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Water Resources and Fisheries Production Dynamics for Development of the Fisheries in Sepahijala District of Tripura, India

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HIGHLIGHTS

- A positive and significant relationship between total fish production and water resources in culture and capture fisheries.
- Sonamura and Bishalgarh sub-divisions of the Sepahijala district have the potential to augment the vertical development of fisheries and aquaculture.
- The Jampuijala sub-division has the potential for the horizontal expansion of fisheries and aquaculture.
- Need for identifying stakeholders, conservation, and proper utilisation of the water resources to develop fisheries.

ARTICLE INFO

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ABSTRACT

Aquaculture, fisheries, and water resources are important to a region's socioeconomic growth. The study was conducted by using a descriptive research design in all seven blocks of three sub-divisions of the Sepahijala district of Tripurato assess the water resources and utilisation dynamics for fisheries and aquaculture production in the district from the perspective of the development of fisheries in the region. Information regarding the study was based on the cross-sectional and time-series data, collected from the Department of Fisheries, Government of Tripura from 2016-18. The study revealed that culturable water resources were highest in the Sonamura subdivision and lowest in the Jampuijala subdivision. A similar trend was observed in capture fisheries and fish seed production. The study also confirmed the positive and significant relationship between total fish and prawn production in cultural fisheries and culturable water resources; total fish seed production and water were utilised for fish seed production; and between total fish and prawn production from capture fisheries resources with capture fisheries water resources. The study suggested formulating a meticulous strategy by identifying potential stakeholders, assessing availability, conserving, and ensuring proper utilisation of the water resources for the development of the fishers in the district.

INTRODUCTION

Tripura is blessed with both lotic (running) and lentic (standing) rainfed water bodies with an average rainfall of 2100 mm, (DoE&S, 2018). These water bodies improve the landscape's beauty, give recreational opportunities, serve as habitats for wildlife and plants, and have an impact on the climate (Das et al., 2024). However, the water holding capacity of the water bodies in Tripura is poor. Most

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of the soils in Tripura are red lateritic and acidic (Saha et al., 2017). The water area of Tripura is 34,416.94 ha, comprised of lakes, rivers, tanks, ponds, reservoirs, etc., of which only 26,534.18 ha is used for fishing (DoE&S, 2018). The rivers Gomati (249 million cubic meters), Manu (170 mcm), and Khowai (115 mcm) carry almost 67.5 per cent of Tripura's total flow. However, 32.5 per cent of the total surface flow is carried by other rivers (ENVIS Centre: Tripura, 2013).

The culture fisheries resources and aquaculture plays a significant role in the region's socioeconomic development (FAO, 2022). Aquaculture is important both in terms of its contribution to the economy and human nutrition (Sajeev et al., 2023). It also creates a great opportunity for employment in any region (NFDB, 2018). One of the most important sources of many aquatic species, particularly fish, is freshwater bodies. Fish is arguably vital for human nutrition (Saikia et al., 2024; Patra et al., 2017). Natural breeding grounds for fish and most of the other aquatic animals heavily depend on water resources (FAO, 2020). Thus, it is necessary to have a clear understanding of water resources in any location for sustainable fisheries and aquaculture through better management and to develop a proper strategy for the socioeconomic development of the fisheries in the region (Mir et al., 2023; Sarkar et al., 2022). In this subset, this study aims to assess the water resources and utilisation dynamics for fisheries and aquaculture production in the Sepahijala district from the perspective of the development of the fisheries in the region.

METHODOLOGY

Tripura is located in the northeastern part of India, bordered to the north, west, south, and southeast by Bangladesh and the east by Assam and Mizoram states of India. It is situated between latitudes 22°57′N and 24°33′N and longitudes 91°10′E and 92°20′E (ENVIS Centre: Tripura, 2013). This study was conducted in a descriptive research design in the Sepahijala district of Tripura. The total area of the district is 1043.04 km^2, and the total population is 5,42,731(Govt. of Tripura, 2023). The Sepahijala district of Tripura, with a total area of 1043.58 km^2, is one of the recently established districts in the state. The Baramura's minor hilly ranges are primarily within the Jampuijala Sub-Division and only cover around 12% of the district. There are 520.97 km^2 areas of the river, 39.33 km^2 of the rivulet, 67 ha of barrage and 100 ha of the lake in the Sepahijala district (DoE&S, 2018). The main water resources of Sepahijala district are comprised of the Gomati and Bijoy rivers. In addition, nearly all fish farmers (96%) do not have a reliable source of water for their fish ponds other than precipitation, and most of the fish farmers (88%) have seasonal ponds (Shil et al., 2022). The Gomati River has the largest basin of any river in Tripura, with 132 km^2 of its 2,492 km^2 catchment area located in the Sonamura subdivision of the Sepahijala district (Das et al., 2024).

All seven blocks of the three subdivisions in the Sepahijala district of Tripura were the locale of this study. The cross-sectional and time series data gathered from the Department of Fisheries, Government of Tripura, from 2016 to 2018 served as the basis for the study's information. Cross-sectional data at the block level were used to analyse the status of water resources of the Sepahijala district, and time-series data were utilised for accurate projection of fish production. The collected data were analysed and interpreted to draw a logical conclusion using descriptive statistics (frequency, mean, and standard deviation), Spearman's correlation analysis, and graphical representation.

RESULTS

Water resources and culture fisheries production dynamics in Sepahijala district in 2017-18

The study unfolds that the available water resources of the Sepahijala district were 3824.96 ha, comprised of 28514 water bodies such as ponds and tanks, mini barrages, rivers, rivulets, and lakes, under culture and capture fishery resources. It could be observed from Table 1 that the total number of culturable water bodies (ponds/tanks, mini barrages and others) was the highest in the Sonamura sub-division with 14302 water bodies, whereas 8640 and 5572 water bodies were recorded at Bishalgarh and Jampuijala sub-divisions, respectively. In terms of the area of water bodies, Sonamura, Bishalgarh, and Jampuijala sub-divisions comprised 1841.86 ha, 1150.13 ha, and 832.97 ha water areas, respectively.

Table 1 also ascertains that total fish and prawn production from culture fisheries resources was highest in the Sonamura sub-division (4691.09 MT), as culturable water resources were maximum in this sub-division (1841.86 ha). Sonamura sub-division was followed by Bishalgarh (3029.22 MT) and Jampuijala (1986.97 MT) sub-divisions in total fish and prawn production from culture fisheries resources. The same trend was also found in the case of total fish seed production. But, fish seed production in Jampuijala was abysmally low at 11.1 Lakh as only 1.64 ha water area was utilised for fish seed production in this sub-division. The Nalchar block produced the highest amount of fish seeds (175.97 Lakh), which was followed by the Bishalgarh block (89.9 Lakh) because of maximum water areas (11.6 ha and 6.15 ha in Nalchar and Bishalgarh, respectively) utilised for fish seed production among the all the blocks. The total fish seed production in the Sepahijala district was 441.94 Lakh, as evident from Table 1.

New water bodies made during 2016-18

The result presented in Table 2 shows that 55.79 ha, 60.49 ha, and 27.1 ha new areas were made for fisheries in the Jampuijala, Sonamura, and Bishalgarh subdivisions, respectively in 2017-18. It is observed from Table 2 that the maximum percentage (7.18%) of increase in water bodies for fisheries was achieved in the Jampuijala subdivision. Block-wise data of newly made water bodies are also presented in Table 2 shows that during 2017-18, no new water body was made in Bishalgarh Municipal Corporation (M.C) and Sonamura Nagar Panchayat (N.P.) whereas, the maximum number of water bodies were made at Jampuijala and under Kathalia block of Sonamura sub-division, as the Jampuijala sub-division lagged in terms of the number of fish culturable water resources, as shown in Table 1.

Division-wise water bodies made by different agencies

It is visible from Figure 1 that the contribution of Government agencies was more in the making of new water bodies in the

Table 1. Culturable water resources of Sepahijala district in 2017-18

Subdivision	Block	Culturable Water Resources								Fish and Fish Seed Production in Culture Fisheries		
		Ponds/Tanks		Minibarrage		Others		Total				
		Nos. of water bodies	Area of water bodies (ha)	Nos. of water bodies	Area of water bodies (ha)	Nos. of water bodies	Area of water bodies (ha)	Nos. of water bodies	Area of water bodies (ha)	Total Fish and Prawn Production from Culture Fisheries Resources (MT)	Water Area Utilised for Fish Seed Production (ha)	Total Fish Seed Production (Lakh)
Bishalgarh Sub-division	Bishalgarh	5293.00	628.71	137.00	31.23	107.00	33.69	5537.00	693.63	1751.35	6.15	89.90
	Charilam	2890.00	391.92	190.00	58.12	23.00	6.46	3103.00	456.50	1277.87	1.82	21.00
Jampuijala Sub-Division	Jampuijala	4102.00	556.00	1468.00	276.77	2.00	0.20	5572.00	832.97	1986.97	1.64	11.10
Sonamura Sub-Division	Sonamura N. P	202.00	22.70	0.00	0.00	0.00	0.00	202.00	22.70	57.57	0.96	8.75
	Melaghar M.C	492.00	93.43	0.00	0.00	0.00	0.00	492.00	93.43	274.24	1.6	55.00
	Nalchar	3862.00	455.97	150.00	28.85	0.00	0.00	4012.00	484.82	1162.55	11.6	175.95
	Mohanbhog	1787.00	284.37	502.00	89.31	4.00	0.44	2293.00	374.12	986.44	4.62	40.50
	Boxanagar	2756.00	302.73	502.00	92.46	10.00	2.28	3268.00	397.47	1091.95	0.62	2.74
	Kathalia	3615.00	379.00	420.00	90.32	0.00	0.00	4035.00	469.32	1118.34	3.28	37.00
Total		24999	3114.83	3369	667.06	146	43.07	28514	3824.96	9707.26	32.29	441.94

MC- Municipal Corporation, **NP-** Nagar Panchayat

Sepahijala district compared to private agencies. In the case of sub-division-wise data (Figure 1), it was observed that 55.79% and 42.51% of new water bodies were made by Government agencies in Jampuijala and Sonamura sub-divisions, respectively during 2017-18, whereas only 13.93% and 17.98% of water bodies were made by the private sector in Bishalgarh and Sonamura Sub-divisions, respectively. However, no water body was made by the private sector in the Jampuijala sub-division.

Capture fisheries water resources of the Sepahijala district

There were 727.3 ha of capture fisheries water resources available in the Sepahijala district, comprising rivers, rivulets, barrages, and lakes. The rivers occupied the largest water areas (520.97 ha) compared to other capture fisheries water resources, as evidenced by Table 3. The Sonamura sub-division (414.97 ha) had more capture fisheries water resources than those other sub-divisions. It was observed in block-wise distribution that the Melaghar block had the largest (150.72 ha) water area available for capture fisheries.

Sector-wise utilisation of water resources for fisheries

The average of the sector-wise utilisation of water resources for fisheries was calculated and presented in Table 4. It was visible from Table 4 that the majority of the utilisation of water resources for fisheries was done privately by the fishers or other private sectors, with an average of 368.40 ha, followed by the Government sector with only 10.82 ha on average. But, a very negligible contribution was seen from SHGs (1.06 ha) and Cooperative societies (1.58 ha). The highest participation from the private sector was observed from the Sonamura sub-division, as fisheries and aquaculture are very popular among the progressive fish farmers in this sub-division.

The relationship between water resources and production parameters in fisheries in the Sepahijala district was measured by Pearson's correlation coefficient, and presented in Table5. Results suggest that Total fish and prawn production from culture fisheries resources was positively and significantly correlated with culturable water resources at the 1% level of significance (Das, 2019). Similarly, total fish seed production was positively and significantly correlated with the water area utilised for fish seed production at the 1% level of significance. In the case of capture fisheries in the Sepahijala district, total fish and prawn production from capture fisheries resources were positively and significantly correlated with capture fisheries water resources at the 5% level of significance (Chutia et al., 2018).

DISCUSSION

The results of the study help enlighten the different aspects of water resource utilisation and its relation with fisheries production in the study area. The state of Tripura is primarily fish-consuming, and its supply cannot keep up with the state's rising demand (Shil et al., 2022). Sepahijala district can play an important role in meeting the increasing demand of the state because of the productive water resources of the district. Water resource assessment of Sepahijala district helps identify different water resource availability, conservation, and proper utilisation of the

Table 2. Growth in new water bodies made during 2016-18

Subdivision	Block	TWBM*-2017-18	TWB*-2016-17	% Growth in New Water Bodies Made
Bishalgarh Sub-division	Bishalgarh M.C	0.00	50.86	0.00%
	Bishalgarh	18.56	631.6	2.94%
	Charilam	8.54	447.96	1.91%
Jampuijala Sub-Division	Jampuijala	55.79	777.18	7.18%
Sonamura Sub-Division	Sonamura N.P	0.00	22.7	0.00%
	Melaghar M.C	0.43	93	0.46%
	Nalchar	12.55	476.79	2.63%
	Mohanbhog	2.91	371.21	0.78%
	Boxanagar	16.62	381.85	4.35%
	Kathalia	27.98	443.44	6.31%
Total		143.38	3696.59	3.88%

*__TWBM__-Total water body made; __TWB__- Total water body, __MC__- Municipal Corporation, __NP-__ Nagar Panchayat

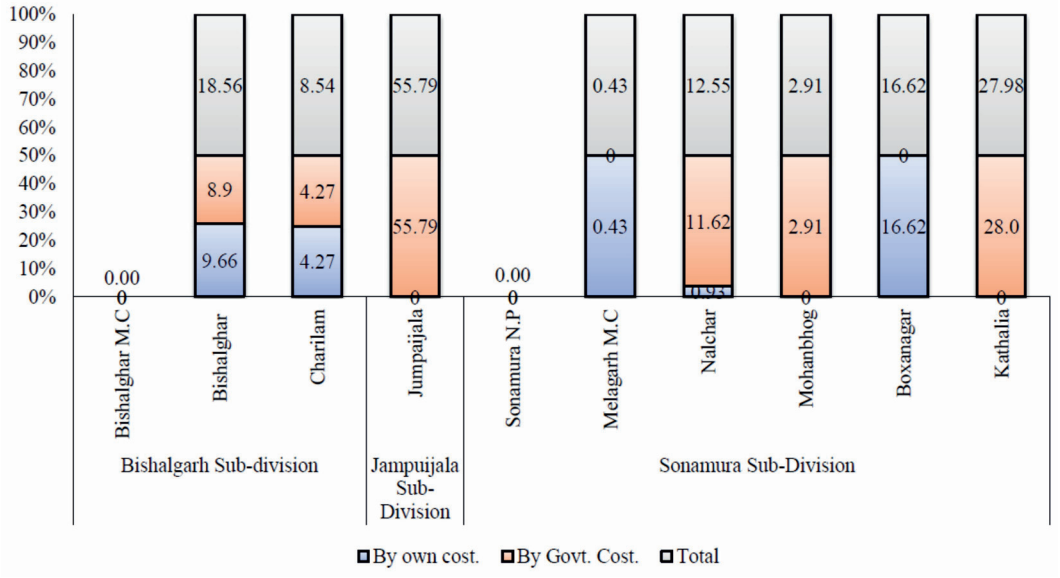

Figure 1. Sub-division wise new waterbodies made by different agencies

Table 3. Different types capture fisheries water resources of Sepahijala district

Subdivision	Block	River	Rivulet	Barrage	Lake	Total Area of capture resources (ha)	Average	SD	SE
Bishalgarh Sub-division	Bishalgarh	108.93	6.64	0.00	0.00	115.57	28.89	53.45	30.86
	Charilam	93.10	10.50	0.00	0.00	103.60	25.90	45.07	26.02
Jampuijala Sub-Division	Jampuijala	70.97	22.19	0.00	0.00	93.16	23.29	33.46	19.32
Sonamura Sub-Division	Sonamura	10.00	0.00	0.00	0.00	10.00	2.50	5.00	2.89
	Melaghar	50.72	0.00	0.00	100.00	150.72	37.68	47.94	27.68
	Nalchar	15.02	0.00	51.80	0.00	66.82	16.71	24.44	14.11
	Mohanbhog	142.01	0.00	0.00	0.00	142.01	35.50	71.01	40.99
	Boxanagar	24.22	0.00	0.00	0.00	24.22	6.06	12.11	6.99
	Kathalia	6.00	0.00	15.20	0.00	21.20	5.30	7.18	4.15
Total		520.97	39.33	67.00	100.00	727.3	-	-	-

water resources concerning sustainable fisheries and aquaculture in the region (Biswas, 2008). Culturable water resources are more in the Sonamura subdivision due to the presence of the Gomati River basin in the sub-division. A similar scenario is also found in the case of capture fisheries and fish seed production. The study also establishes the positive and significant relationship between total fish and prawn production in cultural fisheries and culturable water resources; total fish seed production and water area utilised for fish

Table 4. Sector-wise utilisation of water resources for fisheries

Division	Subdivision/Block	Private (ha)	Cooperatives (ha)	SHG (ha)	Government (ha)
Bishalgarh Sub-division	Bishalgarh M.C	45.17	0.00	0.00	0.98
	Bishalgarh	613.41	0.00	3.48	28.51
	Charilam	433.84	0.00	4.52	17.42
Jampuijala Sub-Division	Jampuijala	803.65	0.00	1.72	27.60
Sonamura Sub-Division	Sonamura	20.30	1.28	0.00	1.12
	Melaghar	90.30	2.25	0.64	0.24
	Nalchar	476.63	3.50	0.92	3.39
	Mohanbhog	368.00	3.52	0.48	1.88
	Boxanagar	390.87	0.00	1.04	3.20
	Kathalia	441.84	0.00	3.04	23.84
Average		368.40	1.06	1.58	10.82
SD		252.62	1.50	1.57	12.04
Min		20.30	0.00	0.00	0.24
Max		803.65	3.52	4.52	28.51
Median		412.36	0.00	0.98	3.30

Table 5. Relationship among water resources and production in fisheries in Sepahijala district

Parameters	Culturable Water Resources	Capture Fisheries Water Resources	Total Fish and Prawn Production from Culture Fisheries Resources	Total Fish and Prawn Production from Capture Fisheries Resources	Water Area Utilised for Fish Seed Production	Total Fish Seed Production
Culturable Water Resources	1	0.243	0.994**	0.407	0.362	0.241
Capture Fisheries Water Resources	0.243	1	0.337	0.702*	0.118	0.392
Total Fish and Prawn Production from Culture Fisheries Resources	0.994**	0.337	1	0.484	0.338	0.217
Total Fish and Prawn Production from Capture Fisheries Resources	0.407	0.702*	0.484	1	0.073	0.227
Water Area Utilised for Fish Seed Production	0.362	0.118	0.338	0.073	1	0.959
Total Fish Seed Production	0.241	0.392	0.217	0.227	0.959**	1

* 5% level of significance, ** 1% level of significance

seed production; and between total fish and prawn production from capture fisheries resources with capture fisheries water resources (Chutia et al., 2018; FAO, 2024). Hence, the Sonamura sub-division of the Sepahijala district has the potential to augment the vertical development of fisheries and aquaculture, which needs efficient and sustainable utilisation of water resources.

On the contrary, the Jampuijala sub-division lags in terms of fisheries and aquaculture activities due to relatively lesser water resources available, hilly terrain, a higher percentage of tradition-bound fish farmers, lack of innovativeness among the fish farming communities. These are evidenced by the lesser involvement of fish farmers and private sectors in the making of new water resources for the horizontal expansion of fisheries and aquaculture in the subdivision. However, the Government sector has made a serious attempt in this regard (Nirmalkar et al., 2022), which is evidenced by the quantum jump (7.18%) in the making of new water resources in the subdivision in 2017-18 over the base year 2016-17. Thus, the Jampuijala sub-division provides scope for the horizontal expansion of fisheries and aquaculture in the district.

CONCLUSION

Water resource mapping of the Sepahijala district reveals the fact that the Sepahijala district of Tripura has the potential relation to sustainable fisheries and aquaculture in the region. The sub-division-wise analysis suggests that the Sonamura and Bishalgarh sub-divisions of the district have the potential to augment vertical development whereas, the Jampuijala sub-division has the potential for the horizontal expansion of fisheries and aquaculture in the district. Hence, a meticulous strategy formulation is needed by identifying potential stakeholders, water resource availability, conservation and proper utilisation of the water resources for target-oriented horizontal and vertical development to augment sustainable fisheries and aquaculture in the region.

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