PRESENT STATUS AND PROSPECTS OF FISHERIES RESOURCES, FISH SEED AND FISH AVAILABILITY IN TRIPURA

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ABSTRACT

Tripura State has witnessed admirable growth in aquaculture sector, in recent years and has potential for substantial improvement in production of fish. The paper is an attempt to analyze the present status and future trend in fisheries resources; fish seed production, fish production and availability of inter-state fish, to make short-term projection. The State has rich potential resources in the form of water area under culture and capture fisheries. Out of the total culture fisheries resources, ponds and tanks contribute nearly 61.88 %. Out of total 1,34,010 fish farmers, highest number of fish farmers were reported in West Tripura District, has 38.06 % of the total fish farmers, followed by South Tripura District (29.48 %). Private fish farmers contributed highest to total fish production from culture fisheries. The contribution of carps (84.98 %) to the total fish production of Tripura was recorded to be the highest among all the species. West and South Tripura Districts contributed over two thirds of the total fish production in culture fisheries. Among capture fisheries, reservoir Gumati alone contributed 43.08 % and available rivers and rivulets contributed 46.97 %, respectively; to the fish production in capture fisheries. South and Dhalai Tripura Districts contributed a major portion (79.19 %) to the total capture fisheries production. Fish seed production has been recorded to be higher than the requirements in the State. The time series data on culture water resources, and production of fish and fish seed; showed that Tripura witnessed an exponential growth over last one decade including sourcing of inter-state fish (ISF). Tripura is expected to produce 63,616 mt fish, supplemented by 24,513 mt inter-state fish by the end of 2015. During this period, culture fisheries resources are expected to reach an area of 25,731 ha, while fish seed production is expected to be about 6,043 lakhs.

Key words: fisheries resources, fish seed production, fish production, projection, Tripura

I. INTRODUCTION

Among different states of North East States of India, Tripura witnessed an impressive growth in freshwater aquaculture sector and has potential for substantial improvement in the fish yield. The economy of the State is primarily

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based on agriculture and allied activities, including fisheries. Fishery is considered to be one of the vital sectors for economic development of Tripura State. This is due to the fact that the State has about 95 % fish eating population and unlike other parts of NE India, fish is a preferable food item for the people of Tripura where rice and fish form the basic diet (Government of Tripura, 2009a).

The State has potential resources in the form of 19,258 ha water area under culture fisheries and 7,879 ha under capture fisheries during 2008-09 (Government of Tripura, 2009b). Tripura achieved a fish production of 36,991 tonnes during 2008-09 from 13,688 tonnes during 1998-99. Despite such spectacular growth, the demand for fish in the State was higher than its supply and fish is being sourced from other states especially from West Bengal and Andhra Pradesh, besides the neighbouring country Bangladesh (Nandeesha, 2008). The achievement in fish seed production has been higher than requirements in the State since past several years (Government of Tripura, 2009a). A total of 1,37,264 fish farmers and 77,748 full time, part time and occasional fishermen are currently involved in the fisheries sector during 2008–09, as reported by the Department of Fisheries, Government of Tripura (Government of Tripura, 2009b).

In the present investigation, an attempt has been made to study the fish and fish seed production patterns across different regions of the State of Tripura vis-a-vis its potential resources. Information on fish production trend in Tripura along with its future projection is necessary for making effective and scientific developmental planning. Keeping this objective in view, the paper analyzes to project the fisheries resource availability, production and supply of fish seed and fish in the State.

II. MATERIALS AND METHODS

The study was conducted in one of the North East (NE) States, Tripura; landlocked by international border from three sides. The State is endowed with rich diversity of aquatic resources. About 83 % of the State's population lives in rural areas (Anon, 2009). Agriculture and allied activities is the mainstay of the people of Tripura and more than 50 % of its population depends on agriculture for livelihood. Contribution of agriculture and allied activities to the Gross State Domestic Product (GSDP) is 23 % (Government of Tripura, 2008).

Material for this study is based on the cross section and time series data collected from secondary sources, mainly from the Department of Fisheries, Government of Tripura. Secondary data was collected from April to August 2010 and cross section data representing the information of the year 2008-09. Cross section data upto district level was analyzed to understand the status of fisheries sector at present horizon. Time series data related to fish production and productivity were collected for last one decade at state level to make the projections relevant for the State.

Tabulation, percentage analysis and graphical representation of data were used for analyzing and presenting the findings of the study. Tabulation is the most systematic way of presenting numerical data in an easily understandable form. Tabulation in descriptive analysis has clear expression of the implication, and easy

and convenient to compare related numerical data. Percentage form was used while discussing the parameters of the study, to make the document more convenient for the reader. Graphical representation of data was made to highlight outstanding features of data and make comparison of trends and relationship cases. Trend in resources, fish seed production, fish production and inter-state fish were described by exponential functions of the following form:

$$Y = ab^{X}$$

Where, 'Y' is a dependent variable, say resource or production etc.; 'x' is the year, while 'a' and 'b' are constants. The equation has been transformed to linear form using logarithmic transformation.

III. RESULTS AND DISCUSSION

Culture and Capture Fisheries Resources and Production:

Fisheries resources of Tripura comprise of ponds and tanks, mini barrages, rivers, rivulets and few lakes and reservoirs under culture and capture fisheries, adding to the total of 27,137 ha of water resources. Tripura is considered as an important state from the view of culture based fisheries. The total area under culture fisheries is 19,258 ha (71 % of total water resources) contributing 95 % (35,152 tonnes) of fish production during the year 2008–09. Capture fisheries comprised of only 7,879 ha (29 % of total water resources) and contributed only 5 % of the total fish production. Out of the total culture fisheries resources, ponds and tanks contribute nearly 62 % (11,918 ha). The average size of the ponds in Tripura is 0.101 ha. Small ponds contribute 66 % to culture fish production and 63 % to the total fish production. South and West Tripura Districts of the State have more fisheries resources and therefore contribute 36.45% and 31.83%, respectively, to the total fish production in culture fisheries. With only one reservoir (Gumati - 3049 ha) and a lake (Rudrasagar -100 ha), the State has meager capture fisheries resources. Among all the capture fisheries resources, Gumati reservoir alone contributes 38.7 % of total capture fisheries resources. South and Dhalai Tripura Districts accounted 79.2 % to total capture fisheries production (Table 1).

Culture Fisheries Resources and Production under Different Categories:

Different categories of producers documented by Department of Fisheries, Government of Tripura (DoF, GoT) are private fish farmers, State Fisheries Department, other government departments, fisheries co-operative societies and self-help groups (SHGs). Among all these categories, private fish farmers alone contribute 91 % of total culture fisheries resources of Tripura and accounted for 93% to the total culture fish production of the State. Among the four districts, West Tripura District has the highest water area under private fish farmers followed by South, North and Dhalai Districts (Table 2). While considering water resources held under the fisheries department, SHGs and fisheries co-operative societies; South Tripura has the highest contribution in culture fisheries resources followed by West Tripura District. It was also observed that the number of fisheries based SHGs is highest in South Tripura District. However, contribution of other departments (including joint forest management) in culture fisheries was observed

to be the highest under West Tripura District during 2008-09. Fish production from the resources under fisheries department and co-operative societies was highest in South Tripura, whereas SHGs and other government departments showed better production in West Tripura District; among all the districts of Tripura. Private fish farmers from West Tripura District contributed highest than the private fish farmers of other districts (Table 2 can be seen for details).

Number of Fish Farmers:

A total of 1,34,010 fish farmers in Tripura were reported by DoF, GoT during 2008–09. Out of total fish farmers, 38.5 % of the farmers belong to Scheduled Tribes; whereas 17.6 %, 19.0 %, 6.8 % and 18.1 % of the total farmers belong to Scheduled Castes (SC), Other Backward Classes (OBC), Religious Minority (RM) and General category, respectively. Highest number of fish farmers was reported in West Tripura District, which was 38 % of the total fish farmers, followed by South Tripura District (see Table 3).

Species-wise Production of Fish:

Carps, being most important cultured species of Tripura, accorded 85 % to the total fish production of the State (see Table 4). Among the carps, Indian Major Carps (Catla, Rohu, Mrigal), contribution to the total carps was found to be 60 % of the total carp production and 51 % to total fish production. Though, production of exotic carps (Silver Carp, Grass Carp, Common Carp, Big Head etc.) and minor carps (Bata, Gonia, Kalabasu etc.) is significant in the State, they are not as popular as Indian Major Carps. Non-carp production in Tripura is found to be much lower than carps and contributed only 15 % to the total fish production. Among non-carps, catfish (Pabda, Singhi, Magur etc.) and other species (Koi, Paco, Moca, Tilapia etc.) contributed 33.3 % and 66.7 % to the total fish production of the State, respectively (see Figure 1 & 2).

Fish Seed Production and Requirement:

Unlike many Indian states, Tripura State is not only self-sufficient in fish seed production but has surplus seed in the past few years. The requirement of fish seed (Table 5) was imputed based on the assumption that 9,250 and 800 numbers of fish seed were required to stock in available water resources under culture and capture fisheries, respectively (DoF, GoT, 2009). West Tripura District has produced the highest number of fish seed, followed by South Tripura District. Both the districts contributed nearly 82 % of total fish seed produced in the State. While comparing the production pattern among different producer categories, it was observed that private fish seed producers were contributing 91.8 % of total fish seed production. Here, West Tripura District had highest fish seed production by private fish farmers among the four districts. The contribution of fish seed production to the total State fish seed production by government (3.4 %), cooperative societies (1.3 %) and SHGs (3.4 %), were found to be meager as compared to private farmers. Contribution of fish seed production by co-operative societies and SHGs among four districts showed that co-operatives of South Tripura and SHGs of West Tripura contributed more among the respective categories of all the four districts. Overall,

all the four districts at district level and State, in general, showed surplus production of fish seed and though requirement of fish seed varies among different districts or sub-divisions, but the State is producing enough fish seed to meet its requirement.

Projection on Water Resources, Fish Seed, Fish Production and Sourcing Inter-state Fish:

Time series pattern of culture fisheries water resources, fish seed and fish production and fish sourced from outside-state (termed as inter-state fish, ISF) has been depicted in Figure 3. Trend in Figure 3 showed that there was an exponential pattern of growth in resources, seed and fish production and inter-state fish. Considering so, data were analyzed through linear regression after taking the natural log of variables as follows:

$$Y_{WR} = a_1 b_1^{X} \Rightarrow \ln(Y_{WR}) = \ln(a_1) + X \ln(b_1) \quad \ldots\ldots\ldots\ldots(1)$$
$$Y_{FS} = a_2 b_2^{X} \Rightarrow \ln(Y_{FS}) = \ln(a_2) + X \ln(b_2) \quad \ldots\ldots\ldots\ldots(2)$$
$$Y_{FP} = a_3 b_3^{X} \Rightarrow \ln(Y_{FP}) = \ln(a_3) + X \ln(b_3) \quad \ldots\ldots\ldots\ldots(3)$$
$$Y_{IF} = a_4 b_4^{X} \Rightarrow \ln(Y_{FI}) = \ln(a_4) + X \ln(b_4) \quad \ldots\ldots\ldots\ldots(4)$$

Where,

$\ln(Y_{WR})$	=	Natural log of culture fisheries resources
$\ln(a_1)$	=	Intercept of equation (1)
$\ln(b_1)$	=	Slope of equation (1)
$\ln(Y_{FS})$	=	Natural log of fish seed production
$\ln(a_2)$	=	Intercept of equation (2)
$\ln(b_2)$	=	Slope of equation (2)
$\ln(Y_{FP})$	=	Natural log of fish production
$\ln(a_3)$	=	Intercept of equation (3)
$\ln(b_3)$	=	Slope of equation (3)
$\ln(Y_{IF})$	=	Natural log of ISF
$\ln(a_4)$	=	Intercept of equation (4)
$\ln(b_4)$	=	Slope of equation (4)
X	=	Year

The above equations were fitted using time series data from 1998 to 2009. Calculations of R2 values were found to be 0.97, 0.85, 0.93 and 0.89 for the equations (1), (2), (3) and (4), respectively. High Annual Compound Growth Rate (ACGR) was observed for ISF (16.719 %), followed by fish seed (12.788 %) and fish production (11.4 %). The ACGR for culture fisheries water resources were found to be 5.840 %. However, Table 6 depicted an increasing trend in water resources under culture fisheries during the past few years. This might be because of excavation of ponds and tanks under Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) activity in the recent years. The fitted equations were found as follows:

$$\ln(Y_{WR}) = 9.1906 + 0.05675\,X \quad \ldots\ldots\ldots\ldots (1)$$
$$\ln(Y_{FS}) = 6.6608 + 0.12034\,X \quad \ldots\ldots\ldots\ldots (2)$$
$$\ln(Y_{FP}) = 9.26438 + 0.10566\,X \quad \ldots\ldots\ldots\ldots (3)$$
$$\ln(Y_{FI}) = 7.47879 + 0.15459\,X \quad \ldots\ldots\ldots\ldots (4)$$

Using the above equations, the pattern in culture fisheries water resources, fish seed and fish production and ISF, were projected for 2015 (see Table 6). Projection showed that the State would able to produce 41,689 tonnes of fish, while availing 13,208 tonnes of inter-state fish by the year 2011. Long term projections are not generally advisable as the prevailing conditions are likely to undergo change. However, assuming that significant changes do not take place, it is estimated that fish production will reach 63,616 tonnes by 2015, while incoming inter-state fish will be of the order of 24,513 tonnes.

IV. CONCLUSION

Tripura has witnessed an impressive growth in fish production and productivity during last decade, which was 13,688 tonnes and 1,133 kg-1 ha-1 yr-1 in 1998-99; and reached 36,991 tonnes and 2,074 kg-1 ha-1 yr-1 in 2008-09, respectively. The State has potential resources in the form of 19,258 ha water area under culture fisheries and 7,879 ha under capture fisheries during 2008-09. Out of the total culture fisheries resources, ponds and tanks contributed nearly 61.9 % (11,918 ha) and the average size of the ponds in Tripura was 0.10 ha. Fish seed production in the State has been higher than requirement in recent years. The time series data on culture water resources, production of fish seed and fish showed that Tripura has observed a remarkable growth over last one decade including outsourcing of fish (ISF). It has been projected that Tripura is expected to produce 63,616 tonnes fish, 6043 lakh fish seed, culture fisheries resources to 25,731 ha and availing 24,513 tonnes of ISF by the year 2015. On the other side, demand for fish in the State is estimated to rise to 80,153 tonnes, by 2015 (Debnath et al., 2012) and present study showed projected production of 63, 616 tonnes fish by 2015. The results of this study have specific implications for state fisheries development and it would be a supportive document for policy management and strategy formulation. The study also indicates the necessity to prioritize suitable strategic options for augmenting local fish production.

Table 1. Culture and capture fisheries resources (ha) and production (tonne) of Tripura, India during 2008-09

Culture fisheries									
District	Ponds/tanks			Mini-barrage			Total		
	No.	Area	Production	No.	Area	Production	No.	Area	Production
North Tripura	22124	2062.24	4212.38	7431	1551.92	2646.73	29555	3614.16	6859.11
Dhalai Tripura	10246	1062.06	1757.62	8214	1793.58	2532.97	18460	2855.64	4290.59
West Tripura	48730	4849.47	9638.94	7883	1860.10	3173.81	56613	6709.57	12812.75
South Tripura	36707	3944.14	7643.11	9193	2134.84	3546.44	45900	6078.98	11189.55
Total (State)	117807	11917.91	23252.05	32721	7340.44	11899.95	150528	19258.35	35152.00

Capture fisheries									
District	River & rivulets		Lake & barrage		Reservoir		Total		
	Area	Production	Area	Production	Area	Production	No.	Area	Production
North Tripura	458.95	58.26	132.38	123.80	0.00	0.00	-	591.33	182.06
Dhalai Tripura	811.18	135.20	0.00	0.00	1524.67	567.78	-	2335.85	702.98
West Tripura	1272.80	141.29	509.46	59.24	0.00	0.00	-	1782.26	200.53
South Tripura	1644.65	528.84	0.00	0.00	1524.67	224.27	-	3169.32	753.11
Total (State)	4187.58	863.59	641.84	183.04	3049.34	792.05	-	7878.76	1838.68

Source: Government of Tripura (2010)

Table 2. Culture fisheries resources (ha) and production (tonne) under different producer categories of Tripura, India (2008-09)

Category	District	North Tripura	Dhalai Tripura	West Tripura	South Tripura	Total (State)
Fisheries department	Area	14.91	15.26	9.36	69.36	108.89
	Production	4.83	5.42	1.20	38.14	49.59
Other Department	Area	157.92	89.50	437.80	282.64	967.86
	Production	212.59	103.13	509.98	392.54	1218.24
Fish. Coop. Society	Area	30.82	12.20	60.92	91.42	195.36
	Production	38.58	13.94	115.67	146.67	314.86
Private fish farmers	Area	3340.70	2630.33	6085.03	5484.01	17540.07
	Production	6466.54	4000.72	11914.04	10363.91	32745.21
Self Help Groups	Area	69.81	108.35	116.46	151.55	446.17
	Production	136.57	167.38	271.86	248.29	824.10
Total	**Area**	**3614.16**	**2855.64**	**6709.57**	**6078.98**	**19258.35**
	Production	**6859.11**	**4290.59**	**12812.75**	**11189.55**	**35152.00**

Source: Department of Fisheries, Government of Tripura (2010)

Table 3. District-wise number of fish farmers in Tripura, India (2008-09)

Districts	ST	SC	OBC	RM	Gen	Total
North Tripura	6851	5357	7048	3608	3832	26696
Dhalai Tripura	9825	2766	2035	220	1962	16808
West Tripura	18895	9079	10777	4270	7983	51004
South Tripura	15967	6409	5647	1049	10430	39502
Total (State)	**51538**	**23611**	**25507**	**9147**	**24207**	**134010**

Source: Department of Fisheries, Government of Tripura (2010)

Table 4. Species wise production of fish under different districts of Tripura, India (2008-09)

District	Carps				Non-carps			Total
	IMC	Exotic	Minor carps	Sub-total	Catfish	Other fish	Sub-total	
North Tripura	3591.03	1901.12	492.88	5985.03	352.03	704.11	1056.14	7041.17
Dhalai Tripura	2546.70	1348.25	349.54	4244.49	249.68	499.40	749.08	4993.57
West Tripura	6636.86	3513.58	910.92	11061.4	650.63	1301.29	1951.92	13013.28
South Tripura	6081.77	3224.49	835.98	10142.2	597.16	1203.26	1800.42	11942.66
Total (State)	**18856.36**	**9987.44**	**2589.32**	**31433.1**	**1849.50**	**3708.06**	**5557.56**	**36990.68**

Source: Department of Fisheries, Government of Tripura (2010)

Table 5. Fish seed production and requirement (in lakh) under different producer categories of Tripura, India (2008-09)

District	Govt	Coop Society	Private fish seed producer	SHGs	Total production	Total fish seed requirement
North Tripura	15.67	0.80	271.69	27.30	315.46	299.97
Dhalai Tripura	21.80	5.52	178.08	2.13	207.53	238.78
West Tripura	23.54	3.97	1198.82	60.07	1286.40	555.36
South Tripura	37.84	27.72	985.73	9.32	1060.61	524.77
Total (State)	**98.85**	**38.01**	**2634.32**	**98.82**	**2870.00**	**1618.88**

Source: Department of Fisheries, Government of Tripura (2010)

Table 6. Year-wise (time series) data on water resources, production of fish and fish seed, inter-state fish and its projection upto 2015 in Tripura State, India

Year	Culture fisheries water resources (ha)	Fish seed production (in lakh)	Fish production (mt)	Inter-state fish (mt)
1998-99	10676.10	1056.00	13688.10	2124.00
1999-00	11211.62	1049.09	14016.80	3190.00
2000-01	11747.14	1049.00	14351.91	2588.30
2001-02	12282.66	1103.11	14695.79	3444.10
2002-03	12636.96	1145.00	16155.08	3300.00
2003-04	13290.48	1361.30	17980.00	4211.25
2004-05	14067.44	2009.32	19837.75	3613.16
2005-06	15160.52	2910.98	23870.58	6043.09
2006-07	16465.79	2191.13	28634.00	7902.70
2007-08	17374.80	2533.04	32829.66	8660.01
2008-09	19258.35	2870.00	36990.68	11504.37
ACGR	***5.840 %***	***12.788 %***	***11.14 %***	***16.719 %***
Projection:				
2009-10	19373.94	3310.902	37508.36	11315.8
2010-11	20505.35	3734.32	41688.48	13207.66
2011-12	21702.83	4211.887	46334.45	15415.81
2012-13	22970.25	4750.528	51498.19	17993.14
2013-14	24311.68	5358.053	57237.41	21001.37
2014-15	25731.44	6043.273	63616.24	24512.54

Source (upto 2008–09): Department of Fisheries, Government of Tripura (2010)
ACGR = Annual Compound Growth Rate

Capture fisheries resources were not considered as it was observed to be constant for last decade (7878.76 ha)

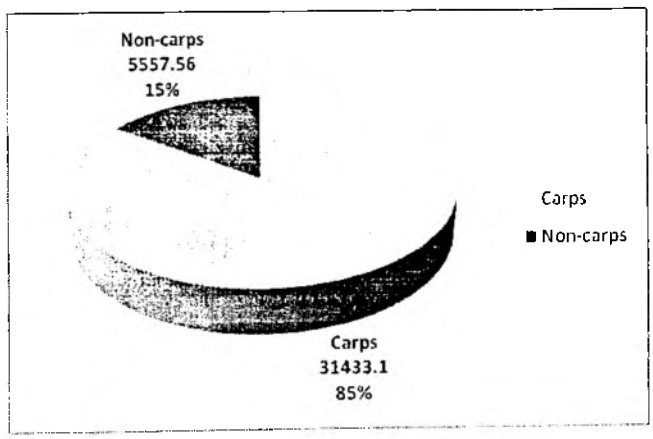

Figure 1. Contribution of carps and non-carps to total fish production (tonne) in Tripura State (2008–09)

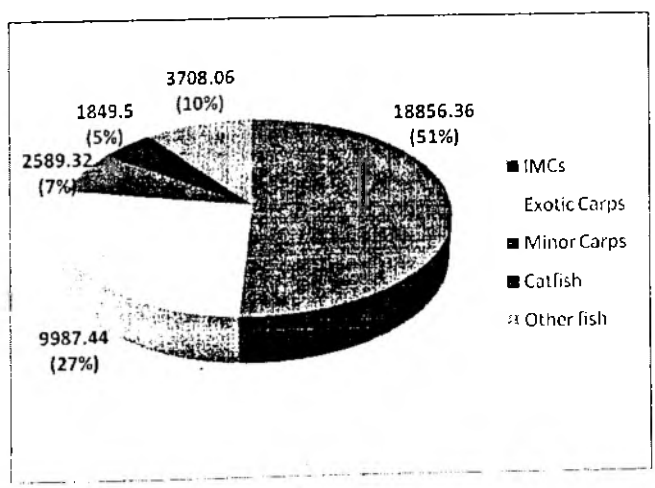

Figure 2. Species-wise fish production (tonne) in Tripura State (2008–09)

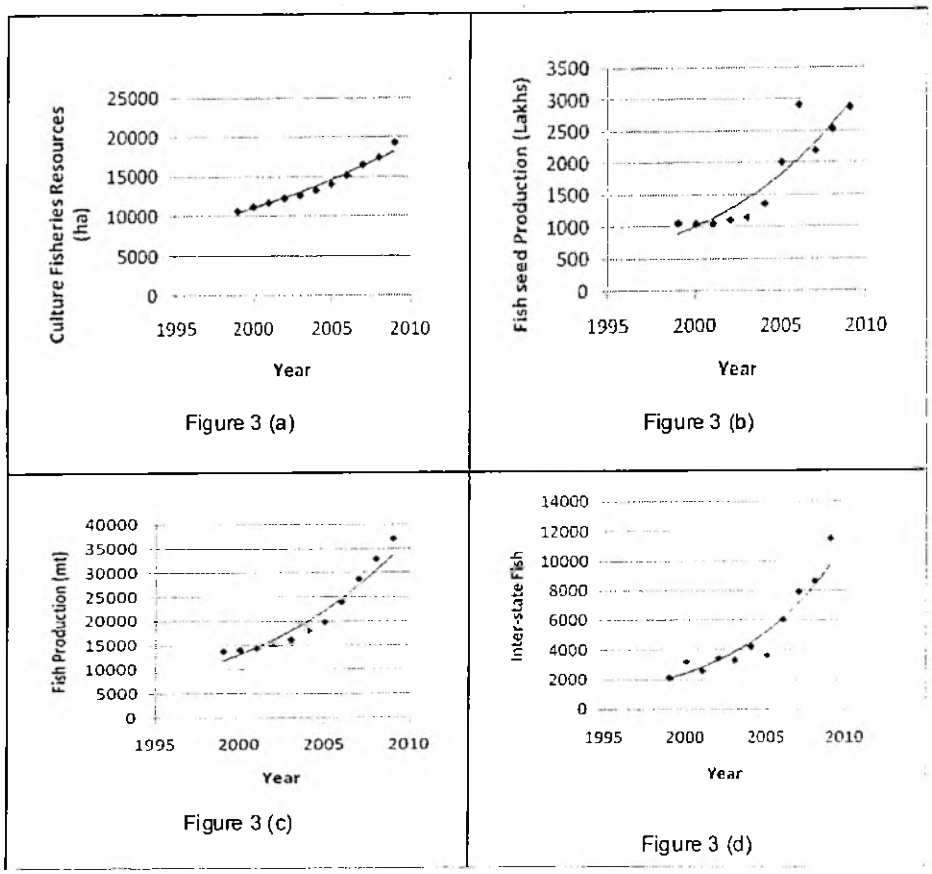

Figure 3. Time series pattern of (a) Culture Fisheries Water Resources, (b) Fish Seed Production, (c) Fish Production, (d) Inter-state Fish, in Tripura

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