15	27	30.5	34	34	74.5
Hamedan	19	43	54	157	250	273	236
Yazd	0	0	10	12	23	55	21.5
Total	18221.5	18292	19650	21462.58	21031	24614	26811.7

Sources: CDSD, 1997[a] and Aquaculture Department for 1995, 1996

[88] - Woshmgear reservoir was added to water-bodies, however before 1993 was a farm.

Table II.4: The natural and semi-natural water-bodies over 500 hectares water surface in Iran.

Water-bodies	Province	Surface area (ha)
Hamon lake	Sistan-Baluchestan	250,000
Horol-Azim	Khuzestan	120,000
Hor-Shadegan	Khuzestan	50,000
Anzali Lagoon	Gilan	10,000
Lashtac &Bakhtegan	Fars	8,000
Aras Dam Barrage	Azarbiajan	7,500 (in Iran)
Dez Dam Barrage	Khuzestan	6,580
Chahnemehs	Sistan-Baluchestan	5,000
Shahid Kazemi Dam Barrage	Kordestan	4,500
Zayandeh Roud Dam Barrage	Esfahan	4,000
Droudzan Dam Barrage	Fars	4,500
Kafter Dam Barrage	Fars	4,000
Parishan Lake	Fars	4,000
Mehabad Dam Barrage	West Azarbiajan	2,000
Magol Lake	Mazandran (Gorgan)	1,500
Esteglal Dam Barrage	Hormozgan	1,200
Norouzkhou Dam Barrage	East Azarbiajan	1,000
Zarivar Lake	Kordestan	750
Chonechanan Gulf	Gilan	700
Jiroft Dam Barrage	Kerman	600
Yousefkandi Dam Barrage	West Azarbiajan	500
Golpayegan Dam barrage	Isfahan	500
Shahid Sobhani Reservoir	Khuzestan	500

Source: Annual report of Aquaculture Department, 1995

Table II.5: Total aquaculture and inland fisheries production in provinces 1989-1995.

Year	1989	1990	1991	1992	1993	1994	1995	% chang 1989-95
Eeat Azarbaijan	123	311	307	609.5	886	762	690	460
West Azarbaijan	926	888	988	1240	1250	1744	1982	114
Isfahan	291	442	793	1499	1068.5	571	682	134
ILam	21	32	71	92	85	60	59	181
Tehran	1217	1267	1293	1581	1506	1840	1565	29
Char mahal -B	64.5	55	105	215	260	820	963	1393
Khorasan	385	423	457	581	634	758	815	112
Khuzestan	11336	12190	12850	10327	10137	8154	11294	0
Zanjan	5	6	13	n	65	n	108	2060
Semnan	16.5	16	18.5	10	3	n	151	815
Sistan	2759	3520	4370	4119.5	3020	3416	2800	1
Fars	479	602	384	1249.5	3016	1396	2178	355
Ghazvin	160	156	203	186	84.5	60	130	-19
Ghom	74	76.5	32.5	67	n	n	n	n
Kordestan	191	414	466	740.5	748	836	758	297
Kerman	30	32	94	130	171	250	334	1013
Kerman shah	90	95	100	141	227	182	387	330
Kohkiloyeh	27	42	53	151	172	39	27	0
Gilan	15848	14605	16066	11529	13012	14231	15145	-4
Lorestan	274	277	277	290.5	147	344	383	40
Mazandaran	6121	6522	6088	7292.5	7225	10468	11560	89
Markazi	31	18	30	40.5	81	34	149	381
Hamedan	21	50	62	177	302	423	319	1419
Yazd	0	0	10	72	23	55	23	n
Total (country)	40490	42039.5	45131	42440.5	44123	46446	52980	31

Source: CDSD, 1997[a] and Aquaculture Department for 1995, 1996.

Appendix III

Table III.1: The exchange rate of R 1 to $US.

1981	1982	1983	1984	1985	1986	1987
0.012501	0.011983	0.011465	0.010894	0.01143	0.013070	0.014309
1988	**1989**	**1990**	**1991**	**1992**	**1993**	
0.014428	0.013889	0.01498	0.01475	0.014173	0.000605	

Source: CBI, 1992-1996 *op.cit.*

Table III. 2: Food Balance Sheet of fish and fishery products in live weight and fish contribution to protein supply.

Year	production	Non-food uses	Imports	Exports	Stocks variations	Total food supply
	(......................metric tons in live weight ....)					
1975	66739	0	532	6380	0	60891
1976	69816	0	4600	3707	0	70709
1977	69575	0	10590	8347	0	71818
1978	67101	0	5253	4546	0	67808
1979	65269	750	7220	3817	0	67922
1980	43529	850	7144	1708	0	48115
1981	44582	1000	12938	1134	0	55386
1982	95724	1200	6110	1443	0	99191
1983	111886	1400	14498	1491	0	123493
1984	115771	1650	5315	1678	0	117758
1985	118541	1950	132	1429	0	115294
1986	151695	2300	202	909	0	148688
1987	210955	2550	251	1222	0	207434
1988	235005	2950	40	1221	0	230874
1989	260187	3450	247	1490	0	255494
1990	269506	1950	0	1316	0	266240
1991	275725	2950	28404	2058	-26	299095
1992	334203	3000	30000	2226	-556	358421
1993	343888	3250	na	1698	555	339495
Average 1982-93	210257	2383	7100	1515	-2	213456
% change 1982 to 93	259	171	-100	18	--	242
% average annually growth 1982-93	12.5	9.5	15	3	--	12.5

Source: Fish and fishery products. World apparent consumption statistics based on food balance sheet (1961-1993). FAO fisheries circular No.821 revision 3.

Table III. 2 (continue): Food balance sheet of fish and fishery products in live weight and fish contribution to protein supply.

Year	Population	Per capture supply	Fish proteins	Animal proteins	Total proteins	Fish/Animal	Fish/total
	(000)	Kg.	(..........(grams per capture per day)........)			%	%
1975	33344	1.8	0.5	15.1	69.3	3.3	0.7
1976	34376	2.1	0.6	16.2	67.1	3.7	0.9
1977	35420	2	0.6	17.8	69.9	3.4	0.9
1978	36535	1.9	0.5	17.3	65.9	2.9	0.8
1979	37796	1.8	0.5	16.9	66.8	3	0.7
1980	39254	1.2	0.4	17.1	68.8	2.3	0.6
1981	40926	1.4	0.4	18.2	71.8	2.2	0.6
1982	42785	2.3	0.7	18.1	73.1	3.9	1
1983	44782	2.8	0.8	18.4	75.5	4.3	1.1
1984	46845	2.5	0.7	17.7	72.4	4	1
1985	48910	2.4	0.7	16.4	68.7	4.3	1
1986	50982	2.9	0.8	15.9	68.8	5	1.2
1987	53042	3.9	1.1	15.6	69.4	7.1	1.6
1988	55072	4.2	1.2	15.4	69.7	7.8	1.7
1989	57046	4.5	1.3	15.4	72.8	8.4	1.8
1990	58946	4.5	1.3	15.9	68.2	8.2	1.9
1991	60766	4.9	1.4	16.5	75.3	8.5	1.9
1992	62507	5.7	1.7	17.1	75.9	9.9	2.2
1993	64169	5.3	1.6	17.5	78.5	9.1	2
Average 1982-93	53821	4	1	17	72	7	2
% change 1982 to 93	50	130	129	-3	7	133	100
% average annual growth 1982-93	3.8	8	8	0	1	-	-

Source: Fish and fishery products. World apparent consumption statistics based on food balance sheet (1961-1993). FAO fisheries circular No.821 revision 3.

Market chain study

To provide an overview of the market for carp products such as market infrastructures, distribution methods, market systems, marketing channels, the different carp products in the market, seasonality of purchasing and other factors, primary research from the sellers and distributors together with other information from various sources was carried out in 1996.

The diverse structure of the markets for carp products is such that extensive primary data would be prohibitively time consuming. No specific study of the cultured carp market and the number of intermediaries in Iran is known to have been published. However, a survey of distributors was conducted in 11 main cities from 6 provinces, including Gilan, Mazandran, Tehran, E-Azarbiajan, Isfahan and Fars. Information was collected by personal and telephone interviews in these provinces. In Tehran and Rasht (capital of the Gilan province) a stratified sample from the main markets was used. There is no specific market for carp products in other cities, but, where only a few sellers operated all of them were interviewed.

The questionnaire was prepared, to collect both quantitative and qualitative information. Interviewers from inside and outside Shilat were also chosen to communicate with the respondents and were carefully trained for this specific marketing research task.

There are no special processing units for carp, however, some data were obtained through personal communication with new processors and marketing companies as well as marketing experts in Shilat and outside Shilat. To ensure a representative perspective the market, interviews and telephone surveys were also conducted using an unstructured questionnaire which sought to obtain qualitative, rather than quantitative data.

Questionnaire For Fish Seller

1-General characteristics:

City: .... Market name: .... Seller's name: ....
Seller's background: ....
Educational level: ....
Wholesaler: .... Retail: ....

2-Sale facilities (store): ....

The area of fish store .... m^2.	Yes	No
Hygienic fish selling place:	Yes	No
Cold storage trucks:	Yes	No
Ordinary vehicles:	Yes	No
Refrigerator in store:	Yes	No
Fish cleaning facilities:	Yes	No
Other facilities:		

3-What kinds of products do you stock in your store year round and how many?

Cultured carp species	..........percent
Caspian Sea species	..........percent
Persian Gulf and Oman sea species	..........percent
Chicken	..........percent
Meat	..........percent

4- What is your supply system for cultured carp.

Self-products Purchasing from other suppliers
Buying from wholesale centre

5- What is your purchasing mechanism for cultured carp.

Cash purchase Buy on credit
Pre-purchase periodically
Commission Specify..............

6- Where do you buy cultured carp.

Within Province Out of province

7-Purchasing time: (cultured carp).

Month	1 (Mar.)	2	3	4	5	6	7	8	9	10	11	12 (Feb.)
Percent												

8-What kinds of vehicles do you use for transporting carp.

Trucks with cold storage Trucks without cold storage and with ice
Trucks without cold storage and ice

9-The provision revolving fund.

Receiving loans from banks or other financial institution.
Receiving loans from other sources.
Receiving goods on trusteeship basis.

10- Characteristics of presentation carp.

-Supply fresh carp in mixed form. .... percent.
-Supply carp separated in terms of weight. .... percent.
-Supply frozen carp in mixed form. .... percent.
-Supply frozen carp separated in terms of different size. .... percent.
-Supply processed carp with specified processing type. .... percent.
-Supply processed frozen carp with specified processing type. .... percent.
-Supply carp in other processing methods.

11-Sales period for carp species.

Month	1(Mar.)	2	3	4	5	6	7	8	9	10	11	12 (Feb.)
%age sale												

12-Who are your consumers within province.

Wholesaler Retailer Co-operatives
Hotels and restaurants Supermarket chains
Governmental organisation or Economic institution
Processing units Ultimate consumer Others

13- Who are your consumers out of province.

Wholesaler Retailer Co-operatives
Hotels and restaurants Supermarket chains
Governmental organisation Processing units
Ultimate consumer Economic institution Other

14- The sale forms of carp.

Sell in cash Purchase in advance Commissioning
Sell on credit
Periodically
Specify........

15- Is there a supervision on your sale prices? Who?
Municipality　　Commerce　　Trade union
Specify any other.......

16- Which of the following bodies supervises the hygienic supply of fish?

Shilat　　Food health monitoring Organisation　　Veterinary Organisation
Municipality　　Union　　Specify any other.......

17- Do you supply fish all year round?
Yes　　No
If no, in which seasons do you usually supply?

18- How long have you been involved in carp market? ....
How many years have you worked in this place?......

19- Who are your typical consumers?
Permanent consumers　　Occasional consumers

20- Has there been an instance wherein, in spite of demand for carp, there was no carp to supply?
Quite a lot　　Many instances　　Not too many　　Rare

21- Have you ever been had instances wherein in spite of availability of carp, there was not any demand for carp?
Quite a lot　　Many instances　　Not too many　　Rare

22-Which species do the buyers usually look for? Specify in hierarchical order.
A-........................
B-........................
C-........................
D-........................

23- What qualities do the consumers take into account while purchasing carp?
Specify in hierarchical order............
A- The price of carp compared with the price of other fish.
B- Familiarity
C- Availability
D- Appearance.
E- Specify any other points.

24- Please provides further comment in case, the questionnaire did not cover your areas of interest concerning cultured carp.

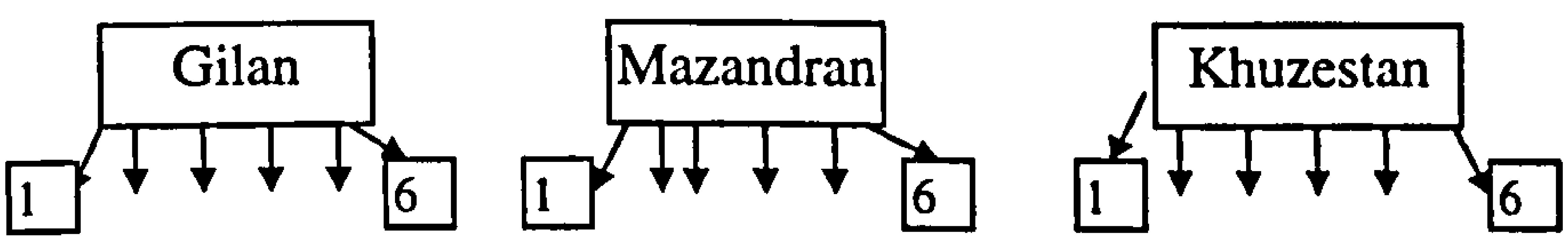
Appendix IV

Carp farming survey methods

A study of yield production, input costs, productivity and profitability of carp farming was carried out to help clarify the contribution of production costs, yields and profitability and their differences with location, farm size and cultured systems. A comprehensive census survey including number and areas of carp farming was conducted by CDSD in 1995. The primary information from the CDSD census and other data available in Shilat and its affiliated departments showed three main carp farming provinces, including Gilan and Mazandran in the Caspian area and the Khuzestan province together accounted for 87% of farm areas, 92% of farms and 91% of production. This study covered these three main provinces.

The farms were classified and as shown in Figure IV.1, each province was stratified into six categories[89]:

Figure IV.1: Carp farming categories in the three main provinces.



(1) Very small (less than 0.1 ha water surface, coded as <0.1),
(2) Small (0.1 to 1 ha water surface, coded as 0.1<<1),
(3) Medium (1 to 5 ha water surface, coded as 1<<5),
(4) Large medium (5 to 20 ha water surface, coded as 5<<20),
(5) Large (20 to 50 ha water surface, coded as 20<<50), and
(6) Very large (more than 50 ha water surface, coded as >50).

In 1995, farms were sampled in each of the 18 categories by random sampling (using random table) covering the production period 1994. Carp culture in Kerman (desert zone) and West-Azarbiajan (Mountain area) provinces have also recently started, though 2 farms from Kerman and 3 farms from West-Azarbiajan were also collected by random sampling. Overall, the sample covered 10% of the population.

After the sample was selected, I prepared my questionnaire for required information and checked with my supervisors. Interviewers, particularly those familiar with aquaculture and statistics from inside and outside Shilat were chosen and were carefully trained for the carp farming study. Data obtained from different categories were entered into a Borland Quattro-Pro for Windows Version 5 spreadsheet and methods for classification, summarising, averaging, and other functions were used for analysis. These data were supplemented with other data maintained by Shilat experts (mostly Aquaculture Department and its affiliated provincial offices) and the Research and Training Organisation. Wherever data was not sufficient, additional personal communication with farmers, institutions and other experts were carried out to ensure a representative perspective on the farming sector.

[89] - 0.1∈{<0.1}, 1∈{0.1<<1}, 5∈{1<<5}, 20∈{5<<20}, 50∈{20<<50}.

Farm questioner

Statistics for carp farming, 1995
Statistics questionnaire (data belonging to year 1994 production)

Province:
City:
Established year:
Address:

Activity and ownership of farm

Raw	Question	Answer			
1	State on statistics day	Active	Semi-Active	In active	Other
2	Ownership in 1994	Individual	Company	Governmental	Co-operative or partnership
3	Cultured species	One species	Several species	Duck and fish	Fish and rice

Technical details of farm in 1994

Explanation	Code	Answer	Unit
Area of cultured carp ponds			Sq.
Annual production capacity of carp			Tonnes
Holding area of breeder's ponds			Sq.
Capacity of larva production			Piece
Capacity of fish fry production			Piece
Area of larva and fish fry ponds			Sq.

%age water used resources in farm

	Code	%
River	1	
Dams	2	
Deep well	3	
Semi-deep well	4	
Aqueduct	5	
Pool	6	
Sewage & flood water	7	
Public water canal	8	
Drainage canal	9	
Other	10	

Volume & value of fry/fingerling used in farm for production purpose in 1994.

Explanation	Code	Total volume (piece)	Average value 100 piece (Rial)	Total value (Rial)
Common carp fry / fingerling				
Silver carp fry / fingerling				
Bighead carp fry / fingerling				
Grass carp fry / fingerling				

Volume & value of feed used in farm in 1994.

Explanation	Code	Total volume (kg)	Average price per kg (Rial)	Total value (Rial)
Wheat				
Barley				
Rice				
Wheat barn				
Barley barn				
Rice barn				
Fresh Lucerne				
Fish meal				
Blood meal				
Bone powder				
Concentrate feed				
Slaughter wastage				
Others *		Incl.(	)	

* Kilka, Bread, Splenalgian, Useless weed, Sunflower oil – cake, Shrimp, Barely, Barn, Silkworm cocoon, Meat, Cyst of artemia, Flour, Barely flour, Grouts, Dried milk, etc.

Volume & value of chemical & animal fertilisers used in farm in 1994.

Explanation	Code	Total volume (Kg)	Total value (Rial)
Aztec fertilisers			
Phosphorous fertilisers			
Other chemical fertilisers			
Animal fertilisers			

Volume & value of chemical & drugs used in the farm in 1994

Explanation	Code	Total volume used (g)	Average price per (g) (Rial)	Total value (Rial)

Volume and value of fuel used in 1994

Explanation	Code	Total volume used (Litre)	Average price per litre (Rial)	Total value of used volume (Rial)
Benzene				
Gas oil				
Kerosene oil				
Other oil fuels				
Engine oil				
Liquid gas (cylinder)				
Natural gas (pipe-Laid)				
Firewood & coal				
Other				

Other costs in farm in 1994

Explanation	Code	Costs (Rial)
Water		
Electricity		
Maintenance of machinery		
Maintenance of buildings		
Maintenance of pond & area		
Transportation of staff		
Packaging		
Sale commission		
Insurance		
Interest		
Others		

Number of staff and their salary and/or wages in 1994

Explanation	Code	Response
Permanent salary & wages (man/day/year)		
Temporary salary & wages (man/day/year)		
Family worker (man/day/year)		

Volume & value fry /fingerling production in 1994

	Code	Production in 1994 (100 pieces)	Sold in 1994 (100 pieces)	Average price of 100 pieces (Rial)	Total value (Rial)
Common carp fry/fingerling					
Silver carp fry /fingerling					
Big head carp fry/fingerling					
Grass carp fry/fingerling					

Volume & value of carp production in 1994

Species	code	Total production in 1994	Self consumed or freely given to others in 1994	Sale in 1994 (kg)	Average price per kg (Rial)
Common carp					
Silver carp					
Bighead carp					
Grass carp					

Investment in farm in 1994

	Code	Purchase	Construction	Basis repair	Sale or transfer	Sale or transfer costs	Total costs (Rial)
pond							
Accommodation building							
Administration building							
Store & saloon							
Other buildings							
Machinery							
Vehicles							
Administration facilities							
Furniture							
Others							

Appendix V

Consumer study methods

To be able to define a marketing strategy for cultured carp an analysis of consumer responses to the marketing aspects of carp and its products including personal information of respondents and their preferences, seasonal purchasing and consumer purchasing behaviour for carp consumption are addressed. The diverse structure of the markets for carp products throughout the country with 25 provinces and a population of 61 million are such that extensive primary data for a part of PhD study would be impossible and would be prohibitively time consuming and expensive.

The results of carp producers, distributors and sellers responses and other personal communication showed almost 50% of carp is sold in Tehran. During the last two decades, the population of Tehran has increased by 8% annually, mainly, though immigration from other parts of the country. Consequently, Tehran was chosen for the consumer study. According to Shilat (1996[b] *op.cit*) there is a significant difference between households related to income, education level and other socio-economic aspects in 3 different areas of Tehran, known as north, centre, and south Tehran.

Primary personal and telephone communication showed, in each noted area (north, centre and south) that there is a large central market for different services and consumption goods, such as meat, fruits, vegetables, and others, people buy their needs, particularly at weekends (Thursday and Friday) in these central markets. The sample was selected by a stratified random technique from population of these markets at weekend (2 days) in February 1997. Primary communication showed, each central market was visited by almost 2,000 consumers per day. The required sample was collected by a random technique in each central market. It was decided to sample 50 consumers (2.5% of the number visiting each day) and these were selected using random number tables.

I prepared my questionnaire to collect the required data on consumers. Interviewers, male and female, particularly those familiar with statistics, conversation and able to communicate well to interact with respondents from inside and outside Shilat, were chosen and carefully trained to work in pairs. Data selected from different areas were coded and entered into a SPSS for Windows Release 5.0 spreadsheet and methods for classification, summarising, and other functions were used for analysis.

These data were supplemented with other data maintained by sellers, distributors and other institutions and experts by telephone and personal communication to ensure a representative perspective on the consumer study.

The Consumer Questionnaire

General characteristics,

Age Birthplace Location

Occupation: 1- Employee 2- Free-job worker

3- Housekeeper 4- Student

Educational level: 1- Illiterate 2- Below diploma
3- Diploma 5- Bachelor 6- Postgraduate qualification
Marital status: 1- Single 2- Childless and married
3- Married with less than 3 offspring
4- Married with 3 and more than 3 offspring

1-1- Which of the following species are you familiar with?
1- Common carp 2- Grass carp 3- Silver carp 4- Bighead
5- Trout 6- Caspian Sea species 7- Southern fish species
1-2- Which of the above species have you served?

2- Determine the qualities of the carp species in terms of priority?
2-1-....Reasons: 1- Lower price 2- Taste and flavour
3- Availability 4- Appearance
2-2-....Reasons: 1- Lower price 2- Taste and flavour
3- Availability 4- Appearance
2-3-....Reasons: 1- Lower price 2- Taste and flavour
3- Availability 4- Appearance
2-4-....Reasons: 1- Lower price 2- Taste and flavour
3- Availability 4- Appearance

4- Which forms of cultured carp do you like?
Whole fresh Gutted fresh Whole frozen Gutted frozen Fillet Smoked form Salted Other

5- What is your seasonality fish consumption?
All year round On particular season occasionally

6- Which sort of flesh do you give better priority for consumption?
Sea Species, Cultured carp, Trout, Chicken, Red meat, Others

7- Give reasons in case the cultured carp is not the top priority in your protein consumption.
7-1- Relatively higher prices than other flesh.
7-2- Lack of access to safe and suitable fish.
7-3- Inadequate familiarity.
7-4-: Cooking problems.
7-5-: Taste and flavour.
7-6-: Others.

8- In case of supply increase of cultured carp, will you increase.......... your consumption?
Very great Great Moderate Little

9- In case of a rise in income, will you .... your consumption?
Very increase Moderate increase Decrease Unchanged

11- In case of a decline in price of cultured carp, will you .... your consumption?

Very increase Moderate increase Decrease Unchanged

12- Which factors do you consider while purchasing cultured carp?

Price, Delivery form, Appearance, Quality, Trust in the seller

Appendix VI

Table VI.1: The countries with GNP per capita (US$) in 1991(2000-4000).

						1990				
country	GNP $head^{-1}$	pop (1992)	pop (2000)	Urban Pop (%) 1992	Urban Pop (%) 2000	Fishery production (t)	Aquaculture production (t)	Fish supply (kg yr^{-1} $capita^{-1}$)	fish protein (gr $capita^{-1}$ day^{-1})	Fish/animal proteins (%)
Uruguay	2880	3.1	3.3	89	88	90829	7	5.2	1.3	2.9
Trinidad and Tobago	3790	1.3	1.4	66	77	3300	9	4.7	1.4	6.2
Chile	2360	13.5	15.3	85	89	5195418	116269	25.5	5.9	19.4
Venezuela	2720	20.2	23.6	91	94	332340	2144	14.6	4.1	14.8
Panama	2130	2.5	2.9	54	59	161733	3900	17.3	5.4	17.1
Malaysia	2520	18.8	22.3	45	51	602539	79378	26.2	7.1	27.9
Mauritius	2380	1.1	1.2	41	43	14657	100	21.2	6.9	24
saint Lucia	2700	0.1	0.2	..	..	974	..	18.3	5.9	14.9
Grenada	2300	0.1	0.1	..	..	1800	..	28.5	9	27.8
Iran	2410	61.6	77.9	58	63	267768	42420	4.8	1.4	8.7
Botswana	2580	1.3	1.7	27	43	1900	..	3	1	4.6
Belize	2180	0.2	0.2	51	..	1556	..	6.1	1.7	5.1
South Africa	2540	39.9	47.9	50	66	536400	3622	9.3	2.9	10.7
Argentina	3790	33.1	36.2	87	89	555571	1202	6.1	1.7	2.7
Mexico	3080	88.2	102.6	74	77	1401041	40789	10.8	2.8	8.8
Brazil	2920	154	172.8	77	81	800000	29700	5.6	1.6	5.9
Dominica	2440	0.1	0.1	57	..	700	..	21.7	6.2	15.7
Saint Kitts and Nevis	3780	..	..	41	..	1700	..	43.2	12.8	28.9
Suriname	3650	0.4	0.5	43	54	4000	..	6.7	2.2	9.2
Gabon	3980	1.2	1.6	47	54	22000	5	28.2	8.1	37.4
Czech-oslovakia	2700	15.7	16.3	76	83	22407	24135	7.7	2.8	4.6
Hungary	2750	10.5	10.5	66	68	33889	14230	4	1.2	2.2
Pakistan*	400	124.9	154.8	33	38	479036	12670	2	0.6	3.5
Turkey*	1790	58.4	68.2	64	74	382170	7687	4.6	1.4	8.6
Iraq*	..	19.3	24.8	73	75	14000	15142	0.7	0.2	1.7
All developing countries	880	4240	4930	35	49	56261488		9.4	2.7	19.2
Industrial countries	14920	1210	1400	74	78	41027648		26.1	8.2	13.8
World	4160	5450	6330	44	57	97289136		13.3	4	16.1
Developin g countriest (near-East)						1045412		4.3	1.2	7
Asia continental						35065408		9.7	2.8	22.6
Arab states	2130			55	61					

Sources: UNDP, 1994 *op.cit,* FAO, 1992[d] *op.cit* and Muir, 1995 *op.cit.*