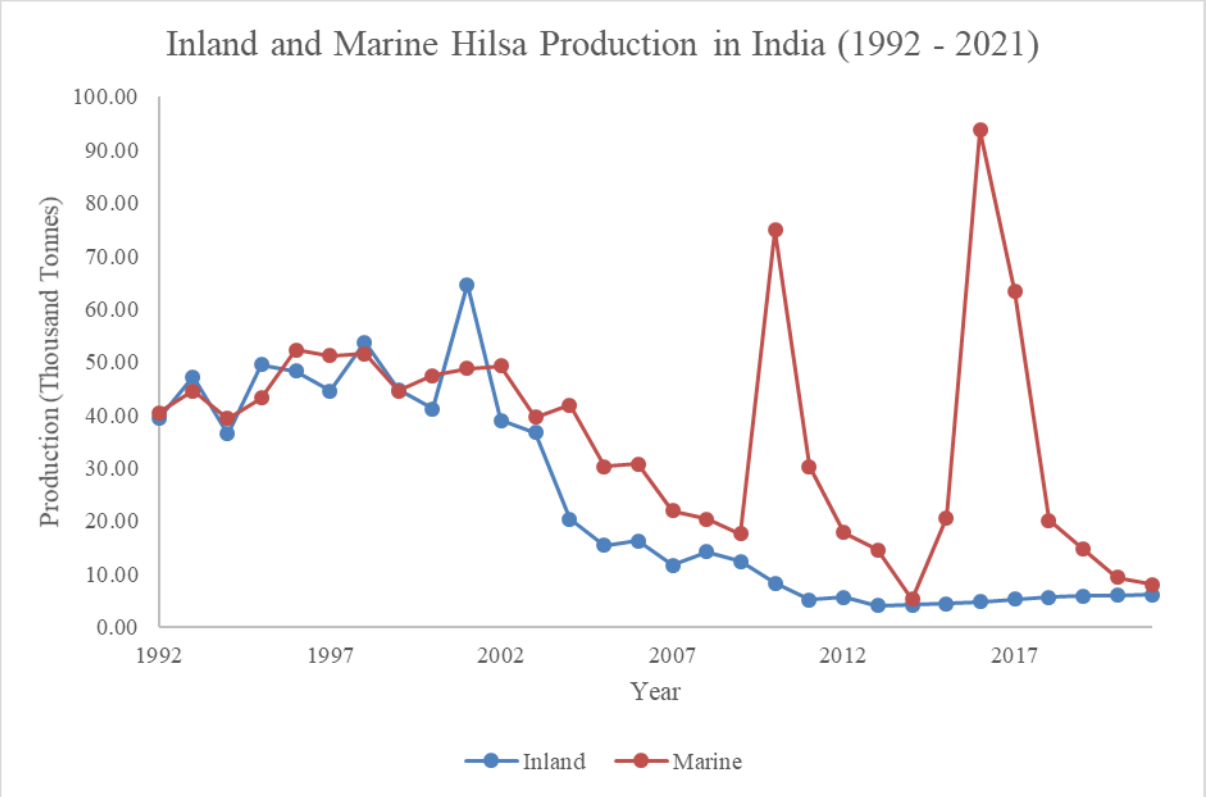
11. Supplementary Materials

Demographic and Socio-economic Characteristics of Fishers of River Hooghly in West Bengal in the study

Major Sampling Site	**Caste Composition**	**Average Age (years)**	**Educational Attainment**	**Average Family Size (no. of members)**	**Average Monthly Household Income** (₹) **(during five months of fishing season)**	**Secondary Occupation**
Hooghly district	SC (100%)	45	Illiterate = 58%, Primary Literate (upto STD V) = 42%, Secondary Level (upto STD X) = 2%	3 - 4	20000	Fishing other fish (100%)
North 24 Parganas district	SC (100%)	41	Illiterate = 43%, Primary Literate (upto STD V) = 44%, Secondary Level = 10%, Graduate = 1%	4	30000	Fishing other fish (100%)
Murshidabad district (Farakka)	SC (88%), General (7%) and OBC (5%)	37	Illiterate = 49%, Primary Literate (upto STD V) = 26%, Secondary Level (upto STD X) = 19%, College Drop-out = 1%, Graduate = 3 (nos.) fishers, Ph.D. = 1 (no.) fisher	5	12500	Fishing other fish (37.3%), *Bidi* Making (34.4%), Daily wage labourer (15.3%), Rickshaw (Toto) Driver (9.1%), Shop keeper (2.4%), Fruit seller (0.5%), Tea seller (0.5%), Nut seller (0.5%)
South 24 Parganas district	SC (100%)	33	Illiterate = 29%, Primary Literate (upto STD V) = 68%, Diploma = 3%	3	27500	Fishing other fish (45%), Daily wage labourer (39%), Retail vegetable seller (16.1%)

Fish Caught Other than Hilsa

Major Sampling Site	Fish Species Harvested	Percentage of Fishers Harvesting the Fish Species
Hooghly district	Rohu, Catla, Scribbled Goby (*Bele* in Bengali), Snakehead murrel (*Shol*), Giant River Catfish (*Aar*), Mrigal, Gangetic Hairfin Anchovy (*Phasa*), Long Whiskers Catfish (*Gule*), Giant Snakehead (*Gajaar*)	Rohu = 29% Catla = 29% Scribbled Goby = 21% Snakehead Murrel = 4% Giant river catfish = 4% Mrigal = 21% Gangetic hairfin anchovy = 14% Long whiskers catfish = 11% Giant snakehead = 4%
North 24 Parganas district	Snakehead murrel (*Shol*), Climbing perch (*Koi*), Singhi, Bronze Featherback (*Folui*), Rohu, Scribbled Goby (*Bele*), Catla, Indian River Shad (*Khoyra*), Ganges River Sprat (*Kechki*), Gangetic Hairfin Anchovy (*Phasa*), Gangetic mystus (*Tengra*), Freshwater Shark (*Boal*), Asian seabass (*Bhetki*), Indian Featherback (*Chitala*), Giant River Catfish (*Aar*), Giant freshwater prawn, Long Whiskers Catfish (*Gule*), Orangefin labeo (*Kalbasu*), Pama croaker (*Bhola*), Gangetic stingray (*Shankar*)	Snakehead Murrel = 4% Climbing perch = 4% Singhi = 4% Bronze featherback = 4% Rohu = 15% Scribbled Goby = 15% Catla = 11.11% Indian River Shad = 3.70% Ganges River Sprat = 3.70% Gangetic Hairfin Anchovy = 7.41% Gangetic mystus = 11.11% Freshwater Shark = 3.70% Asian seabass = 3.70% Indian Featherback = 3.70% Giant River Catfish = 44.44% Giant freshwater prawn = 7.41% Long Whiskers Catfish = 11.11% Orangefin labeo = 11.11% Pama croaker = 3.70%
Murshidabad district (Farakka)	Rohu, Catla, Rita, Gangetic mystus (*Tengra*), Olive barb (*Sar punti*), Snakehead murrel (*Shol*), Orangefin labeo (*Kalbasu*), Long whiskered catfish (*Aar*)	Rohu = 17.65% Catla = 17.65% Rita = 11.76% Gangetic mystus = 29.41% Olive barb = 5.88% Snakehead murrel = 5.88% Orangefin labeo = 11.76% Long whiskered catfish = 5.88%
South 24 Parganas district	Mango fish (*Topse*), Pama croaker (*Bhola*), Gangetic mystus (*Tengra*), Gangetic Hairfin Anchovy (*Phasa*)	Mango fish = 50% Pama croaker = 50% Gangetic mystus = 50% Gangetic Hairfin Anchovy = 50%



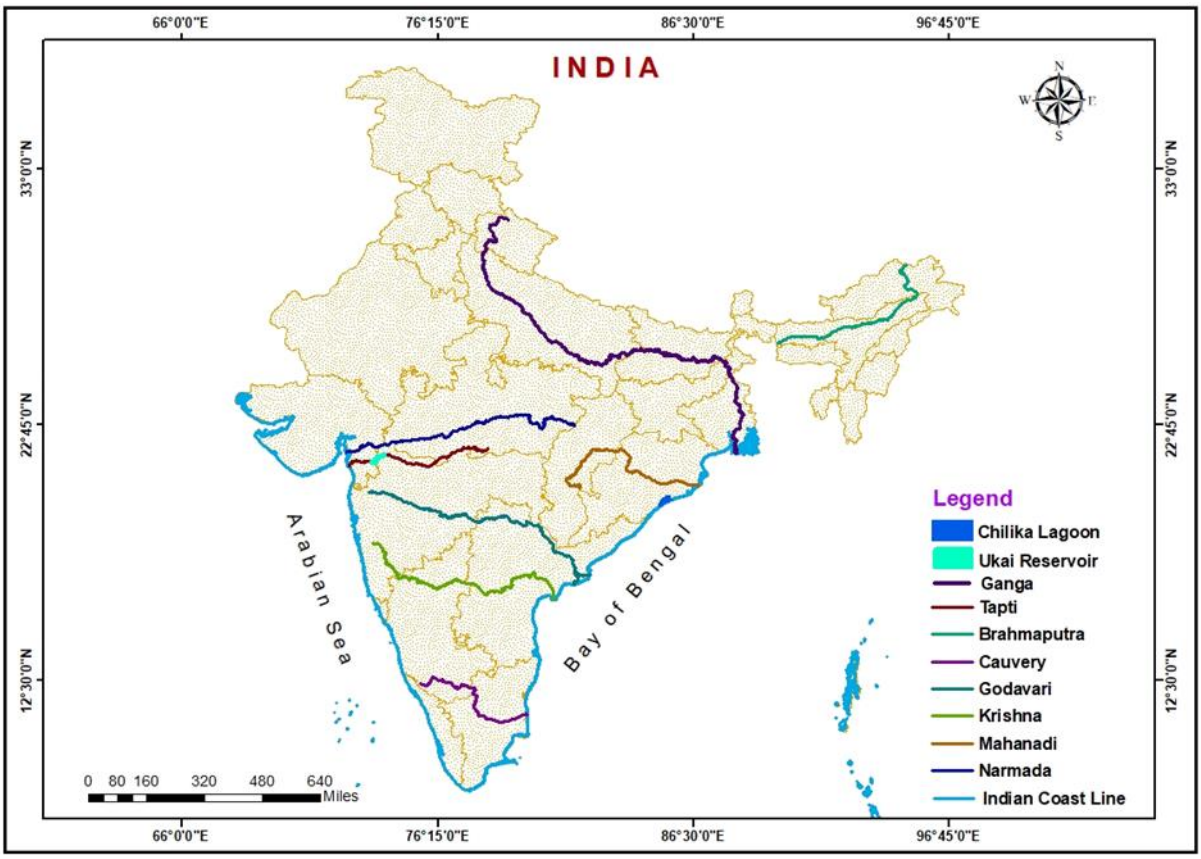
Hilsa catch trend in India (Source of data: FAOFishStatJ Database, Dutta et al., 2021, Sajina et al., 2020 and Unpublished data of ICAR – CIFRI Institutional Project)

Historical trends in Hilsa catch in Rivers (except river Hooghly), Estuaries, Reservoirs and Lagoons of India

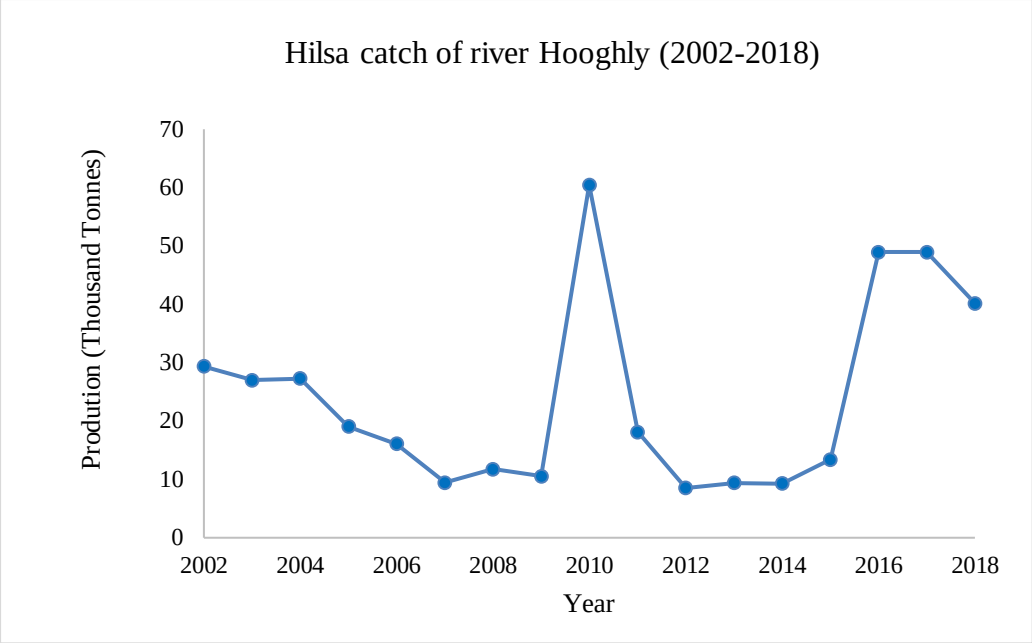
River	**Trend in Hilsa Catch**
Mahanadi Estuary	The production of Hilsa in Mahanadi during 1951 – 1960 was 310 tonnes, in 1961 – 1970 was 292.7 tonnes [25], and in 2001-2010 was 112 tonnes [8]. Barrages, obstruction in freshwater flow to the estuary and increased fishing efforts have resulted in Hilsa decline.
River Brahmaputra	In 1960s and 1970s, Hilsa catch in river Brahmaputra was 1,000 tonnes. From 1987 to 1999, the catches were stable, averaging7 tonnes per year [26]. From 1973 to 1999, the contribution of Hilsa to the total riverine catch declined from 11.2% to 2.1% [27]). After this, there was a substantial increase in the catch from 2000 to 2009, with wide fluctuations reaching upto 14 tonnes per year. Hilsa catch declined to a meagre 2.3 tonnes in 2011 [27;8]. From 2010 to 2019, Hilsa catch again declined steeply to 3 tonnes per year, but

	percentage composition remained the same [28]. The reasons attributed were recruitment overfishing and growth overfishing during migration.
River Narmada	The construction of Sardar Sarovar Dam in the river and the commencement of its functioning in 1994, the development of sand bars in the mouth of the estuary, a decrease in depth and overfishing have altered the hydrological regime of the river, resulting in the steady decline of Hilsa registering its record low status(419 tonnes) in 2015 [29; 8]. In 2006-07, the recorded Hilsa catch was 5,180 tonnes. One of the highest catches was recorded in 1993-94, which was 15,319 tonnes [29].
River Tapti	Fluctuating but good catch of Hilsa has been found along the estuary and freshwater stretch of river Tapti from 2005 to 2016, with the production ranging from 7.5 to 213 tonnes [8].
Vallabh Sagar (Ukai) Reservoir	Ukai reservoir has a self-recruiting population of Hilsa where increase in Hilsa production was registered from 1 to 52 tonnes during 1989-90 to 1996-97. This increased to 119 tonnes during 1998-99 and then there were fluctuating trends after that [8].
River Godavari	Hilsa fishery assumed the highest importance in river Godavari among all the south Indian rivers during 1950s and 1960s [30]. Hilsa was available all-round the year in the river. There were very early attempts to raise Hilsa in hatcheries [31;32; 33; 34;35]. Hilsa production showed a drastic decline from 1940s (8,250 tonnes) to the present time (14.5 tonnes) [8]. The construction of Godavari barrage in 1970(erstwhile Dowleswaram barrage during 1850s) has also impacted the Hilsa population in the river.
Chilika lagoon	A declining trend has been observed in Chilika lagoon from 1980s with low catches of 4.08 tonnes during 2009-10[8].
River Cauvery	The construction of Mettur Dam in the river in 1934 was responsible for the complete extinction of Hilsa [36]. In the early 1900s, Hilsa was recorded to be spawning at Trichy. Before the construction of Mettur dam, Hilsa ascended the anicuts on Cauvery upto Mettur for breeding by migrating through the lower anicuts in the river delta,

	and also in the main deltaic branch of the river, which was the Coleroon [37].
River Krishna	Hilsa fishery was an important fishery in the Krishna River of Andhra Pradesh, along with catches from the sea along the Andhra coast [37]. The construction of Prakasam barrage at 1850s and its impacts spelled disaster for the Hilsa production from the river.



The map of India with the rivers, estuaries, lagoon, and reservoir where Hilsa population existed in the native fish fauna



Hilsa catch trend in river Hooghly (Source: 2002 to 2015 Hilsa catch data (Dutta et al., 2021), 2016 to 2018: Unpublished data of ICAR – CIFRI Institutional Project)

Particulars Considered in Meta-analysis of Case Studies of Hilsa Fishers in India

SL. No.	Author(s)	Study Area	Theme of Study	Sample size	Demographic characteristics	Socio-economic characteristics pertaining to fisheries as livelihood	Methodology and Analytical Approach	Specific Outcome of Study
1	Roy et al., 2016	Hooghly-Bhagirathi River System	Livelihood analysis of Hilsa fishers	300	Age, Caste composition, Family size, Family Composition, Educational status, Family Income	Expenditure pattern, Contribution of Hilsa fishery to family income, Perception of Hilsa fishers regarding reasons behind decline in Hilsa fishery	Correlation co-efficient of family incomes with socio-economic variables	Problem Tree analysis
2	Dutta et al., 2021	India (West Bengal) and Bangladesh	Investigates economic efficiency and existing management practices of Hilsa fisheries of West Bengal, India and Bangladesh	Catch and effort data, fishing cost and Hilsa price data of India (West Bengal) and Bangladesh from 2002 to 2015	Not addressed	Not addressed	Gordon-Schafer surplus production model (economic efficiency), logistic growth equation, harvest function, bio-economic model (MSY and OSY of effort, harvest and biomass)	Deterministic bio-economic model on Hilsa fishery, Open Access Equilibrium (OAE), Effort of OAE (E_{OAE}), Harvest of OAE (H_{OAE}), Maximum Economic Yield (MEY), Effort of MEY (E_{MEY}), Harvest of MEY (H_{MEY}), Biomass of MEY (X_{MEY}), Optimum Sustainable Yield (OSY), Optimal stock, Optimal effort, Optimal Profit, Issues of effort tax and landing taxes for Hilsa fisheries, Potential solutions to Open Access Problem
3	Dutta and Hazra, 2017	Hooghly-Bhagirathi	Hilsa fishery exploration	Not specified	Not addressed	Marketing and economic aspects,	Qualitative description of	Market demand and supply scenario in India

		River System	from ecological, biological, social and economic point of views			social impact, conservation and management	facts and figures	and Bangladesh, marketing functions in Bangladesh, social importance of Hilsa in Ganga-Brahmaputra-Meghna basin, and conservation and management measures in India and Bangladesh
4	Sajina et al., 2020	Hooghly-Bhagirathi River System and associated coastal waters of Northern Bay of Bengal	Estimation of annual catch of Hilsa and fishing effort	Primary data for four consecutive years from 2013 to 2016	Not addressed	Not addressed	Stratified Multi-stage Random Sampling for estimation of monthly catch of Hilsa, validation of sampling method	CPUE, study of Hilsa fishing crafts and gears, catch estimation,
5	Sahoo et al., 2018	Ganga – Brahmaputra – Meghna Basin (India and Bangladesh)	Review on Hilsa breeding, attempts at Hilsa aquaculture in South Asian region, culture potential based on market study	Market surveys in major Hilsa markets during 2011 – 2012 in India and 2011 – 2015 in Bangladesh	Not addressed	Market prices, Hilsa market trends in India and Bangladesh, Hilsa marketing channels in Bangladesh	Case Studies, Hilsa market survey	Demand for culture-based Hilsa fisheries, Market fluctuations and price fluctuations, increasing prices of Hilsa in India and heavy reliance on Bangladesh for fulfilling market demand of West Bengal
6	Chacraverti, 2021	West Bengal (Diamond Harbour in South 24 Parganas district; Kanthi in East Medinipur district; Godakhali in	Conservation of Hilsa fisheries in West Bengal	103 Hilsa fishers	Age, Sex, Religion, Caste, Literacy, Income, Family Size, Indebtedness, Primary source of income, Secondary occupation	Experience in Hilsa fisheries, Dependence on Hilsa fisheries, Monsoon and Non-monsoon Income, Craft and gear ownership, Awareness pertaining to Hilsa conservation,	Descriptive Statistics and qualitative analysis	Socio-economic status of Hilsa fishers and the state of conservation of Hilsa fisheries n West Bengal

		South 24 Parganas district; Nakol, Shyampur II Block, Howrah district; and Jagannathpur, Uluberia, Howrah district)				Profit sharing on Hilsa fishing trips, Amount of Hilsa catch seasonwise, Market price of Hilsa seasonwise, Demand and supply scenario,		

Meeting with fishermen at lower stretch of river

Socio-economic data collection from upper stretch of the river

Women fishermen selling Hilsa in evening at Godakhali fish market

Hilsa Specimen from Ganga River (Photograph taken by National Mission for Clean Ganga Project Members of ICAR – CIFRI during social survey)