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Growth performance of marine fisheries in Gujarat— Disaggregate Analysis

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Abstract

This account gives the districtwise and specieswise growth and instability of marine fisheries in Gujarat. The data pertaining to the districtwise marine fish production and total number of mechanised and non-mechanised boats in Gujarat were collected and compiled from the Fisheries Dept., Govt. of Gujarat, for the period 1960-98. The study indicated that at Junagadh, Kutch and Jamnagar districts the total marine fish production has increased over the years, whereas drastic decline was observed in Valsad and Amreli districts.

Introduction

Gujarat state, on the west coast of India lies between 20°1′ and 24°7′ N. latitude and 68°4′ and 74°4′ E. long. The fisheries sector is of great significance in view of the excellent physical and biological resources in the state. The state with a long maritime tradition is blessed with 1600 km long coastline, and has been in the forefront of maritime activities. The coastline of Gujarat extends along 10 districts, from Kutch in the north and Valsad in the south, accounting for about 21 per cent of the total coastline of India (Pravin *et al.*, 1998). The ports of Gujarat handled 25.7 million metric tonnes of cargo during the year 1997-98, constituting over 80 per cent of the total cargo handled by minor and intermediate ports of the country and 9 per cent of the traffic handled through all the Indian ports during the same year (The Economic Times, July 28, 1999).

Gujarat coastline accounts for about 59 per cent of the total west coast of the country. Two extensive gulfs - the Gulf of Kutch and the Gulf of Cambay are situated in Gujarat. The topography of the coastal regions is marked by salt marshes, belts and gravel patches. The state has 2.14 lakh sq. km. of EEZ and 1.64 lakh sq. km. continental self. It contributes 21.2 per cent to the total marine fish production of the country and tops among all the maritime states (Mehta *et al.*, 1998). Total marine fish production in the state during 2000-01 was 6.2 lakh tonnes and inland fish production 0.4 lakh tonnes, making a total of 6.6 lakh tonnes.

The foreign exchange crisis faced by the Government of India (GOI), and the keenness on the part of the state Government to promote exports to earn foreign exchange, provided a new thrust to fisheries development. As a result, the current development and management of the

fishery sector focuses attention on the need to conduct research studies to provide information and analytical techniques which can contribute to the planning process, institutional development and the economic efficiency of the fishery sector. Keeping this in view, the present study was undertaken to examine districtwise and specieswise growth and instability of marine fisheries in Gujarat.

This paper forms a part of ICAR adhoc project on "An economic analysis of fish production in Saurashtra region". The financial assistance by ICAR for this project is gratefully acknowledged.

Material and methods

Commensurate with the objective of the study, the secondary data pertaining to the district wise marine fish production and total number of mechanised and non-mechanised boats in Gujarat State were collected and compiled from the Commissionerate of Fisheries, Government of Gujarat, Gandhinagar, for the period from 1960-61 to 1997-98, whereas the data on specieswise marine fish production were obtained from 1980-81 to 1997-98.

Analytical framework

A brief description of analytical techniques used is presented below:

Tabular analysis

Tabular analysis was extensively used to achieve the objectives of study. Ratio and percentage methods were used to estimate the cost and returns from fish production.

Growth rates

In order to examine the periodwise trend of production and export of fish, linear and exponential functions were fitted on the basis of three years moving average data. But the exponential function was finally selected considering the higher value of coefficient of determination (R^2). The form of exponential function is as under:

$$Y = ab^t \text{ or } \log Y = \log a + t \log b$$

Where, Y = production/export of fish

t = time period in years (1, 2,.....n)

b = coefficient

a = intercept

Per cent annual compound growth rate (r) was computed as

$$r = \{ \text{antilog of } (\log 'b') - 1 \} \times 100$$

Instability indices

Production of fish is known to fluctuate widely over time and regions. Disparities in the movement of these indicators from one region to another may indicate heterogeneity in the economy. 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 purposes of policy making to study in which of the districts/time periods, the production, export and prices of fish are

more stable/ unstable than in the others. Coefficient of Variation (C.V.) is used as the usual measure of instability. Hence, the periodwise coefficients of variation were computed separately for different districts of Gujarat. The usual measure of C. V. is given by

$$C.V. = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

The C. V. 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, C.V. does not take into account any such time trends of the data while measuring instability in the variate values (Mitra, 1989). The Instability Index (I.I.) was, therefore measured by fitting an exponential time trend. Instability index was constructed based on the residuals as under:

$$I.\ I. = \sqrt{\frac{\sum_{i=1}^{n} e_i^2}{(n-k)}}$$

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

n = number of observations

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 measuing instability of Indian exports and imports of agricultural commodities.

Results and discussion

Districtwise marine fish production

Table 1 shows the districtwise compound growth rates of marine fish production in Gujarat. During 1960-70, the compound growth rates of marine fish production were positive and highly significant in almost all the districts but were negative and highly significant in case of Valsad, Amreli and Surat districts during 1970-80. A drastic decline in marine fish production in these districts during 1970-80 was also confirmed from the results presented in Table 3. Rapid industrialisation in Surat and Valsad districts during this period might have adversely affected the fish production which in turn resulted into seasonal migration of fishermen from Surat and Valsad to Jakhau, Mumbai, Okha and other ports. In case of Amreli district, the fishermen of Veraval and Porbandar used to go for fishing in the sea of Amreli district but it enhanced the growth rate of fish production of Junagadh district (23.21%) since both Veraval and Porbandar ports are located in Junagadh district (Now Porbandar is bifurcated from Junagadh district). During 1980-90, the growth rates were positive in all the districts, though it was significant only in four districts. Devaraj *et al.* (1998) reported that the annual growth rate of catch ranged from 1.7 per cent during 1993-94 to 26.4 per cent during 1988-89. Very high negative and significant growth rates of marine fish production in Rajkot district during 1990-98 could be attributed mainly to the occupational

Table 1. *Districtwise compound growth rates of marine fish production in Gujarat*

Districts	1960-61 to 1969-70	1970-71 to 1979-80	1980-81 to 1989-90	1990-91 to 1997-98	All
Junagadh	1.87**	23.21**	10.90*	4.50**	9.03**
	(0.56)	(0.86)	(0.92)	(0.80)	(0.93)
Valsad	17.77**	-32.96**	16.59**	12.98**	0.59
	(0.92)	(0.98)	(0.97)	(0.99)	(0.005)
Kutch	8.27**	3.58*	22.44**	4.15**	12.91**
	(0.87)	(0.49)	(0.80)	(0.92)	(0.94)
Amreli	4.67**	-8.39**	1.57	-1.94	0.66
	(0.89)	(0.89)	(0.05)	(0.06)	(0.07)
Jamnagar	4.72	26.95**	7.30**	2.90**	11.62**
	(0.46)	(0.86)	(0.74)	(0.73)	(0.95)
Surat	--	-24.55**	3.95	14.70**	8.80**
	(0.86)	(0.29)	(0.95)	(0.55)	
Bhavnagar	--	-9.32	0.69	-5.88**	11.62**
	(0.43)	(0.004)	(0.66)	(0.80)	
Bharuch	--	-13.91	2.03	10.23**	4.09**
	(0.31)	(0.09)	(0.91)	(0.46)	
Kheda	--	15.42	7.99	3.33	7.24**
	(0.32)	(0.35)	(0.33)	(0.47)	
Rajkot	--	-0.15	2.55	-14.21**	0.31
	(0.0004)	(0.05)	(0.97)	(0.004)	
Total	7.75**	5.34**	9.82**	4.51**	6.11**
	(0.97)	(0.91)	(0.98)	(0.85)	(0.97)

Note : Figures in parentheses indicate values of R^2
* and ** indicates 5 and 1 per cent level of significance, respectively

change of fishermen of Navlakhi port of Rajkot district as the loading and unloading cargo activities initiated at this port tempted the fishermen for better remuneration. In general, the instability indices were comparatively higher during 1970-80 in all the districts of Gujarat, except Kutch, Amreli and Jamnagar (Table 2).

Relative share of different districts in marine fish production of Gujarat is presented in Table 3. Wide fluctuations in relative share of different districts in the total marine fish production of the state over a period of time were observed. The share of Junagadh district in the total marine fish production of the state during the triennium ending 1960-63 was 33.2 per cent which increased to 56.4 per cent during 1995-98. On the other hand, the share of Valsad and Amreli districts declined from 25.2 to 11.7 and from 36.6 to 7.6 per cent respectively, during the same period. However, relative share of Kutch and Jamnagar districts increased substan-

Table 2. *Instability indices of districtwise marine fish production in Gujarat*

(In per cent)

Districts	1960-61 to 1969-70		1970-71 to 1979-80		1980-81 to 1989-90		1990-91 to 1997-98		All	
	C.V.	Instability Index	C. V.	Instability Index	C.V.	Instability Index	C.V.	Instability Index	C.V.	Instability Index
Junagadh	6.08	0.13	44.51	0.28	26.13	0.16	10.12	0.08	76.16	0.28
Valsad	41.83	0.24	80.16	0.32	38.47	0.17	25.77	0.09	68.62	0.91
Kutch	19.71	0.23	12.23	0.19	41.27	0.39	9.07	0.06	112.82	0.38
Amreli	12.07	0.13	23.61	0.22	16.12	0.35	16.26	0.36	25.80	0.34
Jamnagar	15.96	0.23	63.21	0.49	20.57	0.71	7.00	0.12	91.57	0.49
Surat	--	--	47.51	0.61	17.35	0.35	29.23	0.20	88.83	0.70
Bhavnagar	--	--	19.35	0.45	24.95	0.44	16.41	0.36	75.69	0.52
Bharuch	--	--	53.81	0.77	15.74	0.38	21.64	0.23	42.20	0.53
Kheda	--	--	63.55	0.91	26.25	0.51	12.36	0.11	53.32	0.71
Rajkot	--	--	9.28	1.05	28.62	0.74	33.73	0.24	30.35	0.68
Total	18.80	0.06	13.01	0.11	23.03	0.10	9.85	0.05	65.66	0.12

Table 3. *Relative share of different districts in marine fish production of Gujarat*

(In tonnes)

Districts	1960-63	% share	1969-72	% share	1979-82	% share	1989-92	% share	1995-98	% share
Junagadh	27416	33.27	32980	22.58	144218	69.78	279480	57.31	368765	56.43
Valsad	20814	25.25	57278	39.21	5852	2.83	36749	7.54	76943	11.77
Kutch	1655	2.01	3572	2.45	5481	2.65	58924	12.08	73688	11.27
Amreli	30167	36.60	47903	32.79	25563	12.37	44687	9.16	50143	7.67
Jamnagar	2363	2.87	4335	2.97	20409	9.87	54368	11.15	66762	10.22
Surat	--	--	--	--	1114	0.54	3646	0.75	8718	1.33
Bhavnagar	--	--	--	--	943	0.46	4188	0.86	2968	0.45
Bharuch	--	--	--	--	1384	0.67	2181	0.45	3487	0.53
Kheda	--	--	--	--	320	0.15	1092	0.22	1212	0.19
Rajkot	--	--	--	--	1388	0.68	2326	0.48	897	0.14
Total	82417	100.00	146069	100.00	206675	100.00	487644	100.00	653587	100.00

tially from 2.0 to 11.2 per cent and from 2.8 to 10.2 per cent, respectively during the periods under study. The share of all the remaining districts in total marine fish production of the state is meagre. In general, it can be concluded that the Junagadh district ranked first among all the districts in the total marine fish production with its share of 56.4 per cent during 1995-98, followed by Valsad (11.7%), Kutch (11.2%), Jamnagar (10.2%), Amreli (7.6%), etc.

Specieswise marine fish production:

Table 4 presents the specieswise compound growth rates of marine fish production in Gujarat. It can be seen from the table that, positive and significant compound growth rates of fish production separately in both the periods were found in case of ribbonfishes, shrimps, cuttlefishes, squids, sharks, catfishes, prawns (M), seerfishes and miscellaneous fishes.

Table 4. *Specieswise compound growth rates of marine fish production in Gujarat*

(In per cent)

Fish species	1980-81 to 1989-90	1990-91 to 1997-98	All
Small sciaenids	13.27** (0.96)	2.10 (0.36)	10.35** (0.92)
Bombay duck	1.26 (0.05)	3.64* (0.50)	7.90** (0.82)
Ribbonfishes	34.12** (0.91)	11.69** (0.97)	22.31** (0.93)
Shrimps	10.80** (0.97)	9.37** (0.90)	11.10** (0.99)
Cuttlefishes/squids	21.24** (0.91)	7.73** (0.79)	15.61** (0.94)
Sharks	11.29** (0.72)	5.54** (0.82)	8.22** (0.89)
Catfishes	12.32** (0.99)	7.35** (0.78)	8.44** (0.95)
Clupeoids	3.55 (0.32)	10.99** (0.99)	4.56** (0.73)
Coilia spp.	13.83** (0.73)	3.27 (0.28)	10.99** (0.88)
Prawns (M)	3.95** (0.59)	10.56** (0.77)	6.14** (0.85)
White pomfret	0.91 (0.07)	3.31 (0.42)	2.22** (0.57)
Jew fish	8.42** (0.97)	-4.83 (0.26)	5.30** (0.62)
Seerfishes	8.99** (0.87)	4.38** (0.86)	4.94** (0.86)
Mullets	8.34** (0.58)	4.07 (0.29)	2.67* (0.27)
Perches	37.91** (0.96)	4.43 (0.46)	19.84** (0.86)
Silver bellies	8.11** (0.75)	0.35 (0.03)	2.99* (0.31)
Eels	-2.69 (0.38)	6.55** (0.94)	0.51 (0.04)
Black pomfret	-3.48 (0.41)	0.45 (0.03)	-0.27 (0.01)
Hilsa	-9.31** (0.51)	-0.87 (0.03)	-7.35** (0.76)
Threadfins	11.79** (0.58)	0.30 (0.001)	8.78** (0.73)
Crabs	2.85 (0.22)	6.46** (0.59)	8.14** (0.86)
Leather jacket	1.13 (0.02)	-12.56** (0.89)	-2.84* (0.29)
Indian salmon	14.71** (0.82)	-6.78** (0.77)	0.085 (0.0002)
Prawns (J)	2.18 (0.23)	0.59 (0.008)	2.60** (0.53)
Lobsters	24.83** (0.90)	-11.78** (0.96)	4.07 (0.17)
Miscellaneous	9.93** (0.96)	6.30** (0.95)	7.56** (0.97)
Total	9.82** (0.98)	4.51** (0.87)	8.86** (0.97)

Table 4 continue

Note : Figures in parentheses indicate values of R^2
* and ** indicates 5 and 1 per cent level of significance, respectively.

The annual compound growth rates for the overall period, *i. e.* from 1980-98 indicated that, the fish production of almost all the species under study increased significantly, except *Hilsa* and Leather Jacket which showed significant but negative growth rates. On an average, the annual increase in fish production was the highest in case of ribbonfishes (22.31%), followed by perches (19.84%), cuttlefishes and squids (15.61%), shrimps (11.10%) etc. The increase in production was mainly due to the fact that these are the trawl catch and the number of trawling boats increased significantly, during this period. Moreover, an increase in the efficiency of trawling, stay fishing and availability of infrastructure facilities have led to enhanced the production. On the other hand, it is pertinent to note that the *Hilsa* and Leather jackets are caught mostly by gillnets, *i. e.* by OBM. The number of OBM units in operation has declined during 1990-98. This could be attributed as one of the reasons for decline in the catch of these species.

Instability indices of specieswise marine fish production in Gujarat are presented in Table 5. It can be seen from the table that the instability indices of majority of the species declined during 1990-98 as compared to the period 1980-90. For the overall period, it may be concluded that the instability indices of threadfins, lobsters, perches, Indian salmon etc. were found relatively higher indicating an unstable production of these species. The probable reason for the higher instability indices of these species could be attributed to long life span (> 5 years) and their exploited age is predominantly > 2 years, before which, these resources are not found in the fishing grounds or do not get caught discriminately. Thus, an over fishing of these species in any year would restrict their future production. It is therefore, suggested that the extension efforts need to be strengthened to educate the fishermen about the various breeding periods and life cycle of different species, physiological characters of fishes, and the consequences of over fishing.

Temporal change in specieswise marine fish production in Gujarat is presented in Table 6. Except few species *viz.*, leather jackets, Indian salmon, lobsters, *Hilsa*, prawns (J), threadfins and jew fishes, the production of all other species has increased in the recent years. During the triennium ending 1995-98, the per cent increase in fish production compared to the period 1989-92, was the highest in case of ribbonfishes (95.44%), followed by clupeoids (88.78%), shrimps (72.23%), prawns (medium) (69.79%), cuttle fishes/ squids (54.19%), etc.

Conclusion

It can be concluded from the study that relative share of Junagadh, Kutch and Jamnagar districts in the total marine fish production of the state increased substantially over a period of time, whereas a drastic decline in case of Valsad and Amreli districts was noticed. The instability indices were comparatively higher during 1970-80 in all the districts except Kutch, Amreli and Jamnagar. The

Table 5. *Instability indices of specieswise marine fish production in Gujarat*

(In per cent)

Fish species	1980-81 to 1989-90		1990-91 to 1997-98		All	
	C. V.	Instability Index	C. V.	Instability Index		Instability Index
Small sciaenids	30.34	0.15	7.24	0.08	42.58	0.18
Bombay duck	14.39	0.28	10.90	0.19	38.82	0.26
Ribbonfishes	73.87	0.34	24.54	0.17	71.94	0.33
Shrimps	26.40	0.09	18.91	0.14	48.39	0.11
Cuttle fishes/squids	44.14	0.41	16.73	0.18	58.08	0.33
Sharks	30.90	0.54	12.35	0.18	35.82	0.40
Catfishes	27.74	0.08	16.43	0.17	36.68	0.14
Clupeoids	14.36	0.20	22.06	0.05	26.09	0.17
Coilia spp	31.85	0.36	12.20	0.15	45.78	0.32
Prawns (M)	12.92	0.22	22.66	0.29	32.65	0.26
White pomfret	8.19	0.19	10.66	0.18	13.92	0.18
Jewfishes	20.33	0.12	20.33	0.26	31.05	0.27
Seerfishes	20.93	0.18	9.88	0.11	22.32	0.16
Mullet	29.03	0.26	16.48	0.18	25.23	0.29
Perches	79.19	0.40	12.78	0.19	61.98	0.45
Silverbellies	20.10	0.21	4.59	0.08	20.45	0.19
Eels	10.74	0.22	14.51	0.17	12.14	0.23
Black pomfret	13.44	0.18	5.06	0.27	11.35	0.23
Hilsa	30.53	0.31	10.25	0.23	44.77	0.29
Threadfins	28.07	0.60	19.92	0.27	42.04	0.53
Crabs	14.23	0.40	17.64	0.37	40.11	0.40
Levta	9.22	0.17	30.43	0.48	52.98	0.36
Leather jackets	17.76	0.30	30.69	0.27	23.77	0.32
Indian salmon	31.76	0.35	16.40	0.15	26.23	0.43
Prawns (J)	10.67	0.29	14.05	0.32	17.08	0.30
Lobsters	46.45	0.28	26.69	0.14	36.18	0.51
Miscellaneous	23.19	0.14	13.09	0.04	32.91	0.11
Total	23.03	0.10	9.85	5.05	37.95	0.10

compound growth rates of fish production of almost all the species, except *Hilsa* and leather jackets, were positive and significant. The annual increase in fish production was the highest in case of ribbonfishes, followed by perches, cuttlefishes/squids, shrimps, etc. The instability indices of thread-fins, lobsters, perches, Indian salmon etc. were found relatively higher. Awareness campaign among the fishermen on the importance of mesh size regulation would be useful for the sustainable benefit of marine fisheries in the long run. The state Government should

Table 6. *Temporal change in specieswise marine fish production in Gujarat*

(In tonnes)

Fish species	1980-83	1989-92	% change in col. 4 over col.3	1995-98	% change in col. 6 over col.4
Small sciaenids	59745	178821	199.30	204324	14.26
Bombay duck	38851	68980	77.55	97984	42.05
Ribbonfishes	4747	36875	676.77	72070	95.44
Shrimps	8888	21457	141.42	36956	72.23
Cuttle fishes/squids	3356	14805	341.17	22828	54.19
Sharks	6792	13024	91.74	18688	43.49
Catfishes	6543	14413	120.28	20837	44.57
Clupeoids	5564	7368	32.42	13910	88.78
Coilia spp.	4793	14707	206.81	18060	22.79
Prawns (M)	5562	6656	19.68	11302	69.79
White pomfret	8193	9655	17.84	10613	9.92
Jewfishes	5498	10533	91.58	8556	-18.76
Seerfishes	3560	6558	84.23	7970	21.52
Mullets	2731	4512	65.23	5329	18.11
Perch	596	4676	684.56	6371	36.26
Silverbellies	3086	4570	48.08	5289	15.74
Eels	3888	2879	-25.93	4264	48.09
Black pomfret	2714	2630	-3.09	2675	1.70
Hilsa	4236	2415	-42.98	2243	-7.12
Threadfins	561	2151	283.32	2100	-2.37
Crabs	646	1303	101.49	1730	32.82
Levta	420	1049	149.36	1605	53.07
Leather jackets	1143	1873	63.80	965	-48.45
Indian salmon	704	1430	103.03	1017	-28.91
Prawns (J)	1535	1578	2.76	1519	-3.72
Total	210716	487644	131.42	653591	34.03

take necessary steps to enforce sea law demarcating different fishing grounds for different craft gear combination which will help maintaining socio-economic balance instead of creating socio-economic conflicts among the fishermen.

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