

ISSUES, GROWTH AND INSTABILITY OF INLAND FISH PRODUCTION IN SINDH (PAKISTAN) Spatial – Temporal Analysis

MOHAMMAD PERVEZ WASIM*

Abstract. Apart from marine fisheries, inland fisheries (comprising of rivers, lakes, ponds, dams, etc.) are also very important source of animal protein. The consumption of fish is very low in Pakistan. The fisheries sector in Pakistan has not received due attention and as a consequence its contribution in Pakistan's economy has been relatively meager. There are substantial waterlogged and saline areas in Sindh, which are no longer suited for crop producing, they can be developed for fish culture. There is a need to examine the growth and instability of inland fish farming in Sindh before an intensive campaign can be launched to convince farmers to engage in fish farming. The study analyzed the growth and instability in inland fish production for two different periods of Sindh province: Period I (1975-1988) and period II (1989-2002). The study reveals that in period II, the inland fish production growth rate of Khairpur, Larkana, Hyderabad, Badin, Thatta and of Sindh province positively and significantly increased, while that of Sanghar and Tharparkar districts, significantly decreased. The study also confirms that in period I, a majority of districts have moderate growth with less instability in inland fish production as compared to period II. The study also reveals that none of the districts showed continuous increase in the relative share in any period.

I. INTRODUCTION

Faced with a growing population (2.2 percent growth rate per annum, 2002-03) and limited sources of protein, it is essential that Pakistan is able to utilize all available

*The author is Research Economist at Applied Economics Research Centre, University of Karachi, P O Box 8403, Karachi-75270 (Pakistan).

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sources. The present per capita availability of protein is much below the minimum daily requirement and the livestock and dairy farming sector alone will not be able to meet the increasing requirement of protein. Fish is an excellent source of animal protein. The importance of animal protein in human diet as described in a report of a joint FAO/WHO expert group on "Protein Requirement" states that in practice the protein intake for all adults should not fall below one gram of protein per kilogram of body weight. The protein should be derived from a variety of sources and it is desirable that a part of the protein should be of animal origin. As fish protein has a high biological value similar to that of land animals, and is relatively cheaper source of protein, its use may result in bridging the protein gap because of its multifarious economic advantages and nutritional significance. The data presented in Table 1 shows the comparison of the efficiency of utilization of fish protein with other animal proteins. Apart from marine fisheries, inland fisheries (comprising of rivers, lakes, ponds, dams etc.) are also very important source of animal protein. Fish contributes more than 10 percent of the total animal protein intake of the world. The consumption of fish is very low in Pakistan. In 2002-03, it was 1.77 kgs per capita annually (Table 2). Whereas in the rest of South and East Asia the domestic consumption accounts for at least half of the total production. Pakistan consumes domestically only 26 percent with 19 percent being exported and giant 55 percent going for fishmeal. This pattern reflects the low quality of fish brought in by the fisherman.

TABLE 1
Efficiency of Utilization of Various Animal Proteins

Source	Biological Value (%)	Net Protein Utilization (%)	Digestibility (%)	Refuse (%)	Protein Efficiency Ratio	Protein Gain Per 100 Grams Protein Consumed
Fish	96.0	80.0	85.0	13.7 (Cattle)	3.55	77.0
Beef	74.0	68.0	99.0	15.0 (Cattle)	2.30	13.0 (Cattle)
Chicken	74.0	71.0	85.0	32.0	—	18.0

Source: Khan (1986), *Progressive Farming*, Volume 6, No. 5 (Sep/Oct) 1986. Pakistan Agricultural Research Council, Islamabad.

This low average in Pakistan becomes more crucial when other resources of protein are also below the required level. However, there is tremendous variation in per capita consumption of fish within the country. In this respect Balochistan is at the top, *i.e.* 6.80 kgs per capita per annum in 1975-76 which declined to 5.28 kgs per annum in 2002-03. Per capita per annum consumption of fish in Sindh though

declined from 4.25 kgs per capita per annum in 1975-76 to 2.98 kgs per capita per annum in 2002-03, is second. Per capita annually fish consumption of Punjab and NWFP though increased from 0.12 and 0.04 kgs in 1975-76 respectively to 1.00 and 0.71 kgs in 2002-03, is still very low. This indicates that fish in Sindh occupy a prominent place in consumer's diet (though its consumption has decreased). The consumption of fish in Sindh can increase if the price of fish is brought down to a reasonable level. To do that it is essential that production of fish is increased. The government can increase fish production; by giving more incentives and subsidies to fishermen, by improving socio-economic conditions of fishermen and through an efficient fish marketing system.

TABLE 2
Consumption of Fish in Various Provinces of Pakistan
(Kgs per capita per annum)

Year	Pakistan	Punjab	Sindh	NWFP	Balochistan
1975-76	1.28	0.12	4.25	0.04	6.80
1980-81	1.99	0.36	4.30	0.17	15.0
1985-86	1.80	0.57	4.10	0.04	7.60
1990-91	1.70	0.74	3.71	0.74	4.62
1995-96	1.81	0.98	2.58	0.41	4.61
2000-01	1.76	1.00	2.90	0.65	5.15
2002-03	1.77	1.00	2.98	0.71	5.28

Source: Government of Pakistan (1980, 1991-92, 2002-03), *Agricultural Statistics of Pakistan*. Ministry of Food, Agriculture and Livestock, Islamabad.

Recognizing the importance of fish in reducing the existing protein deficiency in the diet of the people, a source of foreign exchange earnings and being valuable raw material for various industrial produce, the Government has adopted measures to explore the potential for increasing fish production. Though fisheries resources have so far been partially exploited, an upward trend has been observed in fish production, *i.e.* marine as well as inland and total production. Total production which was 174 thousand tones in 1975-76, increased to 638 thousand tones in 2002-03 (Table 3). In case of inland fish, increase in fish production was more than nine times during the same period.

The share of Sindh in total, and marine fish production is though more than 66 and 50 percent respectively has exhibited a fluctuating trend. It became 68.2 percent of the total in 2002-03 compared with 72.9 percent in 1975-76. The share of inland fish production in total production increased from 8.0 percent in 1975-78 to 18.3 percent in 2002-03. Its share though somewhat decreased in 2002-03, is showing an

increasing trend. As far as the share of inland fish production in total inland production of Pakistan is concerned, it is showing decreasing trend. It was 70.0 percent in 1975-76 and in 2002-03 decreased to 63.8 percent. The share of Sindh's marine production decreased while that of inland production, it increased.

TABLE 3
Inland and Marine Fish Production in Sindh and
Its Share in Pakistan's Total Fish Production

Years	Pakistan (000 Tonnes)			Sindh (000 Tonnes)			Share of Sindh (Percent)			Share of Sindh Inland Fish Production in Pakistan's Total Inland Production
	Total Prod- uction	Inland Prod- uction	Marine Prod- uction	Total Prod- uction	Inland Prod- uction	Marine Prod- uction	Total Prod- uction	Inland Prod- uction	Marine Prod- uction	
1975-76	174.1	20.0	154.1	127.0	14.0	113.0	72.9	8.0	64.9	70.0
1980-81	279.3	46.3	233.0	204.2	28.9	175.3	73.1	10.3	62.8	62.4
1985-86	408.4	75.1	333.3	275.8	46.6	229.2	67.5	11.4	56.1	62.0
1990-91	481.0	113.2	367.8	320.9	60.3	260.6	66.7	12.5	54.2	53.3
1995-96	541.9	136.4	405.5	358.4	75.4	283.0	66.1	13.9	52.2	55.3
2000-01	614.8	176.4	438.4	422.3	113.6	308.7	68.7	18.5	50.2	64.4
2002-03	637.8	183.3	454.5	435.0	117.0	318.0	68.2	18.3	49.8	63.8

Source: Government of Pakistan (1978, 1982-83, 1991-92, 2000-01, 2002-03), *Economic Survey*. Economic Advisor's Wing, Ministry of Finance, Islamabad.

The value of total fish and fish products in Pakistan in 2002-03 was about 0.80 percent of the country's total GDP. Export earning for fish and fish products which was 3.37 percent in 1976-77, decreased to 1.23 percent in 2002-03. The details regarding fisheries share, in total Gross Domestic Product (GDP), agricultural sector and total export earnings during 1976-77 to 2002-03, are given in Table 4.

TABLE 4
Fisheries Significance in Pakistan Economy

(Percent)

Year	Fisheries Share in GDP	Fisheries Share in Agriculture Sector	Fisheries Share in Total Export Economy
1975-76	0.50	1.54	3.37
1980-81	0.62	2.12	1.91
1985-86	0.78	3.18	2.69
1990-91	0.50	1.28	1.86
1995-96	0.81	3.27	1.59
2000-01	0.90	3.64	1.48
2002-03	0.80	4.24	1.23

Source: Government of Pakistan (1978, 1982-83, 1991-92, 2000-01, 2002-03), *Economic Survey*, Economic Advisor's Wing, Ministry of Finance, Islamabad.

As described earlier, about 64 percent of the country's inland fish production share was contributed by Sindh province. In view of the resources endowed to the province (*i.e.* Indus River, canal networks, reservoirs, lakes, stream, water logged area and village ponds) fish production share can be increased up to 90 percent with proper use of these resources.

However, with the diversion and control of the river and canals under the Indus basin treaty works, water regime has been distributed and the natural breeding grounds of fish have been ruined. Consequently the potential for increased fish production from the riverine and flood plain fishery has been restricted. Hence, the major potential for increase in fish production lies in fish farming on commercial scale especially on water logged areas. Sindh has more than 1050 thousand hectares of area water logged (2002-03).

The total number of persons engaged in fisheries sector during 2002-03 is estimated at 365,000. Out of which 138,000 persons (37.8 percent) were engaged in marine sector and 227,000 persons (62.2 percent) in inland fisheries.

ISSUES OF INLAND FISHING IN SINDH

The following are the issues of inland fishing in Sindh.

1. Till June 2005 the contract/Auction system has played havoc with the fish resources and has resulted in exploitation and worst ever poverty among the fisherfolk communities.

2. The fishermen are living the life of bondage as due to non-availability of formal credit system, the fishermen are compelled to take loans from the middlemen and contractors.
3. Major fishing grounds/lakes in different districts of Sindh have been practically occupied by the influential landlords of those areas.
4. The fisherfolk settlements completely lack educational and health facilities.
5. The fisherfolk villages/populations also lack fresh drinking water as due to lack of fresh water flows from Indus the fishing ground water has become polluted.
6. Due to overall livelihood resource degradation as well as with the encouragement by contractors, non-fishing community populations are being engaged in fishing activities at many fishing grounds, while ignoring the indigenous fishermen.

NEED FOR THE STUDY

Keeping in view the emerging situation, the Sindh government has developed hatcheries and nurseries, to produce fingerlings locally for stocking in rivers, reservoirs and fish farms etc. This represents a minor progress in the establishment of fish farming business in the province. As there are substantial waterlogged and saline areas which are no longer suited for crop producing, they can be developed for fish culture. There is a need to examine the growth and instability of inland fish farming in Sindh before an intensive campaign can be launched to convince farmers to engage in fish farming. No in-depth study of inland fish production in Sindh is available, this study is a maiden attempt in this direction. Results of such a study would also be helpful for the policy makers and extension staff.

Against this background this study was undertaken, with the following specific objectives:

1. To present some brief history about Fish.
2. To estimate growth performance of Fish in terms of inland production for two different periods of Sindh.
3. To estimate the level of instability in inland fish production for two different periods of Sindh.
4. To estimate temporal change in districts and relative share of different districts in inland fish production of Sindh.
5. To make a period-wise comparison of growth rates with their instability indices.
6. To look into the problems faced by fish farmer.
7. To suggest measures to promote fisheries development.

II. DATA AND METHODOLOGY

The study is based on secondary data for the last 28 years, *i.e.* from 1975-76 to 2002-03. The data relating to inland fish production of the districts of Sindh were collected from various issues of *Development Statistics of Sindh*, Government of Sindh, *Agricultural Statistics of Pakistan* and *Economic Survey*, Government of Pakistan. The period 1975-76 to 2002-03 has been divided into three sub-periods, *viz.* period I (1975-76 to 1988-89); period II (1989-90 to 2002-03); and period III (1975-76 to 2002-03).

GROWTH RATES

In order to examine the period-wise and whole period trend of inland fish production, linear, exponential, and semi exponential functions were fitted. But exponential function was finally selected considering the highest value of coefficient of determination (R^2). The form of exponential function is as under:

$$Y = ab^t \text{ or } \ln Y_t = \ln a + t \ln b + \mu_t \quad (1)$$

where,

- Y = fish production (inland)
- a = intercept
- b = expresses the rate of change and when multiplied by 100 gives the percentage growth rate
- t = time period in years (1, 2, ..., n)

INSTABILITY INDICES

Production of fish is known to fluctuate widely over time and regions. It may also indicate the pitfalls in arriving at any general conclusion on the basis of averages only. In reality, wide variations in these data over time, as well as, over space may lead to many of the stresses and strains in the economy. Hence, it might be useful for the purpose of policy making to study in which of the districts/time periods, the production of fish are more stable/unstable than in the others. Coefficient of variation (CV) is used as the usual measure of instability. Hence the period-wise coefficients of variation were computed separately for different districts of Sindh. The usual measure of CV is given by:

$$CV = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100 \quad (2)$$

The CV has an easy interpretation in the context of measuring an overall variation in the data not showing any trend. But usually when we have a time-series for a variable showing some kind of trend which may be linear or non-linear, CV does not take into account any such time trends of the data while measuring instability in the variable values (Mitra, 1980). The instability Index (II) was,

therefore measured by fitting an exponential time trend. There are a number of techniques available to measure the index of instability. Such techniques are found in Coppock (1962), Mac-Bean (1966), Massel (1970), Weber and Sievers (1983), Cuddy-Della Valle (1978), Sing and Byerlee (1990), Parthasarathy (1984) and Wasim (1999). In this study the variability in fish production is measured by a method suggested by Parthasarathy, which was based on residuals,

$$II = \sqrt{\frac{\sum_{i=1}^n ei^2}{(n-k)}} \quad (3)$$

where,

ei = value of residual of i^{th} observation

n = number of observation

k = number of variables

Sen (1989) pointed out that the measure of instability based on exponential time trend is scale free and can be readily used for cross comparisons. Chand and Tewari (1991) also used this method for measuring instability of Indian exports and imports of agricultural commodities.

III. DETERMINANTS OF INLAND FISH PRODUCTION

To determine the factors affecting inland fish production, the following log-linear function was hypothesized.

$$\log IFP_t = \alpha + \beta_1 \log NOF_t + \beta_2 \log NOB_t + U_t \quad (4)$$

where,

IFP_t = Inland fish production in year t.

NOF_t = Number of fisherman in year t.

NOB_t = Number of boats in year t.

U_t = random disturbance term

Other most important independent variable, *i.e.* inland fish production price was also considered, but the data on price was not available. Only marine fish production price is available. Therefore it was not possible to determine its effect.

JUSTIFICATION OF THE VARIABLES

The estimating equation indicates that inland fish production in a given period is a log-linear function of a constant term, two variables and an error term. The theoretical justification for different variables being included as arguments in equation is as follows. The second term in the right hand side of the equation refers

to number of fisherman. Since increase in number of fisherman, other things remaining the same, would provide an incentive to fishermen to catch more fish, we would expect, and the model yields, the coefficient β_1 to be positive. In reverse case the coefficient β_1 will be negative. In other words, it means that due to poverty the fishermen are decreasing and they prefer to do other profitable work like crop farming or livestock farming. In Pakistan and Sindh a majority of the fishermen are poor. The third term on the right hand side is number of boats for fish catching. It is understood that if the number of boats for fish catching will increase, more fisherman will go on boat for fish catching and the fish production will increase, we would expect, and the model yields, the coefficient β_2 to be positive. If the case is reverse the coefficient β_2 will be negative.

Whether this model suffers from auto-correlation problem or not, it will be tested by using the DW d-statistic. "Inter-correlation of variables is not necessarily a problem unless it is highly relative to the overall degree of multiple correlations" (Klein 1962). If there is a strong interrelationship among the independent variables, it becomes difficult to disentangle their separate effects on the dependent variable. If there are more than two explanatory variables, it is not sufficient to look at simple correlations. Thus the term "Intercorrelations" should be interpreted as multiple correlation of each explanatory variable with the other explanatory variable. Thus, by Klein's rule multicollinearity would be regarded as problem only if $R_y^2 < R_i^2$, where $R_y^2 = R_{y \cdot x_1 \cdot x_2 \dots x_k}^2$ and $R_i^2 = R_{xi}^2$ other x 's. With the non-experimental data, it would be impractical to ascertain a priori that the multicollinearity problem among the explanatory variables is not severe. Therefore, a categorical test of intercorrelations among the explanatory variables is conducted and results are presented in Appendix 1. All these ensure the best linear unbiased estimates.

IV. RESULTS AND DISCUSSION

The results of the study are discussed as below:

GROWTH PERFORMANCE OF DISTRICT-WISE INLAND FISH PRODUCTION IN SINDH

The results of district-wise compound growth rates of inland fish production of the districts of Sindh are presented in Table 5. During period I, the inland fish production growth in all the districts (except Badin and Thatta) are positive and significant. In Khairpur, Jacobabad, Sukkur, Nawabshah, Sanghar, Tharparkar, Dadu and Sindh, it is significant at 1 percent level while in Hyderabad it is significant at 10 percent level. In Badin and Thatta, though the growth rate is positive but statistically insignificant. The possible reason may be that the fishermen of these districts are taking the advantage of marine fishing because Thatta and Badin districts are also coastal districts. It is interesting to note that though the growth rate of Thatta is positive and statistically insignificant, its relative share in

TABLE 5
Compound Growth Rates of District-Wise Inland Fish Production in Sindh
(Percentage)

Districts	Period I (1975-1988)	Period II (1989-2002)	All Period (1975-2002)
Khairpur	56.62 (13.00)*	66.89 (3.16)*	65.34 (19.59)*
Jacobabad	52.65 (3.67)*	-59.17 (0.57)	60.11 (4.36)*
Sukkur	80.60 (3.95)*	21.87 (0.34)	59.49 (4.48)*
Nawabshah	62.57 (7.85)*	112.33 (1.37)	33.61 (2.98)*
Larkana	39.63 (2.64)**	111.46 (6.87)*	67.85 (8.29)*
Sanghar	119.29 (3.96)*	-382.87 (2.86)**	38.41 (1.44)
Tharparkar	129.21 (3.65)*	-562.61 (6.52)*	1.78 (0.06)
Dadu	19.94 (4.28)*	94.30 (1.29)	22.66 (2.60)**
Hyderabad	20.15 (1.89)***	256.17 (2.10)***	40.15 (2.48)**
Badin	12.73 (0.60)	549.36 (5.37)*	107.70 (4.39)*
Thatta	40.72 (1.22)	526.69 (3.11)*	62.00 (2.20)**
Sindh	47.17 (3.86)*	121.78 (5.59)*	64.62 (9.75)*

NOTE: *, **, *** Significant at 1, 5 and 10 percent level of significance respective.

Figures in parenthesis are 't' values.

the total inland fish production of Sindh province in that period is 23 percent (more than from each district) Table 10. Tharparkar has the highest growth rate of 129.21 percent per annum, while its share in total inland fish production of Sindh is less than one percent. The lowest growth rate of 12.73 percent per annum is observed by

Badin district while its share is 4 percent. The positive growth rates in nine districts out of eleven districts and in Sindh province clearly indicates that this profession in the above districts and in Sindh province is profitable mainly due to; different sources of fish catching, low prices of inputs used, easy availability of formal credit system, better process of issuing license system and better livelihood resource gradation.

In period II out of 11 districts five districts are positively significant and two districts are negatively significant. The growth rate of Khairpur which was 56.62 percent per annum in period I, increased to 66.89 percent in period II. Similarly of; Larkana from 39.63 percent to 111.46 percent, Hyderabad from 20.15 percent to 256.17 percent, Badin from 12.73 percent to 549.36 percent, Thatta from 40.72 percent to 526.69 percent and of Sindh province from 47.17 percent per annum in period I to 121.78 percent in period II. The growth rate of Sanghar and Tharparkar significantly decreased. Sukkur, Nawabshah and Dadu districts were previously (period I) positively significant but in period II they become insignificant. It means that the inland fisheries profession in the districts of Khairpur, Larkana, Hyderabad, Badin, Thatta and in Sindh province are profitable. The fishermen of Sanghar, Tharparkar, Sukkur, Nawabshah and Dadu districts were not finding this job profitable mainly due to; contract system, non-availability of formal credit system, overall livelihood resource degradation, insufficient sources of catching fish and shifting of fishermen to other profitable work, (for example agriculture). The increase in the growth rate of 5 districts in period II (specially Badin and Thatta) may be due to; fighting of fishermen against contract system, better availability of formal credit system and better fishing grounds. They must have to purchase fishing nets and fishing boats, which requires money.

Except Sanghar and Tharparkar, the growth rate of other districts and Sindh province are positive and significant in all period. In all period though the growth rate of Sanghar and Tharparkar become positive but statistically insignificant. Positive and significant growth rates of inland fish production in almost all the districts and province during all period show the active involvement of Sindh Fisheries Department. A number of initiative are being taken by the Sindh Fisheries Department which, inter-alia, include strengthening of extension services, diversification of fishing efforts, development of value added products, enhancement of per capita consumption and upgradation of socio-economic condition of fishermen's community.

If a differentiation is made between two periods, then it can be said that more districts have positive and significant growth rates in period I, as compared to period II.

INSTABILITY IN INLAND FISH PRODUCTION

The level of instability in inland fish production is very important for sustainable production. We have estimated district-wise instability in inland fish production for period I, period II and all periods in Table 6 using equation (3). Instability

percentage change in inland fish production are also calculated for period II over period I (Table 7).

TABLE 6
Instability Indices of District-Wise Inland Fish Production in Sindh

Districts	Period I (1975-1988)		Period II (1989-2002)		Period III (1975-2002)	
	Instability Index	CV	Instability Index	CV	Instability Index	CV
Khairpur	0.08	6.88	0.19	2.65	0.05	8.11
Jacobabad	0.15	7.30	0.41	6.05	0.10	9.63
Sukkur	0.18	9.86	0.33	5.08	0.10	8.06
Nawabshah	0.11	7.13	0.37	8.07	0.09	7.52
Larkana	0.16	6.52	0.16	2.82	0.08	8.10
Sanghar	0.22	15.95	0.47	15.57	0.14	15.47
Tharparkar	0.24	31.19	0.38	34.88	0.15	33.74
Dadu	0.09	2.55	0.35	6.71	0.08	5.32
Hyderabad	0.13	4.07	0.45	11.17	0.11	9.35
Badin	0.19	8.33	0.41	14.76	0.14	17.72
Thatta	0.23	10.95	0.53	16.79	0.15	14.66
Sindh	0.14	4.78	0.19	2.55	0.07	5.74

Instability in inland fish production in all the districts and province (except Sanghar, Tharparkar and Thatta) of period I are low. The higher instability of inland fish production in the districts of Sanghar (0.22), Tharparkar (0.24) and Thatta (0.23) did not deter the concerned districts from attaining high growth rates. Nadkarni and Deshpande (1983) also found the positive association between growth and instability in crop yields in Karnatka. Khairpur district (0.08) has the lowest degree of instability in inland fish production. In period II, the magnitude of instability in inland fish production of all the districts (except Larkana) and province increased as compared to period I. The production instability of Nawabshah (0.37), Dadu (0.35) and Hyderabad (0.45), increased by more percentage as compared to other districts and province (Table 7). It means, it may be concluded that the higher instability of inland fish production in the districts of Nawabshah, Dadu and Hyderabad did not deter from attaining high growth rates.

TABLE 7
 Period-Wise Relative Instability Index and Their Percentage Change
 in Inland Fish Production in the Districts of Sindh

Districts	Production		Percentage Change II over I
	Period I	Period II	
Khairpur	0.08	0.19	137.50
Jacobabad	0.15	0.41	173.33
Sukkur	0.18	0.33	83.33
Nawabshah	0.11	0.37	236.36
Larkana	0.16	0.16	0.00
Sanghar	0.22	0.47	113.63
Tharparkar	0.24	0.38	58.33
Dadu	0.09	0.35	288.89
Hyderabad	0.13	0.45	246.15
Badin	0.19	0.41	115.78
Thatta	0.23	0.53	130.43
Sindh	0.14	0.19	35.71

For better understanding of growth and instability in inland fish production, we have presented Table 8. In period I, the districts of Khairpur, Jacobabad, Sukkur, Nawabshah, Larkana, Dadu, Hyderabad and Sindh province has moderate growth in inland fish production accompanied by low level of instability while Sanghar and Tharparkar districts has high growth and high instability in inland fish production. In period II, the growth rate of inland fish production of the districts of Khairpur, Hyderabad, Badin, Thatta and Sindh province significantly increased but at the same time their instability also increased. The growth rate of Sanghar and Tharparkar districts significantly declined but their instability increased. High instability for the districts of Sanghar and Tharparkar may be due to limited sources of catching fish, poverty of fishermen and non-profitable job for the fishermen.

Changes in inland fish production growth rate which cause instability can be due to a number of factors which include, non-strengthening of extension services, diversification of fishing efforts, behavior of prices and less per capita consumption.

A moderate and significant growth in inland fish production accompanied by a low level of instability is desired for sustainable development of agriculture as compared to high growth in production and high level of instability.

TABLE 8
Period-Wise Growth and Instability in Inland Fish Production
in the Districts of Sindh

Districts	Period I		Period I	
	Growth (%)	Instability	Growth (%)	Instability
Khairpur	56.62*	0.08	66.89*	0.19
Jacobabad	52.65*	0.15	-59.17	0.41
Sukkur	80.60*	0.18	21.87	0.33
Nawabshah	62.57*	0.11	112.33	0.37
Larkana	39.63**	0.16	111.46*	0.16
Sanghar	116.29*	0.22	-382.87**	0.47
Tharparkar	129.21*	0.24	-562.61*	0.38
Dadu	19.94*	0.09	94.30	0.35
Hyderabad	20.15***	0.13	256.17***	0.45
Badin	12.73	0.19	549.36*	0.41
Thatta	40.72	0.23	526.69*	0.53
Sindh	47.17*	0.14	121.78*	0.19

NOTE: Taken from Tables 5 and 6.

*, **, ***, Significant at 1, 5 and 10 percent level of significance respectively.

DISTRICT-WISE TEMPORAL CHANGE AND RELATIVE SHARE OF INLAND FISH PRODUCTION

Temporal change in district-wise inland fish production in Sindh is presented in Table 9. It can be seen from the table that the production of inland fish declined in the district of Badin during the triennium ending 1980-85 as compared to previous period. The highest percentage increase was recorded in Sanghar district (656.23 percent), and lowest percentage increase was recorded by Dadu district (40.67 percent). A quantum decline in the inland fish production in the districts of Sukkur, Nawabshah, Sanghar, Tharparkar, Dadu and Hyderabad during 1990-95 as compared to 1985-90 was noticed, though their relative shares were 15.08, 2.28, 12.92, 0.19, 5.38 and 7.17 percent respectively (Table 10). The maximum percentage increase in inland fish production was in Jacobabad district (90.29 percent) during 1990-95 over 1985-90. Its relative share was also 17.18 percent.

Percent increase in inland fish production during 1999-03 over the period 1995-99 was maximum in Nawabshah district, (in 1990-95 over 1985-90 it was negative production) 253.38 percent, followed by Jacobabad (224.13 percent), Sanghar (93.32 percent), Sukkur (69.40 percent), Dadu (64.14 percent), Khairpur (41.75 percent) and Larkana (20.61 percent). But the relative share of all these districts in the total inland fish production of the province is low (Table 10). The inland fish production of Badin and Thatta districts though declined during 1999-03 as compared to 1995-99 but they have maximum relative share during the period. Tharparkar and Hyderabad also recorded negative increase in inland fish production. A perusal of Table 10 shows that the relative share of the districts of Khairpur, Jacobabad, Sukkur, Nawabshah, Sanghar, Dadu and Badin in the total inland fish production of Sindh declined during 1999-03 as compared to 1975-80, though their absolute production increased. This was due to increase in the relative share of other districts [Larkana, Badin and Thatta (Table 10)]. It is interesting to note that none of the districts showed continuous increase in the relative share in all the different periods. Thatta district ranked first in relative share of total inland fish production in the province (27.32 percent), followed by Badin (21.36 percent), Sukkur (10.60 percent), Larkana (9.72 percent), Hyderabad (8.46 percent) etc. A Bar-Diagram showing average relative share of different districts in inland fish production for different periods are presented in Appendix 2.

TABLE 9

Temporal Change in District-Wise Inland Fish Production

(Metric tones)

Districts	1975-1980	1980-1985	Percentage Change	1985-1990	1990-1995	Percentage Change	1995-1999	1999-2003	Percentage Change
Khairpur	2322	4140	78.29	6315	7690	21.77	6515	9235	41.75
Jacobabad	6568	11437	74.13	22419	42661	90.29	8927	28935	224.13
Sukkur	8800	37418	325.20	43249	37422	-13.47	22978	38925	69.40
Nawabshah	4900	10261	109.41	14345	5656	-60.57	4910	17351	253.38
Larkana	7911	13395	69.32	19054	30041	57.66	29598	35698	20.61
Sanghar	3032	22929	656.23	33140	32080	-3.20	3490	6747	93.32
Tharparkar	111	836	653.15	2028	470	-76.82	126	52	-58.73
Dadu	9507	13374	40.67	14564	13297	-8.70	12508	20531	64.14
Hyderabad	11636	16567	42.38	20594	17812	-13.51	50333	31085	-38.24
Badin	5413	5196	-4.01	7302	8363	14.53	86858	78437	-9.69
Thatta	22619	39058	72.68	49227	52703	7.06	128650	100255	-22.07
Total	82819	174611	110.83	232237	248195	6.87	354893	367251	3.48

TABLE 10
Relative Share of Different Districts in Inland Fish Production of Sindh
(Metric tones)

Districts	1975-1980	Percent Share	1980-1985	Percent Share	1985-1990	Percent Share	1990-1995	Percent Share	1995-1999	Percent Share	1999-2003	Percent Share
Khairpur	2322	2.80	4140	2.37	6315	2.71	7690	3.10	6515	1.83	9235	2.51
Jacobabad	6568	7.93	11437	6.55	22419	9.65	42661	17.18	8927	5.52	28935	7.87
Sukkur	8800	10.62	37418	21.43	43249	18.62	37422	15.08	22978	6.47	38925	10.60
Nawabshah	4900	5.92	10261	5.87	14345	6.17	5656	2.28	4910	1.38	17351	4.72
Larkana	7911	9.55	13395	7.67	19054	8.20	30041	12.10	29598	8.34	35698	9.72
Sanghar	3032	3.66	22929	13.13	33140	14.27	32080	12.92	3490	0.98	6747	1.84
Tharparkar	111	0.13	836	0.48	2028	0.87	470	0.19	126	0.03	52	0.01
Dadu	9507	11.48	13374	7.65	14564	6.27	13297	5.38	12508	3.52	20531	5.59
Hyderabad	11636	14.05	16567	9.48	20594	8.87	17812	7.17	50333	14.18	31085	8.46
Badin	5413	6.53	5196	2.97	7302	3.14	8363	3.37	86858	24.49	78437	21.36
Thatta	22619	27.31	39058	22.37	49227	21.20	52703	21.23	128650	36.25	100255	27.32
Total	82819	100.00	174611	100.00	232237	100.00	248195	100.00	354893	100.00	367251	100.00

DETERMINANTS OF INLAND FISH PRODUCTION

To determine the factors affecting inland fish production, equation (4) was applied. The results of the equation are given below:

$$LIFP_t = 31.33882 + 0.457786 * NOF_t + 0.185860 NOB_t$$

(3.729965) (1.072453)

$$R^2 = 0.657796$$

$$DW \text{ 'd' (statistic)} = 1.778998$$

NOTE: Figures in parentheses are 't' values.

*Significant at 1 percent level of significance.

The above equation not only gave a high value of the coefficient of multiple determination (R^2) but also indicated the absence of multicollinearity (Appendix 1) and autocorrelation (indicated by the calculated Durbin-Watson 'd' statistics). In the above equation only the number of fishermen in Sindh is positive and significant at 1 percent level of significance. It means that there is a direct relationship between number of fishermen and inland fish production in Sindh. As the number of fishermen is increasing, the inland fish production is also increasing. It indicates that in Sindh province the profession of fishermen is profitable. As far as the other

variable (number of boats) is concerned, though it is positive but statistically insignificant. This variable has no effect on inland fish production. It may be mainly due to bad socio-economic condition of the fishermen's community.

PROBLEMS AND CONSTRAINTS FACED BY INLAND FISH FARMERS IN SINDH

The following problems are faced by inland fish farmers:

1. Seed is a basic component in fish farming. Timely use, accurate quantity, proper length of fingerlings and suitable combination of species can have positive effect on fish production. But, fish farmers are facing the problems regarding the seed. Seed supplied by Fisheries Department are not in proper length. Also the problems faced by fish farmers are non-availability of the high valued and desired types of species. Undercounting and untimely supply of seed are also major problem.
2. Non-availability of preservation of fish facility at any stage of marketing system is also lacking.
3. Availability of credit at the right time and at reasonable interest rates may prove a key element that determines the intensification, expansion of production and technological improvements in fish farming business. Procedural complexities and inadequate grace period for repayment of loan are the main problem with respect to credit availability.
4. Lack of extension service and non-availability of training facilities in fish farming are also the main problems in increasing fish production.

V. CONCLUSIONS

The study analyzed the growth and instability in inland fish production for two different periods of Sindh province: Period I (1975-1988) and period II (1989-2002). The study reveals that in period I, nine districts (out of eleven districts) and in Sindh province the growth rate of inland fish production is positive and statistically significant. This means that in the above districts and in Sindh province the fishing profession is profitable mainly due to; different sources of fish catching, low prices of input, easy availability of formal credit system, better process of issuing license system and better livelihood resource gradation. The study also confirms that in period II, the growth rate of Khairpur, Larkana, Hyderabad, Badin, Thatta and Sindh province positively and significantly increased, while that of Sanghar and Tharparkar districts, significantly decreased. The negative growth may be due to; non-profitability of this job, poverty, shifting of inland fish farmers to other profitable job, contract system, non-availability of formal credit system, overall livelihood resource degradation and insufficient sources of catching fish. The increase in the growth rate of 5 districts in period II (specially Badin and Thatta) may be due to; fighting of fishermen against contract system, better availability of formal credit system and better fishing grounds. The results of the

study also indicate positive and significant growth rate in all the districts (except Sanghar and Tharparkar) and province in All period. This shows the active involvement of Sindh fisheries department. The study also indicates that in period I, a majority of districts have moderate growth rate with less instability in inland fish production as compared to period II. The study also reveals that in period II, the growth rates of the districts of Jacobabad, Sanghar and Tharparkar not only decreased but their instability also increased. Moderate growth and low instability in inland fish production is the best situation from the biodiversity point of view. However, high growth and high instability (most of the districts of period II) in inland fish production needs a special attention in the future research agenda. The results of the study also confirms that the relative share of the districts of Khairpur, Jacobabad, Sukkur, Nawabshah, Sanghar, Dadu and Badin in the total inland fish production of Sindh declined during 1999-03 as compared to 1975-80, though their absolute production increased. This was due to increase in the relative share of other districts. The study also reveals that none of the districts showed continuous increase in the relative share in any of the periods.

VI. POLICY IMPLICATIONS

The results obtained in this study lead to important implications that seem to be relevant from the point of view of policy formulation.

1. The study confirms that in period II, the growth rate of inland fish production in the districts of Sanghar and Tharparkar significantly declined. Therefore the production growth rate needs to be increased. This can be done through: improving their socio-economic conditions, decreasing the prices of inputs, increasing the sources of catching inland fish production, strengthening of extension services, diversification of fishing efforts, development of value added products, enhancement of per capita fish consumption, ending of contract system, better availability of formal credit system and better livelihood resource gradation.
2. The fisherfolk organizations including Pakistan Fisherfolk Form [PFF] should be made part of the process of issuing licenses under license system as in the past the Fisheries Department officials failed the system by issuing fake license fees receipts to the fishermen, pocketing the license fees, and reporting to the government that fisherfolk communities are not paying their license fees.
3. Fish Hatcheries should be established near major fishing waters to provide fish seed for those fishing grounds as no new fish seed is coming due to lack of flows from Indus. The performance of existing fish hatcheries should be improved forthwith.
4. The study also indicates high instability in all the districts (except Larkana and Sindh province) in period II, as compared to period I. The instability can be declined through controlling the price of inland fish production,

improving their socio-economic conditions, decreasing the prices of inputs, strengthening the extension services and enhancement of per capita fish consumption.

5. The study also reveals that none of the districts showed continuous increase in the relative share of inland fish production in all the different periods. The relative share of all the districts in inland fish production of Sindh needs to be increased. This can be done if the Sindh Fisheries Department takes the following steps:
 - (i) Strengthening of extension services.
 - (ii) Improved management of inland waters.
 - (iii) Increased local consumption of fish by telling the peoples that its consumption will minimize the disease of Heart and Blood Pressure.
 - (iv) Upgradation of socioeconomic condition of the fishermen's community.
 - (v) Improvement in marketing arrangement.

Some of the other policy implications are being listed here, which do not directly depend upon the results of the study but indirectly they depend upon Sindh fishermen fishing.

1. The contract/Auction system has played havoc with the fish resources and has resulted in exploitation and worst ever poverty among the fisherfolk communities. The government needs to abolish contract system from all the fishing grounds. License system should be adopted on all the fresh water fishing grounds.
2. Even if license system is introduced in the fishing grounds there are fears that the influential people, who have been exploiting the fishing resources of the fishing grounds, would not allow the fishermen to fish independently and would threaten and even punish them. The government needs to make the fishermen fishing in the fishing grounds under license system.
3. Major fishing grounds/lakes in different districts of Sindh have been practically occupied by the influential landlords of those areas. Those landlords, with the help of Fisheries Department officially receive contracts of the fishing grounds and exploit the fishermen. In many cases the fishermen are killed and their fishing boats and nets are taken away by the influential landlords and their henchmen whenever the fishermen raise their voice against their injustice. The government needs to bring such illegal occupations of the fishing waters to an end and take severe action against the landlords occupying fishing grounds and exploiting fishermen.

4. Indus flow should be considered as important for the wetlands/fishing grounds as is being considered for agriculture. In the case of water availability wetlands and fishing grounds should also be provided their due water shares besides providing water share to agriculture, industries and urban consumers.

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APPENDIX 1

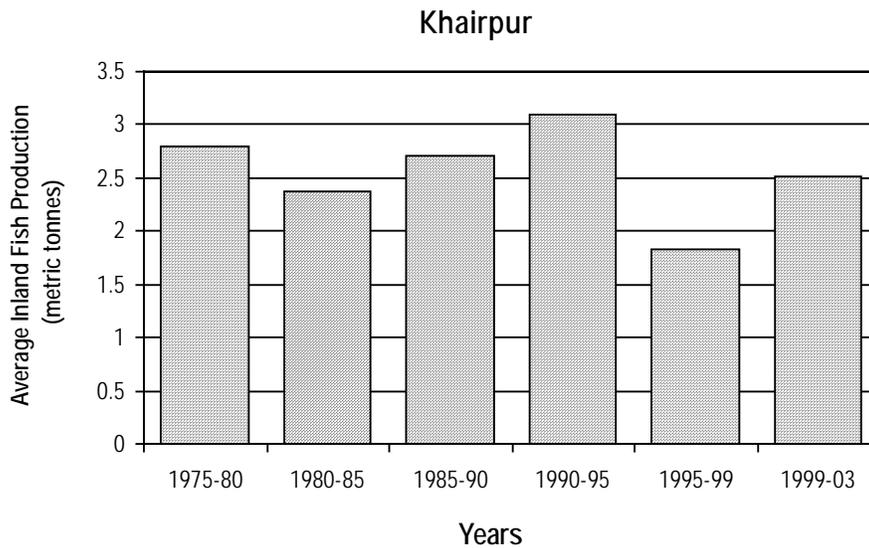
Test of Multicollinearity of the Explanatory Variables (By Klein's Rule)
Used in the Regression Analysis of Inland Fish Production

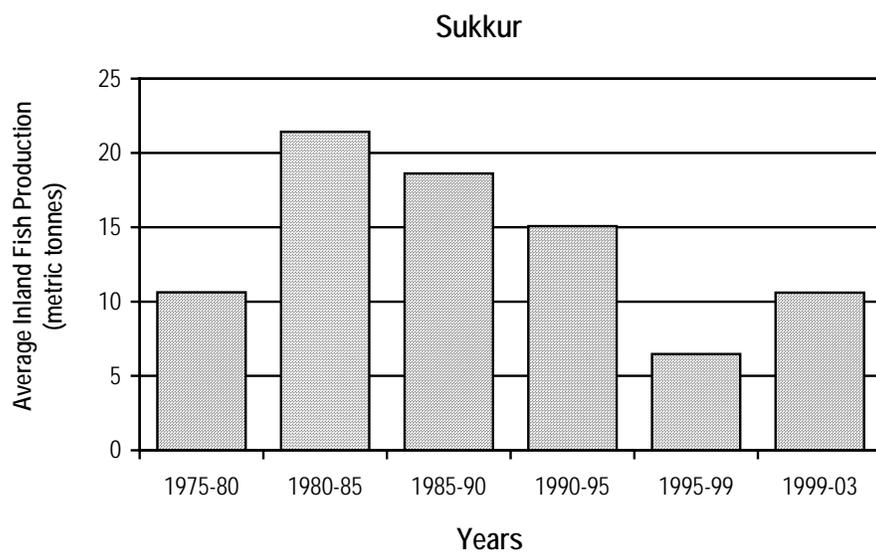
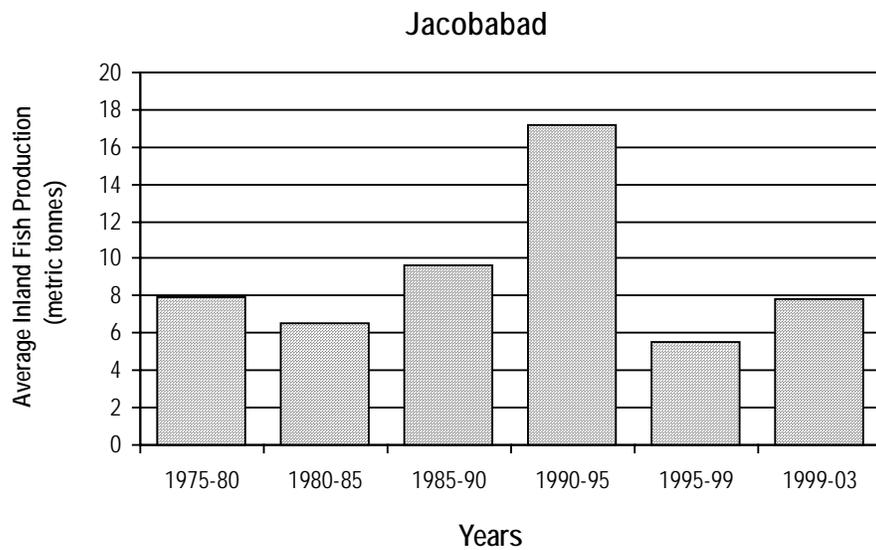
Province	Total R^2	Partial R^2 (Each Explanatory Variable as a Dependent Variable)	
		Number of Fishermen	Number of Boats
Sindh	0.66	> 0.36	> 0.28

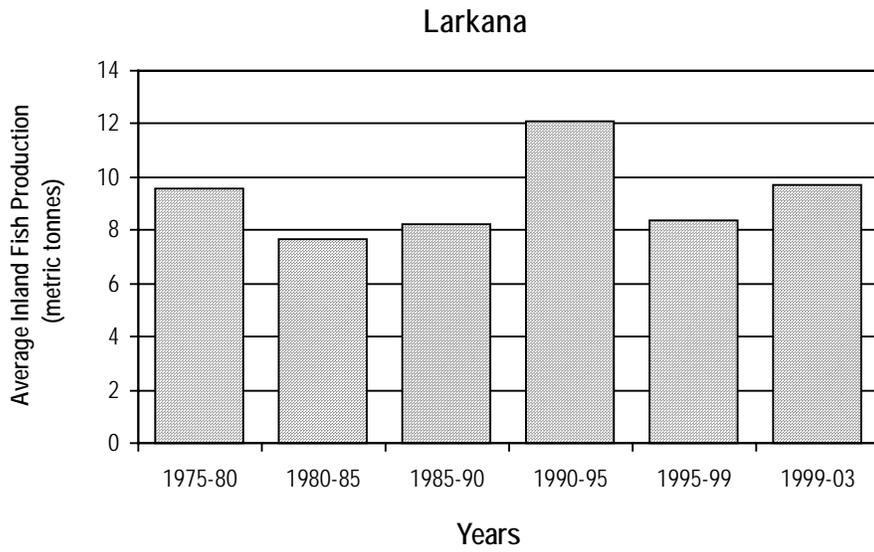
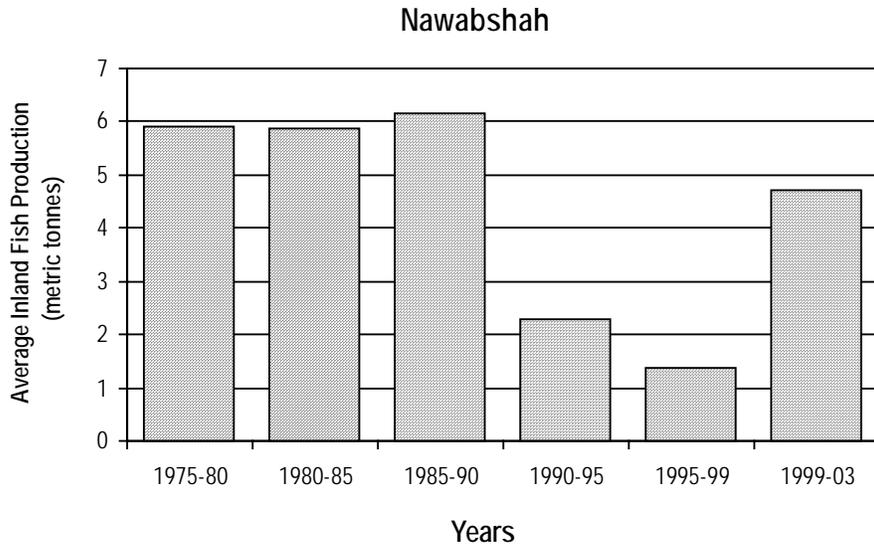
NOTE: Each explanatory variable used as dependent variable, in turn, on other explanatory variables (according to the model type of the Table Equation). If the partial R^2 is greater (>) then the total R^2 , then there is harmful multicollinearity of the variable on the other variable conversely (*i.e.* R^2 total > R^2 partial). The collinearity problem is not serious (see Maddala, 1977). The associated symbol of the explanatory variables, *i.e.* > indicates that the total R^2 is greater than the partial R^2 . All the variables are in natural logarithms.

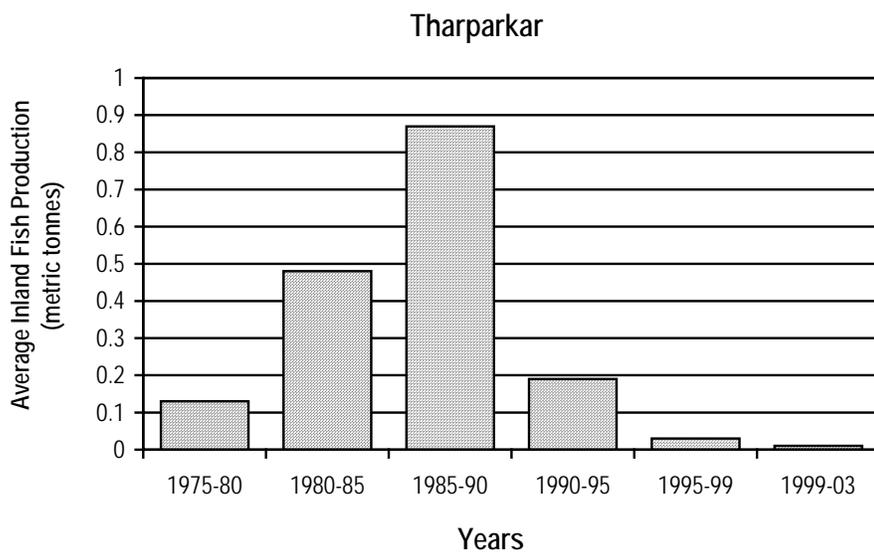
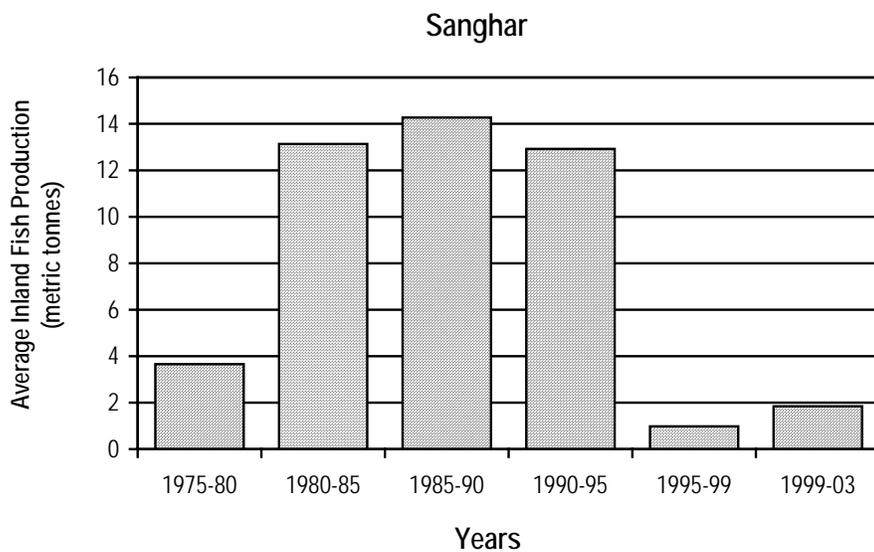
APPENDIX 2

Bar-Diagram Showing Averages of Different Districts
in Inland Fish Production of Sindh, 1975-2003

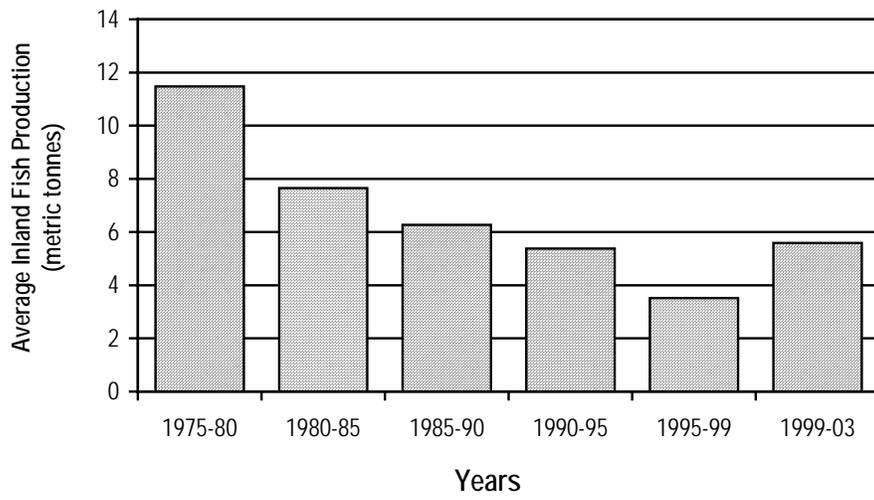








Dadu



Hyderabad

