HILSA CONSERVATION IN WEST BENGAL

A BRIEF STUDY

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A brief study

Santanu Chacraverti

Project supported by the Oak Foundation

and the

Society for Direct Initiative for Social and Health Action (DISHA)

February 2021

Preface

Anyone following the media in West Bengal in the last few years has read or heard something about the great hilsa crisis and the need of conservation. Fish lovers, of course, know the hard way about hilsa scarcity and forbidding prices. In the wake of a growing concern with hilsa scarcity, the government of West Bengal came up with hilsa conservation measures, as embodied in an order and notification in 2013.

It is true that there was no serious effort on the part of the administration to implement the measures indicated in those instruments. Nevertheless, they continued to hang as a sort of framework—as measures that should or would be taken and were occasionally referred to, at least in the media. In subsequent years, some awareness programmes were launched and some feeble efforts were made to discourage the fishing and sale of juvenile hilsa. It was clear that at some point, the issue of implementing conservation measures would become unavoidable.

DISHA, which closely works with the small-scale fishers (SSF), felt the urgency to look at the issue of hilsa conservation in West Bengal in general and to the aforementioned instruments of conservation from an approach that does not ignore the urgent livelihood concerns of the multitudes of hilsa fishers in West Bengal. This study, which finally took off in the autumn of 2018, came in the response to the said notification and order.

However, as has been specifically noted in this work, the fishers, specifically the large population of small-scale or artisanal fishers who were dependent on hilsa fishing had at no point been consulted in the conception and designing of these instruments. This, along with basic problems in their contents, makes implementation hugely problematic, even setting aside the question of the half-heartedness accompanying the measures.

The origin of these instruments their nature are subjects discussed at some length in this study. Here, we merely discuss some of the motifs underlying it.

It is a venerable tradition in the making of Indian law and policy that stakeholders, particularly if the latter belong to the disempowered sections, are not consulted. There is an occasional exception to the rule, though it is difficult to recall a robust one. The hilsa conservation measures were not an exception. Nobody knows the

total number of artisanal hilsa fishers, let alone those who might make some earning from hilsa fishing on a part-time basis. However, by any estimate, the number would need to be counted in tens of thousands. Taking the families of the fishers into consideration, the total number of directly affected population is likely to be counted in hundreds of thousands. In addition, there are a huge number of workers drawn from the fishing communities who work on mechanized fishing crafts targeting hilsa. Yet, even the most active and knowledgeable members of these communities weren't aware that such measures were being conceived.

Given the lack of proper consultation, it isn't entirely surprising that the legal-administrative instruments of conservation that emerged left a great deal to be desired, as we shall see.

It is not our case that all round stakeholder consultation in preparing a measure is a warranty of perfection and success. Neither is it our case that such consultation is absolutely necessary. For, one can think of several instances of successful and beneficial measures conceived and implemented by authoritarian institutions, whose authors would have found the idea of grassroots opinion-seeking absurd. For, there are numerous factors involved in wise designing and effective implementation of a scheme and it is difficult to predict with certainty what would succeed and what would not. However, there are obvious political administrative reasons in favour of extensive stakeholder consultation, as we shall see later.

One major factor behind success is a combination of felt urgency and strong resolve. Hilsa conservation in Bangladesh is a case in point. Hilsa is a hugely important economic and nutritional item in Bangladesh. Therefore, when concerns about the condition of the hilsa stock and long term sustainability of hilsa fishing emerged, these immediately became national concerns. The Bangladesh government approached the matter with dead seriousness. The result was a spate of conservation measures that were meaningful and effective in improving fishing sustainability and long term production improvement. The measures are not flawless—one major area of concern is that the compensation given to the fishers for the fishing ban periods appears to be woefully inadequate. This is a grave issue. Yet, the fishers have benefited from increased production, as is evidenced from various reports.

Hilsa is nowhere as important for the West Bengal economy as it is for Bangladesh. Perhaps that is why the drive for hilsa conservation in this State has been half-hearted at best. Yet, this was not inevitable. It has been the fortunate experience of the author of this report to meet scholars and officials, either directly or through their writings—persons who are committed to the cause of both conservation and livelihood. This has inspired the author, who began the study rather half-heartedly, to get on with it and bring it somewhere near completion.

Now, we come back to the question of consultative processes in preparing a measure. In designing a measure, it is usually best to involve parties who are knowledgeable on the issue and/or have a stake in it. The epistemic benefits are obvious. One gets to know about the issue from all angles. Moreover, and equally important, involving all stakeholders in formulating a measure helps ensure its success—for those involved can now identify with it and contribute to making it a success. Moreover, this is the process one naturally expects of governments in a twenty-first century democracy.

We hope this study will contribute a little towards understanding the issue and formulating action plans.

March 2020

Postscript

A draft version of the study report was completed in March 2020. Thereafter, the author waited for comments. Unfortunately, nothing of significance appeared, except for an occasional approving noise—leaving the author grateful but unenlightened. So, the existing text was taken treated as final, although some typos were corrected and there have been an occasional change in language, formatting, etc. It would have been best had the author been able to include information or arguments from subsequent reports and writings. However, that has not been possible due, largely, to the author's other engagements. Hence, the information and views expressed herein reflect essentially the author's state of knowledge and understanding as in March 2020.

February 2021

Acknowledgement

This study would not have been possible without the support of the two organizations mentioned on the title page.

I am deeply indebted to my friends at DISHA, particularly to Pradip Chatterjee and Sasanka Dev, for their unstinting help and support and their patience with the huge delay in getting on with the writing—though I guess they are used to it by now.

I need not formally thank Debasis Shyamal and Milan Das, for an expression of my gratitude to them is becoming so usual nowadays that one can easily take it for granted. Nevertheless, I do thank them for helping organizing FGD sessions, tolerating my countless phone calls, and for cheerfully providing help and information at a moment's notice. Having such bountifully generous friends can easily become a bad habit.

I thank Ranajit Haldar, Ranajit Patra, Debasis Patra, and Gautam Bera with all my heart for conducting the surveys.

I am also hugely grateful to Bidhan Chandra Dey and Tapasi Dolui for playing a crucial part in organizing FGDs in Howrah and South 24 Parganas and to Madhupriya Das, Avishek Haldar, and Chandrima Haldar for their support at the Diamond Harbour meeting. I am grateful to Dhruba Dasgupta for playing a crucial role at the FGD at Nakol and preparing a report.

I am deeply grateful to all members of the small-scale fishing community who participated in the FGDs and patiently responded to the survey questions.

I thank my friend Mukut Roy Choudhury for helping to arrange the interviews. I thank Dr Saptarshi Biswas, Deputy Director Fisheries/DGM SFDC and Project Director Hilsa Conservation and Research, Prof. Ashim Kumar Nath of the Sidho-Kanho-Birsha University, and Mr. Bablu Ghosh, veteran researcher in artificial hilsa breeding-rearing-ranching experiments for their time and generously answering my questions.

I should not forget to thank Sujoy Jana of Baguran Jalpai, for tolerating an occasional phone call for miscellaneous information related to some aspect or other of the study.

Lastly, but by no means unimportantly, I thank all those who I have forgotten to mention and seek their forgiveness.

Santanu Chacraverti
Kolkata
February 2021

Regarding source citations

The sources are indicated not in the author-date style but in the more conventional “notes bibliography” style. Moreover, the sources are placed in page footnotes, accompanied, occasionally, with comments and additional information. Hopefully, this will prove friendlier to readers than the system of endnotes. Of course, the sources have been listed again at the end of the study. The referencing style is influenced to an extent by the Chicago Manual (CMOS 2017), but does not rigorously follow it or any other system. Moreover, there is likely to be an occasional inconsistency in their formatting. Regrettable as that is, it is not likely to inconvenience the reader.

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This study: what, whence, and whereto
In lieu of an executive summary

This study

We have seen in the preface that this study came into being in response to the hilsa conservation measures of the Government of West Bengal, as enshrined in certain legal-administrative instruments and its purpose is to examine the question of hilsa conservation without forgetting the urgent livelihood needs of the small-scale fishers (SSF).

Here, we shall try to capture in brief the highlights of the study methodology and the facts, arguments, and findings that have been dealt with in detail in the chapters that follow.

Study methods

The method of study is (or should be) decided by study goals. In this case, the goal was to understand the nature and extent of the threat to hilsa and the issue of hilsa conservation, look at the usual measures of conservation employed or conceived, examine closely the notification and order in which the West Bengal Government's efforts to conserve and protect hilsa are enshrined, and form an educated opinion of what should be done to conserve this natural resource in the medium and long run, while at the same time, keeping in view the urgent and immediate livelihood concerns of the multitude of traditional small-scale fishers and their families. With this goal, the investigation proceeded to examine the information on hilsa production in Bangladesh and India, the geo-hydrological context of the species in question, and the literature on the nature of the species and its reproductive biology, life cycle, and fecundity. Further, it examined the studies on the decline of hilsa and West Bengal and Bangladesh and the various recommendations. In addition to examining literature, the study involved interviewing concerned researchers and government officers. As the study involved incorporating the needs and concerns of the small-scale hilsa fishers, the next important item in line was to examine the studies on the artisanal hilsa fishers in West Bengal. This was followed by focused group discussions (FGD) of the fishers and a survey of their demographic and socio-economic and some elements of their

notions and ideas and awareness of issues deemed relevant to the study. The survey involved 103 hilsa fishers selected through *convenience sampling* and spread over five districts.

The basics

1. Hilsa or Ilish or *Tenualosa ilisha* (in the currently approved scientific nomenclature) is a fish that is a shad fish; its not too distant relatives are herrings and sardines.
2. It might is largely confined to the Asian waters and forms the basis for important commercial fisheries in Bangladesh, India, Myanmar, Pakistan, and Kuwait. However, it is by far the most abundant in the Ganga-Brahmaputra-Meghna river systems and coastal waters of India and Bangladesh.
3. Therefore, it is little wonder that in the global production of hilsa, Bangladesh leads, with India coming second. But, it is a very poor second. As per the most recent reliable statistics, Bangladesh produces 86.7% of the world's hilsa. India is the second largest producer, but is way behind, accounting for about 8% of the global total. Moreover, in India, it is the Bhagirathi-Hooghly system (freshwater, estuarine, and coastal waters) that produces the lion's share of the hilsa catch.
4. Bangladesh's advantage vis-à-vis India is not surprising. The overall volume of freshwater flowing out through the Lower Meghna channels (which combines the Padma-Brahmaputra-Meghna flows) is far greater than the volume of water flowing out through the Hooghly mouth, thus providing a far wider and inviting ambience for hilsa shoals out on their spawning migration.

Conservation efforts in Bangladesh and West Bengal

1. Hilsa conservation is a very important economic and livelihood concern in Bangladesh. Therefore, there is little wonder that the threat of declining catch became a major national issue and resulted in attempts to conserve hilsa. It is also heartening to observe that, at least on the face of it, the results have led to their desired goals—increased sustainability and better production prospects.
2. As compared to Bangladesh, hilsa plays a far smaller role in West Bengal's economy. This is possibly the reason that conservation efforts have been relatively half-hearted.

3. Nevertheless, hilsa is a major cultural icon in West Bengal, and has played an important role in its economy. Indeed, in terms of livelihood, studies show that hilsa contributes significantly, even majorly, to the livelihood of tens of thousands of fishers in West Bengal.
4. Therefore, hilsa conservation is in the best interests of the people of this state. It is also in the interests of the fishing community hugely dependent on it.

The IUCN moment

1. It so happened that the IUCN came to play a substantial role in inspiring a conservation-targeted project across Bangladesh and West Bengal during 2010-14, under the Ecosystem for Life (E4L) programme. The hilsa featured prominently in this inter-country programme across Bangladesh and India. The programme prominently included a research project on hilsa migration, spawning, threats, etc. and on outlining the possibilities of conservation. An inter-country joint research team, including noted researchers and working on a common methodology, was put in place. The research output, whose essentials were in place by 2012, appears to have inspired and contributed to the designing of the conservation measures in West Bengal.
2. The IUCN sponsored study, the studies on which it drew, and other studies thereafter have highlighted various aspects of hilsa biology, fecundity, population characteristics, migration, and spawning patterns in the Ganga-Brahmaputra-Meghna estuary. Many of these studies have also sought to find threats to the hilsa population and causes for catch and stock decline.
3. The IUCN sponsored study was one of the chief outputs of the E4L programme of the IUCN, which, reportedly placed importance to stakeholder consultation. However, there does not seem to be any evidence that small scale fishers were formally consulted regarding the goal and nature of the study being conducted and that its recommendations were genuinely shared with them.

What the hilsa studies indicate

Studies on hilsa biology, feeding habits, fecundity, spawning migration and spawning habits of hilsa do not always agree on particulars. Nevertheless, the consensus or at least majority opinion regarding the hilsa stocks entering the Hooghly would seem to suggest the following particulars:

a. The hilsa population found in the Bhagirathi-Hooghly belong wholly or overwhelmingly to the anadromous ecotype

b. The spawning migration of hilsa into Hooghly appears to depend on an assortment of factors—water temperature, depth of water, turbidity, degree of salinity, food availability, etc.

c. The hilsa seem to undertake spawning migration into the Bhagirathi-Hooghly system twice a year—one during June-July to October and another during January-March; the first is the major hilsa season in Hooghly and the second the minor season

d. In the first season, peak spawning possibly occurs in the time bracket usually defined by the first full moon during the Bengali month of *Aswin*—beginning a few days before the full moon and continuing for several days after; most of these days usually fall in October; there seem to be less information regarding peak spawning period during the minor hilsa season; however, there is an opinion that it would be during late February-early March (an observation based on the high availability of gravid hilsa during that period)

e. Changes in the ambient factors that invite the hilsa into the river will cause less hilsa to enter the river

f. Some particular stretches of the Bhagirathi-Hooghly have been identified as "spawning ground" for hilsa—the Nishchintapur-Godakhali stretch, the Hooghly Ghat-Kalna stretch, and the Lalbagh to Farakka stretch. In addition, the sand bars near the Matla, Thakuran and Raimangal estuaries look promising as spawning grounds

The causes of decline of hilsa in the Bhagirathi-Hooghly system

1. Finding exact causes of complex processes can be difficult. However, in the case of the decline in hilsa in the Bhagirathi-Hooghly system, the causes are perhaps not very difficult to identify. First of all, as this study has argued (reiterating a well-known fact) that the overall volume of freshwater flowing out through the Lower Meghna channels (which combines the Padma-Brahmaputra-Meghna flows) is far greater than the volume of water flowing out through the Hooghly mouth, thus providing a far wider and inviting ambience for hilsa shoals out on their spawning migration. Therefore, compared to her larger and more voluminous

eastern sisters, the Hooghly was always at a comparative disadvantage. Yet, the disadvantage was only a comparative one. For, compared to other rivers in India, the Hooghly, blessed by a considerable share of Ganga's flow, and further fortified by inputs from her other tributaries, brings a huge volume of water to the Bay of Bengal and has always attracted huge shoals of hilsa. Therefore, the causes of her decline must be sought elsewhere. The prime accused and convicted are as follows: Siltation at the mouth of the estuary causing reduction in the depth of water, impacts of barrages and dams, increased water abstraction (mostly for irrigation and industrial purpose), pollution, resulting in changes in water characteristics and food availability, huge impact of mechanized fishing on marine biodiversity and on the hilsa stock in the Bay of Bengal region close to the Hooghly mouth, lack of mesh size regulation, juvenile fishing, and overfishing including the exploitation of brood fish.

2. In connection with the above, this study argues that while it is fine to have a comprehensive list of important causes of decline, for conservation purposes it is important to indicate a hierarchy among the factors, on two axes—first, according to the degree of importance and, secondly, the ease of intervention and management. The present study is in no position to indicate a hierarchy along the *first* axis. However, it suggests that it is possible to indicate a hierarchy of factors along the second axis. Thus, myriad-point or non-point factors like river pollution and abstraction of river water, although they might be of huge importance, are less easy to address through intervention than siltation of river mouth, ban on juvenile fishing, or severe restriction on destructive gears

3. In enumerating and evaluating causes, it appears that sufficient importance is not being given to the destruction of hilsa stock in the marine environment. True, studies often mention trawling as causing damage to hilsa stock and do not always mince words in describing the negative impact on marine biodiversity and resources by poorly regulated mechanized fishing. Some have also mentioned or implied that mechanized overfishing has hugely impacted hilsa populations and that MSY for hilsa in northern Bay of Bengal is being exceeded. Most revealingly, studies show how the overwhelming bulk of hilsa catch and catch increase in the Bhagirathi-Hooghly system comes from marine sources. Nevertheless, the implications for these in the case of an anadromous stock seems gets relatively

less importance and the impact of destructive fishing and overfishing in the river gets more attention. This evaluative imbalance needs to be addressed—without downplaying the seriously negative role of juvenile or brood fish destruction in rivers and estuaries.

Regarding the recommendations in various studies

1. An understanding of the nature of the hilsa biology and ethology and an understanding of the causes of decline have led to recommendations in various studies. We have examined in some detail the policy recommendations of the IUCN and also compared them to a minor set of recommendations made by the BOBLME study. Two recommendations in the BOBLME study appear to be of some importance. They are: 'routine collection of catch and effort information to update the current stock status periodically is highly indispensable' and 'more research regarding spawning ground survey and migration of Hilsa'. These are important because they suggest that our knowledge regarding these may not be secure or might require updating, given that we are dealing with highly dynamic systems. As regards the IUCN study, a few observations are suggested. First, the general tenor of the recommendations appears to be fine. However, and secondly, there should have been a much greater emphasis on strict regulation of mechanized fishing. Thirdly, the emphasis on ban on juvenile fishing and the principle of targeting the peak spawning period for fishing ban appear to be in order. Fourthly, stressing on the principle of "adequate compensation" to fishers for the ban period is also welcome.
2. One important aspect should be considered in prescribing recommendations. As studies on the reproductive biology of the hilsa makes clear, the hilsa is a highly fecund fish. Therefore, effective protection of juveniles and brood fish for even a brief period is likely to make a considerable difference to population size and catch statistics. This is indicated by the striking results attained in Bangladesh.

The hilsa conservation measures in West Bengal

1. The hilsa conservation measures embodied in the West Bengal government's notification (under the West Bengal Inland Fisheries Rules) and order (under the Marine Fishing Regulation Act), both issued in April 2013 leave much to be desired. The six-month ban on the estuarine and freshwater areas of the designated

Hilsa Sanctuaries (extending to about 318 km) appears to have little rationale or science. Moreover, any attempt to implement such a ban without substantial compensation would lead to huge distress and massive protests. There are other aspects of these instruments that are unsatisfactory. Perhaps the most disturbing aspect of these instruments was that they emerged without prior consultation with the stakeholders—at least members of the small-scale fishing community had no inkling that any such instruments were in the offing.

2. Anyway, there was no significant effort to implement the six-month ban. In the years following the issuance of these instruments, only some attempts to restrict juvenile fishing and control mesh size became noticeable in some areas. There were also some awareness campaigns in some areas as testified by the fishers interviewed in these surveys. Moreover, there was no offer of any compensation package. The entire exercise lacked the zest, motivation, direction, and teeth characterizing the Bangladesh instruments. Anyway, given the nature of the instruments, it is perhaps better that there was no serious effort to implement it.

The community in question: what existing studies indicate

Since it is the purpose of this investigation to look at conservation measures keeping in view the concerns of the small-scale fishers, it has examined some studies on the social and economic status and conditions of the small-scale fishing population and has discussed a few of them. These studies reveal that the majority of the artisanal of small-scale fishers are educationally and economically disadvantaged and most come from 'lower' caste backgrounds, which, more often than not, is synonymous to social and economic disadvantage.

The community in question: what our surveys and FGDs indicate

Our surveys corroborate the findings of the earlier study, perhaps bringing into sharper relief the social and economic disadvantages of the community in question. It shows that the overwhelming bulk of the respondents (93%) belonged to the SC category and that two very traditionally specific fishing castes, *Malo* and *Jeliya Kaibarta* accounted for 50 out of a total of 103 respondents (i.e. 48.54%), with other occupationally less well defined, but nevertheless castes also traditionally associated with fishing, made up the lion's share of the remaining respondents. The survey also provides data on their caste and literacy status and indicators of their income. It brings out a picture of

indebtedness and their dependence on either merchant vendors or moneylenders for loans. The survey also brings out some interesting information about mesh sizes used in the gill nets by the professional hilsa fishers, the months in the year in which the fishers fished for hilsa and other fish, the fishers' knowledge of the government restrictions regarding hilsa, their knowledge of the possible spawning seasons for hilsa, etc. What stands out is the low awareness of the community about governmental conservational concerns with only about half the respondents having some awareness of the government notification /order and only about a third having some notion of the specificities, even if very broadly.

The FGDs bring out the preparedness of the fishers for drastic actions against destructive activities like using poisons for fishing. The fishers were agreeable to implementable restrictions on juvenile fishing, banning of zero-meshed nets, and brief period of bans targeting spawning periods, provided the latter was accompanied by adequate compensations—which they felt must be equal to their average earnings for that period. In the FGDs in the areas where fishers were acquainted with marine fishing, the participants repeatedly insisted on the need to seriously restrict marine depredations and destructive fishing.

Our recommendations

The following courses of action appear to be suggested by this study:

1) The inadequacy of the notification and order of 2013 appear to be evident. It is evident to academic experts and responsible members of the Fisheries Department, Government of West Bengal. Therefore, the need for a new policy and instruments appear to be evident.

2) As to what exactly the new policy and the contents of the new instruments should be, can only be decided through active consultation of the stakeholders, concerned experts, and other concerned members of the civil society. Perhaps, such a consultation could lead to the creation of a dedicated task force consisting of representatives drawn from the government, expert bodies, and stakeholder organizations—this time, including the representatives of small-scale fishers as a cardinal constituent.

3) Based on what this study seems to have found, perhaps the following could be the general direction of action:

- Top priority must be given to reducing the impact of mechanized fishing in the northern Bay of Bengal. Following the Union Governmental direction of 61 days of fishing ban on the East Coast from 15 April to 14 June, the West Bengal Government also directs a ban on its territorial waters for the same duration. However, as inputs from our FGDs suggest, two months holiday on rampant depredation and destruction might not be sufficient to protect our marine and coastal resources. Perhaps, double the time might be more advisable. The exact duration, calendar, and zone of restriction must be determined through careful consideration and discussion. Since the state government's jurisdiction is limited to the territorial waters and the zone of protection must extend further, there is need to find ways and means to do so. And, under no circumstances must mechanized craft be allowed to fish within territorial waters and any breach of this restriction must result in severe penalties—beginning with but not confined to cancellation of license.
- Certain areas have been marked as hilsa sanctuaries. This was done way back in 2013. These can be continued to be accepted on a provisional basis. However, investigations should be periodically conducted to check the indicators to determine whether the designations need revision.
- As in Bangladesh, periods of fishing bans in the Hilsa sanctuaries would seem to be highly desirable. However, these periods should be short and targeted. The first period could be as follows: a spell of one month centred on the first full moon in the Bengali month of Aswin, or, alternatively, the Bijaya Dashami could be taken as a time marker for deciding the period (in which case, perhaps the Ephemerides based on the reformed Indian Calendar would be a better guide than the commercial *Panjika*s). A second ban during the lesser spawning season also seems advisable. The timing and duration of the ban should coincide with the highest incidence of Hilsa spawning. Whatever the period, the ban should be enforced across all the hilsa sanctuaries with unflinching strictness. Moreover, the ban should also be enforced at and near the *estuarine mouth*, irrespective of the fact whether that is included within a hilsa sanctuary.
- Appropriate monetary compensation (as distinct from food support or similar) should be given to bona fide fishers and the amount of

compensation should be computed on the basis of the number of fishing days lost multiplied by the average daily earning of a hilsa fisher (an indication of such an amount may be found in this study and can be further verified by consultation with the fishers).

- The mesh size in gill nets should be strictly regulated. In fact, an effective gill net not only catches fish by gilling, snagging, or wedging, it also catches by ensnaring (which can help trap even the relatively smaller prey). Therefore, the size of the mesh should be determined based on these considerations and the minimum size might be determined as not less than 100 mm, perhaps even more. However, in determining minimum permissible mesh size, as in all other respects, decision must be based after taking into considerations the inputs from actual fishers.
- Mosquito nets and bag nets with zero-meshed rear ends must be banned.
- Strongest possible penal measures must be employed against applying poison for 'fishing', as reported by fishers.
- Bona fide artisanal fishers along the stretch of the Bhagirathi-Hooghly and the Indian Padma should be called upon to form people's vigilance committees for implementation of the fishing regulations.
- Although studies indicate that hilsa is a resilient species—a feature probably related to its anadromous life cycle—such resilience is bound to have limits. We know that the condition of hilsa and other fish stocks in rivers depend not only on fishing intensity and practices but on ambient conditions in the river, including water volume, water level, dissolved oxygen levels, other chemical and physical parameters, biotic components and conditions of the water, and so on—the long term population dynamics of hilsa and other stocks would depend on the state being able to ensure the overall health of our rivers. Specifically in the case of the Bhagirathi-Hooghly, which is a downstream channel of the Ganga, there must be efforts to link hilsa conservation with overall river protection.

Introduction: study goals, methods, and mode of presentation

The goal of a study determines (or should determine) the methods employed by it.

Goals

In this case, the goal was to understand the nature and extent of the threat to hilsa in West Bengal, the issue of hilsa conservation, and the measures desirable to protect and conserve hilsa—while keeping in view the livelihood concerns of the small-scale of artisanal hilsa fishers. Thus, the study needed to look at the usual measures of conservation employed or conceived, examine closely the notification and order in which the West Bengal Government's efforts to conserve and protect hilsa are enshrined, and form an educated opinion of what should be done to conserve this natural resource in the medium and long run, without riding roughshod over the urgent and immediate livelihood concerns of the multitudes of traditional small-scale fishers and their families.

Investigation: items and methods

With this end in view, the investigation proceeded to examine and analyse the following:

- Available information on hilsa production in Bangladesh and India,
- The literature (research papers and reports) on the geo-hydrological context of the species in question, the nature of the species, its reproductive biology, life cycle, and fecundity, the decline of hilsa in West Bengal and Bangladesh and the various recommendations regarding addressing this problem
- Interview concerned researchers and government officers

Further, as the study involved incorporating the needs and concerns of the small-scale hilsa fishers, the next important item in line was

- To examine the studies on the artisanal hilsa fishers in West Bengal.

This was followed by

- Focused group discussions (FGD) of the fishers, and

- A survey of their demographic and socio-economic and some elements of their notions and information-set deemed relevant to the study.

The survey involved 103 hilsa fishers selected through convenience sampling and spread over 5 districts.

FGD and Survey: Details and outline of method

Five focussed group discussions (FGD) were conducted across 3 districts, as follows:

At Diamond Harbour, South 24 Parganas District, on 12 September 2018
At Kanthi (Contai), Purba Medinipur District, on 25 September 2018
At Godakhali, South 24 Parganas District, on 26 September 2018
At Nakol, Shyampur II Block, Howrah District, on 12 November 2018
At Jagannathpur, near Uluberia, Howrah District on 06 July 2019

No FGDs could be organized in Murshidabad and Nadia—the two other districts where surveys were conducted.

The surveys were conducted across 5 key hilsa fishing districts of West Bengal—out of the 10 (counting Kolkata) districts touched and blessed by the Bhagirathi-Hooghly. The surveyed districts are Murshidabad, Nadia, Howrah, South 24 Parganas, and Purba Medinipur.

The purpose of the survey and the logic behind it, which dictated the scope and method of the survey, was as follows:

- To learn about the nature and conditions of traditional small-scale hilsa fishers and learn about their experiences and opinions
- Since, getting to interview fishers in all districts contiguous to the Bhagirathi-Hooghly was not feasible given the general scope and resources of the project, it was decided to undertake the survey in 5 out of the 10 districts—which was understood to be a fair spread; moreover, within the Bhagirathi-Hooghly area, regional spread was ensured through getting 35 fishers from the relatively upstream districts of Murshidabad and Nadia, with 15 out of 20 respondents from the Indian Padma. It is true that these Padma fishers are not directly affected by the sanctuary declaration in the notification, as we shall see. However, they came under the other restrictive aspects of the notification and, in any case, were an important hilsa fishing community.

- Four survey-takers, each with considerable fishing experience, were selected from the fishing community. They were carefully advised and guided in the beginning and at various junctures during the survey.
- The questionnaires were fairly long and detailed and answers needed to be crosschecked against one another, resulting in a long engagement with the respondents. Therefore, random sampling was not an option as there was no way of ensuring that the randomly selected unknown respondent would agree to engage with the survey-taker (in fact, the chances of refusal or reluctance were higher than the chances of acquiescence). Therefore, only two options were available: either conduct the survey only among friends, relatives, and familiar respondents or take the path of convenience sampling (once the location was chosen based on initial decisions and following the chain of acquaintance) and speak to those who were willing to speak. It goes without saying that in order to avoid the problems of *reach* inherent in the first, the second option, or convenience sampling, was done. Hence, the sample in this study does not have the representative worth of a random or probability sample but it is certainly not definitively biased or loaded, but is rather determined by the contact chains and convenience on the one hand and the luck of the draw on the other.
- It is possible that the non-random character of the survey affected the representative character of the results to a degree and perhaps randomness would have produced somewhat different figures. However, given that there was no definitive bias or purpose involved, there is a fair chance that the sample generated is not too far from being representative. This appears to be borne out by the overall character of the sample demography—e.g. the low literacy rates and high incidence of scheduled caste representatives agrees with the findings of earlier studies.

Presentation of the findings

The findings have been presented as a fairly simple narrative, the flow of which should be apparent from the Contents page. However, three elements need mentioning.

First, there is no ‘literature review’ section separated out from the general narrative. Rather, reference to studies and their findings have come up in response to

the needs of the narrative and argument and, where necessary, such findings have been not merely utilized but compared with each other or commented upon.

Secondly, the information derived from the interviews and FGDs have also been reported in course of the narrative. However, in the case of the FGDs (but not in the case of interviews), the basic information derived has also been reported in a separate chapter.

Thirdly, the information derived through the surveys, which pertains entirely to the artisanal fishing community, their practices, and their awareness of certain things, have been reported separately in two chapters. However, an occasional reference to such information has also been made in the course of the narrative.

Chapter 1: The hilsa phenomenon

Tale of Decline

During the last ten years or so, the hilsa has grown to be a topic commanding both media and academic attention. The overarching theme has been the drastic decline in hilsa yield in India. However, when one speaks of India in this connection, it must be borne in mind that the main concern has been the hilsa yield in West Bengal. For, today, so far as India is concerned, it is West Bengal that dominates hilsa production in India. For example, the latest data on marine hilsa landings in India that we have from the CMFRI is as follows:

Total marine hilsa landings in India = 20, 180 tonnes
Total marine hilsa landings in West Bengal = 13, 510 tonnes[1]

This shows the predominance of West Bengal (67% of the total Indian yield). This is the marine yield, but roughly the same proportion applies to the total yield as the marine yield constitutes the overwhelming share of the total yield and, in any case, the production of the freshwater and estuarine catch in the Bhagirathi-Hooghly is by far the highest among the freshwater catches in India.

Hilsa yields are declining everywhere in India, including West Bengal. Parallel tales of decline had come from Bangladesh some time ago. Of course, the catch in Bangladesh is several times higher than in West Bengal, so, even the reduced catch was higher than the maximum for that period in West Bengal. But, all this we will get to see in due course.

A word of caution might be in season. In this study, we shall inspect quite a lot of data on Hilsa yield. We shall see, the yield figures for West Bengal *are far from being chiselled in stone* and are often questioned within the establishment itself. But, irrespective of the quality of the figures, the crisis of hilsa yield is undeniable. If nothing else, it is testified by the living experience of the fishing community dependent on hilsa fishing.

[1] *Marine Fish Landings in India* 2018, ICAR-CMFRI, Kochi, 2019.

Iconic

Both media and academic reports making resounding noises about the decline in hilsa catch tend to begin with the cultural, and indeed iconic, significance of the hilsa in Bengali society, east and west. Indeed, the Bengal area has always had a love affair with hilsa. Down history, hilsa has been the darling of most of East Bengal cuisine. However, even for most fish lovers in West Bengal, it was an item of culinary admiration, often bordering on worship. Thus, the drastic decline in riparian catch, resulting in non-availability and forbidding prices, became an item of angst.

Livelihood

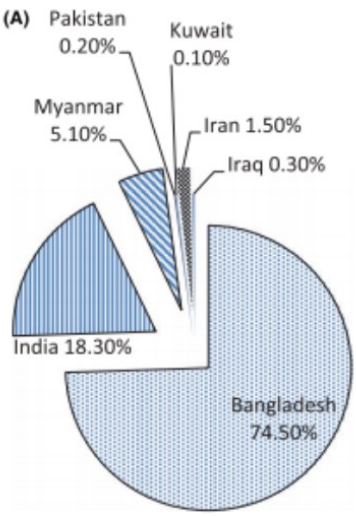
But, a far greater tragedy occurred as the livelihood of hundreds of thousands faced peril. For the decline in hilsa catch, paralleled by decline in catch of other fish in rivers and the coastal waters, has resulted in impoverishment and loss of livelihood for hundreds of thousands of people dependent on fishing for their livelihood. Many of the traditional riparian fishers in Bengal were from the Malo caste, which tended to depend entirely on fishing for their livelihood. In addition, there were Jele (or Jeliya) Kaibarta and Rajbanshi castes and some other 'low' castes.

During the last two and a half decades, in the districts through which the Bhagirathi-Hooghly flows, uncountable numbers of hilsa fishers have lost livelihoods. This is testified by persons who have had the privilege of observing hilsa fishing from an intimate range.[2] Interestingly, the loss of livelihood is not confined to the aforementioned districts. For example, in the 1940s and 50s, some of the most daring and enterprising fishers came from the Basirhat area, adjoining the West Bengal Sundarbans, a community captured memorably in Samaresh Basu's famous novel, the *Ganga*.

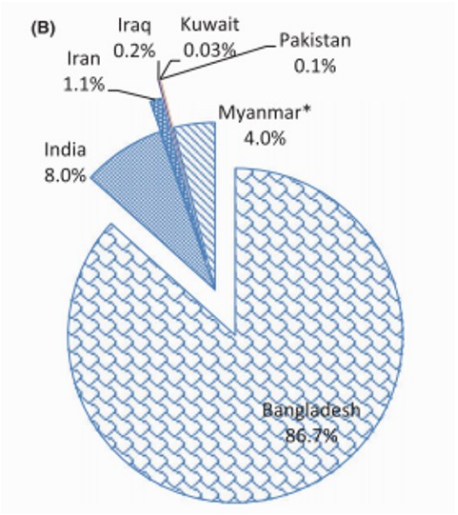
Bangladesh

This is the point where one is compelled to remember Bangladesh. This is because Bangladesh, in more ways than one, is the country of the hilsa. Indeed, if one chooses to be parochial, it would be no great exaggeration to say that hilsa is a largely Bengali fish and a predominantly Bangladeshi one. The pie charts below will indicate why.

[2] Interview of Mr Bablu Ghosh on 3 January 2020 and Prof Ashim Kumar Nath on 3 January 2020 and 16 March 2020.



Average share of global production during 1984-2013[3]



Average share of global production during 2010-2015

As we can see, Bangladesh has enjoyed the status of being far in advance of other hilsa producing countries for quite some time and, as per the most recent reliable statistics, produces 86.7% of the world's hilsa. India is the second largest producer, but is way behind Bangladesh. Moreover, in India, it is the Bhagirathi-Hooghly system (freshwater, estuarine, and coastal waters) that produces the lion's share of the hilsa catch. But, the Bhagirathi-Hooghly system is a part of the Ganga-Brahmaputra-Meghna system. In fact, rather than describing hilsa in terms of Bengali and Bangladeshi, it would perhaps be more appropriate to say that hilsa is largely, even predominantly, a fish belonging to the Ganga-Brahmaputra-Meghna system, most of which happens to be inhabited by a people speaking Bengali who have given hilsa an important place in their cuisine. Moreover, in the chequered history of this subcontinent, it transpired that the Bengalis were divided among two countries, one of which is the sovereign nation of Bangladesh and the other is state of West Bengal. And Bangladesh, possessing as it does the greater part of the Ganga-Brahmaputra-Meghna system, is also the enjoyer of the largest natural supply of hilsa. But, from the late 1990s, even this large supply of hilsa in Bangladesh was struck by a huge decline in their yields.

[3] Mohammad Jalilur Rahman *et al.* "Catch Trend and Stock Assessment of Hilsa *Tenualosa ilisha* using Digital Image Measured Length-Frequency Data," *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science* 10, no. 4, 390, https://doi.org/10.1002/mcf2.10034.

Conservation measures

Not only does Bangladesh produce the most hilsa in the world, the fish happens to dominate their fishing industry and is an important item in their export. So, when the hilsa decline hit Bangladesh, the entire economy was hurt. This resulted in a spate of measures to conserve the species, beginning in 2003-4.

Something similar happened in West Bengal, though much belatedly and with much less zest. In the early 2000s, the hilsa catch starting declining rapidly. By 2011, it was clear that the production was suffering on a permanent basis. Environmentalists, environmentally aware scientists, and fisheries experts started writing and commenting.

The IUCN enters the scene

By 2010, however, another player had joined the game. This was the IUCN. Sometime before 2010, the IUCN, in consultation with researchers in both India and Bangladesh, conceived a new project—The *Ecosystems for Life (E4L)*: *A Bangladesh–India Initiative (Dialogue for Sustainable Management of Trans-boundary Water Regimes in South Asia)*. The declared goal was to try and develop a "neutral platform among key elements of civil society" for discussing the management of the Ganga, Brahmaputra, and Meghna rivers shared by both countries. The Ecosystems for Life Project commenced in 2010, and received its entire USD 6.4 million budget from The Minister for Development Cooperation of the Netherlands. The project was scheduled initially to run from 1 February 2010 up to 31 July 2014; subsequently, however, it was extended up to 31 December 2014. Through IUCN-facilitated collaborative deliberations, the Project Advisory Committee chose to focus on five major thematic areas: food security, water productivity and poverty; impacts of climate change; environmental security; trans-boundary inland navigation; and biodiversity conservation.[4] The scope of the last-mentioned item, *biodiversity conservation*, was defined as follows: "Addressing conservation needs of indicator species such as hilsa, the Gangetic Dolphin and other riverine biodiversity".[5] The above scope and concomitant funds were utilized by concerned fisheries experts in India and Bangladesh to kick-start a research initiative on hilsa. (As to what happened with

[4] Randal Glaholt, Julian Gonsalves, and Donald Macintosh, *Ecosystems for Life: A Bangladesh–India Initiative*: *External Review Report*, Submitted to IUCN, August 2014, 6.

[5] Glaholt *et al.*, *Ecosystems for Life: External Review Report*, 10.

regard to dolphins and other riverine biodiversity is not exactly clear; but, that is an issue with which we are not directly concerned in this study.)

The project laid great emphasis on the conducting of joint research studies. First, appropriate institutions and individuals were identified in both India and Bangladesh in creating Joint Research Teams (JRTs). Next, the members of the JRT met to develop common methodologies before undertaking research in their respective countries.

The field studies were conducted in 2011 and, at least as far as India was concerned, the results were out as paper publications in 2012.[6] Indeed the recommendations, at least in their essentials, appear to have been made ready by 2012. As the *IUCN in Asia: 2012* report informs us,

> In 2012 IUCN facilitated the International Trans-boundary Policy Dialogue on hilsa Fisheries Management between Bangladesh and India under the 'Ecosystems for Life: A Bangladesh India Initiative'. The dialogue was based on an extensive set of policy recommendations to conserve the hilsa fisheries. The meeting saw broad agreement on the recommendations, which were subsequently included in a draft plan of action that was submitted to the governments in both countries for consideration and adoption. The plan includes an annual ban on hilsa fishing during the same period of the year in both countries to protect the juvenile and brood fish.[7]

Further, the press release informs us of the final session of the trans-boundary dialogue occurred on 24 July 2012, where the final recommendations and draft action plan on hilsa were presented. As the communiqué reads:

> After a day of inspiring and engaging discussions, the International Trans-boundary Policy Dialogue on hilsa Fisheries Management between Bangladesh and India successfully concluded an elaborate set of policy recommendations to conserve the hilsa. The recommendations include the proposal for an annual ban on hilsa.

[6] For India, see for example, Utpal Bhaumik and AP Sharma, "Present Status of Hilsa in Hooghly-Bhagirathi River," *Bulletin No. 179*, CIFRI, 2012

[7] *IUCN in Asia*: 2012, https://www.iucn.org/sites/dev/files/import/downloads/iucn_asia_profile_2012__2_.pdf, 11.

> ...A recent study titled 'The importance of migratory and spawning patterns for the conservation of hilsa in Bangladesh and India' was presented at the dialogue which highlighted a set of recommendations to conserve the hilsa fisheries. Funded by the Ecosystems for Life, the research was conducted by a trans-boundary joint research team following an agreed common methodology that focused on the migration route of hilsa with emphasis on the Ganges river system...
>
> The joint research suggested that during March-May most of the juveniles (80-150mm) start downstream migration. In Bangladesh there is a restriction on the use of bag and scoop nets for catching hilsa below 230mm. Implementation of a similar policy in India during these months would facilitate juveniles' migration to the sea and assist in reaching the original stock levels.
>
> Another recommendation is that river dredging is needed at appropriate points along the Padma-Meghna and Hooghly-Bhagirathi river systems to maintain proper a water flow to ensure hilsa migration.[8]

It might be mentioned in this context that the Regional Fisheries Management Advisory Committee (RFMAC) of the BOBLME[9] had also come up with its own management advisory on hilsa by June 2012. It said:

> 1. Reduce the numbers of fishing vessels targeting hilsa to increase stock numbers.
>
> 2. Protect spawning and nursery areas to rebuild the stock by introducing seasonal closures and hilsa sanctuaries.
>
> 3. Reduce the catches of juvenile hilsa by introducing regulations to make 110 mm mesh nets the legal minimum mesh size to be used by hilsa fishers.
>
> 4. Increase compliance with hilsa fishery regulations through awareness programmes and strengthening monitoring and enforcement capacity.

[8] *IUCN Trans-boundary Policy Dialogue Recommends Joint Action by Bangladesh and India for Sustainable hilsa Fisheries Management*, 25 July 2012, https://www.iucn.org/content/iucn-trans-boundary-policy-dialogue-recommends-joint-action-bangladesh-and-india-sustainable#:~:text=IUCN%20Trans%2Dboundary%20Policy%20Dialogue%20Recommends%20Joint%20Action%20by%20Bangladesh,for%20Sustainable%20hilsa%20Fisheries%20Management&text=The%20recommendations%20include%20the%20proposal,the%20juvenile%20and%20brood%20fish.).

[9] Bay of Bengal Large Marine Ecosystem Project.

5. Establish dialogue and collaboration with the water management and land use authorities to create a better understanding of fisheries requirements and increase the amount of riverine habitat, water flow and improve water quality.

6. Establish in-country multi-agency committees to monitor the implementation of the national hilsa management plans.[10]

It might also be mentioned that the RFMAC included members not only from all the member countries (including India) but also the IUCN.

It is these international-level and expert-backed recommendations that appear to have been important in influencing the Indian authorities in particular to take action (Bangladesh had already begun taking action several years back, as we will see; these recommendations perhaps only contributed to accentuating and defining hilsa policy in Bangladesh).

We need to mention something here. The output of the joint research on hilsa under the IUCN initiative, although its findings were drawn upon by 2012, appears to have received a finalized published form in 2014.[11] It is a rich source of information, which we shall be making use of in this study.

Was there any real consultation with small scale fishers?

Here, we must mention one thing of great significance.

The E4L, under which the joint research studies in Bangladesh and India were conducted, repeatedly mentioned the need for involving all stakeholders in developing understanding and policy decisions regarding the problems involved. Reportedly, the stated objectives of the E4L had read:

1. To develop a multi-stakeholder forum, through which civil society groups can engage in constructive and informed dialogue under the Track III approach for managing trans-boundary water regimes.

[10] *Management Advisory for the Bay of Bengal Hilsa Fishery*, Regional Fisheries Management Advisory Committee, June 2012, http://www.boblme.org/BOBLME-2012-Leaflet-RFMAC_Advisory-hilsa/files/assets/basic-html/page1.html.

[11] Dewan Ali Ahsan, M Niamul Nasser, Utpal Bhaumik, Sugata Hazra, and Subhra Bikash Bhattacharya, *Migration, Spawning Patterns and Conservation of hilsa Shad (Tenualosa ilisha) in Bangladesh and India*, (Ecosystems for Life: A Bangladesh-India Initiative production), IUCN and Academic Foundation, New Delhi, 2014.

2. To develop a comprehensive knowledge base on integrated Water Resources Management (IWRM) issues in the management of trans-boundary water regimes involving scientists, research institutes, universities and civil society organizations in the region.

3. To develop capacities and foster mutual learning between civil society organizations and act as bridge between similar processes in the region for enhancing participation in multi-stakeholder dialogue processes and for better management trans-boundary water resources in the region.[12]

Moreover, according to the project review submitted in 2014, from which we have just quoted, stakeholders were apparently repeatedly consulted and several stakeholder consultations were undertaken.[13] Now, so far as India is concerned, which, in this case, means West Bengal, representatives of artisanal or small-scale fishers were not consulted. Leading representatives of two organizations, both working specifically with small-scale fishers, one at the national and another at the state level (West Bengal), the National Fishworkers Forum and the Dakshinbanga Matsyajibi Forum respectively, denied any knowledge of any consultation with small-scale fishers conducted by the government or by any large-scale hilsa conservation initiative at any time between 2010 and 2014.[14]

The West Bengal Government acts

Anyway, in the case of West Bengal, the Fisheries Department took legal and administrative action by issuing notification and order on hilsa conservation in 2013, as briefly mentioned in the introduction. Of course, the measures already taken in Bangladesh possibly also provided guidance and inspiration. Unlike Bangladesh, however, the effort to implement the measures was only half-hearted. But, we can say no more here without running ahead of the narrative.

So, we shall tell the tale as planned and begin by taking a closer look at the fish that is the source of the furore.

[12] Glaholt *et al.*, *Ecosystems for Life: External Review Report*, 6.
[13] Glaholt *et al.*, *External Review Report*, 6, 8, 10, 18, 19, 28, 78.
[14] Interview of Mr Pradip Chatterjee and Mr Milan Das on 27 December 2019.

Chapter 2: The species in question

To be very specific, we are discussing the fish that is known in eastern India as the *Ilish machh*. It might be worthwhile to stick to the name *Ilish* for a while. We shall soon see why this is so.

First scientific identification and naming of Ilish

Ilish was known to Asian cultures for ages and it is quite possible that it has found mention or even description in texts dealing with systematic knowledge such as the *Ayurveda* and *Yunani*.[15] Hence, the question of the *first* naming and identification would be a tricky one.

However, here we are talking of 'scientific naming and identification' and the term 'scientific' is being used here in the fairly narrow sense of the Linnaean system of species identification and naming that developed in Europe in the 18th century and, in its essentials, evolved into what is considered the scientific paradigm of species identification and nomenclature. Shakespeare notwithstanding, scientific scholars attach a lot of significance to names and, though one would love to poke fun at the earnestness of nomenclature disputes, researchers will argue that these are not mere pedantic issues, for the name is meant to provide a clue to biological kinship and, thereby, the actual genetic affinity of a species.

Possibly the first scientific description and identification of Ilish was by Patrick Russell, reportedly in 1803. He noticed the fish at Vizagapatnam and referred to it by its local Telugu name, 'Palasah', and made the identification with the fish found in Bengal and known to the English in Bengal as the 'Sable Fish' (which, as Francis Hamilton notes in his famous work, is none other than the *Ilisha* or *Ilish*).[16] Russell

[15] For example, one finds the characteristics of hilsa as food in the following book, *Handbook on Unani Medicines with Formulae, Processes, Uses and Analysis*, Asia Pacific Business Press Inc. (New Delhi: 2003), 126.

[16] Patrick Russell, *Descriptions and Figures of Two Hundred Fishes; collected at Vizagapatam on the Coast of Coromandel*, G & W Nicol, Pall Mall, London, 1803, 77-78. As indicated in the main text above, Hamilton himself drew attention to Russell's identification in his book: Francis Hamilton, *An Account of the Fishes of the River Ganges and its Branches* (Edinburgh: Archibald Constable and Company, 1822), 243-44. However, Hamilton, after careful examination of Russell's description of the species in question, was slightly doubtful whether the said gentleman had been correct in his identification and whether he might not have mistaken it for another fish. Subsequent to Hamilton, however, everyone agreed to accept Russell's identification and give him credit for the first scientific identification of the fish. See, for example, Peter J.P. Whitehead, *Clupeoid fishes of the world (suborder*

provides a description of the fish and classifies it under the genus *Clupea*, though he desists from offering a species name.

Scholars seem to agree that the first methodical description and successful scientific naming of the fish under the Linnean system was done by the aforementioned Francis Hamilton in 1822. He observed the fish in the Ganga (Ganges) and its branches and called it *Clupanodon ilisha*. His description is of historical interest. I quote it exactly and in full because of its acuity and liveliness and because many zoologists, even fisheries experts in Bengal, may not have read it.

> Except in wanting teeth, the *Ilisha* has the most strong resemblance to the Shad, {*Clupea alosa*,) and there is reason to suspect that the Indian and Latin names may be radically the same. The *Ilisha* frequents the bay of Bengal and the large salt water estuaries of the Ganges, and in the rainy season ascends the larger rivers to spawn. I have seen it as high as Agra and Kanpur, but so high up it is very rare. At Patna on the Ganges, and Goyalpara on the Brahmaputra, it is pretty common, but rather poor and exhausted. About Calcutta and Dhaka it is in the utmost abundance and perfection, and is the richest and highest-flavoured fish that I know, having a taste of both the salmon and herring; but, owing to innumerable small bones, it is difficult to eat, and it is heavy of digestion. Its common size is about a foot and a half in length, but it is occasionally twice that dimension.[17]

It may be noted that Hamilton refers to the fish as *Ilisha*, taking cue from the Bengali word *Ilish*. Nowhere in the passage, nor indeed in the book, does he use the term *hilsa*, which was more popular in Hindi and which established itself in academic literature only in the twentieth century. However, the term 'ilisha' was to make a comeback in scientific nomenclature, as we shall see.

Fish lovers will also be intrigued by the dimensions of Ilish that are mentioned. A foot and half Ilish, described by Hamilton as being of common size, would be highly valued in the Indian market today and anything exceeding the size would be considered a prize specimen, and its double is nowadays mostly in the realms of 'heard' and 'read'.

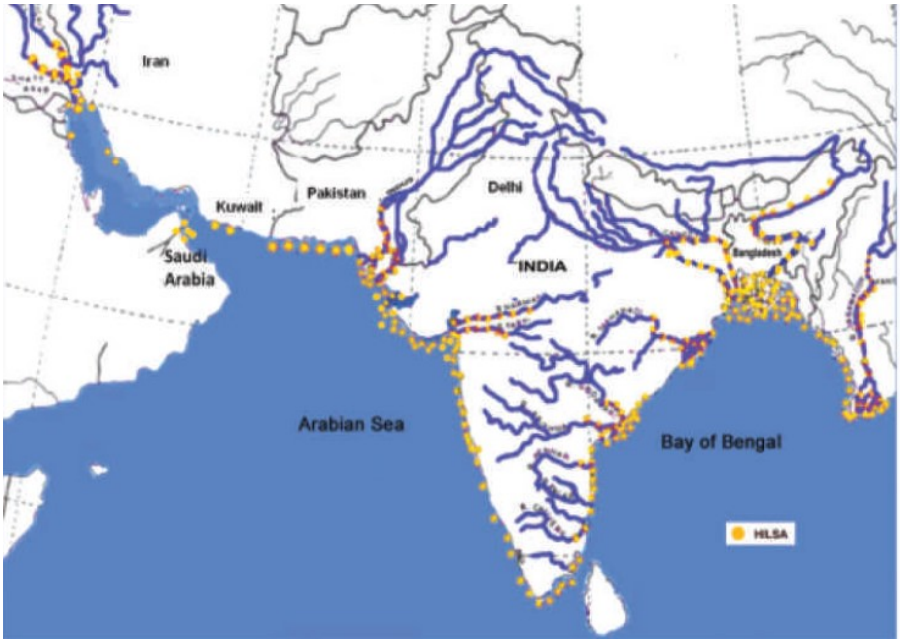
Clupeoidei): an annotated and illustrated catalogue of the herrings, sardines, pilchards, sprats, shads, anchovies, and wolfherrings, UNDP-FAO, Rome, 1985, 222. Incidentally, not too many scholars after the nineteenth century seem to have studied Russell's book.

[17] Hamilton, *An Account of the Fishes*, 244.

The Geography of Ilish

It is no accident that the first scientific description and identification (by Russell) of Ilish occurred in South India and Hamilton, responsible for the first scientific nomenclature of the fish, observed it on the Ganga. For, the fish is most commonly found in the coastal waters and rivers of India and Bangladesh. However, the Ilish is not entirely parochial. It is also found in the coastal waters and rivers of Myanmar, Indonesia, Sumatra, Pakistan, Kuwait, Iraq, and Iran and forms the basis for important commercial fisheries in Bangladesh, India, Myanmar, Pakistan, and Kuwait. But, it is by far the most abundant in the Ganga-Brahmaputra-Meghna drainage systems of India and Bangladesh.[18]

The following map shows the occurrence of Ilish in Asia.



Distribution of hilsa in the Indo-Pacific Region[19]

The Nomenclature of Ilish

'Ilisha', the term first used in a scientific nomenclature by Hamilton 1822, has made a comeback in recent times. However, the full designation is somewhat different than Hamilton's. As we know, in the Linnaean system of nomenclature or naming, a species is described using two names—the first name beginning to the genus and second to the

[18] VR Suresh, AM Sajina, S Dasgupta, D De, DN Chattopadhyay, BK Behera, Ritesh Ranjan, Vindya Mohindra, S Bhattacharya, *Current Status of Knowledge on hilsa*, ICAR-CIFRI, Kolkata, 2017, 2.

[19] Suresh *et al.*, *Current Status of Knowledge on Hilsa*, 2.

species, with the genus name beginning with an upper case letter and the species name indicated by only lower case letters. According to the most accepted scientific nomenclature today, what we describe as *Ilisha* (or hilsa) belongs to the genus *Tenualosa*.[20] Hence, its name in the Linnaean system today is *Tenualosa ilisha* or *T. ilisha* and not *Clupanodon ilisha*, as Hamilton designated it, by putting the fish under the genus *Clupanodon*. Unfortunately, the genus Clupanodon seems to have suffered a bad career, for its only species (*Clupanodon thrissa*) is supposed to have been identified as a species and named as early as 1758,[21] and as these lines are being written, this species continues to be only species in the genus. But, we must go back to our Ilish.

On further inquiry, we learn that the genus *Tenualosa* belongs to the subfamily Dorosomatinae (often popularly known as 'shads'), and this subfamily in turn belongs to the family Clupeidae.[22] We might be further interested to know that the Clupeidae is a family of ray-finned fishes, which includes shads, herrings, sardines, and menhadens.[23]

Summarizing the above paragraph in layperson's terms, we can say that the Ilish or hilsa is a shad fish and its not too distant relatives are herrings and sardines. Further, its scientific name is *Tenualosa Ilisha* (*T. Ilisha*). However, notwithstanding the fact that nowadays it is more commonly viewed as belonging to the *Tenualosa* genus and not the *hilsa* genus, common English usage continues to refer to it as the *hilsa shad*.[24]

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[20] https://www.fishbase.se/summary/1596.

[21] Apparently by the great Linnaeus himself; see, *Clupanodon thrissa*, *WoRMS taxon details*, http://www.marinespecies.org/aphia.php?p=taxdetails&id=280223.

[22] *Fish Identification: Find Species*, https://www.fishbase.se/identification/SpeciesList.php?genus=Tenualosa.

[23] *Family Clupeidae - Herrings, shads, sardines, menhadens*, Fishbase, https://www.fishbase.se/summary/FamilySummary.php?ID=43.

[24] The scientific naming of the hilsa has quite a history. From Francis Hamilton, who first named the fish as *Clupanodon ilisha* in 1922, down to Munro, who called it *Tenualosa ilisha* in 1955, the fish was given different names by different authors, based largely on different identification of the genus. However, the majority of scholars in the nineteenth century followed Russell in preferring the genus *Clupea*. In 1917, however, Regan created the genus *Hilsa* to include hilsa-like clupeoids of the Indian Ocean region. For a long time, Regan's nomenclature *Hilsa ilisha*, held sway. However, subsequently, Munro's nomenclature received approval from Fisher and Bianchi in 1984 and later gained wide, if not universal, acceptance. For the nomenclature of hilsa subsequent to Hamilton, with authors and dates, see V.R. Suresh *et al.*, *Current Status of Knowledge on Hilsa*, 4. However, not everyone knowledgeable seems to agree with this nomenclature. The name *Hilsa ilisha* continued to be used up to the early twentieth century. See also a fairly recent article: Abdus Salam Bhuiyan, "Nomenclature of Bangladesh National Fish Hilsa," *BdFISH Feature*, http://en.bdfish.org/2010/09/nomenclature-bangladesh-national-fish-hilsa/. Here, the author argues that Ilish's genus is not *Tenualosa* but *Hilsa* and it should be called

It is also relevant here to note that four other species under the genus *Tenualosa* have been identified in the estuaries and coastal waters of tropical Asia. These are *T. toli* (*Tenualosa toli*) or Toli shad, *T. Marcura* (Longtail shad), *T. reevesii* (Reeve's shad), and the *T. thibadeaui* (Laotian shad).[25] Among these five species, *T. ilisha* is the most common in Indian waters. One also finds *T. toil* (Toli shad). This is commonly known in Bengal as *Chandani Ilish*, and even this has become rare these days. Another fish, similar in appearance to *T. ilisha*, though smaller, is also found in the Indian waters. It is *hilsa kelee* (Kelee shad), taxonomically first described by Cuvier in 1829.[26] It is possibly the only known extant species in the *hilsa* genus. However, so far as Indian waters are concerned, only the *T. ilisha*, (the famous Bengali *Ilish machh*) supports a significant commercial fishery, whereas *T. toli* and *hilsa kelee* have meagre presence.

Our study, of course, focused on the *T. ilisha*, although the government orders restricting hilsa also restrict the other shads referred to above, presumably because these have become rare and deserve conservation. In referring to *T. hilsa* hereafter, we shall use the scientific name only occasionally. We would have liked to refer to it as Ilish. However, for the last hundred years or so, the fish has been referred to in English as the hilsa or hilsa shad. Therefore, to avoid any possible misunderstanding of non-Bengali readers, we shall follow that convention. To reiterate, in what follows, the term *hilsa* or *hilsa shad* will denote *T. ilisha*.

Let us look at a few photographs of hilsa in the waters of Bengal.

The shad fishes common in Indian waters, particularly the Bay of Bengal

Hilsa ilisha.

[25] Suresh *et al.*, *Current Status.*

[26] Suresh *et al.*, *Current Status*; Utpal Bhaumik, "Decadal Studies on Hilsa and its Fishery in India - A Review," *Journal of Interacademicia* 17, no.2. (2013): 377-405; "Hilsa kelee," *Fishbase*, https://www.fishbase.se/summary/hilsa-kelee.

The three species commonly known as hilsa, A. *Tenualosa ilisha* (hilsa shad), B. *Tenualosa toli* and C. *hilsa kelee*[27]

hilsa caught on the Hooghly, just north of Ghoramara

[27] Bhaumik, *Decadal Studies.*

At a market in Ghoramara

At Godakhali—fish caught in the nearby river

Ilish

Manju Dolui from Sutahata with hilsa caught by her and her husband on 10 August 2019; 18 inches long and 1 kg 890 gm weight —an exceptionally large specimen in today's terms

Size

The length of newborn hilsa larvae is reported to be 2.3–3.1 mm. At 2 years of age, reported sizes and weights were 30–35 cm and 1–1.5 kg, with maximum length reported to be 65.6 cm. IUCN reports a maximum weight of hilsa female as 2.49 Kg.[28] Studies suggest that female hilsa grow faster than male.[29]

Anadromous

Anybody who knows anything of hilsa shad knows that it is an anadromous fish—i.e. it is born in freshwater, spends most of its life in the sea, returns to freshwater to spawn, and goes back to the sea once again.

Biology

The *fishbase* provides the following summary of hilsa biology:

> Schooling in coastal waters and ascending rivers for as much as 1200 km (usually 50-100 km). Migration though is sometimes restricted by barrages. Hilsa far up the Ganges and other large rivers seem to be permanent river populations. Feeds on plankton, mainly by filtering, but apparently also by grubbing on muddy bottoms. Breeds mainly in rivers during the southwest monsoon (also from January to February to March). Artificial propagation has been partially successful in India... Known to be a fast swimmer, covering 71 km in one day... Marketed fresh or dried-salted.[30]

Life cycle and mating behaviour

The *fishbase* has the following summary:

> Breeds mainly in rivers, upstream to about 50 km or even over 1000 km as in the Ganges (younger fishes may breed in the tidal zone of rivers). In some rivers the migration is restricted by barrages; there is some evidence that hilsa far up the Ganges and other large rivers, although migrating upstream to spawn, are permanent river populations that do not descend to the sea. The main

[28] J Freyhof, "*Tenualosa ilisha*, Hilsa," *The IUCN Red List of Threatened Species*, IUCN, 2014, https://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T166442A1132697.en.

[29] M Shahadat Hossain *et al.* "Tropical hilsa shad (*Tenualosa ilisha*): Biology, fishery and management." *Fish and Fisheries* 20, no. 1 (September 2018): 44–65, https: //doi.org/10.1111/faf.12323.

[30] "*Tenualosa ilisha* (Hamilton, 1822) Hilsa shad," *Fishbase*, https://www.fishbase.se/summary/Tenualosa-ilisha.html.

breeding season is during the southwest monsoon, with a shorter season from January to February or March.[31]

Notice that both the references from fishbase, an international fish information data site, refer to India. This, once again, testifies to the close connection of the species with the Indian subcontinent. Indeed, the bulk of the hilsa research has been conducted in Bangladesh and India. We shall have to consider a little of that research in terms of hilsa migration behaviour, feeding habits, etc. in the next chapter.

[31] "*Tenualosa ilisha* (Hamilton, 1822)."

Chapter 3: Hilsa in the Bhagirathi-Hooghly system

The focus of this study is not hilsa shad per se, but hilsa *in the Bhagirathi-Hooghly system*. Pursuing that focus, however, would call for repeated reference to the Padma-Brahmaputra-Meghna system in Bangladesh. That, in turn, calls for understanding the nature of the Ganga-Brahmaputra-Meghna system as a whole.

Ganga is the most important river system in India and one of the largest in the world. In the course of its run from the upper Himalayas to the Bay of Bengal, the river goes through different phases and ends its journey after passing through a hugely fanned out delta, large tracts of which are covered by mangrove swamps. Many tributaries join the Ganga on its journey to the sea.

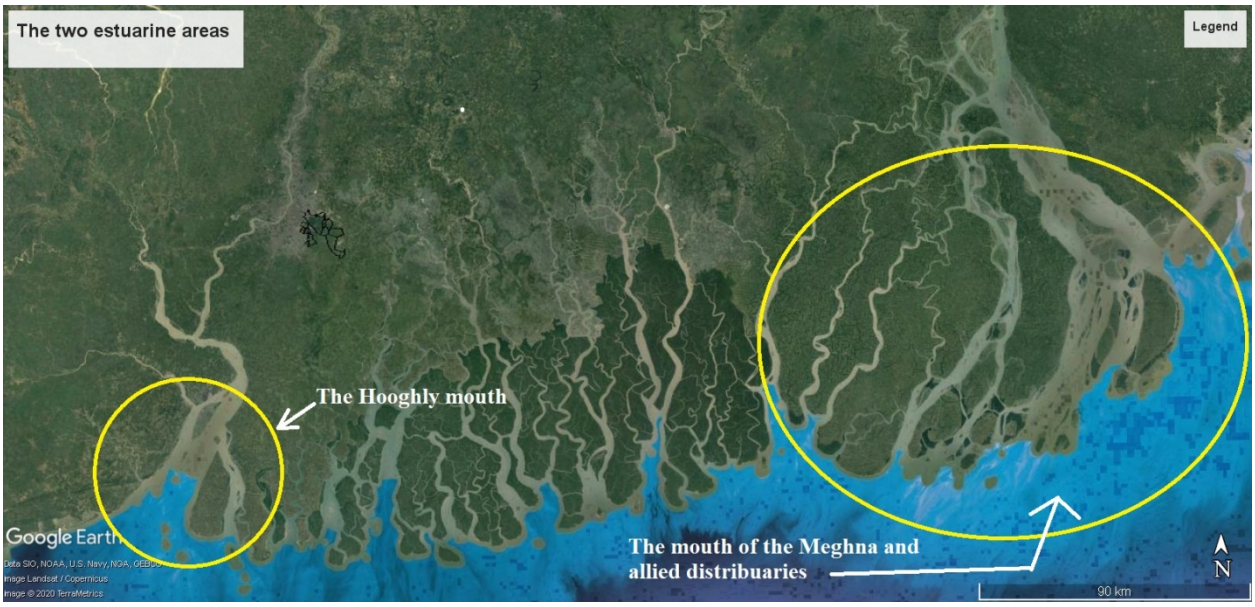
The River Yamuna is the most important tributary and meets the Ganga on its right bank at Allahabad. From Allahabad, the river Ganga flows eastwards. Having entered West Bengal, the main channel of the river flows in a south-easterly direction as the river Padma and enters Bangladesh. Here, near Goalanda in the Dhaka division, it meets the Brahmaputra River—another mighty river that crosses into Bangladesh through its northern border from Assam and takes on the name 'Jamuna'. The combined stream of Padma-Jamuna (Brahmaputra) is met by the Meghna River near Chandpur Sadar. Hereafter, the combined stream is known as the Lower Meghna, which finally breaks up into a number of distributaries leading to the Bay of Bengal.

Whereas the main channel of the Ganga branches off to the south-east as the Padma, the lesser channel courses southwards through West Bengal. It is known as the Bhagirathi, or, more appropriately, Bhagirathi-Hooghly (Hooghly being the stretch of the river after the Jalangi meets it at Nabadwip). During the last five centuries, this channel had weakened, converting it into the lesser, actually much lesser, channel, and large tracts had dried up. The Bhagirathi was properly revived only after the Farakka barrage was built in 1975 and a feeder canal was constructed immediately upstream of the main barrage to draw a portion of water from the Ganga and feed the Bhagirathi at a point near Jangipur, about 41 km downstream from Farakka.

Thereafter, the Bhagirathi courses along for about 150 km (124 km as the bird flies) and having received the waters of the Jalangi River near Nabadwip, becomes the

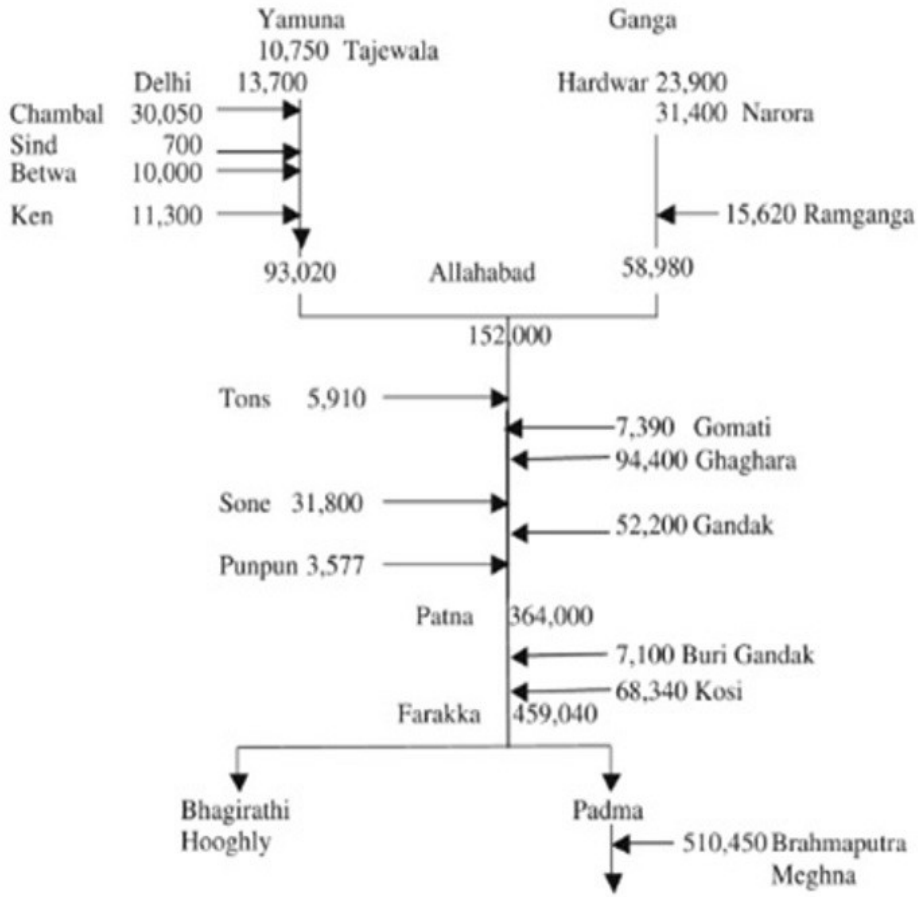
Hooghly. The Hooghly, which from Nabadwip onwards comes under tidal influence, flows along through Kolkata and having received water from its tributaries (the most important of which are the Rupnarayan and the Haldi), finally reaches the Bay of Bengal. The total length of the river from Farakka to the Bay of Bengal at Sagar is about 560 km.[32]

As might be suggested by the description above, the Padma-Meghna or Lower Meghna estuary is a much more powerful hydrological agent than the Bhagirathi-Hooghly estuary. If we compare the two estuaries on Google Earth, this becomes immediately apparent, though perhaps only superficially.



The superficial impression, however, is confirmed when we look at actual hydrological estimates. The average annual discharge of the Ganga, the Brahmaputra and the Meghna rivers are 16,650 m^3/s, 19,820 m^3/s, and 5,100 m^3/s, respectively.[33] We know that the Ganga River divides into the Bhagirathi and the Padma. Now, even if we assume that thanks to the Farakka barrage, the Bhagirathi is able to acquire half of the Ganga water, even then, and notwithstanding the flows of the Rupanarayan and Haldi into the Hooghly near the river mouth, the Brahmaputra and Meghna inputs make the Lower Meghna Estuary hydrologically far more potent than the Hooghly estuary. This is also suggested by the following line diagram.[34]

[32] See, e.g., "Inland Navigation," *Gangakosh: Overview*, http://117.252.14.242/Gangakosh/ganga.htm.
[33] Sharad K. Jain *et al.*, *Hydrology and Water Resources of India*, Springer, Dordrecht, 2007, 340.
[34] Jain *et al.*, *Hydrology*, 341.



Line diagram of Ganga and its major tributaries. Numbers are average annual flows (MCM)

Note that in the above, there is no figure for annually discharge for the River Bhagirathi.[35] This is simply because the numbers are not available—at least they do not appear to be available in the expected sources.

The following map will also be of interest.

[35] *Hydrology and Water Resources of India*, 341.

Freshwater habitats of hilsa shad in the Ganga-Brahmaputra-Meghna drainage systems of India and Bangladesh[36]

It is the much larger volume of freshwater of the Lower Meghna estuary and its much wider mouths that possibly accounts for the far larger numbers of hilsa that are attracted into it, as compared to the Hooghly. We shall have more to say about this later.

The above map shows the Ganga up to Allahabad in the north and west. However, as regards the present geography of the hilsa, *this extension to the north and west is largely academic*. The hilsa effectively *ceased to exist as* viably fish-able stock north of the Farakka after the barrage on the Farakka was completed in 1975.

Feeding behaviour, as observed in the Indian subcontinent

Over time, various researchers have studied the feeding habits of hilsa in its various stages of life cycle in different water systems. The outcomes of these studies are rather diverse and occasionally differ strikingly from each other.[37] Discounting the outside chance of error in finding, the mindboggling diversity that continues to prevail might simply be due to the fact that hilsa feeding varied according to age and maturity[38] (newly spawned, slightly older juvenile, more mature juvenile, still more mature fish,

[36] Taken from Bhaumik, "Decadal Studies on Hilsa," and slightly amended.

[37] For summaries of the study outcomes of hilsa's feeding habits, see Bhaumik, "Decadal Studies on Hilsa," 379 and Suresh *et al.*, *Current Status*, 19-21.

[38] 'Maturity' in this context usually means reproductive maturity and is usually measured by the Gonado-Somatic Index (GSI).

etc.), stage of life (pre-spawning, spawning, and post-spawning stage,) water system (e.g. particular river, estuarine stretch and upper river), food availability, and season (which, in turn, might involve water temperature, oxygen levels, etc.). Through all the huge variation in the hilsa feeding reports, the important features that seem to emerge is that compared to their body weight, the juveniles (called *jatkā* in Bangladesh) are more voracious feeders than more mature fish and that phytoplankton (prominently including diatoms [39]), algae, and copepods (very small crustaceans) in various proportions tended to constitute the overwhelming bulk of the food intake across age and habitat.[40] The following description from a study on hilsa in the Meghna seems to be largely consonant with most other findings:

> The study has provided an in-depth understanding of the food and feeding biology of hilsa at different age groups, with insights into selective feeding on different plankton using the electivity index. The yearlong study indicated that Bacillariophyceae (diatoms), Chlorophyceae (green algae) and crustaceans (Copepoda and Cladocera) formed the major food constituents in the guts of hilsa in all size groups, with a small amount of silt, debris and unknown particles in negligible quantities. It also indicated that both Chlorophyceae and Bacillariophyceae dominated in general; however, zooplankton (mainly crustacean) dominated in the early age groups. Bacillariophyceae (diatoms) from among the phytoplankton was the most preferred hilsa food group, especially at the early stages of its life cycle, and their neutral response to Chlorophyceae changed to positive when they reached maturity. The hilsa's preferred food items in the form of phytoplankton and zooplankton were available in the environments of the hilsa fishery areas, especially in the sanctuary areas, throughout the year. It was also observed that natural food availability was greatest from January to April...[41]

Breeding migration in the Bhagirathi- Hooghly system

The following information emerges from studies[42]:

[39] Unicellular algae with transparent cell walls made of silica.

[40] Utpal Bhaumik, *Decadal Studies*, 379 and V.R. Suresh *et al.*, *Current Status*, 19-21.

[41] Kaisir Mohammad Moinul Hasan *et al.*, *Food and feeding ecology of Hilsa (Tenualosa ilisha) in Bangladesh's Meghna River basin*, Working Paper, IIED, London, 2016, 15.

[42] The material in this section has been largely taken (though far from wholly) from Ahsan, *et al.*,

1. **Anadromous**: Because the hilsa shad is mostly anadromous in nature, it is capable of withstanding a wide range of salinity and migrating long distance from marine habitat to up-stream freshwater. The hilsa lives in the sea and coastal waters for most of its life but migrates to inland freshwater through rivers in Indian sub-continent for spawning.
2. **Usual habitation-seasonal migration**: In the Hooghly-Bhagirathi system, the hilsa normally inhabits the lower region of estuaries and foreshore areas of the sea. It prefers to reside in this region due to presence of sub-surface oxygen, relatively low salinity, strong tidal action, high turbidity, heavy siltation, and abundant plankton. It migrates into the freshwater environment of the river system for breeding followed by nourishment of young ones. The upstream migration of winter spawners and the downstream migration of the *spent* summer spawners are likely to intermingle at various points in one or other environment.
3. **Strong swimmers**: The hilsa are strong swimmers and can cover 61.2 to 70.8 km in one day.[43]
4. **Maturity**: By 'maturity' of hilsa, in the context of this discussion, one understands reproductive maturity, and this is usually measured by the Gonado-Somatic Index (GSI). Over decades, fisheries researchers and experts had studied the maturity of hilsa of varying lengths (and of correspondingly varying ages) and found that both female and male hilsa tended to acquire reproductive maturity after acquiring a particular length. Studies seem to indicate that this "minimum necessary" length varies across water areas (e.g. across Hooghly, Chilika, Mahanadi, and Ganga near Allahabad). Interestingly, we seem to have data from Hooghly (going back to 1958) suggesting female maturity at 190-200 mm length and male maturity at 160-170 mm length. Another set of data from Chilika (from 1972) seems to suggest female maturity at 186 mm and male maturity at 172 mm. However, it is also clear from the data across water bodies

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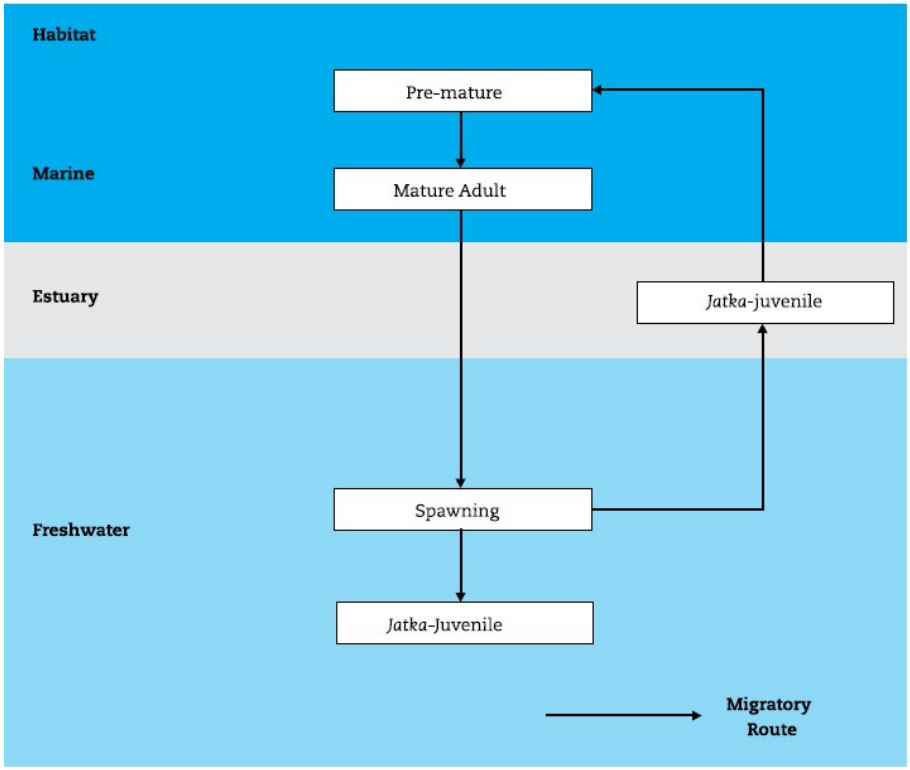
Migration, Spawning Patterns and Conservation of hilsa Shad, 2014; V.R. Suresh *et al.*, *Current Status*; and B. K. Das, *et al.*, *Exploratory survey on hilsa (Tenualosa ilisha) catch and life stages availability along up / down stream of Farakka Barrage*, Project report, NMCG-CIFRI, Barrackpore, Kolkata, 2017. Other sources used have been referred to in their appropriate places.

[43] V.R. Suresh *et al.*, *Current Status*, 36.

that the minimum for females is more commonly close to 300 mm and for males the minimum was commonly close to 250 mm.[44] It is also clear from the studies over decades that the growth (and, presumably, maturity) of the hilsa varies from one environment to another or in the same environment from year to year as a result of changes in food availability, density dependent growth factors, etc.



Migratory Pattern of hilsa[45]

5. **The major season and lesser season of migration in the Hooghly estuary**: As the hilsa approaches its reproductive phase, it starts its migration into rivers, in our case, into the Hooghly estuary. The major upstream migration of brood hilsa from the sea into the Hooghly estuary largely coincides with the southwest monsoon i.e., from July-August to October and the peak-breeding of hilsa happens during full moon in October. The peak period of migration can extend into November. Another season, a lesser one, when upward migration for breeding occurs, is January-March.

[44] See, for example, V.R. Suresh *et al.*, *Current Status*, 23 and Md Abdul Wahab, Malcolm Beveridge, and Michael Phillips, *Hilsa: Status of fishery and potential for aquaculture*, WorldFish Proceedings, Penang, 2019, 73.

[45] Ahsan, *et al.*, *Migration, Spawning Patterns*, 56.

6. **The return journey of the spent fish and offspring**: The spring spawners that enter the river for spawning in January-March return to the sea during July-August when these get caught in large numbers. The monsoon spawners that enter the river during September-October return to the sea after spawning and these spent fishes are also caught in large numbers during January-March. Similarly, the offspring of spring spawners make a journey towards the sea from the river during November-January, whereas the offspring of monsoon spawners return to the sea from the river during July-October. The timing of return of the offspring of the spring and monsoon spawners to the sea is not as precise as the riverward migration of their parents. Full recruitment[46] of juveniles into the marine fish stock is observed during July and January with a peak in October. The minimum size at recruitment into the sea is at 160-180 mm, whereas juveniles are fully recruited into the fishery at a length of 260-270 mm approximately at an age of 1 year. But the maximum exploitation of this stock is affected when they congregate in the near shore areas and lower estuaries at lengths of 300-390 mm at the age of about 2 years.[47]
7. **Fecundity**: hilsa is a highly fecund fish. As the fish does not exhibit parental care, the high fecundity enables it to compensate for any great loss of progeny that may occur due to predation and unfavourable hydro-ecological conditions. Several past studies on hilsa in Indian waters have suggested that the fecundity of hilsa increases with increasing size and weight of the fish; the estimates range from 0.1 million to 2.0 million eggs for fish ranging in length from 25 to 55 cm. Further, it was seen that for fish in the size range of 25 to 40 cm, the fecundity estimate is about 0.25 to 0.40 million; for fish in the size range of 40 to 50 cm the estimate is 0.4 to 1 .6 million and for fish above 50 cm, it is 1.3 to 2.0 million. Studies on the 'broad' and 'slender' types of hilsa indicate a highly significant difference between the two types in fecundity estimates.[48] A subsequent study on the Hooghly-Bhagirathi has produced the following data: Number of eggs in individual mature ovaries of hilsa ranged from 44,002 (length 27.4 cm/weight 234.5 g) to 1,554,894 (length 40.3 cm/weight 855 g).

[46] "Recruitment" here denotes the number of new young fish that enters the fishing population in a fishery.

[47] From Ahsan, *et al.*, *Migration, Spawning Patterns*, 59-61.

[48] BT Anthony Raja, *A Review of the Biology and Fisheries of the Hilsa ilisha in the Upper Bay of Bengal*, BOBLME, 1985, 11-12.

Therefore, finding more than 1 million eggs for a large-sized fish (longer than 40 cm) is fairly common and even for smaller sizes, less than 30 cm, one can easily expect anything from 40,000 to 100,000 eggs.[49]

8. **Pre-Farakka barrage**: Earlier studies (from the pre-Farakka barrage period) indicate that in the past, the hilsa of the Ganga river system used to migrate up to Agra, Kanpur and Delhi for spawning in the years of huge abundance, while in normal years, the fish used to migrate up to Allahabad, where abundance was observed up to the Buxar region.
9. **The prime attractors**: It has been observed that migration of hilsa takes place in large numbers only when the various factors are favourable for them and act as attractors. The possible prime attractors are:

    Turbidity—the monsoon runoff of hugely turbid water above 100 NTU turbidity (preferably 100–140 NTU) is prime requisite for attracting shoals of brood hilsa to the Hooghly-Bhagirathi system.

    Volume—Volume of freshwater discharge from the estuary during monsoon. *Salinity*—this, of course, is directly related to the preceding.

    Temperature—The temperature of river-estuarine water has been observed to drop by 1.5°C from average of 31.3°C (29.5-32.6°C) to 29.8°C (29.3-30.2°C) during monsoon migration of the brood fishes. On the other hand, in late winter (February) the ambient temperature rises by 1.8°C from an average of 27.6°C (26.8-28.4°C) to 28.6°C (27.0-31.8°C), which might influence upstream migration and breeding of hilsa.

    Depth—Depth also seems to play a limited role in movement of migrating hilsa and water depth of 18-20 m has been observed to be ideal for stress-free movement of brood stocks. Of course, the hilsa fishes pass through comparatively lower depth (average 10 m) in winter months. It is worth mentioning here that the size of migratory hilsa in the winter is smaller than that of the migratory specimens in the monsoon season.
10. **Other attractors**: However, current velocity, primary productivity, and availability of planktonic food are also possible significant attractors.

[49] Utpal Bhaumik, "Fisheries of Indian Shad (*Tenualosa ilisha*) in the Hooghly–Bhagirathi stretch of the Ganga River System," *Aquatic Ecosystem Health & Management* 20, no. 1-2 (2017): 135.

11. **Depth of movement in sea and river**: It has been observed that hilsa move on the surface in the foreshore region, whereas in the river, they move in deeper zones. The species moves in shoals.
12. **Depth of movement—ingress with high tide and egress with low tide**: Observational netting showed that a large number of hilsa was entangled in the gill net at the top and central portion during high tide especially in the evening hours during their migration process into the river. On the contrary, during low tide migrating, spent fishes from river into the sea were invariably gilled at the bottom of the net indicating the habitat of the spent fish.[50]
13. **Some hilsa appear to be non-anadromous**: It appears that some hilsa continue to remain in fresh water. It also appears that some hilsa appears to spawn in the sea. S. Dutt suggested[51] that there might be three different ecotypes of the fish, as follow a) the more common fluvial anadromous stock that feed and grow in the coastal waters and spawn in the lower and middle reaches of the river above the level of the tidal influence; b) fluvial potamodromous stock that are physiologically, but not geographically, landlocked and that live and give birth in the middle reaches of the rivers[52] (which could be one explanation of the existence of juveniles in the upstream of Farakka barrage); and c) purely marine form that appear to have been observed by Pillay off the Saurashtra coast.[53] [In addition, to the three possible ecotypes, some scholars have raised the possibility of hilsa spending its entire life-cycle in a 'confined' water body—the specific report is about the hilsa in Ukai (Vallabh Sagar Reservoir) in Gujarat.][54] This raises a question whether all the hilsa population in the Hooghly-Bhagirathi system can be said to decisively belong to **group a** above. The question seems to remain an open one. What is clear, however, is that the majority of the hilsa population in the Hooghly-

[50] Ahsan *et al.*, *Migration, Spawning Patterns*, 59.

[51] Suresh *et al.*, *Current Status*, 34.

[52] See also an early study by Sunder Lal Hora, "A Preliminary Note on the Spawning Grounds and Bionomics of the so-called Indian Shad, *Hilsa ilisha* (Hamilton), in the River Ganges," *Records of the Indian Museum*, XL (1938): 147-58; and a follow-up study, Sunder Lal Hora and K.K. Nair, "Further Observations on the Bionomics and Fishery of the Indian Shad, *Hilsa ilisha* (Hamilton), in Bengal Waters", *Records of the Indian Museum*, XL (1941): 35-50.

[53] Suresh *et al.*, *Current Status*, 34

[54] Utpal Bhaumik *et al.*, "Adaptation of Hilsa (*Tenualosa ilisha*) in freshwater environment of Ukai (Vallabh Sagar) reservoir, Gujarat, India," *Fishing Chimes*, 33, no. 1-2 (2013): 110-113.

Bhagirathi system behave in an anadromous manner as has been described in some detail.

The narrative above seems to indicate something. Certainly, we appear to know a great deal about the hilsa. However, at least in some important areas, the available knowledge seems to be less secure than one would have liked. Surely, any knowledge is fundamentally insecure and can be overtaken by new findings. But, it is usually possible to identify more secure (i.e. better observed and tested) areas of knowledge and less secure ones. In the case of hilsa, it seems easy to identify areas of definite uncertainty. We are scheduled to meet some more such areas later.

Spawning habits of hilsa in the Bhagirathi-Hooghly system

It has been observed that the life cycles of most marine and estuarine species involve complex migrations between spawning and nursery grounds. Older hilsa spawning for the second and third time, do so in the higher reaches of the river; however, the younger hilsa making their first spawning migration are more responsive to changes in salinity and spawn in the lower portions of the river.[55]

Present spawning grounds: During the commencement of the southwest monsoon and consequent flooding of rivers, hilsa starts its spawning migration upstream. There was a time when hilsa swam north past Farakka to the upper reaches. However, after the construction of the Farakka barrage in 1975, and notwithstanding the construction of two fish locks for facilitating fish movement to and from upriver, the migration of adult fish through the barrage from the Feeder canal is non-existent and from the Padma is miniscule. It is now clear that hilsa in the Hooghly-Bhagirathi system spawn downstream of the Farakka barrage.

Unless otherwise mentioned in the text or notes, the data below is largely from the study done under the IUCN programme.[56] A migrant mature hilsa lays eggs; the eggs are deposited in freshwater where hatching takes place in about 23-26 hours at an average temperature of 23ºC. Researchers have recorded that the newly hatched larvae were 2.3 mm in size. After hatching, the larvae and juveniles gradually made their way downstream towards the coastal waters and sea over a period of several months,

[55] Utpal Bhaumik, "Migration of Hilsa Shad in the Indo-Pacific Region: A Review," *International Journal of Current Research and Academic Review*, 3 no. 11 (November, 2015) 143.

[56] Ahsan *et al.*, *Migration, Spawning Patterns*, 2014.

feeding and growing on the way. On the whole, these juveniles usually graze from five to six months in freshwater before they make a move to sea water. We have seen that the spawning migration usually begins in June-July. Thus, clusters of eggs would be in various places upstream from the foreshore by October-November. According to researchers, major spawning takes place during October–November and minor spawning during January–March and May–July.[57] The fries, once hatched from the eggs, would start migrating downstream. Another upward migration would take place in January-March and their eggs also would hatch and the larvae and fry start migrating downwards.

No wonder, researchers have found that hilsa having the size range of 40-150 mm are usually widely available during February to May[58] in the foreshore and riverine waters of Hooghly-Bhagirathi river system and even some deltaic rivers of Sundarbans. They are caught in large numbers using current nets of small mesh size during their grazing period in rivers as well as seashore. Based on egg and fry availability, stretches between Nishchintapur and Diamond Harbour at downstream, Hooghly Ghat and Kalna in freshwater tidal zone and Lalbagh to Farakka in Bhagirathi River could be demarcated as possible breeding zones for hilsa. In 2011, monsoon breeding of hilsa at and around Kalna was first observed in July. The breeding activities shifted downstream south of Diamond Harbour (Nishchintapur area) following decreased river discharge and resultant low depth in upper reaches during August-September.[59]

In the zones associated with breeding mentioned above, post-monsoon breeding occurred with varying intensity and periodicity. The combined catch of fry and advanced juveniles was highest during April and July, 2011. The catch of the advanced juveniles was more downstream between Godakhali and Nishchintapur. The percentage of fry in the total catch was more in the upper freshwater reaches. These advanced juveniles often fall prey in large numbers to artisanal fishing in these zones during April and July.

Post-monsoon breeding occurred in all demarcated breeding zones with variation in intensity and period. The combined catch of fry and advanced juveniles was highest

[57] Bhaumik, "Decadal Studies on Hilsa and its Fishery in India," 386.
[58] Ahsan *et al.*, *Migration, Spawning Patterns*, 64.
[59] Ahsan *et al.*, *Migration, Spawning Patterns*, 64-66.

during April and July, 2011. The catch of the advanced juveniles was more downstream between Godakhali and Nishchintapur. The percentage of fry in the total catch was more in the upper freshwater reaches.

The presence of advanced juveniles in the entire stretch round the year needs further research.

3.6.3 Recruitment[60] patterns found by the researchers

A mixed population of fry to juveniles (23-163 mm) was available almost round the year with spatio-temporal variability in size and density. The stretch between Nishchintapur and Godakhali produced 34.25 % of fry-juveniles. 42.17 % of the recruits were from the upper freshwater tidal zone located between Hooghly Ghat and Kalna. The pattern of recruitment was erratic during post-monsoon season. It was observed that such recruitment was most at Farakka region in December 2010. In the period that followed, in January and February 2011, the recruitment was higher in upper freshwater tidal zone between Hooghly Ghat and Kalna and comparatively low around Diamond Harbour stretch at the downstream. The advanced juveniles above 100 mm showed a trend of downward movement from April onwards. Early juveniles behaved like resident species of the river-estuarine system and nurtured in comparatively deeper zones, which formed potential areas for their harvest.

In the marine and estuarine part, *hilsa* juveniles were highest in Sagar Island and Frasergunj, moderate in Kakdwip and lowest among the Canning and Gathkhali samples, confirming location of spawning ground at the confluence of the Hooghly River. Increasing trends in number of *hilsa* juveniles in Stations 4 and 5 samples indicated possibility of existence of other spawning grounds at the confluence of Matla-Bidya-Raimangal complex. Semi-structured interview with fishermen also supports the possibility of hilsa spawning grounds at the confluence of Matla-Bidya-Raimangal complex close to submerged sands of 2-3 meter water depth.

As mentioned earlier, the above findings were from the study conducted under the IUCN umbrella in 2011. Another study was conducted by the CIFRI under the BOBLME umbrella.[61] The official duration of the study was from June 2013 to

[60] Here, "recruitment" denotes the process in which young fish enter the exploited area and become liable to contact with the fishing gear.

[61] D. Panda *et al.*, *Final Project Report on Procedures and Methods for Continuing Assessment of the Status of Hilsa Resources in India*, Report to FAO for the BOBLME Project (Kolkata: ICAR-CIFRI, 2015).

December 2014; however, the practical work, including sample collection, was completed by September 2014.[62] The findings were as follows:[63]

The researchers identified five maturity stages for female hilsa based on appearance of ovary and egg. They recorded ripe and spawning individuals in large quantity during two distinct periods, July-October and February-April—that is, they observed that during 2013-14, winter breeding had shifted to February-April. Note that this is in slight contrast to the IUCN's aforementioned E4L programme-sponsored study, where the minor breeding migration was confirmed to be January-March. In the BOBLME study, no mature specimen of hilsa was encountered during December-January. As per their observation, based on the occurrence of mature individuals, while the major spawning season of hilsa in West Bengal waters was July-October, in consonance with usual understanding and the E4L study, the minor spawning season was found to be February-April.

The other important finding from the BOBLME study related to spawning grounds. The findings were as follows:

The researchers sought to identify the spawning ground based on the two criteria a) occurrence of ripe/running individuals and b) occurrence of early life stages (egg/larvae). Experimental fishing was conducted during the spawning season in the following inland stations to find the proportion of ripe/running females in the catch.

Category	Sl. no.	Stations	Latitude	Longitude	Sub zones
Inland	1.	Farakka	N 24°10'53.2''	E 88°16'06.6''	Feeder canal Ganga ghat Beniagram ghat
	2.	Lalbagh	N 22°46'41.6''	E 88°22'11.4''	Hazaridwari ghat Krishnamati ghat
	3.	Nabadwip	N 23°22'44.2''	E 88°21'35.1''	Dandapani ghat Kharer math Kalna
	4.	Tribeni	N 22°59'00.1''	E 88°24'10.0''	Bolagarh Kunti ghat Tribeni

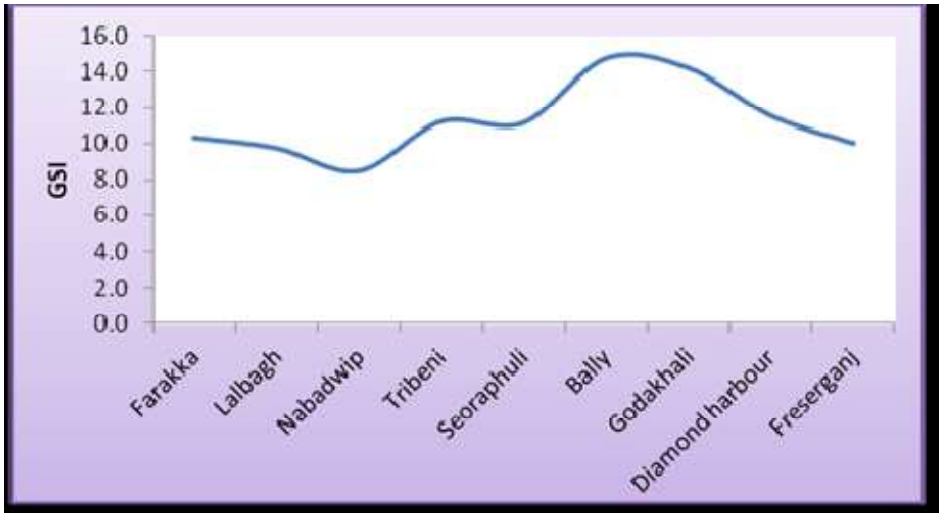
[62] Panda *et al.*, *Final Project Report*, 3-4.

[63] Panda *et al.*, *Final Project Report*, 39-43.

	5.	Sheoraphuly	N 22°10’11.0’’	E 88°12’02.0’’	Hooghly ghat Bichali ghat Nawabganj Seoraphuli ghat Gandhi ghat Srirampore ghat
	6.	Bally	N 22°38’08.6’’	E 88°21’21.6’’	Dakshineswar Bally ghat Nimtala ghat
	7.	Godakhali	N 22°23’49.4’’	E 88°08’20.1’’	Godakhali Burul
	8.	Diamond harbour	N 22°23’49.7’’	E 88°08’19.9’’	Raichawk Diamond harbour Sultanpur FH Nishchintapur
Marine	9.	Fraserganj	N 19°38’34.4’’	E 85°10’13.3’’	Kakdwip Namkhana Hard wood point 10 mile Bazar Fraserganj FH
	10.	Digha	N 21°36’13.9’’	E 87°27’40.4’’	Udaypur Shankarpur Petua ghat (Kanthi) Digha Mohana

The researchers dissected the specimens and estimated the gonado-somatic index (GSI) of the females. The highest GSI was observed from Bally (15%) followed by Godakhali (14%). However, higher GSI value was recorded from the stretches of Diamond Harbour-Godakhali, Bally-Sheoraphuli-Tribeni, and Lalbagh-Farakka. See figure below[64]:

[64] Panda *et al.*, *Final Project Report*, 42.



It is to be noted that the Diamond Harbour station includes the substation Nishchintapur and Sheoraphuly includes the substation Hooghly Ghat.

The maximum recorded value of GSI from these stations indicated occurrence of ripe females as compared to other stations. Hence, it could be inferred that the spawning activities were more in these stretches.[65]

The fertilised eggs were encountered in lower stretches like Diamond harbour, Godakhali, Bally and Sheoraphuli during September and October. Though there was occurrence of ripe females during July-October and February-April in the river, fertilised eggs were reported during September and October only. Hence, felt the researchers, more stringent investigations with sophisticated equipment were necessary for studying the distribution of eggs and larvae, which was beyond the scope of the particular study.

However, from the findings of distribution of ripe individuals, higher GSI and fertilised eggs, it was inferred that the spawning activity was more in lower stretches like Diamond Harbour-Godakhali, Bally-Sheoraphuli, and in upper stretch i.e. Lalbagh-Farakka in the Hooghly-Bhagirathi River.[66]

Interesting inputs arrive from another study on hilsa in the vicinity of the Farakka barrage. The nature of the study was as follows:

It was an exploratory survey on catch and life stages availability in the vicinity of Farakka barrage, both up and downstream—i.e. it included the Feeder Canal and

[65] Panda *et al.*, *Final Project Report*, 42.
[66] Panda *et al.*, *Final Project Report*, 43.

Bhagirathi-Hooghly and downstream Ganga on the one hand and upstream Ganga on the other. It was carried out by ICAR-CIFRI, Barrackpore under National Mission for Clean Ganga (NMCG) project during March to June 2017.[67] It appears to be the last large-scale study on hilsa presence and spawning activity in West Bengal that is available in the public domain. The conclusions of the study were as follows:

The survey observed the availability of hilsa both in the feeder canal and in the downstream of Farakka barrage. However, only a small quantity as juvenile hilsa was recorded in the upstream of the barrage. The presence of juveniles upstream indicates the possible migration of hilsa through the barrage or establishment of a native population in the upstream, which, the research team felt, called for further investigation.

The various life stages observed at various sites and observations thereon were as follows[68]:

1) Only a meagre quantity of fish could be recruited in the upstream of the barrage and consisted only of fry, fingerlings, and juveniles.
2) It seems highly probable that some juvenile hilsa migrated from the Padma to the upstream but none did from the Hooghly Feeder Canal; however, hilsa did migrate from the upstream to the Feeder Canal.
3) A dominant group of age 1+ year (190 – 260 mm length) and 2+ years (261 – 345 mm) was observed at both downstream and feeder canal from March to April and age of 2+ and 3+ (346 – 415 mm) during May to June.
4) The fish from May-June had fully matured gonads indicating breeding period of hilsa.
5) This appears to be slight deviation from early studies, in that a small scale migratory run for breeding is being noticed only up to March/April in both the Padma-Ganga and Hooghly-Bhagirathi river systems and presence of such fish in May-June would seem to be strikingly unusual.

[67] B. K. Das *et al.*, *Exploratory survey on hilsa (Tenualosa ilisha) catch and life stages availability along up / down stream of Farakka Barrage*, *Final Report*, Submitted to National Mission for Clean Ganga (NMCG), Ministry of Water Resources, River Development & Ganga Rejuvenation, Government of India, NMCG-CIFRI, 2017.

[68] Das *et al.*, *Exploratory survey*, Executive Summary, 1-14, and 38.

6) What the authors felt was equally unusual was the presence of a female sample of length 179 cm and weight only 59 gm with late maturing (Stage IVE) gonads.
7) Both the shifting of maturation period of gonads and advanced maturing hilsa of 179 cm length could be due to several ambient and environmental factors including climate change. This calls for the further investigation on the migration and reproductive behaviour of hilsa in Padma-Ganga and Hooghly-Bhagirathi river systems.

Summing up on spawning and comments

1) Although mostly anadromous in character, there appear to be some evidence that there are ecotypes of hilsa that can adapt completely to a marine habitat and another ecotype that are potandromous—i.e. live and give birth in the middle reaches of the rivers. There also seem to be some evidence that there are hilsa stocks spending their entire life-cycle in "confined" water areas.
2) Even completely anadromous stocks tolerate significant variations in environment—i.e. temperature, food kind and availability, turbidity, salinity, etc. Nevertheless, as one might expect for a given species, there appear to be certain characteristics in the environment that are most favourable to the growth and reproduction of the hilsa.
3) So, far as the Bhagirathi- Hooghly is concerned, the two independent studies seem to agree, at least roughly, on the location of the spawning grounds. The BOBLME study has nothing to say about Kalna or the Matla-Bidya-Raimangal river mouths. This is understandable, given that it did not recruit any samples in those locales. For the rest, the two studies seem to agree—i.e., regarding the vital importance of the Godakhali Nishchnitapur stretch, the promising nature of the Hooghly Ghat area, and the Lalbagh-Farakka stretch. The importance of the river at the vicinity of Farakka is also borne out by the BOBLME study.
4) However, there seem to be at least one important issue with regard to the identification of the spawning ground and season. The two main studies identifying hilsa spawning grounds in the Bhagirathi-Hooghly agree on a great deal in terms of location findings; however, they were carried out in close temporal proximity—one in 2011 and the other in 2013-14—when ambient conditions might not have changed considerably. But, the situation might have

changed in the succeeding years. Studies on hilsa, including the ones cited above, suggest that there are ambient aquatic conditions (including temperature) ranges that are particularly conducive to the migration and breeding of hilsa.[69] Given this and the fact that ambient conditions in the river (and sea) might be changing due to climate change and other factors (e.g. pollution load), it is an open question whether there have been some changes in the spawning season and grounds for hilsa. A larger number of consecutive-years studies would seem to be necessary to get an idea of patterns and trends in this regard.

5) There is one element in the BOBLME study that would seem to demand comment. The study says:

> Earlier reports indicated that female below 300 mm size groups are hardly found to take part in spawning activity. In the present study late maturing (Stage-IVE) hilsa was observed at 179 mm in the downstream of barrage. This is an interesting observation and could be due to climate change and other environmental factors that triggers for the early maturation process.[70]

Now, the observation of fishers that emerged during a focused group discussion at Diamond Harbour[71] also seemed to indicate that there were more specimens of brood hilsa of smaller lengths. However, while it is quite possible that the finding of relatively late mature (female) hilsa at 179 mm is indicative of recent environmental changes (e.g. climatic changes), earlier findings of relatively smaller lengths associated with advanced maturity encourages us to be more careful about coming to a quick conclusion without more corroborative study.

There are other features examined in the above studies. However, they will be cited only in connection to specific issues that are examined in this study. We now move on to our next item: Declining catch of hilsa in the Bhagirathi-Hooghly and in the immediate coastal waters, resulting in hue and cry, declaration of conservation measures, and, of course, a huge plight for fishers—including the countless numbers of artisanal fishers, our main concern in this study.

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[69] For list of specific parameters, see, for example, Ahsan *et al.*, *Migration, Spawning Patterns*, 41, 49.

[70] Das *et al.*, *Exploratory survey*, 18.

[71] The event took place on 12.09.2018.

Chapter 4: The declining catch in the Bhagirathi-Hooghly

As we have seen, the notorious decline in hilsa yield has not only created a furore in the media, it has also stimulated academic research and provoked governmental conservation measures. Since the present study comes in view of the crisis and the West Bengal government's attempts, albeit feeble, at conservation, we must first look at the exact nature of the crisis. For that, we must begin with yield data of hilsa.

The conservation measure came in 2013. Therefore, it is important to look at the yield figures until then. And, since our concern is with hilsa catch in West Bengal, we shall be concentrating on the yield figures for West Bengal until 2013.

The problem with fishery production figures in India, and certainly in West Bengal, is that one is not certain how reliable they are. There are grounds for believing that the methodology of putting together fish yield figures leaves much to be desired. Even an extremely cautious and euphemistic comment in the BOBLME study has the following to say:

> The past available hilsa information on catch and effort were collected from Department of Fisheries (DOF), Government of West Bengal and ICAR-Central Marine Fisheries Research Institute (CMFRI), Kochi. Only the time series data on catch of hilsa could be collected from both the organisations. The differences in estimates were observed even for the same period in the data supplied by both the organisations. This might be due to the difference in sampling strategy adopted by both the organisations. The multistage stratified random sampling programme was followed by ICAR-CMFRI, Kochi.[72]

We have used the synopsis of the data provided by BOBLME study. We shall use it, comparing or complementing it with other figures, when necessary. We have avoided using the data provided by the Department of Fisheries, Government of West Bengal. We have only quoted figures from the CMFRI (given nothing more reliable was at hand), which provides us with marine production data. For inland catch data, we have

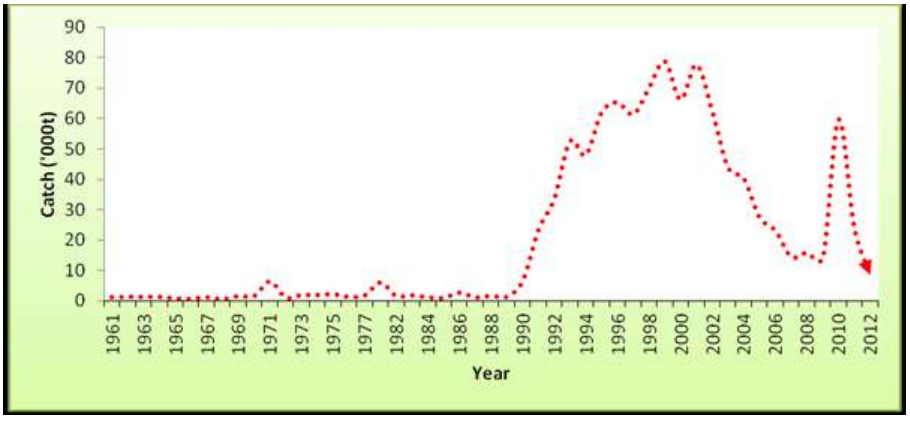
[72] Das *et al.*, *Exploratory Survey*, 6.

used the data provided by the BOBLME and from other expert sources, as we shall see.

Five decades of hilsa landings

The data from 1961 revealed that the production of hilsa in West Bengal was 1,058 tonnes in 1961. It rose 78,905 tonnes during 1999, and then declined to 8,679 tonnes during 2012. The trend during the intervening years may be seen in the figure below. As is indicated in that figure, there was a sudden increase in landing just after 1989 from 1,489 to 6,656 tonnes in 1990, then to 23,520 tonnes in 1991, and so on. One of the reasons of sudden increase in landing might be due to the large scale modernisation of fishing gear (adoption of monofilament gill net) in the state during the period. The monofilament gill nets are far less visible in water and, therefore, much better in ensnaring fish. Its high efficiency, low cost, and far improved durability encouraged fishers to adopt it widely. As a result of modernisation the catch was increased up to 53 times in between 10 years (1989 to 1998).[73]

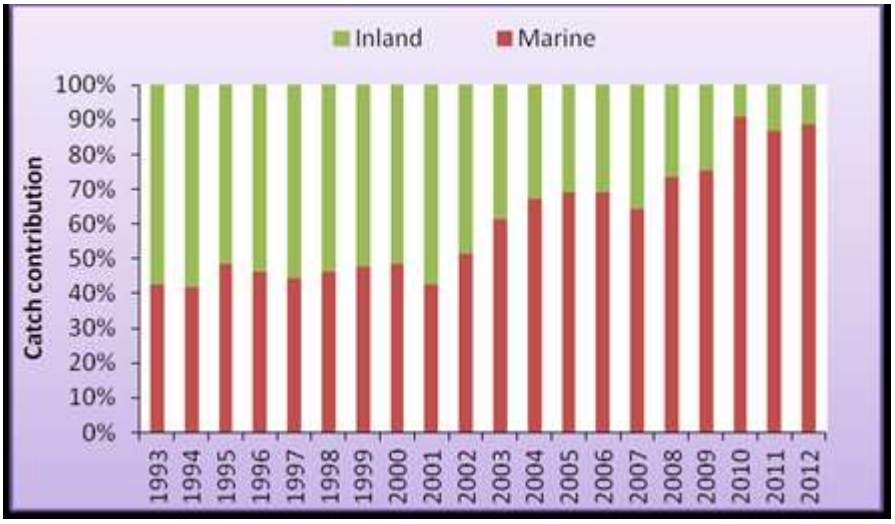
However, there was a steady decline in landings after 2001 (with exception of the sudden peak of 2010), which might be due to overfishing of resource during post modernization period.



hilsa production, 1961 to 2012[74]

Now, total hilsa catch means both marine and inland (freshwater and estuarine). This sector-wise data is available only from 1993. Their respective proportions of the total yield are represented in the following bar chart:

[73] Das *et al.*, *Exploratory Survey*, 6-7.
[74] Das *et al.*, *Exploratory Survey*, 7.



Inland and Marine—sector-wise proportion from 1993 to 2012[75]

As can be seen, as the total yield was increasing, the share of the marine sector in the total yield also continued to increase steadily, with an occasional slight downward dip, and reached a maximum of 91% in 2010. The marine sector has contributed more than 87% of catch during 2010-12. Correspondingly, the hilsa catch from inland sector was in declining trend with 58% during 1993 to only 9% during 2010 and 11% during 2012. In the year 2002, the catch from both the sectors was almost equal and thereafter the riverine share declined drastically. And, since the total yield itself was steadily and rapidly declining between 2001 and 2010, *the decline of inland's share of the total also means rapid decline of the inland yield in absolute terms*.

The BOBLME study has naturally taken the data on marine yield from the CMFRI database. And, so far as the marine yield is concerned, the database provides data on the nature of craft and craft share of the hilsa landings from 1992 to 2012. Their classification distinguishes three kinds of craft— 'mechanised', 'motorised', and 'non-motorised'. The data appears to reveal that, over time, the share of the yield from the mechanized sector has continued to increase such that, by 2012, the mechanized sector's total contribution to the total yield from 1993 to 2012 was almost 90%.[76] The total share of motorized craft was almost 10%. It is no wonder that the share of the

[75] Das *et al.*, *Exploratory Survey*, 9.

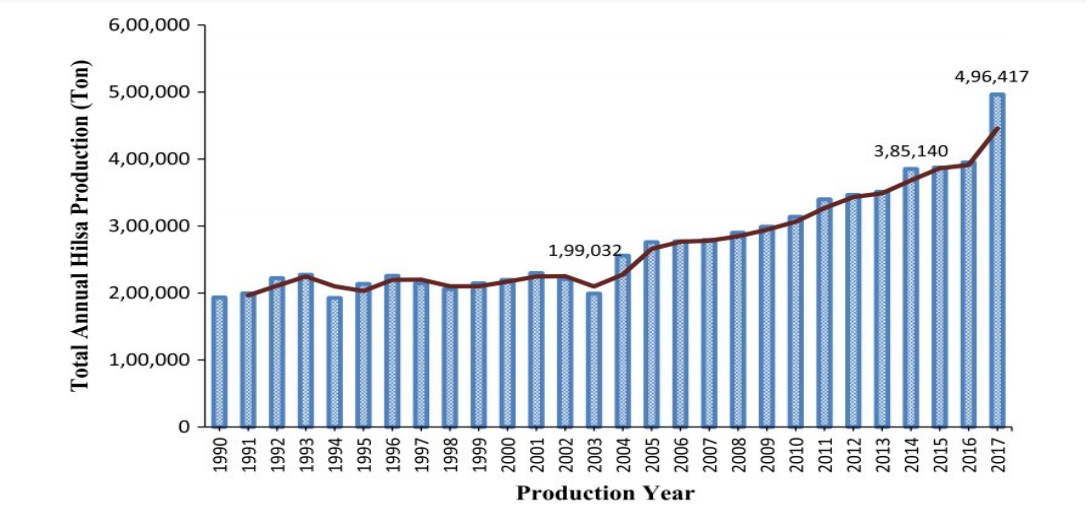
[76] Panda *et al.*, *Final Project Report*, 9. The exact language used is "mean contribution of about 90% of the total catch landed during 1993 to 2012" which, of course, amounts to the same thing, only in a more roundabout way.

non-motorized craft amounted to less than 1% of the accumulated landings during the two decades in question.[77]

Obviously, the use of mechanized craft, with its immense power and reach, accounts for the increased yield. This is why the overwhelming bulk of the yield comes from mechanized craft. Hence, whenever one thinks in terms of overfishing or overexploitation of fish stock in the marine sector, it would be natural to begin the inquiry with mechanized craft. But, we shall come to that later.

Yield and Decline: The situation in Bangladesh

Already in Chapter I, we had mentioned declining yields in Bangladesh, something that led to conservation measures being put in place. It is time to look at the nature of the decline and the aftermath. The following figure is quite eloquent about of catch quantity and trend.[78]



As one can see, hilsa production tended to remain roughly constant from 1991 to 2002, with small rises and dips. There was a noticeable dip in 2002-03. In 2003-04, the first conservation measure came into operation, followed by an immediate rise in 2003-04. Thereafter, on the one hand, several conservation measures were implemented in Bangladesh and, on the other, hilsa production has continued to rise, more or less steadily, up to 2016-17 (when it was 496,417 tonnes; this appears to be most recent year for which authoritative data is available in the public domain)[79].

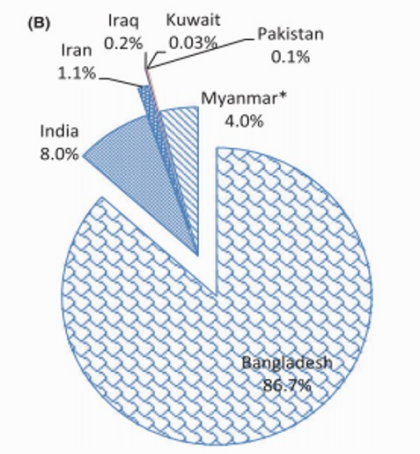
[77] Das *et al.*, *Exploratory Survey*, 9.

[78] Jalilur Rahman *et al.* "Catch Trend and Stock Assessment," 391.

[79] See also, Abu Siddique, "National fisheries week 2018: Ilish production up by 150%," *Dhaka*

Given the steady rise in production, and no other explanation available for the steady increase, a causal relationship between conservation measures and increase in production appears to be very likely.

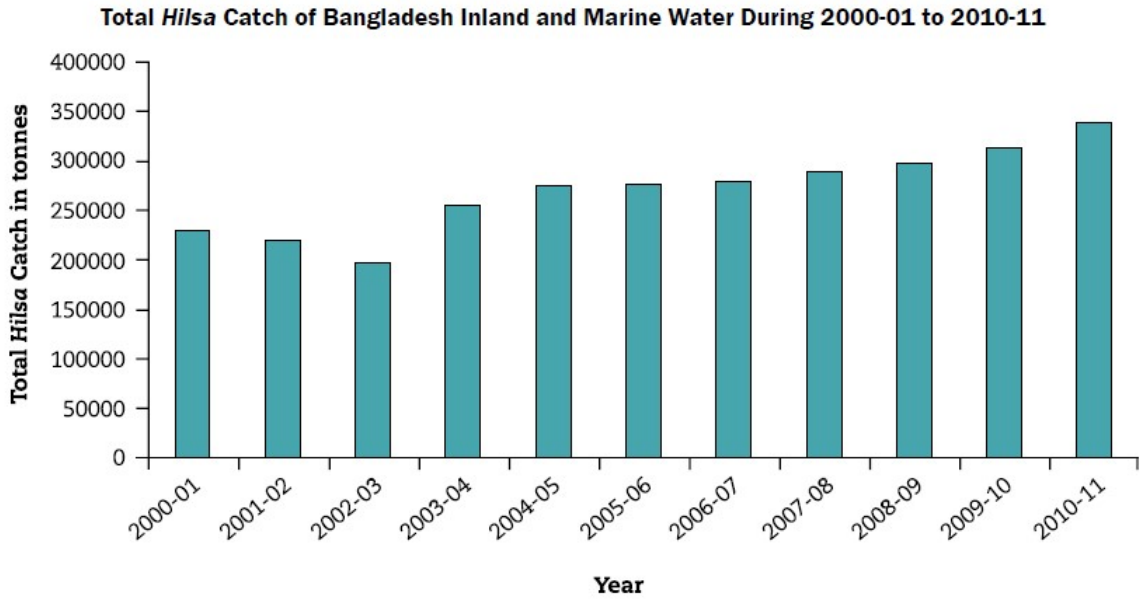
The other feature of hilsa production in Bangladesh is the huge difference in quantum when compared to the production in the Bhagirathi-Hooghly system. As we have just seen, in recent years the production of hilsa in Bangladesh has grown steadily. We have also seen in the very first chapter that Bangladesh produces almost 87% of the world's hilsa while the whole of India's combined production add up to 8% of the global production.

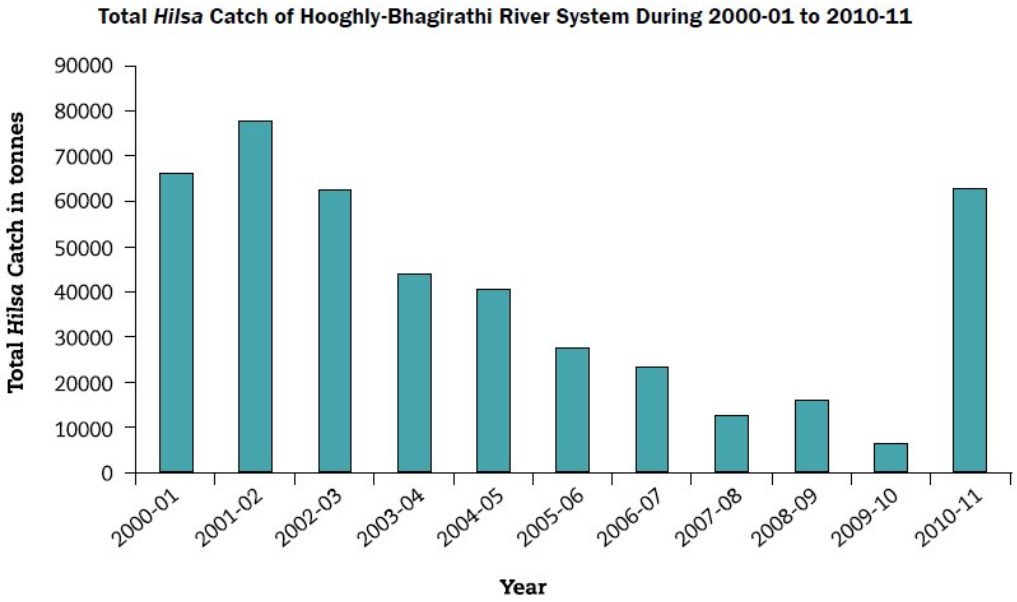


Bangladesh produces almost 87% of the world's hilsa while the share of the whole of India is only 8%.

But, even before the recent spurt in production, Bangladesh was several times ahead. Looking at the decade from 2001 to 2011 we see the following:

Tribune, 24 July, 2018, https://www.dhakatribune.com/bangladesh/2018/07/24/national-fisheries-week-2018-ilish-production-up-by-150.





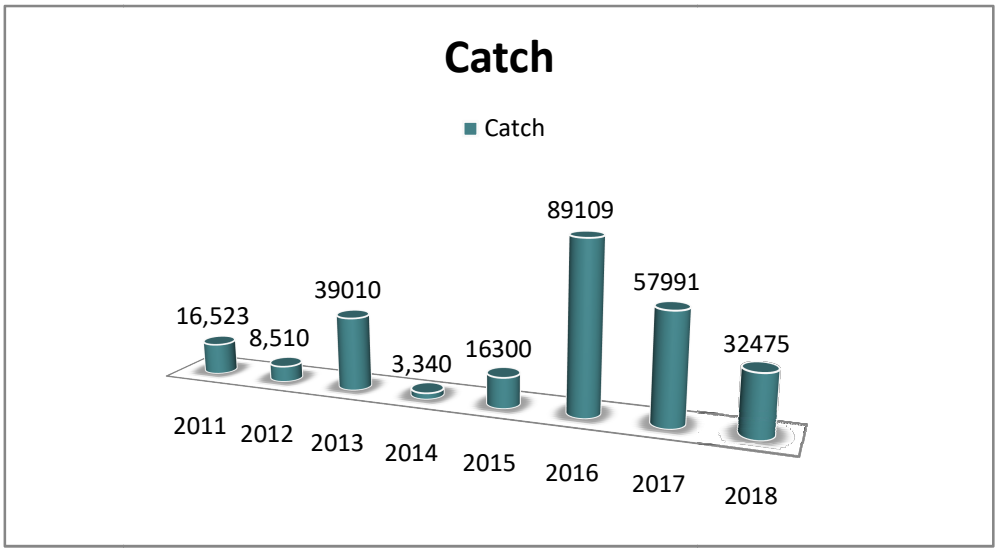
The two figures provide data on hilsa production in the Ganga-Brahmaputra-Meghna system (i.e. Bangladesh) and in the Bhagirathi-Hooghly system (West Bengal). As we can see, in the decade for which data is provided, the highest production in West Bengal was in 2001-02 and it was less than 80,000 tonnes. On the other hand, the highest production for Bangladesh was in 2010-11, and it was close to 350,000 tonnes. And, even in the year of its lowest production, 2002-03, the production was a almost 200,000 tonnes (199,032 tonnes), i.e. *two and a half times that of West Bengal's maximum*.

The cause, as we have suggested and is in consonance with what the studies imply, lies in the much larger fresh water flow in the Ganga-Brahmaputra-Meghna system, something we have also examined in some detail.

More recent figures for the Bhagirathi-Hooghly system

For, marine hilsa catch from the northern Bay of Bengal area adjoining the Bhagirathi-Hooghly system, we have CMFRI data for more recent years.

Year	Catch in tons
2011	16,523[80]
2012	8,510[81]
2013	39,010[82]
2014	3,340[83]
2015	16,273[84]
2016	89,109[85]
2017	57,991[86]
2018	32,475[87]
2019	Not available as yet



We have not sought to provide the corresponding data on inland fish catch for the above years, for, notwithstanding the availability of such data with the Department of Fisheries of the Government of West Bengal, the reliability of such data remains

[80] *Handbook on Fisheries Statistics 2014*, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India, 2014, 34.

[81] *Handbook on Fisheries Statistics 2014*, 38.

[82] *CMFRI Annual Report*, 2014-16, CMFRI-ICAR, Kochi, 2015, 12; also *State-wise Data, West Bengal 2013*, CMFRI, http://www.cmfri.org.in/WB.

[83] *CMFRI Annual Report*, 2014-16, CMFRI-ICAR, Kochi, 2015, 12; also *State-wise Data, West Bengal* 2013, CMFRI, http://www.cmfri.org.in/wb2014.

[84] *Marine Fish Landings in India 2015*, ICAR-CMFRI, 4.

[85] *Marine Fish Landings in India 2016*, ICAR-CMFRI, 5.

[86] *Marine Fish Landings in India 2017*, ICAR-CMFRI, 5.

[87] Inferred from data given in "Indian marine fish landings fall 9% in 2018 year-on-year", *The Economic Times*, last updated 12 July 2019, https://economictimes.indiatimes.com/news/economy/agriculture/indian-marine-fish-landings-fall-9-in-2018-year-on-year/articleshow/70194874.cms?from=mdr.

questionable, as there is no evidence of any exercise of meticulous collection and estimation.

However, very recently, an apparently more careful and statistically rigorous attempt to measure hilsa yield in the Bhagirathi-Hooghly system has been made. The study is entitled "Status of hilsa Fishery in Hooghly-Bhagirathi River System and Associated Coastal Waters of Northern Bay of Bengal".[88] It involves 9 authors, most of who are from the CIFRI-ICAR at Barrackpore and two from the CMFRI, Kochi. The study, undertaken over a four-year period (2013-16), appears to have been carefully done for the years in question and would appear to call for serious attention.

Regarding the problems of hilsa catch statistics, the study says:

> ...reliable catch statistics and fishing effort data are highly fragmentary, as most of the catch statistics are not based on proper methodology. As a catch and stock status form two pertinent measures for evaluating the status of a fishery, erroneous catch data might lead to wrong resource management decisions. Diversity of gear used, diffused nature of fish landing and marketing centers and socioeconomic complexities of the fishers have a major impact on the type and quality of catch statistics, resulting in deficient or unreliable data situations. hilsa, like other clupeid fishes, are characterized by substantial year-to-year, season-to-season and area-to-area fluctuations in availability, caused by variable success in recruitment, which, in turn, is regulated in complex and less predictable ways by physical, chemical, biological and fishing-related factors.[89]

And further,

> ... Though there are multiple agencies providing catch data of hilsa, the data are sometimes neither comparable nor aggregated at the national level as the concepts and definitions of the generation of these data vary from region to region.[90]

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[88] A. M. Sajina *et al.*, "Status of hilsa Fishery in Hooghly-Bhagirathi River System and Associated Coastal Waters of Northern Bay of Bengal", *Proceedings of the National Academy of Science*, *India*, *Section B: Biological Science*, 3 October 2019; from the author's page-unnumbered copy uploaded at https://www.researchgate.net/publication/336240900_Status_of_hilsa_Fishery_in_Hooghly-Bhagirathi_River_System_and_Associated_Coastal_Waters_of_Northern_Bay_of_Bengal.

[89] Sajina *et al.*, "Status of Hilsa Fishery," first page.

[90] Sajina *et al.*, "Status of Hilsa Fishery," first page.

In order to arrive at more reliable catch estimates, the authors declaredly employed a *stratified multistage random sampling method* "developed for marine fish catch estimation in India" and customized to suit the migratory and seasonal characteristics of hilsa fishery. Below we provide a brief glimpse into the catch estimate method, as presented by the authors.[91]

The stratification over space was done based on the known migratory route of the hilsa from sea to freshwater along the Bhagirathi-Hooghly River. The strata selected were marine, estuarine, major freshwater, and minor freshwater hilsa landing zones. The division of freshwater zone into major and minor landing zones was for increasing the homogeneity of each stratum (i.e. increasing the similarity of the landing centres within each stratum). Thus, the major landing centres were divided into marine, estuarine, major freshwater zones and the minor freshwater zone was constituted by 21 minor landing centres along the Bhagirathi-Hooghly that had been identified. However, some of the landing centres lying in the estuarine zone were considered as marine (e.g. Namkhana), as the vessels carrying catches from marine zones are landed in these centres. Important landing centres within each stratum (i.e., zones) were listed, based on historical knowledge regarding the catch. Second-stage stratification over space was done across the landing centres.

A calendar month was taken as the stratum over time, and one zone and a calendar month constituted a space–time stratum. Two random consecutive days in a month (i.e., 24 h direct observations with 12 hours on each day, the duration depending on the most active landing time in the centre) were assigned for each major landing centre for gathering the catch estimates. As fishing operation in marine, estuarine, and tide-influenced freshwater centres usually took place on the spring tide periods of the lunar cycle, therefore sampling days for such centres were selected randomly within the two spring tide periods, whereas, for the other centres, the days were selected on a completely random basis. Hence, the total number of actual fishing days in a month in each selected centre was obtained through an inquiry from fishers. For each zone, the number of 'landing-centre days' was estimated by multiplying an average number of actual fishing days of sampled landing centres with the number of total landing centres

[91] Sajina *et al.*, "Status of hilsa Fishery," second page, fourth page.

in that zone. For the minor centres, monthly observations were made from 20% of the identified minor centres on a random basis to get an estimate of scattered hilsa catch.

There are other niceties to the method, but the above should suffice for a basic idea. Even a brief glimpse into the statement on method seems to indicate that an amount of rigour and precaution are involved. However, in order to undertake a more critically thorough appreciation of the method, one would need access to more information, including the data tables, which do not appear to be available in the public domain at this point.

The application of the above method has resulted in the following catch estimates for the years indicated.

Zones	2013–2014		2014–2015		2015–2016		2016–2017	
	Catch (t)	% of total catch	Catch (t)	% of total catch	Catch (t)	% of total catch	Catch (t)	% of total catch
Marine	15,302.3	93.8	45,371.6	99.5	12,025.96	98.6	48,633.88	99.4
Estuarine	174.87	1.1	59.2	0.13	71.01	0.6	31.10	0.1
Freshwater								
Major	399.03	5.2	34.45	0.43	26.12	0.8	53.43	0.5
Minor	441.81		150.26		69.07		204.02	
Total catch (t)	16,318.01		45,615.52		12,192.17		48,922.43	

Estimated annual catch of hilsa (April 2013 to March 2017)

Certain aspects and features of the above data would seem to demand consideration.

First, it is interesting but by no means unexpected that the CIFRI official reports uphold the above data for the years concerned.[92]

Second, the situation is different with CMFRI reports. However, the yield here is provided for financial years, while the CMFRI data cited earlier is provided for calendar years. For convenience of comparison, we are reiterating the CMFRI data below. Incidentally, we are also including the CMFRI data for the financial year 2013-14 (this is the only financial year data from the CMFRI that seems available).

[92] See, for example, *CIFRI Annual Report 2013-14*, CIFRI-ICAR, Kolkata 2014, 10. *CIFRI Annual Report 2014-15*, CIFRI-ICAR, Kolkata 2015, 12; and *CIFRI Annual Report 2016-17*, CIFRI-ICAR, Kolkata 2017, iv.

CMFRI data								
Year	2011	2012	2013	2014	2015	2016	2017	2018
Catch (metric tonnes)	16,523	8,510	39,010	3,340	16,300	89,109	57,991	32,475
Financial Year			2013-14					
Catch (metric tonnes			38,773[93]					

For, the FY 2013-14, it is clear that the CMFRI data does not match the marine catch data from the latest study. For other years, it is impossible to compare exactly with the CMFRI data. Nevertheless, financial and calendar years have nine months in common (April to December) and this stretch includes the peak hilsa fishing season. Therefore, one should be able to compare catch data, e.g. that for 2014 on the one hand and 2014-15 on the other, within a relatively small margin of expected difference. Unfortunately, the marine catch data in the study does not even come close to matching with the CMFRI data. Given this, we wonder, let alone the Fisheries Department data, what we are to make of the CMFRI data down all these years and whether they can be used at all to draw any conclusions, as they obviously have.

However, notwithstanding their own scepticism about earlier data, the authors of the new report have not themselves rejected the earlier data wholesale. They accept that the earlier data captures at least one important fact regarding hilsa yield and that is as follows:

Until the late 1990s, the hilsa catch was relatively small and almost consistent with minor decadal peaks. With the advent of modern fishing technologies and intensification of fishing effort, hilsa catch increased to a great extent since 2000. Since then, a gradual decline in catch from the inland sector is noticeable, whereas the marine catch showed greater year-to-year fluctuations. Further, this is indicative of a strain on the hilsa resources and that the once thriving commercial fishery of the Bhagirathi-Hooghly river system is in essential decline since 2001.[94]

One might tend to agree with this broad generalization as artisanal fishers also confirm that hilsa catch, at least the artisanal catch, has seriously suffered during the last fifteen-twenty years. Moreover, the catch per unit effort (CPUE) has vastly decreased. These came out in the FGDs conducted. (As mentioned in the Introduction,

[93] *Marine Fish Landings in India during the Financial Year 2013-14 (in tonnes),* http://www.cmfri.org.in/uploads/divfiles/Landings-FY-2013-14_final.pdf.

[94] Sajina *et al.*, "Status of Hilsa Fishery," sixth page.

we have avoided questions that might help to measure CPUE, for that would call for more time, expertise, and resources than were available for this survey.)

Coming back to the recent study data on catch cited above, we notice two further items of interest.

First, the catch seems to alternate, with abysmally low figures in one year and significantly higher figure in the next. This cannot be seen as a regular pattern, given the short period at our disposal but is in consonance with the observation of considerable year to year fluctuation.

Secondly, the inland catch is an unbelievably small portion of the total catch—ranging between 93.8% and 99.5% over these four years. Given that on two out of four years, the overall tonnage was very low as compared to past (or even current data of sizeable catch), the total tonnage of the combined non-marine sources shows up as pitifully small. Normally, such pitiful yields are expected to be devastating to livelihoods. And that, apparently, has been the case, particularly in the upper reaches of the river, for example in North 24 Parganas[95] and Nadia[96].

In addition to the general data on hilsa catch, the authors come up with CPUE estimates for fishing across water areas. They report the following findings:

> ... the CPUE was estimated for the gear from important sampling stations during peak fishing months, i.e., monsoon (June–September) and winter (December–February) for four years (2013–2016). CPUE of traditional single-day gillnetters varied from 0.04 to 2.36 kg/boat/day in the freshwater zone and 1.31 to 10.95 kg/boat/day in the estuarine zone in the four years. The CPUE of marine multiday mechanized crafts was estimated from three major centers: Digha, Frazerganj and Namkhana-Kakdwip, and observed CPUEs were high (38.8–563.8 kg/boat/day) during monsoon months and lower (0.3–56.6 kg/boat/day) during winter months...[97]

CPUE can be taken as indicative of stock abundance. However, applying it to time series data can be tricky and misleading, as CPUE depends not only on abundance but on fishing knowledge and skill, technological reach, etc. Therefore, the authors have

[95] Bablu Ghosh interview.

[96] Reported by fishers during general discussion in the course of the survey.

[97] Sajina *et al.*, "Status of hilsa Fishery," seventh page.

avoided applying it to historical data (leaving aside the question of the utility of applying it to datasets, the accuracy of which is doubtful, at best—a question that the authors do not raise in connection with the application of CPUE to historical data). However, the authors applied it to their own study period and area and have the following to say:

> In general, CPUE showed a gradually declining trend toward upstream of the river. Though CPUE will rarely be exactly proportional to the stock density, it often reflects a measure of the stock abundance in the region [39]. As hilsa is a migratory species, the CPUE may indicate the relative abundance in the particular zone or station during the study period rather than the status of the fishery.

Now, we come to a crucial aspect of the study findings—the proportion of juveniles in the catch. We have found in the previous chapter references to investigative reports of gonad maturity of hilsa females at as low as 190 mm (even 186 mm at Chilika) and gonad maturity for males at 160-170 mm.[98] This was also noted by the authors of the study under discussion. Therefore, in determining a definitive cut off size for juveniles, they settled on 150 mm and decided to regard hilsa below this length as definitely juvenile.[99] Armed with this criterion they set out to determine the proportion of juveniles at hilsa landings. But, how did they actually measure the share of juveniles in large landings? The authors explain:

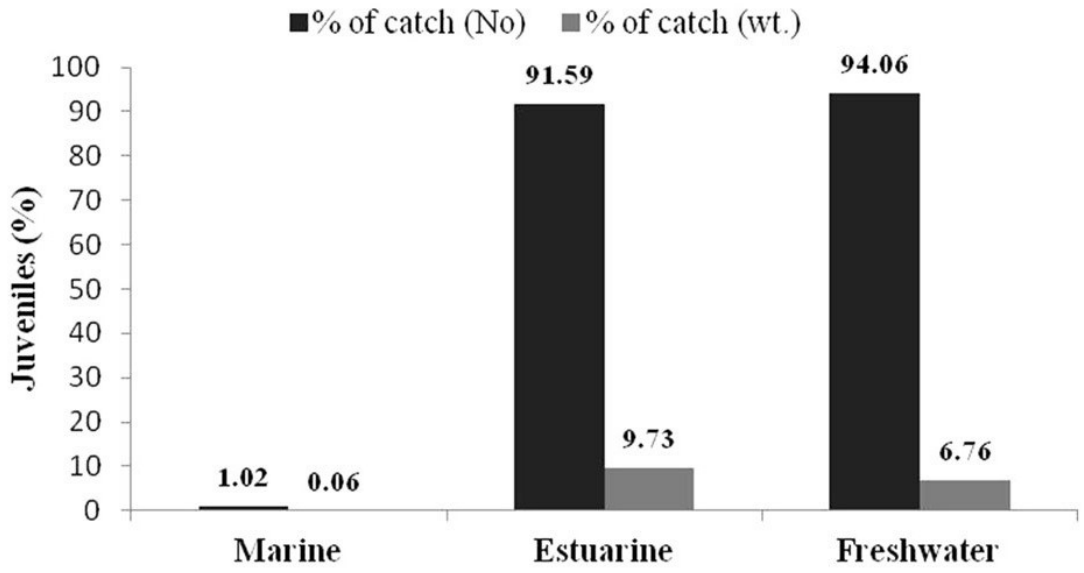
> Since the separation of juveniles from the landed catch was difficult, the juvenile catch was estimated in weight by converting length to corresponding weight through established length–weight relationship and multiplying with the frequency of juveniles from the length–frequency data raised for the whole catch.[100]

The result of their findings is as follows:

[98] Suresh *et al.*, *Current Status*, 23; and *Hilsa: Status of fishery and potential for aquaculture*, WorldFish Proceedings, Penang, 2019, 73.

[99] Sajina *et al.*, "Status of hilsa Fishery," fourth page.

[100] Sajina, *et al.*, "Status of hilsa Fishery", fourth page.



Percentages of juveniles in the catch, by number and by weight[101]

The two most important things that stand out in the above diagram are:

First, percentages by weight of juveniles are extremely small all around, though it is astonishingly low in the case of marine catch.

Secondly, percentages of juveniles in terms of number, however, dominate in the case of estuarine and freshwater catches, though the percent is very low in case of the marine catch. And, as the authors correctly point out that in terms of species conservation and welfare, it is not the proportion by weight but the proportion by number that we should be worried about. For, the number of individual juveniles caught signifies the extent of hurt to the population.[102]

The picture above is both revealing and alarming. This is what the authors make of it.

> The large numbers of juveniles caught from the estuary and freshwater stretches were due to use of small meshed bag nets locally called as Behunti jaal or Bhendi jaal which are operated seasonally in the freshwater tidal stretches of the river system where the juveniles of hilsa spend their early life stages before returning to sea for further growth. The juvenile catch by bag nets

[101] Sajina *et al.*, "Status of hilsa Fishery," sixth page.
[102] Sajina *et al.*, "Status of hilsa Fishery," fifth page.

> is huge as indicated by a study in the year 2010 which recorded 2.8 kg of hilsa juveniles of 5–20 g size out of the 10 kg total catch in a single bag net operation at Godakhali stretch of the river...They are easily marketed as *Gudusia chapra*, another valued small clupeid fish in the region, as hilsa of that size is not relished by the consumers. Thus, catch of immature specimens and brooders are two important reasons for the decline of hilsa, among the yet to be known reasons. Hence, growth overfishing[103] and recruitment overfishing[104] need to me (sic!) immediately managed for protection of the stock.[105]

The extensive fishing of juveniles with nets of small mesh size in the estuarine areas is also attested by the testimony of fishers at the FGDs at Godakhali and Diamond Harbour. Notwithstanding this, the above depiction by the authors might be misleading in portraying the exact nature of the problem. Let us see why this is so.

The percentage breakup of the catch in terms of size and weight must be read in tandem with the structure of the overall catch. Let us look at the table and bar chart once again.

Zones	2013–2014		2014–2015		2015–2016		2016–2017	
	Catch (t)	% of total catch	Catch (t)	% of total catch	Catch (t)	% of total catch	Catch (t)	% of total catch
Marine	15,302.3	93.8	45,371.6	99.5	12,025.96	98.6	48,633.88	99.4
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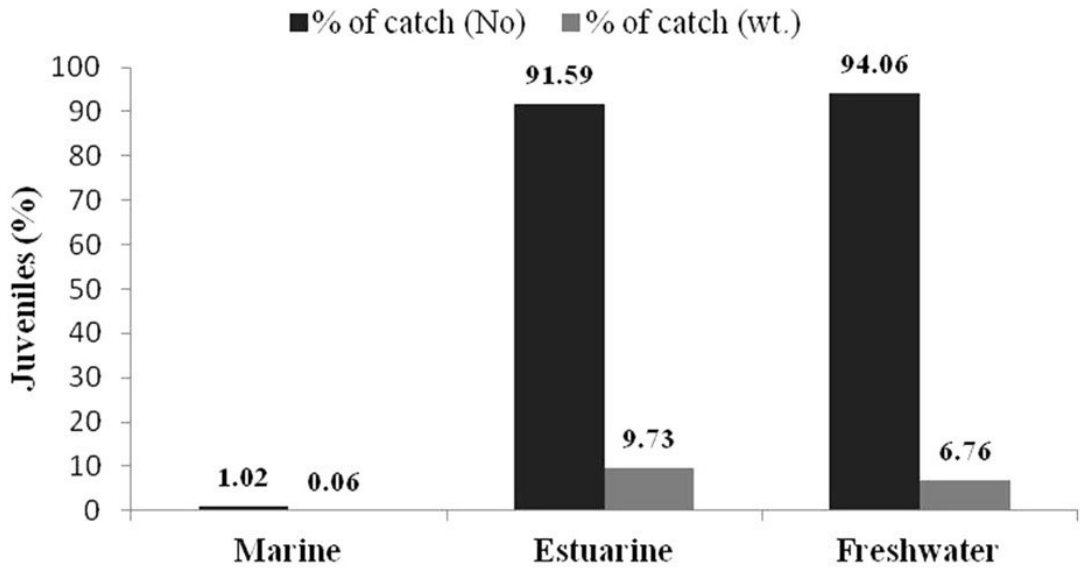
Minor	441.81		150.26		69.07		204.02	
Total catch (t)	16,318.01		45,615.52		12,192.17		48,922.43	

Estimated annual catch of hilsa (April 2013 to March 2017)

[103] Growth overfishing occurs when animals are harvested at an average size (or age) that is less than the size (or age) that would produce the maximum yield per individual.–SC.

[104] "Recruitment" is the number of new young fish that enter a population in a given year. "Recruitment overfishing" is said to occur when the scale of fishing is such that spawning stocks are so reduced as to cause a decline in recruitment. –SC.

[105] A. M. Sajina, *et al.*, "Status of hilsa Fishery", sixth page-seventh page.



By adding the figures for the respective years, we find that the total combined (marine plus non-marine) catch for the four years is 123,048.13 tonnes. Similarly, we find that the total marine catch for the four years is 121,333.74 tonnes. Also, the total estuarine catch over those four years is 336.18 tonnes and the total freshwater catch is 1,378.19 tonnes.

Now, let us re-examine the juvenile numbers in the catch in the light of the above figures. 9.73% of the estuarine catch consists of juveniles (by weight). Therefore, total weight of juveniles in estuarine catch is 32.71 tonnes. 6.76% of the freshwater catch is juvenile catch. Therefore, total weight of juveniles in estuarine catch is 93.16 tonnes. Thus, the total non-marine catch is 125.87 tonnes.

Comparatively, juveniles in the marine catch make up only 0.06% of the total weight—way below the percentages in the non-marine catch. But, on the other hand, the size of the marine catch is again hugely more than the non-marine catch. Computing we find that, in terms of weight, the juveniles in the marine catch amount to a substantial figure—72.8 tonnes. But, this is only the quantity by weight. What is the total number of juveniles in the marine catch (number being of more import in the question of stock depletion)? Unfortunately, there is no way of knowing, since we do not have the data necessary for forming an estimate. However, there appears to be a broad clue. In all the instances—marine, estuarine, and freshwater—the share by numbers of the juveniles in the marine catch is many times higher than their share by weight. However, in case of the marine catch, the ratio of the share of the juveniles by

number and the share of the juveniles by weight is much higher than the corresponding ratios in the cases of estuarine and freshwater catches. Therefore, it is clear that in the case of the marine catch, we have, on an average, smaller juveniles that, proportionally speaking, contribute less to weight than they do in the case of estuarine and freshwater catch. As why this should be so, one can speculate and perhaps fisheries scientists might have an explanation. Anyway, although 72.8 tonnes of juveniles in the marine catch is considerably less than 125.87 tonnes in the case of the combined non-marine catch, the number in the case of the marine catch is by no means correspondingly less. From the proportions indicated, the numbers can be shown to be comparable. However, since we are only talking of contrived estimates and ratios, it is best not to take this further, except for indicating that juvenile destruction is on a comparable scale in the case of the marine catch.

Unfortunately, there is much more at issue with respect to the marine catch. This is orders of magnitudes higher than the catch in Bhagirathi-Hooghly. Another look at the numbers will help us to appreciate the problem involved. While the total combined (marine plus non-marine) catch for the four years is 123,048.13 tonnes, the total marine catch for the four years is 121,333.74 tonnes, i.e. 98.6% of the total. This, as we have seen, involves a huge number of juvenile catch. And this, as one can reasonably guess, involves an enormous number of brood fish.

The counter-argument here is that the East Coast has an oceanic fishing ban in the EEZ from 15 April to 14 June (61 days), which the West Bengal government has matched with a ban on its territorial waters for the same period,[106] and, prior to the Hilsa notification under the Inland Fisheries Act, there was nothing comparable for the inland water areas (except a portion of the estuarine area up to Diamond Harbour, which comes under the jurisdiction of the ADF Marine[107]). The problem is that whatever be the utility of this ban for other fish species, it is of little value in the case of Hilsa. For, Hilsa stocks start congregating towards the river mouth only at the beginning of the monsoon. By the time they start their journey towards the mouth, the ban is over and mechanized gillnetters and trawlers rush in. And notwithstanding the fact that they are not legally allowed within the territorial waters, they come to the river mouth with impunity. As the fishers report, the Hilsa season often sees these

[106] Memo no. 392/EW dated 04.04.2018.

[107] Assistant Director of Fisheries, Marine (office at Diamond Harbour).

mechanized boats operating in the territorial waters. Given that they are targeting Hilsa, it makes perfect sense for them to do so.

The contribution of non-motorised/artisanal/country boats to the total landing of the state remained less than 1% over last two decades. The landings from the motorised boats were significantly felt from 1999 onwards, with an average of 40% share to the total landings. The overall contribution of this sector during last two decades was more than 10%. hilsa fishery of the state was mainly supported by the mechanised boats with a mean contribution of about 90% of the total catch landed during 1993 to 2012. (BOBLME report)

The inland (riverine) catch mainly supported by the non-motorised boats. Non-motorised boats mainly concentrated to seven inland stations, from Godakhali to Farakka. A total of 693.4 tonnes of hilsa was landed in riverine zone during October, 2013 to September, 2014. The station-wise landing is shown in Figure 13. The maximum landings were observed in the lower zone (Godakhali-Bally). In the upper zone, Lalbagh and Farakka were also contributed significantly to the total hilsa landings. However, Godakhali, Sheoraphuly and Lalbagh were found to be most productive area of hilsa fishery. (BOBLME report).

Marine hilsa landing information was collected from CMFRI, Kochi. Catch data were collected from 57 landings centres along the coast of West Bengal for different boats under operation by following multistage stratified random sampling design. A total of 9842 tonnes of hilsa was landed during October, 2013 to September, 2014. About 95% of marine hilsa was landed by the mechanised boats, while nearly 5% by motorised boats. The contribution of non-motorised boats in marine sector was less than 1% (Figure 14). No hilsa was fished during the month of April and May due to fishing closure from 15 April to 31 May every year. (BOBLME report).

The major contribution was made by the mechanised boats (gill netters and trawlers) with 89% (9332 tonnes), followed by the artisanal/non-motorised boats with nearly 7% (721 tonnes) and motorised boats with 4% (482 tonnes) to the total hilsa landings in West Bengal (Figure 18). (BOBLME report).

Chapter 5: Causes of decline in Bangladesh and West Bengal, as identified in the IUCN study, and recommendations therein (with a quick comparison with recommendations in the BOBLME study)

Although, the decline noticed in Bangladesh was nowhere as sharp as noticed in the Bhagirathi-Hooghly system in West Bengal, the decline was sufficiently worrisome to the Bangladesh economy, in which the hilsa plays a greater role than it does in West Bengal. This resulted in the need to identify the causes of decline. The IUCN study, which attends to decline, its causes, and possible management plans necessary to reverse the decline, mentions the following causes of decline of hilsa production in Bangladesh.

- Over fishing in the estuarine mouth region created barriers and also dispersed hilsa on its way to breeding migration in upper freshwater environment.
- Under-sized fishing through zero and small meshed gill/current nets and unwanted hauling of the juveniles are major human factors affecting the migration, spawning and recruitment success of hilsa.
- Increasing jatka fishing by mostly part-time fishermen is a major threat to the sustainability of fish stock. In an interview with fishermen, 80 per cent of the respondents informed that the over-catching of jatka is the main reason for the decline of hilsa stock in the rivers of Bangladesh.
- Over fishing in the estuarine mouth region created barriers and also dispersed hilsa on its way to breeding migration in upper freshwater environment.
- Under-sized fishing through zero and small meshed gill/current nets and unwanted hauling of the juveniles are major human factors affecting the migration, spawning and recruitment success of hilsa.
- Increasing jatka fishing by mostly part-time fishermen is a major threat to the sustainability of fish stock. In an interview with fishermen, 80 per cent of the

respondents informed that the over-catching of jatka is the main reason for the decline of hilsa stock in the rivers of Bangladesh.

- Siltation in river beds due to decreased water flow from upstream especially during dry season) is one of the major constrains of blockage of migration route of hilsa.[108]

This is important information, for obviously Bangladesh has acted as a reference point for investigations into Indian conditions. Now, let us look into the causes of decline that the IUCN study has identified for the Bhagirathi-Hooghly system. These are as follows (the language below is largely close to the original text):

Siltation at Estuary Mouth

Catchment modification and resultant carriage of soil particles has considerably elevated the bed level. The mouth of the estuary has been gradually affected by siltation, creating serious hindrance for hilsa migration into the estuarine system.[109]

Impact of Barrages, Dams, etc.

Construction of dams, barrages, anicuts, etc. over the rivers has created an obstruction in migration of hilsa resulting in sharp decline of its fisheries at upper reaches, the most notorious being Farakka. After commissioning of Farakka barrage over the river Ganga in 1975, hilsa fisheries at upstream of the barrage was negligible in most of the fish landing centres. Eventually an average of 92 per cent reduction in hilsa catch at upstream of Farakka barrage was estimated by the Central Inland Fisheries Research Institute (CIFRI) due to construction of the barrage. Even at Allahabad, where hilsa used to occupy a significant share in total fish catch, now it is only a meagre proportion of the harvest.[110]

Juvenile Fishing

Hilsa breeds through a prolonged breeding season as evidenced by availability of hilsa seed from August to May. This suggests that spawning is not simultaneous for all ascending individuals and occurs at different points of the river. hilsa juveniles are often caught in small-mesh bag net, small-mesh gill net, shooting net, seine net, drag net and scoop net during their migration towards sea especially during November to

[108] Ahsan *et al.*, *Migration, Spawning Patterns*, 72-73.
[109] Ahsan *et al.*, *Migration, Spawning Patterns*, 74.
[110] Ahsan *et al.*, *Migration, Spawning Patterns*, 74.

May and sometimes extending up to July in the river. The investigation in 2010 recorded a very alarming situation when a single bag net catch of 10 kg at Godakhali near Budge Budge had a share of 2.8 kg very small hilsa juveniles at 5-20 g weight. Similarly, the catch of scoop nets (locally called bhetijal) operated between Sodepur and Budge during March consisted mostly of hilsa juveniles (>90% by numbers in total fish caught).

The estimated catch of these juveniles fluctuated between 41.1 tonnes and 151.01 tonnes with an average of 85 tonnes per year during 1998-2010. Their size ranged between 62 mm and 155 mm in length and 2-28 g in weight. An extrapolated estimation reveals that 50 per cent reduction of the juvenile hilsa killing has the potentiality to increase the adult production by about 10 per cent. Another estimate reports that if even 1 per cent more Hilsa juvenile could be saved, then the production of adult hilsa could be increased by 4000 tonnes/year.[111]

Exploitation of Brood Fishes

The fishermen capture gravid female hilsa during their upstream breeding migration mostly at estuary mouth during monsoon. This has a tremendous adverse impact on population recruitment and declining of hilsa fisheries. The undersized hilsa (below 500 g) are being caught in huge numbers using monofilament nets at Frazerganj-Namkhana area in Hooghly estuary defeating the very cause of stock sustenance and leading to decline in of hilsa fishery of the Bhagirathi-Hooghly riverine system. Fish catch recorded from five mechanised boats at the Frazerganj fishing harbour was 5.6 tonnes out of which hilsa alone was 3.2 tonnes (56.3%) and 66 per cent of them were female fish. The observations on maturity conditions revealed that 59.8 per cent of the fishes were in 4th stage of maturity followed by 26.3 per cent in 3rd stage, 7.5 per cent in 2nd stage and 6.4 per cent in 5th stage.[112]

Lack of Mesh Size Regulation

Presently fishing with small mesh sized (<60 mm) gill nets are mainly responsible for reducing the size of hilsa in the coastal region as well as in the freshwaters of the Bhagirathi-Hooghly riverine system.[113]

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[111] Ahsan *et al.*, *Migration, Spawning Patterns*, 75.
[112] Ahsan *et al.*, *Migration, Spawning Patterns*, 75.
[113] Ahsan *et al.*, *Migration, Spawning Patterns*, 75.

Overfishing

In recent years, between 1998-99 and 2002-03, the average annual catch of hilsa in the riverine part has been estimated at 11,482.9 tonnes with an impressive increase of 63.3 per cent from the preceding five years (6279.6 tonnes). Over the years, however, the mean length of hilsa has declined, from 356 mm (1960s) to 300 mm or even less (2000s)—a manifestation of increased efforts, indicating over-fishing. ...The catch dynamics needs a longer multivariant assessment correlating the catch with effort, monsoon rainfall, cyclonic depressions, temperature, salinity, wind speed and direction and other biophysical parameters of the river and the ocean.

In the absence of information about exact number of boats (mechanised, non-mechanized and trawlers) operative at present in the lower estuarine to marine area and their catch details, the catch per haul (effort, kg of hilsa/Hour) data of some control mechanised boat using gill net in the lower estuary have been used. It is observed that during October 2011 catch per unit effort (CPUE) has been highest (19.32±22.1) whereas it was low during June (10.05±7.92) and July (11.64±18.95). The CPUE increases in August (16.45±16.86) and reduced in September (11.53±11.34) and picks up to again the previous level during October. The CPUE decreases in November (15.67±8.73) and December (12.65±6.09).

Another attempt had been made to estimate the CPUE per boat from the fish landing data of Frazergunj fishing harbour. A 10-year data of fish landing vis-à-vis number of registered boats shows that with 90 per cent increase in number of boats the catch of hilsa has increased by 230 per cent.

This is also related to increasing level of technology adaptation and capacity building in the marine fishing sector. However, it also indicates that though the CPUE has steadily increased from 13 to 33 up to 2007, it has dipped to 23 in 2010 in spite of a record harvest which indicates that the hilsa fishing has crossed is sustainable yield limit due to overfishing after 2007.[114]

Ineffective Fish Pass

Fish pass provided in Farakka barrage is non-functional at the present point of time.

[114] Ahsan *et al.*, *Migration, Spawning Patterns*, 75-76.

Tagging experiments conducted by CIFRI revealed that hilsa from Bhagirathi-Hooghly riverine system cannot move across the barrage due to obstruction of the three tire sluice gates. However, hilsa can negotiate and pass through Farakka barrage to a small extent during monsoon from Padma side when all gates are opened.[115]

Loss of Habitat

Increased water abstraction for irrigation as well as use for industrial purpose resulted in reduction of water volume in parts of upper Hooghly estuary which has caused loss of breeding and spawning habitats. Siltation in rivers reduced the water depth unsuitable for hilsa migration. It was observed that hilsa prefers migration at a depth 4-5 m. The loss in habitat is directly related to the recruitment potential of hilsa fishery.[116]

Pollution

Ecological aberrations due to industrial and domestic effluents noticed in selective zones and periodically in most of the river systems also inhibit the upstream migration. Hooghly-Matlah estuarine system flows through highly industrialised area like Haldia complex and Kolkata-Howrah metropolis and receives domestic refuse from thickly populated city areas, and effluent from industrial establishments. This exerts great stress to migratory fishes like hilsa.[117]

Comments on the above analysis

The above narration is fairly detailed and provides a good idea of the possible factors that experts think are responsible for the drastic decline in catch. The factors identified here are same or very similar to those mentioned in research articles. This is understandable for some of the important authors of such articles have been inducted in the team that prepared the IUCN report.

However, there are some issues regarding the above report that might be mentioned. They are as follows:

1. The authors do not indicate any hierarchy among the factors identified—at least not explicitly. There could be two reasons for this. First, they consider all the

[115] Ahsan *et al.*, *Migration, Spawning Patterns*, 76.
[116] Ahsan *et al.*, *Migration, Spawning Patterns*, 76-77.
[117] Ahsan *et al.*, *Migration, Spawning Patterns*, 77.

factors to be of equal importance. Second, they are not sure about the order of importance.

As regards the first possible reason, one can rule that out—for if it were so, it would in itself be a fundamental feature about the factors and would likely have been mentioned. Therefore, it seems the second is the likely cause of the non-mention of the hierarchy. Moreover, this is understandable. It is far easier to ascertain whether a factor, say pollution, adversely affects fish population than to ascertain its importance as a factor among other negatively affecting factors—unless, of course, the extreme degree of harm from the factor is readily apparent or, conversely, the damage is noticeably close to being negligible.

2. However, while it might be rather difficult to set up a hierarchy among factors in order of importance, it might be comparatively easier to identify factors that are serious, yet relatively easier to manage than others. There is no reason why these should not be identified. For example, in the case of Hilsa conservation, factors like pollution or drastic reduction in the volume of river water due to withdrawal for irrigation or industry are very difficult to control without high and multi-level decision-making and huge coordination. This is because they are myriad-point (or non-point) factors. On the other hand, overfishing or overexploitation, use of destructive gears of fishing practices in rivers or seas, and fishing/destruction of juveniles on a large-scale are factors relatively less problematic to manage (as has been evident in the case of various countries, including Bangladesh). Clear classification of factors in terms of which call for immediate and which call for longer-term management (or major policy and implementation changes) is a serious requisite in studies of this sort. The investigations, commentaries, and prescriptions on hilsa would appear to fall short in this respect.
3. In the case of overfishing or juvenile fishing, however, it appears possible to indicate a hierarchy, both in order of importance and logistic ease of intervention. The IUCN sponsored study categorically mentions the devastation caused by mechanized boats on hilsa stock, by destroying huge numbers of brood fish at various stages of (sexual) maturity. It is obvious that the impact of a single mechanized boat can be incomparably more devastating than that of a

large number of artisanal fishing boats or a very large number of small scoop nets, seine nets, drag nets, or bag nets. The reasons are as follows:

i. Because of its size and shape, a large trawl net of trawler can bag entire schools of fishes (in this case, large mesh size at the beginning does not necessarily help the small fish escape for, firstly, the net is not perpendicular or close to perpendicular to the fish's swim vector but is at a slant and secondly, the mesh gets narrower as the net tapers towards the rear). Moreover, the moving trawler covers huge areas bagging up catches on the way. In fact, the incredible amounts of by catch (non-targeted species and unmarketable juveniles) get caught. For example, in the pre-survey focussed group discussion at Kanthi, a trawler worker reported how maunds of juvenile hilsa would occasionally have to be thrown away.[118]

ii. Gill nets, which hang vertically or almost vertically in water are supposed to be less destructive in that when they have large sized meshes, they are expected to allow juveniles or smaller sized fishes go through without much hazard. However, an effective gill net not only catches fish by gilling, snagging, or wedging, it also catches by ensnaring (which can help catch even the relatively smaller prey). Moreover, gill nets of mechanized gillnetters are several kilometres in length and therefore, even at their least destructive, entire adult populations of whole schools of fishes can get caught. Experts point out the huge numbers of gill nets at the mouth of Hooghly in the Hilsa fishing season, [119] leading us to wonder that sufficient hilsa are able to escape the nets and make their way upriver in a number, however, scarce, still supporting thousands of estuarine and freshwater fishers.

Since these are well-known, it is important to indicate hierarchy among factors, whenever possible—and in this case it certainly is possible. This is not by any means to detract attention from the destructive impact that unregulated artisanal fishing can have, nor is it by any means a denial of the need to regulate such fishing—but, rather, this is to point

[118] Focussed group discussion at Contai, 25.09.2018.
[119] For example, in the interview with Prof Ashim Kumar Nath.

out that an appropriate hierarchy can indicate where the greater and more stringent regulation is necessary.

4. It is interesting that if the need to indicate a hierarchy among factors, when that is possible, is not felt with appropriate keenness then, even without any intention to do so, the role of certain factors might get neglected. For example, in the IUCN study, in discussing juvenile fishing, the emphasis has been on artisanal fishing at the estuarine mouth—near Godakhali and downwards.[120] But, large numbers of juvenile fishes get caught in trawl nets as by catch in the sea, as we have reported above. This has not been mentioned. Moreover, when the causes of decline in the perception of fishers has been indicated, it only reports three factors—namely, over-catching of jatka (juvenile hilsa), low discharge of water, and heavy siltation.[121] However, as has been found in this study, coastal and estuarine artisanal fishers, who are well-acquainted with the operation of mechanized boats, unfailingly point out their mass-destructive role in killing countless numbers of both brood fish and juveniles. Thus, the response of 'over-catching' of juveniles, presented as a non-disagggregated response, seems to conceal this reality.

5. There is something else—closely related to the above but meriting separate mention. As has been suggested in the last and present chapter, mechanized fishing close to the territorial waters and illegal mechanized fishing within the territorial waters and the river mouth adversely affects fish stocks. Now, this has two consequences for artisanal fishing.

   First, in the case of an anadromous stock as the hilsa, the massive assault on the stock in the sea is bound to have serious consequences inshore. Far less hilsa enter the river than they would have normally done, placing the artisanal fishers in jeopardy. This puts pressure on them to use whatever gear and method they can to get a catch sufficient to meet their livelihood needs. Normally, the hilsa fishers use gill nets. However, various study reports repeatedly refer to the use of other and more exploitative nets such as bag nets with zero-meshed tapering rears and scoop nets. Thus, when one thinks of conservation measures on the

[120] Ahsan *et al.*, *Migration, Spawning Patterns*, 75.
[121] Ahsan *et al.*, *Migration, Spawning Patterns*, 73.

river and estuarine areas, one must remember that the success of these measures very often depends on their visible benefits. And, that these benefits can be best ensured when one can begin addressing the problem at the sea and river mouth.

Secondly, there is a psychological-political issue. Many in the artisanal fishing community, particularly those in the lower reaches of the river, and certainly those who go to fish at sea, are aware of the plunder-destruction carried out by the mechanized fishing vessels and their effects on the marine and riparian biota. Therefore, they will find the conservation measures more acceptable if they know that stricter measures have been undertaken with respect to the mechanized crafts. A sense of fairness of a measure helps one to identify with it and support it with more zest.

Policy Recommendations in the IUCN study

The IUCN study recognizes that ecosystems and, by implication, conservation measures do not follow national frontiers. Specifically with regard to Hilsa conservation in West Bengal and Bangladesh, it was axiomatic that the entire Ganga-Brahmaputra-Meghna system needed to be viewed as a whole and policy prescriptions designed with that in view. Moreover, inter-country cooperation was an essential desideratum. Therefore, the study provided some general policy prescriptions for the region as a whole. They are as follows:

- The ban on hilsa fishing to protect the juvenile and brood fish should be imposed in both Bangladesh and India *at the same time*.
- Hilsa migration depends on water flow and depth. To maintain proper water flow, appropriate measures are needed at Padma-Meghna and Hooghly-Bhagirathi river systems.
- To ensure conservation of hilsa and other fish species, a complete ban on use and manufacture of zero-meshed nets is required.
- Establishment of any polluting industry and *power station in the estuary or close to the spawning grounds* is not advisable for the health of the estuarine fishery and the mangrove ecosystems.
- It is time that to make a thorough stock assessment of marine and freshwater hilsa at regular intervals using a common methodology for Bangladesh and India.

- There is a necessity to maintain an environmental flow of freshwater in estuaries and associated mangrove ecosystems for sustainable hilsa fishery.
- The hilsa corridor should be opened by removing barriers of bag nets and other small meshed nets from the estuary mouths two days before and after the full moon and new moon of every month.
- There should be research on market dynamics and its effect on hilsa conservation.
- Community-driven approach in mass awareness building on conservation of hilsa is necessary to provide alternative livelihood support.
- Joint initiatives must be taken in technology transfer for captive breeding and domestication of hilsa.

The study provided some specific recommendations for Bangladesh. Since they are in line with measures that we have already discussed and does not fall with the area of our main concern we shall discuss the study's policy recommendations specific to the Bhagirathi-Hooghly system (the recommendation are quoted *as they are*, except for inessential modifications for easier reading).[122]

- Need to strictly adhere to the mesh size (100 mm or 4 inch) regulation especially at estuary mouth to control exploitation of Hilsa of below 500 g brooders to facilitate them to breed at least once in the life cycle.
- During the peak spawning period (October-November), a ban on Hilsa fishing within a 10 km radius of identified breeding grounds should be enforced. During this period, designated riverine Hilsa fishers need to be adequately compensated by the Government towards maintenance of their livelihood.
- To conserve Hilsa fisheries, a stringent ban should be imposed on capturing of juveniles. Strict law enforcement is required to prevent the destruction of Hilsa fisheries. During March-May, most of the juveniles (80-150 mm) start downstream migration. In Bangladesh, there is a restriction on the use of bag and scoop nets for catching Hilsa below 230 mm. A similar policy in India during these months by banning bag nets, lift nets and small meshed gill nets (1 inch) would facilitate the migration of juveniles to the sea and assist in reaching the original stock levels.

[122] Ahsan *et al.*, *Migration, Spawning Patterns*, 85-86.

- It is expected that most of the upstream migrating Hilsa will congregate near Farakka Barrage. Fishing may be prohibited within 5 km of the barrage round the year to protect the species and facilitate brooders for spawning in the area.
- Improvement of the aquatic habitat with more emphasis on wise water management measures in the estuary mouth may encourage more brooders to migrate upstream.
- Decline of catch per unit effort (CPUE) data vis-à-vis reduction of average size species depicts that the stock of Hilsa in the Indian part of the Bay of Bengal appears to be close to its sustainable exploitation limit and needs immediate efforts for stock assessment and management.
- Bottom trawling in shallow continental shelf (up to 30 km) should be strictly banned to save the shallow marine habitat.
- A focused study in India concentrating on possible spawning grounds for Hilsa, submerged sand bars near and within the estuaries of Matla, Thakuran and Raimangal rivers should be explored. These grounds (especially during the breeding season)—after proper demarcation—may be declared 'protected area' for Hilsa.
- The "West Bengal Fishing Act" (sic!) (1984) needs to be amended appropriately to consider the aspect of pollution.

It might be of interest to look at and compare with the recommendations in the BOBLME study.

- At least 24% reduction in present fishing effort and use of gill nets above 90 mm mesh both in inland and marine sector should be enforced for the sustainable management of Hilsa stock in West Bengal waters.
- The use of gill nets below 90 mm mesh and other gears like bag nets (Behundi Jal) should be banned in riverine and estuarine zone.
- Building awareness and adoption of co-management approach in implementing conservation measures for Hilsa is highly solicited.
- Routine collection of catch and effort information to update the current stock status periodically is highly indispensable.
- More research intervention on spawning ground survey and migration of Hilsa need to be implemented.

Comments on the Recommendations

There are some minor concerns with regard to the policy prescriptions, including that some of the prescriptions appear to be somewhat loosely formulated. We shall ignore them in this study.

Some quick (and more substantial) points may be noted here.

First, while the IUCN study has relatively detailed recommendations, in comparison, the recommendations of the BOBLME study are rather sketchy and sparse.

Secondly, while the IUCN study speaks of adhering strictly to 100 mm mesh size, especially at the estuary mouth, the BOBLME study recommends keeping the maximum mesh size to 90 cm. The difference is of significance given the 2013 regulations, which we discuss in the next chapter.

Thirdly, both set of recommendations discourage use of bag nets in riverine areas.

The IUCN recommendations emphasize on a ban on Hilsa fishing within a 10 km radius of identified breeding grounds during the peak spawning period, which it specifies as October-November. It is to be noted, however, that in the main body of the study, the observation regarding peak spawning period is more specific and centres on the first full moon in Aswin, which appears to have been considered in formulating regulation in Bangladesh, rather than a blanket ban during this time. Moreover, as we indicated earlier, "spawning grounds" could be and, indeed, likely to be, relatively dynamic entities, rather than frozen in time. Therefore, periodical updating needs to be conducted on the exact spawning zone at a particular point in time. The BOBLME recommendations, it may be noted, do not stress on any ban period or zone in their recommendations.

The IUCN recommendations speak of the strong possibility that the Hilsa population in the Indian part of the Bay of Bengal is close to its sustainable exploitation limit and needs immediate efforts for stock assessment and management. Moreover, it stresses on the need to ban bottom trawling in shallow continental shelf (up to 30 km) should be strictly banned to save the shallow marine habitat. Leaving

aside the fact of why the recommendation should restrict itself to 30 km in prohibiting bottom trawling, the fact remains that the recommendations do encourage some recognition of the severe damage to marine resources, including Hilsa stock. However, there is no clue in the study or the recommendations suggesting that the marine devastation south of the Hooghly mouth and particularly of an anadromous stock, could be a significant contributory factor to the drastic decline in inland catch. In fact, although computing minimum sustainable yields (MSY), particularly of a migratory stock, can be a tricky business, at least one study makes a definitive and closely argued claim that the MSY for hilsa in the northern Bay of Bengal is being clearly exceeded.[123]

The stress in the IUCN recommendations on the principle of "adequate compensation" to fishers for the ban period is welcome.

Two important recommendations in the BOBLME study are high desirability of 'routine collection of catch and effort information to update the current stock status periodically is highly indispensable' and 'more research regarding spawning ground survey and migration of Hilsa'. They are pertinent and welcome.

[123] Isha Das *et al.*, "Present Status of the Sustainable Fishing Limits for Hilsa Shad in the northern Bay of Bengal, India," *Proceedings of the National Academy of Sciences*, *Section B: Biological Science*, 2018.

Chapter 6: Plans for and implementation of hilsa conservation measures in West Bengal

As the backdrop of West Bengal's hilsa conservation, there were two things; first, the sharp decline of hilsa production, which we have examined in some detail; and secondly, the experience of hilsa conservation policy and its implementation in Bangladesh. We have spoken of the decline at some length. Let us now take quick glimpse at hilsa conservation measures in Bangladesh.

Hilsa conservation measures in Bangladesh

The basic structure in Bangladesh evolved between 2003 and 2011, that is, in the decade preceding the conservation steps taken in West Bengal.

In 2003-04, the government of Bangladesh has adopted a programme to protect *jatka*. Catching, selling, carrying, and transport of *jatka* was prohibited from 1 November to 31 May (7 months). This seemed to lead to immediate success, following which the Government of Bangladesh declared four areas of the coastal rivers (Meghna, Tentulia and Andharmanik Rivers) as hilsa sanctuaries to stop overexploitation in 2005.

Detailed and strengthened programmes for protecting *jatka* were adopted and implemented in 2007-08. In 2011, the government declared "*Jatka* Conservation Week" from 4 April to 10 April, 2011. On the eve of this Conservation Week, i.e. on 3 April 2011, the Fisheries and Livestock minister Abdul Latif Biswas declared that a *new Hilsa sanctuary* would be created soon. That very year, this sanctuary, *fifth* in line, was declared on the Padma between Shariatpur and Chandpur.

***Hilsa* Sanctuary in Bangladesh**

Sl No.	*Sanctuary Area*	*Ban Period*
1.	From Shatnol of Chandpur district to Char Alexander of Laxmipur (100 km of lower Meghna estuary)	March to April
2.	Madanpur/Char *Hilsa* to Char Pial in Bhola district (90 km area of Shahbajpur river, a tributary of Meghna)	March to April
3.	Bheduria of Bhola district to Char Rustam of Patuakhali district (nearly 100 km of Tetulia river)	March to April
4.	Whole 40 km stretch of Andharmanik river in Patuakhali district	November to January
5.	20 km stretch of Lower Padma River between Shariatpur in the north and chandpur and Shariatpur in the south	March to April

The first five hilsa sanctuaries in Bangladesh[124]

By 2011, the action plan to protect hilsa was implemented in 91 *upazilas* of 20 districts. Further, 4 specific spawning grounds for hilsa were identified within the sanctuaries.

Position	Area	Peak Spawning Period (Ban Period of Hilsa catch)
North-East	Shaher Khali/Haithkandi point, Mirersharai	15-24 October
North-West	North Tajumuddin/West Syed Awlia point	15-24 October
South-East	North Kutubdia/Gandamara point	15-24 October
South-West	Lata Chapili point/Kalapara	15-24 October

Peak spawning grounds of Hilsa[125]

A special provision for Hilsa protection was the ban centred on the first full moon in the Bengali month of *Aswin* (approximately 17 September to 17 October). Hilsa fishing in the hilsa spawning grounds and, indeed everywhere in the country, and carry, transport, offer, sell, export or possessing hilsa was prohibited for 5 days before and 5 days after the first full moon in *Aswin*, that is a total of 11 (eleven) days each year.

The above was the basic framework of the conservation measures. What came in the later years was the developing of and working upon this structure. For example, later the Aswin full moon-centric ban was extended to 15 days

[124] Ahsan *et al.*, *Migration, Spawning Patterns*, 78.
[125] Ahsan *et al.*, *Migration, Spawning Patterns*, 78.

(five days before and nine days after the full moon) and in 2016 and 2019, and for those years, the ban was expanded to 22 days (four days before and seventeen days after the full moon). On 25 June 2018, a sixth hilsa sanctuary was declared and soon came into place comprising of 3 adjacent stretches in Barisal district (Habibnagar to Bamnar Char point; Bamnar Char point to Hizla Launch Ghat point; and Hizla Launch Ghat point to Dakshin-Pashchim Jangalia point). The ban on fishing in that area is also March and April. [126] The results of these measures, in all appearance, have been beneficial to production, as evident from the almost dramatic increase in yield figures during the last decade. However, it has entailed serious hardships for artisanal fishers and the river catch dependent poor—although the government has extended planned assistance in various forms. Some of these will be discussed later in connection with the question of conservation in West Bengal. [127]

The declaration of conservation in West Bengal

The declaration of the intent to conserve and the framework of measures to be complied with were articulated in the two documents to which we have categorically referred earlier. These are both pasted below.[128]

[126] Registered no. DA-1, এস.আর.ও. নং ১০৭-আইন/২০১৮। Bangladesh Gazette Notification dated 17 April 2018; Abu Siddique, "Bangladesh gets its 6th Hilsa sanctuary," *The Dhaka Tribune*, 25 June 2018, https://www.dhakatribune.com/bangladesh/2018/06/25/bangladesh-gets-its-6th-hilsa-sanctuary.

[127] The brief summary of conservation measures in Bangladesh has been taken from several sources, including *Migration, Spawning Patterns*, 77-78, Cecily Layzell, "Seasonal ban on brood hilsa helps to protect stocks in Bangladesh," *The Fish Tank*, 9 October 2018, http://blog.worldfishcenter.org/2018/10/seasonal-ban-on-brood-hilsa-helps-to-protect-stocks-in-bangladesh/; Abu Siddique, Bangladesh gets its 6th hilsa sanctuary, Dhaka Tribune, 25 June 2018.

[128] The instruments, one relating to inland and another to marine are as follows: Notification No. 719 Fish/C-1/9R-312012 (Part-I)).- dated the 4th of April, 2013, Fisheries Department, Government of West Bengal; and Order No. No. 7 I 8 Fist/C- 1/9R- 3 t\0t2 (parr-I) dated the 4th of April, 2013, Fisheries Department, Government of West Bengal.

NOTIFICATION

No. 719 Fish/C-1/9R-3/2012 (Part-I).– dated the 4th April, 2013.— In exercise of the power conferred by section 19 of the West Bengal Inland Fisheries Act, 1984 (West Ben. Act XXV of 1984) and in supersession of all earlier notification on the subject, the Governor is pleased hereby to make the following amendments in the West Bengal Inland Fisheries Rules, 1985, published in Part-I of the *Calcutta Gazette, Extraordinary,* dated the 6th May, 1985, vide this Department notification no. 1979- Fish/C-I dated, the 29th April, 1985 (hereinafter referred to as the said rules):—

Amendments

In the said rules,—

(1) after sub-rule (2) of rule 46, *insert* the following sub-rules:–

"(3) For the purpose of conservation of hilsa fish stock in the inland open water system, no persons or group of persons or fishers or fisherman or their assistants under no circumstances shall catch hilsa (species group / family: Hilsa shad-Genus / Species: *Hilsa ilisha* and species group / family: other shads- Genus / Species: other Hilsa species (*tenulosa, macrura and todi*) using any kind of monofilament gill net / nets having mesh size below 90 (ninety) millimeter and other nets having mesh size below 40 (forty) millimeter for other fishes.

(4) No person shall transport, market, sell and possess hilsa (species group / family: Hilsa shad- Genus / Species: *Hilsa ilisha* and species group / family: other shads- Genus / Species: other Hilsa species (*tenulosa, macrura and todi*) having length below 23 (twenty three) centimeter and the same is banned.";

(2) after rule 49, *insert* the following rule:–

"50. **Declaration of Hilsa Sanctuary and protection of Hilsa.–** (1) The riverine area in the river Bhagirathi falling (a) between Lalbagh in Farakka (Murshidabad District), (b) Katwa to Hooghly Ghat (part of

Burdwan & Hooghly District), (c) Diamond Harbour to Nischintapur Godakhali and (d) five (5) square kilometer area around the "Sand Bar" located in the river Matla, Roymongal & Thakuran in Sundarbans area and Farakka Barrage are declared as Hilsa Sanctuaries (protected area for Hilsa).

(2) In order to facilitate spawning, all types of fish catching are banned in the Hilsa Sanctuaries during June to August and October to December every year.

(3) Fishing of hilsa is prohibited within five (5) square kilometer of the Farakka Barrage round the year to protect the hilsa species and facilitate brooders spawning in the area.

(4) For the purpose of conservation of juveniles hilsa (jatka / khoka ilish) migrating downstream towards sea, use of bag net, scoop net, lift net and small meshed gill nets {mesh size below one (1) inch} for catching hilsa below 23.0 centimeters in the inland open water system (including estuarine area) is totally prohibited during February to April every year.".

By order of the Governor,

S. K. DAS
Addl. Chief Secy. to the Govt. of West Bengal.

GOVERNMENT OF WEST BENGAL

Fisheries Department

No. 718 Fish/C-1/9R-3/2012 (Part-I) Kolkata, the 4th April, 2013.

ORDER

In exercise of the power conferred by clause (c) and (d) of sub-section (1) of section 4, read with clauses (i) of section 2 of the West Bengal Marine Fisheries Regulation Act, 1993 (West Ben. Act IX of 1993) and in supersession of all earlier order on the subject, the Governor is pleased hereby to issue the following restrictions regulating catching of hilsa with effect from such date as may be specified by the State Government:—

In fishing hilsa (species group / family: Hilsa shad-Genus / Species: *Hilsa ilisha* and species group / family: other shads- Genus / Species: other Hilsa species (*tenulosa, macrura and todi*) in the territorial water body of the State, the following restrictions are imposed:—

(a) For the purpose of conservation of hilsa fish stock in the open water system, no persons or group of persons or fishers or fisherman or their assistants under no circumstances shall catch hilsa (species group / family: Hilsa shad-Genus / Species: *Hilsa ilisha* and species group / family: other shads- Genus / Species: other Hilsa species (*tenulosa, macrura and todi*) using any kind of monofilament gill net / nets having mesh size below ninety (90) millimeter.

(b) For the purpose of conservation of juveniles hilsa (jatka / khoka ilish) migrating downstream towards sea, use of bag net, scoop net, lift net and small meshed gill nets {mesh size below one (1) inch} for catching hilsa below 23 centimeters in estuarine area of the rivers and bay mouth is totally prohibited during February to April every year.

(c) No persons or group of persons or fishers or fisherman or their assistants under no circumstances shall transport, market, sell and possess hilsa (species group / family: Hilsa shad-Genus / Species: *Hilsa ilisha* and species group / family: other shads- Genus / Species: other Hilsa species (*tenulosa, macrura and todi*) having length below 23 (twenty three) centimeter.

(d) For the purpose of conservation of marine (shallow area) biodiversity and habitat, necessary for hilsa survivality and growth, bottom trawling in shallow continental shelf (12 nautical miles) is totally banned.

(e) For the purpose of promoting breeding / spawning, catching of hilsa (species group / family: Hilsa shad-Genus / Species: *Hilsa ilisha* and species group / family: other shads-Genus / Species: other Hilsa species (*tenulosa, macrura and todi*) of any size is completely banned between five (5) days prior & post of the full moon for the period of 15th September to 24th October every year.

By order of the Governor,

S. K. DAS
Addl. Chief Secy. to the Govt. of West Bengal.

Here we have two separate instruments. The first indicates the creation of two new sub rules under the Inland Fisheries Rules 1985 directed at the conservation of hilsa (and

other fish) and the second is an order under the West Bengal Marine Fishing Regulation Act, 1993. The directions are given below in some detail. However, the three principles that cover the bulk of the provisions across these two instruments are as follows:

- Protecting hilsa and *other similar fishes* in the shad group:
- Banning the fishing of Juveniles (jatka)
- Declaring hilsa sanctuaries and banning fishing in these sanctuaries during certain months in the year

Now, we must look at the specific directions in the two documents.

Given the nature of the first instrument, its directions are applicable only to the inland waters. The directions are as follows:

(a) Use of monofilament gill net having mesh size below 90 mm prohibited for catching hilsa and other hilsa species (tenualosa, marcura, and toli)[129] and no fish of whatever variety may be caught using nets of mesh size below 40 mm;
(b) Transporting, marketing, selling or possessing any fish of the hilsa or shad group of length below 23 cm is banned;

Further, a new rule was added declaring the following as hilsa sanctuaries: 1) The stretch of river between Lalbagh and Farakka; 2) Katwa to Hooghly Ghat; 3) Diamond Harbour to Nishchintapur Godakhali; 4) A 5 sq km area around the 'Sand Bar' located in the river Matla, Raimangal, and Thakuran in the Sundarbans area; 5) Similar sand bars near Farakka barrage and banning fishing in these sanctuaries from June to August and between October to December every year. Moreover, the fishing of hilsa is prohibited within 5 km of Farakka barrage to protect and facilitate brooders spawning in the area. Catching jatka by bag net, scoop net, lift net, and small meshed gill nets for catching hilsa below 23 cm is totally prohibited during February to April every year so as to conserve juvenile hilsa migrating downstream towards the sea. It must be mentioned that the length of the stretch from Farakka to Lalbagh, from Kalna to Hooghly Ghat, and from Godakhali through Diamond Harbour to Nishchintapur add up to 318 km (constituting about 57% of the complete meandering riverine stretch

[129] The terminology used is slightly confusing. For example, the hilsa shad is referred to by the scientific name *Hilsa ilisha*, a nomenclature no longer enjoying scientific consensus. Further, 'toli' is referred to as 'todi' and 'tenualosa' is mentioned as an example of another hilsa species. However, the 'Tenualosa' is not a species but a genus and there are no hilsa species known simply as "tenualosa".

from Farakka to Gangasagar), and that the aforesaid ban of 6 months applies to this combined 318 km stretch.

The other document is in the nature of an order under the provisions of the West Bengal Marine Fishing Regulation Act, 1993. Therefore, by implication, its scope is confined to the coastline of the state and extends into the sea up to 12 nautical miles. Moreover, it also extends inwards into the Hooghly up to the northern point of the Rupnarayan's confluence with the Hooghly—the northern marker of the jurisdiction of the ADF Marine (Diamond Harbour). The directions of the order are as follows:

- Use of monofilament gill net having mesh size below 90 mm prohibited for catching hilsa and other hilsa species (tenualosa, marcura, and toli);
- Catching jatka by bag net, scoop net, lift net, and small meshed gill nets for catching hilsa below 23 cm is totally prohibited during February to April every year so as to conserve juvenile hilsa migrating downstream towards the sea;
- The restriction of catch to sizes above 23 cm exactly as in the previous document;
- Bottom trawling in the shallow continental shelf is banned;
- In the period from 15 September to 24 October of each year, hilsa shad or any fish in the shad fish may not be caught from 5 days prior to full moon to 5 days after full moon (including the day of the full moon-i.e. a total of 11 days).

Comments on the nature of the restrictions as articulated in the two documents

As is evident, the two documents, notwithstanding the difference in the spatial jurisdiction are similar in their specifications except that the second prohibits bottom trawling in the territorial waters of India within the jurisdiction of West Bengal—something that is out of question in the case of the first document, as trawlers are not meant to operate in inland waters in any case.

Our take on the instruments are as follows:

- The immediate impression one gets from the text of the directions and the way that they have been framed in great haste. This is apparent in the phrasing and indeed in the very nomenclature of the fishes being targeted (for example, the hilsa shad is referred to by the scientific name *Hilsa ilisha*, a nomenclature no

longer enjoying approval of most fishery scientists. Further, 'toli' is referred to as 'todi', and the 'tenualosa' is mentioned as an example of another hilsa species, which is strange since we know that the 'Tenualosa' is not a species but a genus and there are no hilsa species known merely as "tenualosa").

- The influence of the IUCN study, and to a large extent the BOBLME study, is immediately perceivable in the marking of the hilsa sanctuary areas and prohibiting transport, sale, possession etc. of hilsa or other shad fish of length below 23 cm and in including the 5 sq km area around Farakka barrage within the Hilsa fishing prohibition zone.
- The difference with the Bangladesh regulations is striking. We have seen that among the six Hilsa sanctuaries, the fishing ban period is in March-April in five and only in one sanctuary, on the Andharmanik River and stretching only 40 km, the fishing ban period is from November to January. And, across all sanctuaries, there is a general fishing ban period based on the first full moon of Aswin, as we have seen, and usually stretches to 15 days. In the case of the West Bengal order, however, there is a complete ban *in all the sanctuary areas for six whole months (June to August and October to December)*. Discussions with both fisheries scientists and responsible officers in the establishment indicated that this 6-month ban is without scientific foundation. It goes without saying that any attempt to impose such a ban would have created serious distress and social disturbance. In that sense, it is a blessing that no serious effort was made to impose the ban.
- With regard to the Prof. Ashim Kumar Nath, in his follow up interview, held that a far shorter yet precisely targeted ban would be far more useful. In his opinion, heavily gravid hilsa in the rivers were found in most abundance at two times—ten days before and ten days after Bijaya Dashami and late February to early March. [130] It may be noted that the first corresponds closely to the Aswin full moon-centric phase, falling within the major period of Hilsa migration, and the second is in consonance with the secondary seasonal migration of Hilsa during January-March.

Implementation

[130] Prof Ashim Kumar Nath, follow-up interview on 16.03.2020.

As anybody who knows anything about the situation in question knows, there has been no serious effort to impose the six-month fishing ban. In some areas, there have been occasional efforts to impose restrictions regarding mesh size and juvenile fishing. In fact, as our surveys reveal, there have been no large-scale or comprehensive awareness programmes or efforts to engage with the fishers.

Chapter 7: The artisanal hilsa fishers—some key inputs from studies

As we have mentioned in the very first chapter, the hilsa crisis not only hits consumers, it strikes at the livelihood of hundreds of thousands of artisanal fishers who are dependent for their incomes on hilsa fishing. (The artisanal fishers are even more vulnerable than workers working on mechanized fishing crafts, at least in the short and medium term, because the mechanized crafts have a wide reach and can travel to less depleted areas.) Therefore, any conservation measure must take into account the conditions and concerns of this community (as one expects in a democratic system). Unfortunately, nothing in the conservation measures reflects the concern of the government with the actual incomes and living conditions of the artisanal hilsa fishers.

However, there are a few studies on the livelihood and conditions of the artisanal fishers of West Bengal. We shall mention three studies, two of which were published in 2012 and one other published in 2016—although all the three studies were based on a survey conducted near in time to one another, and essentially before the conservation measures were declared (in 2013).

The Studies

The first study[131] was conducted across 4 specific stations along a 126 km stretch of the river Hooghly. The stations were as follows: Kakdwip (Station 1: South 24 Parganas; not far from the river mouth) Ariadaha (Station 2: District Kolkata), Barrack pore (Station 3: District North 24 Parganas) and Tribeny (Station 4: District Hooghly). It is immediately evident that (if one measures the Bhagirathi-Hooghly River along its meandering course from Farakka) all the points covered by the study belong roughly to the lower stretch of the Bhagirathi-Hooghly. The survey was reportedly done between March 2010 and February 2012. Fishers, subject to availability, were randomly selected. Semi structured and structured interview schedules were used. A total of 100

[131] Ashim Kumar Nath *et al.*, "Socio Economic Aspects of the Fishers Engaged in hilsa Fisheries in Hooghly Estuary of West Bengal, India," *International Journal of Innovative Studies in Aquatic Biology and Fisheries*, 2 (4), 2016, 20-26, doi: http://dx.doi.org/10.20431/2454-7670.0204004www.arcjournals.org.

fishers were personally interviewed across the four aforementioned stations.[132] Some salient features of the study findings are as follows.

The earnings of artisanal fishers

The study found that fishermen used small manually driven boats accommodating 2 to 3 persons. The cost to make such a boat varied from Rs. 20,000 to 30,000. The net used was the gill net. Formerly, this net was made in families but the study found that at that point of time all were machine made. They cost Rs. 800-1200 per kg, according to quality. A small number of fishermen were found operating the *Shangla jaal* (clap trap) for hilsa fishing particularly in the Barrackpore area. Generally boat owners received the larger share of the profit—about 50% to 60% of the profit. The rest was divided among the other fishermen. The fishes came to the market after moving through various channels from the fisher to the whole seller or a commission agent or retailer or local dealer etc. and ultimately to the consumer.[133]

Fish which was available at the rate of Rs. 600 to 1000 per kg in the market was sold by the fishers to the sellers in Rs. 200-600 per kg according to the size and season. The highest demand was on the May- June and in February. The income of the fishers from one boat effort varied from none to Rs. 600 during the survey.

The range of catch and income per day was captured in the following table.[134]

***Range of catch and income data in upstream centres* 2010-11**				**2011-12**			
Monsoon time		Other time		Monsoon time		Other time	
Catch (kg)	Income (Rs.)	Catch (kg)	Income (Rs.)	Catch (kg)	Income (Rs.)	Catch (kg)	Income (Rs.)
0-1.8	0-432	0-1.8	0-600	0-1.8	0-432	0-2	0-600

It is important to note that if all the members of the boat were from the same family and even then only when higher fish catch occurred and market price was better was such income possible. Thus, the income was a matter of various chance factors. During

[132] Nath *et al.*, "Socio Economic Aspects," 21.
[133] Nath *et al.*, "Socio Economic Aspects," 21.
[134] Nath *et al.*, "Socio Economic Aspects," 22.

this study period, it was found that the exact income varied between Rs. 99 to 231/- in a day.

Many of the fishermen needed to engage in other part time professions due to less and uncertain income. During the study, 78.18% of the fishers are found to be full time hilsa fishers. Most of them had their own nets and boats. They were in this profession for many years, many for more than six decades. Around 21.82% of the fishers were part timers. Among the full time hilsa fishers, 16.36% of people were solely dependent upon hilsa catch and had no other options. 74.55% of the hilsa fishers had some alternative job options but all were daily workers and ones with highly uncertain flow of incomes, like masonry, selling other fish, etc. It was found that only 9.09% people have fixed alternative job options.[135]

Another study,[136] also published in 2012, provided the following details about the earnings of the fishers. It divided the main Hilsa fishing population into two geographical categories—those operating between Farakka and Dakshineswar and those operating between Fraserganj and Raidighi.

Regarding those operating between Fraserganj and Raidighi, the study says:

> ...fishers exploit hilsa in groups by hiring mechanised boats which are locally known as Trawlers. As many as 70% of these mechanized boats are (OAL 57-58 ft) fitted with 4-6 cylinder engines (c.105 HP) and 30% are (OAL 31-36 ft) fitted with 12 cylinder engines (c.15 HP). Such mechanized boats generally fish in the marine zones of the estuary i.e., 30 km from the estuarine mouth during monsoon months whereas they go up to 60 km during winter season. Each boat accommodates 8-11 fishers who share the total catch amongst them. They pay 30% of sale proceeds to the boat owner, 30% is spent towards fuel and other wear and tear of the vessel/net & food cost on board. Out of rest of the 40% amount is divided among the co-fishers where 2% more are given to boat and engine drivers. Mostly they operate gill nets of various sizes for exploitation of hilsa. Their income varies between Rs. 5000.00 - Rs. 8000.00 on an average per head per month. Bigger mechanized boats go for fishing for 2-5 days whereas smaller mechanized boats go for daily fishing. In regard to fish catch who goes

[135] Nath *et al.*, "Socio Economic Aspects," 21-22.

[136] Utpal Bhaumik and A.P. Sharma, "Present Status of Hilsa in Hooghly-Bhagirathi River", *Bulletin No. 179*, CIFRI, 2012.

to deeper areas for 2-5 days exploits on an average 200-400 kg per day during July to September, 100-200 kg during October to December and 50-100 kg during January to march, whereas fish catch by boats operating daily exploits on an average 50-70 kg/boat/day during July to September, 30-40 kg/boat/day during October to December and 10-20 kg/boat/day during January to April.[137]

For the fishers in the stretch between Dakshineswar and Farakka, the study reported that the monthly income of fishers varied between Rs. 3,000 and Rs. 6,000 and catch on an average was 1 to 5kg/boat/day throughout the year.[138]

Artisanal Fishing Population

One interesting aspect of the second study is that it provides an estimate of the artisanal fishing population. It says that about 20,930 fishers operated between Frazergunj and Raidighi, whereas about 5,600 fishers operated in the freshwater zones between Dakhineshwar and Farakka.[139] But, the study does not indicate how the figures were arrived at.

The third study

The third study we choose to mention,[140] published in 2016, was reportedly conducted along "523.59 km of the Hooghly-Bhagirathi river system after Farakka Barrage and ten important fish landing centres were selected as sampling sites, viz., Farakka, Lalbagh, Nabadwip, Kalna, Balagarh, Tribeni, Nawabganj, Diamond Harbour, Kakdwip and Frazergunj." The data in the tables provides the following information across a total of 300 fishers on which data is reported:

Age and caste composition[141]

Age composition	**Respondents**
Young age (<32)	31 (10.34%)
Middle age (33-54)	148 (49.42%)
Old Age (>55)	121 (40.33%)
Caste composition	**Respondents**
Scheduled caste	180 (60%)

[137] Bhaumik and Sharma, "Present Status of Hilsa," 35-36.
[138] Bhaumik and Sharma, "Present Status of Hilsa," 36.
[139] Bhaumik and Sharma, "Present Status of Hilsa," 35.
[140] Aparna Roy *et al.*, "Socio-economic and Livelihood Analyses of Hilsa (*Tenualosa ilisha*) Fishers of lower stretch of Ganga River, India," *Indian Journal of Fisheries*, 63(1): 83-88 (2016), doi:10.21077/ijf.2016.63.1.40172-11.
[141] Roy *et al.*, "Socio-economic and Livelihood Analyses," 84.

Scheduled tribe	18 (6%)
Other backward communities (OBC)	78 (26%)
General	24 (8%)

It is immediately seen from the above table that fishers from scheduled castes predominate and, jointly with the sprinkling of fishers from the Scheduled tribes make up about 66% of the total. Once the other backward castes (26%) are added to the mix, we see a whopping 92% of 'lower caste' presence among the fishing population. Since, it is well-known that on an average 'low' caste' position often tends to be significantly correlated with lower formal education attainments, it is no surprise to see the following information.

Educational status

> Most of the hilsa fishers had education up to primary level (41.75%), followed by secondary level (24.36%). On an average 8.32% of the fishers had educational qualification above secondary level and 19.57% of the fishers were found illiterate. According to the census report of 2011, the average illiteracy rate in West Bengal was 22.9% and therefore the illiteracy level of fishers remains lower than the state average.[142]

Socio Economic Profile of the Fishers

The study found that the main occupation of the respondents was fishing. Some of the fishers or their family members also worked as daily wage labourers, agricultural labourers, handicraft workers (spinning), rickshaw pullers, and vendors during off-season. The average annual family income of the fishers was Rs. 67,385/-, and the annual income from hilsa fishing was Rs. 25,385/ in a year.

The study also found that in the Hooghly-Bhagirathi river system, there were two seasons for hilsa fishing; during monsoon i.e., middle June to middle September (Ashar, Sravana, Bhadra as per local calendar) and late winter i.e., middle of January to middle of March (Magh, Phalgun as per local calendar). In upper stretch from Farakka to Dakkhineswar, hilsa fishers generally caught hilsa on small boats in a small group consisting of two to three members. In the upper stretch, the average monthly income during the hilsa fishing season was Rs. 7000/- and here the income sharing pattern among the fishers was as follows: The income from the boat was divided into

[142] Roy *et al.*, "Socio-economic and livelihood analyses of hilsa", 84.

two parts, boat and gear owner took half of revenue, while the remaining 50% was equally divided among the fishers in the boat.

However, the study also found that in the lower or estuarine stretch, from Diamond Harbour to Fraserganj, fishers caught greater quantity of fish. Here, the average monthly income of the hilsa fishers during peak season was also higher than the fishers of upper stretch i.e. 11,000/- during the peak hilsa fishing months.

As per the findings, in Bhagirathi-Hooghly river system, hilsa fishery contributed a significant share to the income of the fishers—about 38.84% per annum (though not spelled out in the report, it is clear that this is supposed to be an average figure—the actual share would vary across fishers and locality).[143]

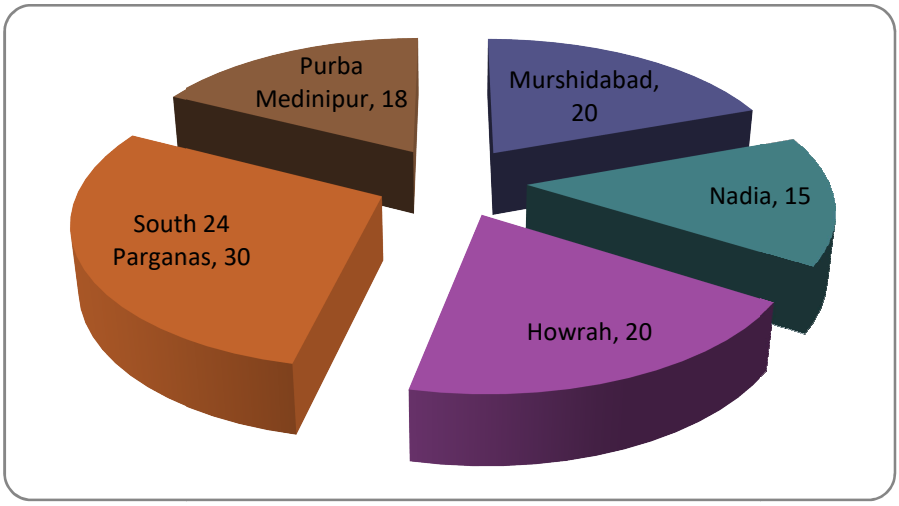
[143] Roy *et al.*, "Socio-economic and livelihood analyses of hilsa", 84-85.

Chapter 8: The community—what our surveys indicate

The surveys in this study were conducted across five key hilsa fishing districts of West Bengal—out of the ten (counting Kolkata) districts touched and blessed by the Bhagirathi-Hooghly. The surveyed districts are Murshidabad, Nadia, Howrah, South 24 Parganas, and Purba Medinipur. The following tables capture the districts and blocks across which the survey was carried out, including the number of people surveyed in each. We skip mentioning the village names, to spare the reader unnecessary detail. However, usually, respondents from a Gram Panchayat were spread across two villages. Only in a few cases, respondents from a Gram Panchayat belonged to either of the two scenarios—only one village or more than two villages.

District	Block	Gram Panchayat	No. of Respondents
Murshidabad	Bhagawangola-II	Kharibona	5
	Jalangi	Sagarpara	5
	Behrampur	Satui Chaurigachha	5
	Lalgola	Bahadurpur	3
	Raghunathganj-II	Sekalipur	2
Total number of Respondents			**20**
Nadia	Nakashipara	Nakashipara	5
	Nabadwip	Mayapur Bamunpukur-II	5
	Krishnanagar-II	Swarupganj	1
	Krishnanagar-II	Belpukur	4
Total number of Respondents			**15**
Howrah	Amta-II	Ghoraberia Chitnan	4
	Amta-II	Bhatora	4
	Bagnan-I	Bakshihat	5
	Bagnan-II	Bantul Baidyanathpur	3
	Shyampur-II	Nakol	4
Total number of Respondents			**20**

South 24 Parganas	Budge Budge-II	Dongaria Raipur [144]	10
	Budge Budge-II	Burul	10
	Diamond Harbour-II	Noorpur	10
Total number of Respondents			**30**
Purba Medinipur	Khejuri-II	Khejuri	4
	Khejuri-II	Nijkasba	2
	Sutahata	Kukrahati	2
	Sutahata	Guaberya	2
	Sutahata	Horekhali	2
	Nandigram-II	Boyal-II	4
	Nandigram-I	Kendimari Jalpai	1
	Nandigram-I	Sonachura	1
Total number of Respondents			**18**
Total number of Respondents across 5 districts			**103**



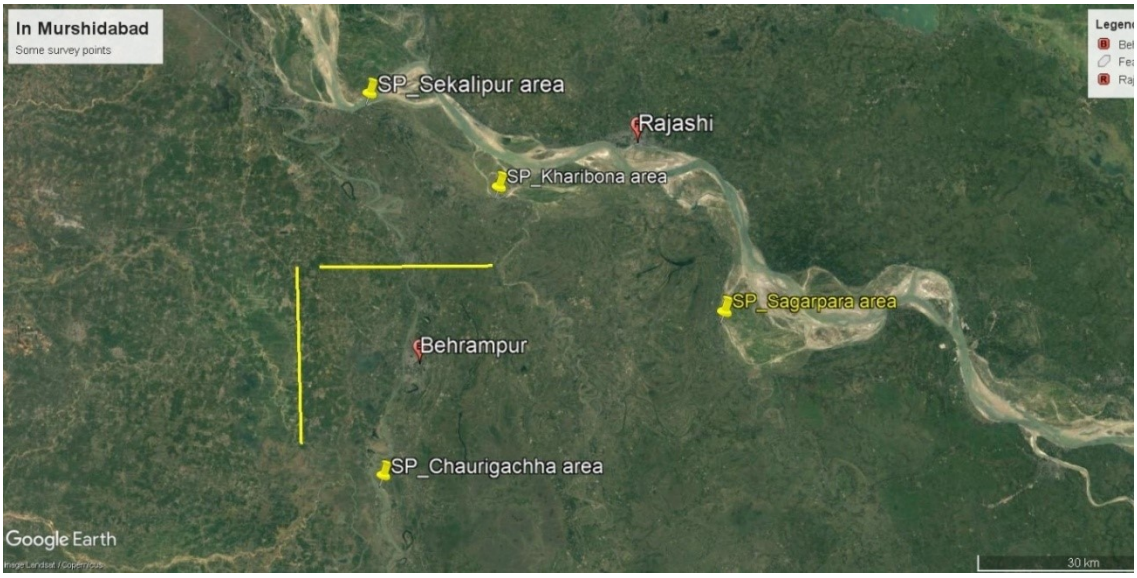
103 fishers across 5 districts

The map location of the respondents

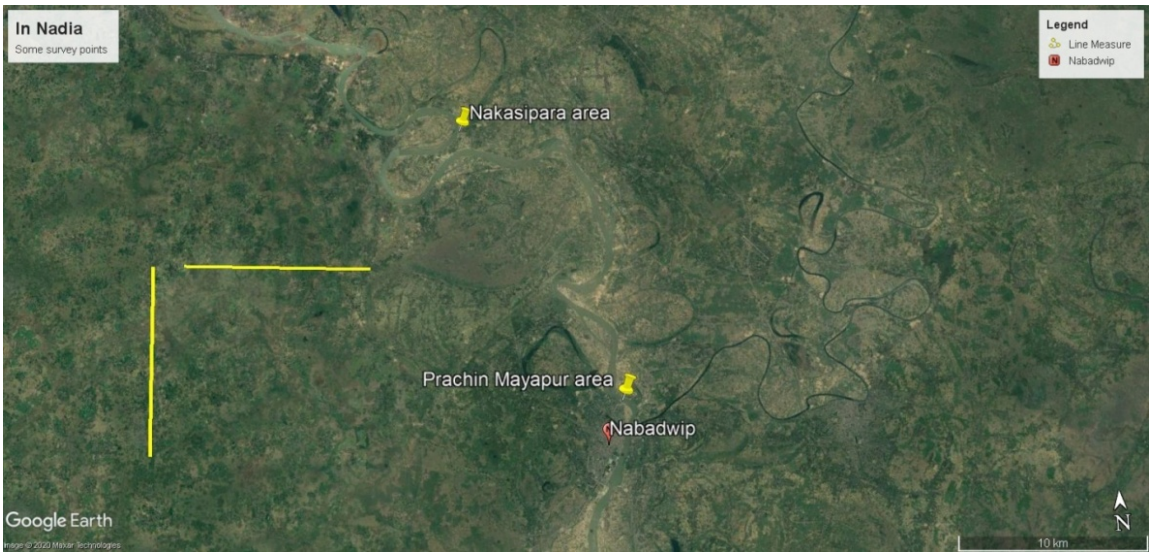
It would be useful to take a look at the overall map location of the respondents, i.e. points where the surveys were conducted. For, Murshidabad and Nadia, the survey locations on the map are based on GPS readings taken during the survey. However, for

[144] Only in Godakhali village.

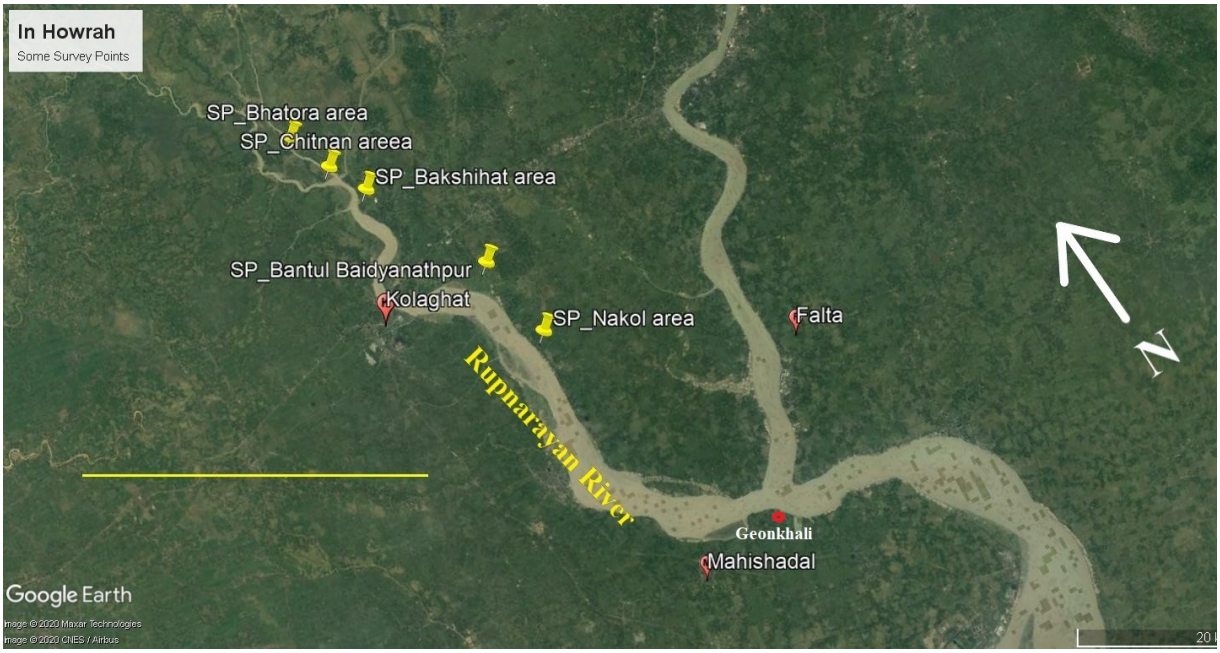
the other districts, the locations, though carefully verified on district maps, are not based on GPS readings and should be taken as reliable but only indicative.



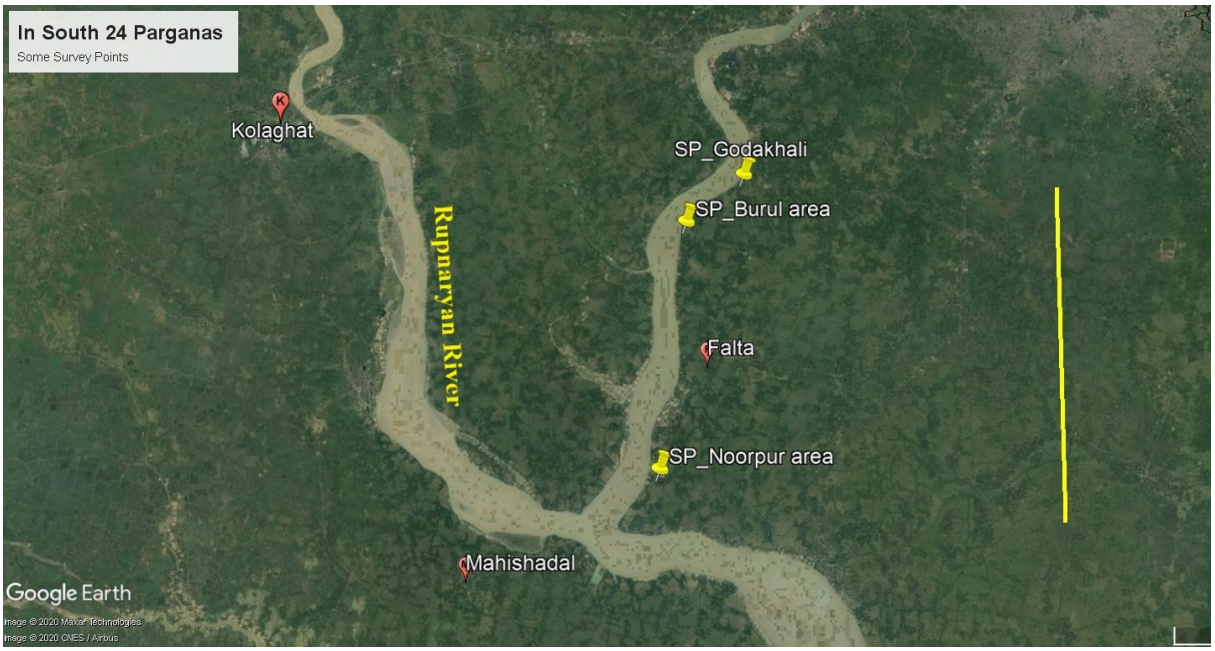
The map shows some of the survey points (SP) in Murshidabad. One may note particularly the three survey points along the stretch of the Padma River in India. The place mark Rajasahi on the other side of the Padma gives an indication of the geographic location of the survey points. The roughly vertical and horizontal yellow lines placed north and east respectively of Behrampur are about 25 km in length, giving an idea of the distances on the map.



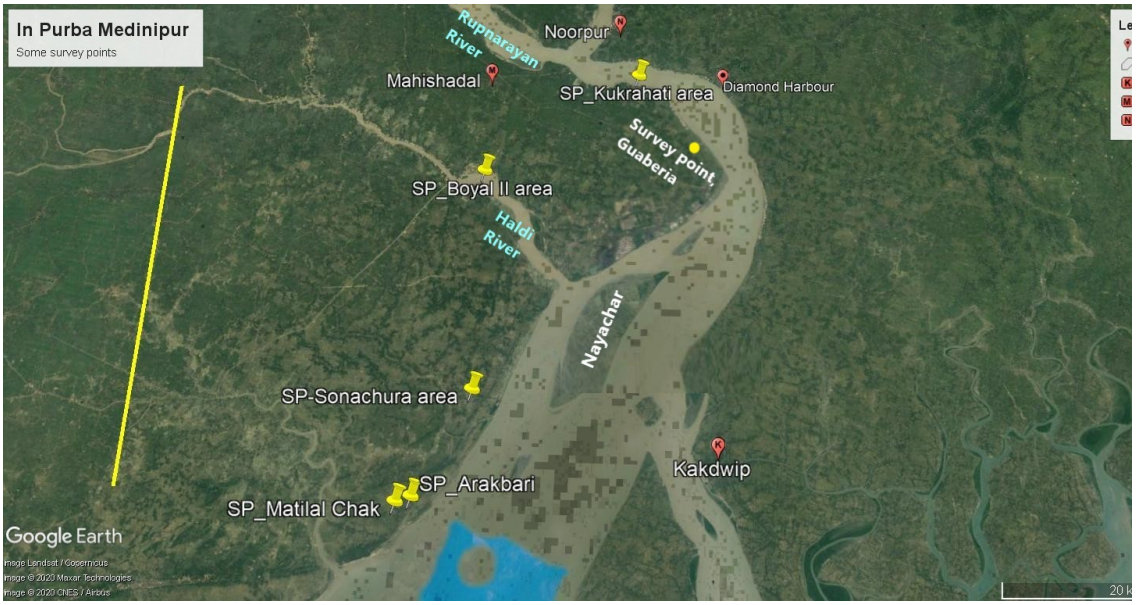
The map shows two of the survey points (SP) in Nadia. The roughly vertical and horizontal yellow lines placed in the left side of the map are about 10 km in length, giving an idea of the distances.



The map has a small anticlockwise tilt indicated by the arrow on the right to give the map the range for which it was meant. It shows some of the survey points (SP) in Howrah. The roughly horizontal yellow line placed in the left of the Rupnarayan River is about 25 km in length.



The map shows some of the survey points (SP) in South 24 Parganas. The roughly vertical yellow line on the right is about 20 km in length.



The map shows some of the survey points (SP) in Purba Medinipur. It is tilted a few degrees clockwise to provide the intended range. The yellow line on the left is almost 40 km in length.

Area of operation of the respondents

The areas of operation were as follows:

In Murshidabad, all fished in their local area. 15 out of the 20 respondents fished at various points (according to the location of their residential villages) on the Indian Padma. The remaining 5 fished on the Bhagirathi in the Chaurigachha area. The boats used were usually 15 to 20 ft long and 6 to 7.5 ft wide dinghies.

In Nadia, all the respondents fished locally, near their localities as indicated in the table and suggested on the map and on the river Bhagirathi.

In Howrah, however, the situation is noticeably different. As a glance at the map of respondents' survey sites in the relevant map will show, the villages of all respondents are on or close to the Rupnarayan River. So, it is no wonder that some of the respondents are local fishers who fish on the river. However, those who fish on the Rupnarayan or at Geonkhali, where the Rupnarayan meets the Hooghly, are only 6 in number. The remaining (14 respondents) go to the sea. This is not to say that they do not participate in riparian fishing, for some of them reported fishing in the Godakhali area and other points on downstream Hooghly. But, the point is that all of them also partake of fishing on the sea. Indeed, only 8 of the 14 had their own boats. Others participated in fishing trips on boats owned by others and even on mechanized boats or trawlers. The artisanal or non-mechanized fishing trips to the sea were near the coast at

various points off the mouth of Hooghly. The geography of mechanized fishing, it goes without saying, extends far beyond.

The respondents from South 24 Parganas appear to be all riparian fishers. The respondents from Godakhali all stated that they fished in the Godakhali area or a few kilometres up or downstream. Similarly, the respondents from Burul also spoke of fishing in Burul and points not too far upstream or downstream. The respondents from Noorpur included Geonkhali and Diamond Harbour into their fishing map. This very limited geographic range is testimony to their artisanal character.

It is no wonder that many of the respondents from coastal Purba Medinipur are sea fishers. In fact, given the geographical outline of the survey in this district, in the case of many respondents, the divide between sea and river fishing is of doubtful value—for their fishing zones are right at the river mouth, where the divide is too fluid to be meaningful. This applies rather strongly to the artisanal fishers of Khejuri, who fish off the eastern edge of the coast off Matilal Chak and Arakbari, in the ill-defined zone where the sea and river contest for territory. Some of them, with larger and motorized boats, venture deeper into the sea, mostly to the area south of Sagar Island. 2 of the 6 respondents from Khejuri reported doing so.

The shoreline of Nandigram I (e.g. Sonachura) is north of Khejuri and that of Nandigram-II (e.g. Boyal-II) is still further north. Thus, 3 respondents from Nandigram-II reported that they usually fished near the mouth of the Haldi on Hooghly and southwards, while one reported fishing largely in the sea, preferring the zone southwards from Sagar Island. The 2 respondents from Nandigram-I spoke of fishing mostly in the marine zone southwards from Sagar Island.

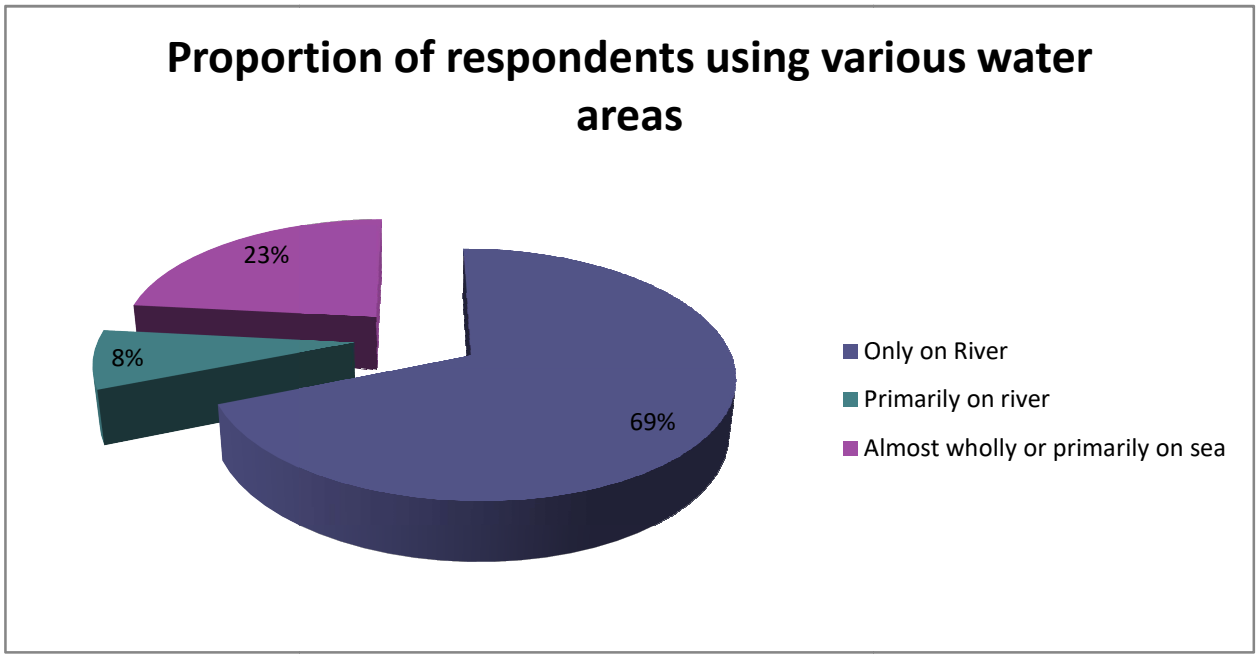
Only 1 out of the 6 respondents from Sutahata said his boat was only into riparian fishing on the Hooghly. The remaining 5 reported fishing in the river, the river mouth, and the sea (preferring the marine zone south of Sagar Island).

District	Respondents	Fishing on River	Fishing on Sea
Murshidabad	20	20 (only on River)	0
Nadia	15	15 (only on River)	0
Howrah	20	6 (only on River)	14 (wholly or primarily on sea)
South 24 Parganas	30	30 (only on River)	0

Purba Medinipur	18	8 (primarily on river)	10 (almost wholly or primarily on sea)

Water Areas Exploited	Numbers	As percentage of the total
Only on River	71	68.93
Primarily on river	8	7.77
Almost wholly or primarily on sea	24	23.30
All	103	100.00

The share of respondents using a particular water area as a percentage of the total number of respondents is captured in the broken pie below.



The basic demographic characteristic of the respondents

The basic demographic profile of the respondents tells us a great deal about the community in question and indicates the essential characteristics and intrinsic vulnerability of the community.

Religious identity and Sex

We begin with these categories not because of any intrinsic priority of significance attaching to them but because they do not bear on the specific nature of the analysis in

this study in any significant way and it is important to see what they indicate and then move on with the more substantively relevant portions.

The district-wise profile is as follows:

District	No. of respondents	Hindu	Muslim	Any other religion	Male	Female
Murshidabad	20	16	4	0	20	0
Nadia	15	15	0	0	15	0
Howrah	20	20	0	0	20	0
South 24 Parganas	30	30	0	0	28	2
Purba Medinipur	18	18	0	0	17	1
All	103	99	4	0	100	3

As the last row indicates, the respondents are overwhelmingly male and Hindu by religious affiliation. This should call for some explanation.

As William Hunter observed, traditionally, fulltime fishers tended to be Hindus. Muslims stuck close to the land and tended to take up fishing occupations mostly on a part-time basis, largely as complementary to their other incomes.[145] Even today, traditional fishers in Bangladesh who fish as their fulltime occupation, tend to be Hindus.[146]

In West Bengal also, the traditional fishing population tends to be Hindus, although there are a small number of fulltime Muslim fishers in various parts of the State. *In fact, the proportion of fulltime Muslim fishers is likely to be somewhat (though not too much) higher than that reflected in this survey*. The possible reason of this has been covered under the methodology section of this study.

The poor representation of women is more easily explained. The survey was being conducted among fulltime boat fishers in Bhagirathi-Hooghly and Indian Padma River. This is a wholly male affair (unlike in certain portions of the Sundarbans, where women take boats out to fish on a significant scale). The three women respondents who have been included have been included because though they are not actual fishers, they are the boat owners and actively involved in the business.

[145] See, for example, http://en.banglapedia.org/index.php?title=Fisherman

[146] Md Rezaul Islam, "Livelihood of the fishermen in Monirampur Upazila of Jessore district, Bangladesh," *Journal of Fisheries* 1 no. 1 (December 2013): 38.

Age

There were 20 respondents from Murshidabad. The mean age of the respondents is 46. Interestingly, the median age is also 46, indicating an almost symmetric distribution. Another important feature is that both mean and median are in the mid 40s. A related feature is 12 out of the 20 respondents, i.e., 60%, are above 40 years of age.

There were 15 respondents from Nadia. The mean age of the respondents is 48.6. The median age is 47.8, again indicating a close to symmetric distribution. 13 out of the 15 respondents, i.e., almost 87%, are above 40 years of age, with 9, i.e. 60%, being above 45 years.

There were 20 respondents from Howrah. The mean age of the respondents is 50. The median age is 49, a predominantly symmetric distribution. 13 out of the 20 respondents, i.e., 65%, are 45 years of age or above.

A very interesting age profile comes from South 24 Parganas. As we can see from the table in the previous page, the survey was conducted at three sites, all important hilsa fishing sites, namely Dongariya Raipur (specifically Godakhali village), Burul, and Noorpur. Since there were a sizeable number of respondents (10) from each, we shall look at their age profiles separately.

There were 10 respondents from Dongariya Raipur (specifically Godakhali). The mean age of the respondents was 28 and the median 26, indicating both symmetry and the predominance of the younger section. Indeed, there was only 1 respondent above the age of 40.

Among the 10 respondents from Burul, the mean age was 38 and the median 39. However, there were just 4 respondents above the age of 40. On the other hand, there were 3 in their 20s, 2 in their 30s, and one was 40 years of age.

Among the 10 respondents from Noorpur, the mean age was 34 and the median 29. There were just 3 respondents above the age of 40.

The central tendencies and 40 upwards numbers for the three locations as a whole is as follows. The mean is 33, the median is 30, and the number of fishers of age 40 or above is just 9.

Now let us look at the data for Purba Medinipur.

There were 18 respondents from this district. The mean age of the respondents was 46 and the median age was 44, indicating a largely symmetric distribution. 13 out of the 18 respondents, i.e., 72.22%, are 40 years of age or above. So, with Purba Medinipur, we are back to the higher age figures. We shall explore a possible explanation of lower age figures for the Godakhali, Burul, and Noorpur area.

Caste

District	Caste and Caste Category		Number
Murshidabad	**Caste**	**Caste Category**	
	Malo	SC	12
	Namashudra		2
	Rajbanshi		2
	Caste not mentioned (Muslim)	OBC	4
	Total		**20**
Nadia	Malo	SC	7
	Namashudra		7
	Muchi		1
	Total		**15**
Howrah	Rajbanshi	SC	13
	Dule		3
	Bagdi		2
	Jeliya Kaibarta		2
	Total		**20**
South 24 Parganas	Jeliya Kaibarta	SC	29
	Was unable to mention the specific tribal community	ST	1
	Total		**30**
Purba Medinipur	Bagdi	SC	7
	Jeliya Kaibarta		7
	Sabar		1
	Pod		1
	Unable to specify caste	General	2
	Total		**18**

The data above is self-explanatory. There is a overwhelming predominance of castes in the SC category in all the districts—96 out of a total of 103 respondents (93%). There were 4 respondents in the OBC category, 2 from the General Category, and only 1 belonging to the ST category.

The presence of the traditional fishing Malo caste is noticeably present in Murshidabad and Nadia, 19 out of a total of 35 respondents across those two districts. These two districts also show significant presence of the Namashudra caste in fishing—a caste that has been rather flexible in the choice of professions in the manual

work category. Another similar caste is the Rajbanshi, dominantly present in Howrah and slightly present among the respondents from Murshidabad. The other traditional fishing caste, the Jeliya Kaibarta, is overwhelmingly present among respondents from South 24 Parganas and also stoutly present in Purba Medinipur.

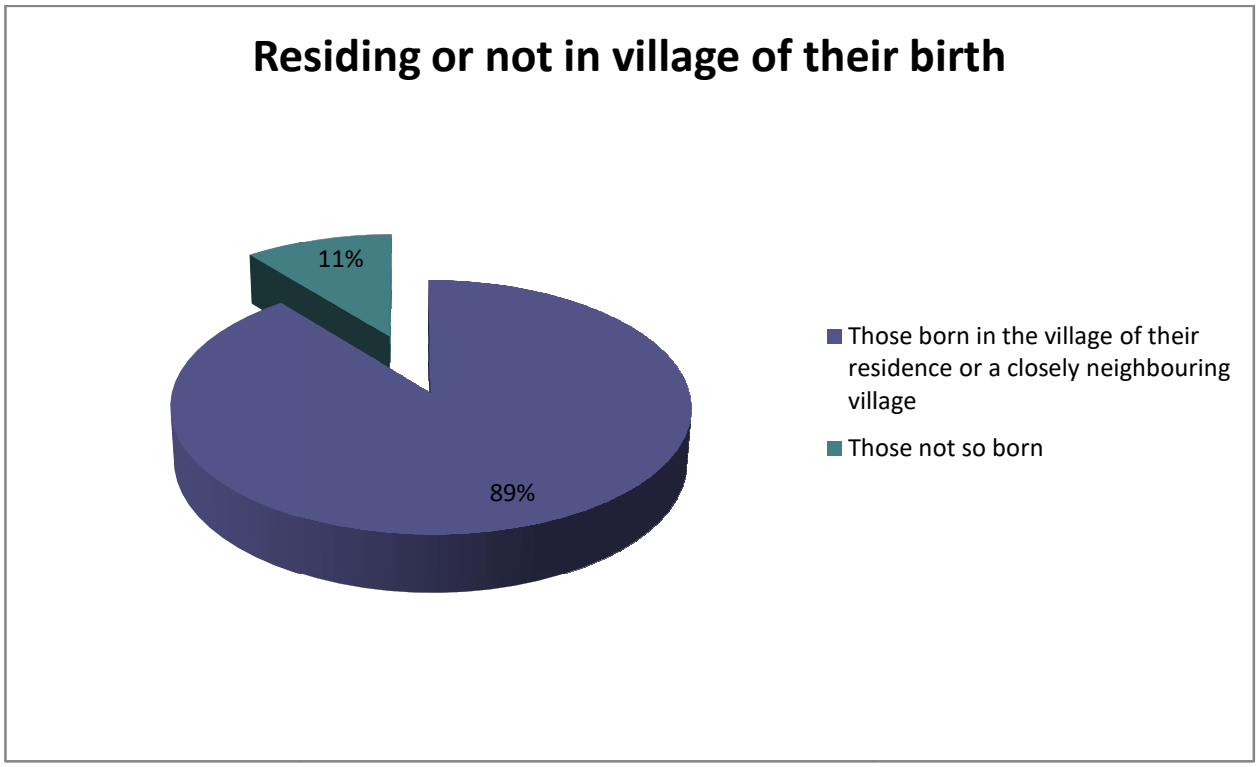
The traditional nature of the community and the degree of rootedness

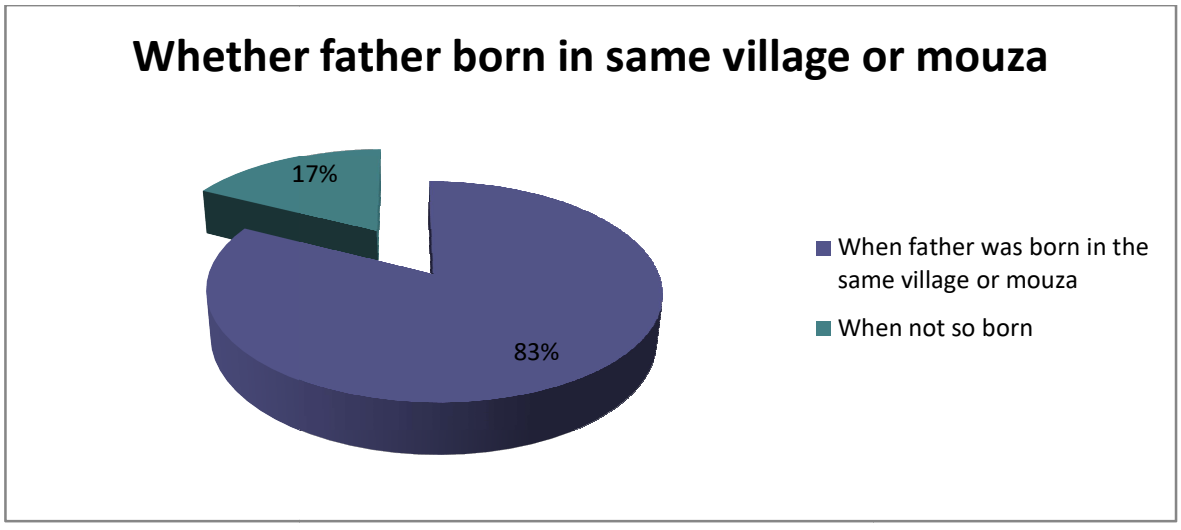
One indicator of the persisting traditional nature of a community is either absence or low degree of geographical mobility across generations. In our case, this was tested for the respondents by asking whether they were born in the village they were residing and whether their father was also born in the same or nearby village (within a few Km). Importance was given to the birthplace of the father than that of the mother because, in the communities in question, the latter customarily came to live with the former (or his family), rather than the reverse. Often the nearby village turned out to what was earlier just another part of the same village but, with rise in population, had become a different village. The following table sums up their responses.

District	No. of respondents	Those born in the village of their present residence or a closely neighbouring village	When father was born in the same village or mouza	Remarks
Murshidabad	20	15	5	Appears to indicate high incidence of migration across generations. However, all those who were not born in the same and neighbouring village and/or those whose parents were not born in the same or neighbouring village were migrants from East Pakistan (or whose fathers were such migrants). Moreover, all those whose parents were migrants were Malo, except for three, two of whom were Rajbanshi, a caste traditionally associated with fishing, though not exclusively.
Nadia	15	12	14	As the previous remark might lead one to expect, all those who were not born in the village of their birth or neighbouring village or whose fathers were not born thus, were migrants from East Pakistan (or whose parents were such migrants); moreover all such respondents were Malo or Namashudra (another caste traditionally associated with fishing, though not exclusively).

Howrah	20	19	20	
South 24 Parganas	30	29	29	The only case where the father was not local was in the case of the woman respondent from this district who had been married into the village in which she currently resides
Purba Medinipur	18	17	17	The single shortfall is in the case where the respondent does not know where his father was born
All	103	92	85	

The overall breakup is presented in the sliced pies below:





Boat-ownership

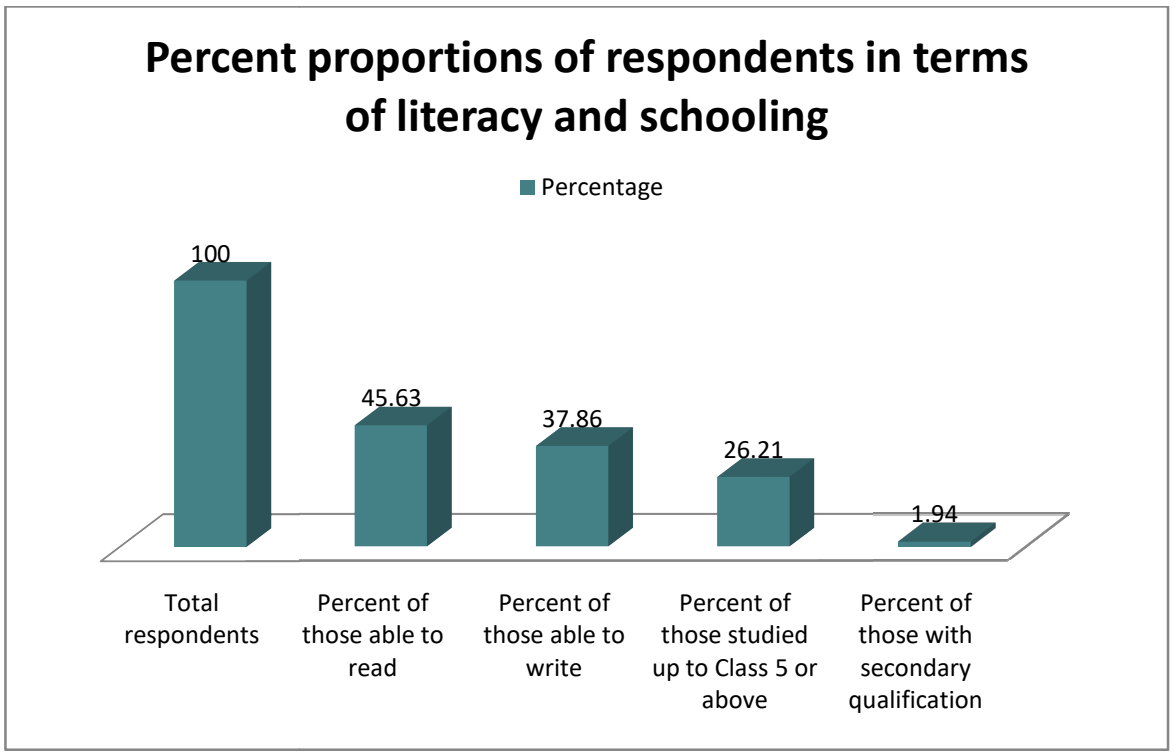
Boat-ownership does not necessarily preclude engaging in other part-time engagements, nor does it prevent a fisher to give up his own profession. However, more often than not, among artisanal fishers, boat ownership is symptomatic of commitment to the profession. Therefore, the survey, in trying to target full-time fishers, has come to focus on boat owning fishers as they are the ones more firmly tied to their profession. However, there are traditional artisanal fishers who do not own boats but engage in fishing as the major source of their livelihoods. These fishers go fishing as crews or partners on the boats of others, on payment of a wage or a share of the profits, perhaps more frequently the latter than the former, as suggested in other surveys. The present survey hasn't looked closely at the nature of the remuneration but has rather concentrated on the ownership status. The following figures indicate ownership status among the respondents across districts.

District	No. of respondents	Boat owners	Non-boat owners
Murshidabad	20	18	2
Nadia	15	11	4
Howrah	20	15	5
South 24 Parganas	30	24	6
Purba Medinipur	18	18	0
All	103	86	17

Literacy and schooling

District	No. of respondents	Number of those able to read	Number of those able to write	Number of those studied up to Class 5 or above	Number of those with secondary qualification
Murshidabad	20	9	5	5	0
Nadia	15	5	5	5	0
Howrah	20	7	7	3	0
South 24 Parganas	30	11	10	9	1
Purba Medinipur	18	15	12	5	1
All	103	47	39	27	2

Focusing on the last row we have (with **total no. as 103**) the following percentages:



The proportion of those that completed primary school (Class 5 or above) and the negligible proportion of those with secondary qualification considered in tandem with the caste profile is a telling indication of the poor enablement and vulnerability of the community in question.

Occupation of the respondents

In Murshidabad, *none* of the respondents reported any significant occupation other than fishing.

In Nadia, only 1 respondent had significant additional income from handloom weaving.

In Howrah, only 2 respondents had significant additional incomes—both from fish farming in their ponds. All others are fulltime capture fishers, with no significant source of alternative income.

In South 24 Parganas, however, 20 out of 30 respondents, declared significant additional incomes. Most of these fishers declared "employment as labourer in lifting silt and sand from river beds" as an important side engagement. The second most popular option seemed to be *zari* work.

In Purba Medinipur, 12 out of 18—i.e. 67%—respondents declared that they had no significant income from a source other than fishing. The rest spoke of various sources of additional income. 4 mentioned working as a day labourer and the remaining two spoke of cultivating self-owned land. (Fishers, more often than not, have small patches attached to their households, which accounts for a small amount of kitchen supply and, occasionally, a little income. However, such cases have not been taken into account, as this is usual for most rural working families irrespective of profession, and, while it makes a difference to the quality of nutrition, is of little significance as a source of income.)

Household size

Family or household size, of course, is an important community characteristic and determines many things, including the family's vulnerability in many ways. Large households can have benefits but must be supported by commensurate income. Often in low income and low income-opportunity situations, small households are more preferable to larger ones.

In the data below, we are considering a household and not a family *per se*. A 'household' has been taken to mean those who share the same kitchen. It should not be confused with family, particularly, if the family is seen to mean a nuclear unit. For example, our survey data on Purba Medinipur fisher households shows a larger frequency of relatively large households, e.g. of 6 or 7 members. However, this simply implies multi-generational presence—of a grandfather or grandfather or both and even, occasionally, an uncle or two.

The family sizes of the respondents are reflected in the following figures:

District	Number of respondents	Max Size of largest family	Min Size of the smallest family	Mean family size	Median family size
Murshidabad	20	7	2	4.25	4
Nadia	15	6	2	3.33	3
Howrah	20	7	2	5.25	5.5
South 24 Parganas	30	7	3	4.1	4
Purba Medinipur	18	8	3	5.8	5

Of incomes

Now, we come to the most tricky part—fishers' incomes. Now, getting data on actual incomes from word of mouth of respondents is difficult and there are careful procedures to be followed to get the estimate right or close enough. This research did not have the requisite personnel for that kind of estimation. Based on what the fishers said about their monthly incomes and expenditures and based on what they felt were their average daily incomes and expenditures, the following data was arrived at.

Family income from fishing (Rs.)			
District	**During the months hilsa was available in quantities deemed significant by the fisher**		**During the months when hilsa was not available in quantities deemed significant by the fisher**
Murshidabad 20 respondents	1 person reported 13,000		1 person 10,000
	7 persons reported 10,000-10,500		14 persons 6000 to 6500
	11 persons reported 9,000 to 9,500		6 persons reported 4000 to 5000
	1 person reported 8,000		
Nadia 15 respondents	1 person reported 13,000 to 14,000		1 person reported 10,000
	4 persons reported 10,000-12,000		9 persons reported 6,000 to 6,500
	6 persons reported 9000, to 9,500		4 persons reported 4,000 to 5,500
	4 persons reported 7,500 to 8,000		
Howrah 20 respondents	1 person 15,000		1 person reported 10,000 for
	3 persons 13,000 to 13,500		
	6 persons 11,000 to 11,500		8 persons reported 7,500 to 8,500
	3 persons reported 9,000 to 10,000		
	4 persons reported 5,000 to 6,000		6 persons reported 5,000 to 7,000
	2 persons reported 4,000 to 4,500		5 persons reported 3,500 to 4,500
South 24 Parganas 30 respondents	10 persons 6 persons reported 21,000 to 25,000		6 persons reported 9,000 to 10,000
	12 persons reported 17,000 to 20,000		11 reported 7,000 to 8,000
	6 persons reported 10,000 to 15,000		7 persons reported 6,000 to 6,500

	2 persons reported 8,000 to 9,000		9 persons reported 4,000 to 4,500
Purba Medinipur 18 respondents	1 person reported 38,000		1 person reported 15,000
	4 persons reported 30,000		3 persons reported 11,000 to 12,000
	2 persons reported 15,000 to 20,000		2 persons reported 7,000 to 8,000 for
	5 persons reported 11,000 to 12,000		6 persons reported 4,500 to 5,000
	4 persons reported 8,000 to 10,000		3 persons reported 3,500 to 4,000
	2 persons reported 5,000 to 7,000		1 person reported 2,500

As we can see, the most frequently reported incomes (which one might call incomes in the modal range) of the fishers are:

Most frequently reported Family income from fishing (Rs.)			
District	**During the months hilsa was available in quantities deemed significant by the fisher**		**During the months when hilsa was not available in quantities deemed significant by the fisher**
Murshidabad	9,000 to 9,500		6000 to 6500
Nadia	9,000 to 9,500		6,000 to 6,500
Howrah	11,000 to 11,500		500 to 8,500
South 24 Parganas	17,000 to 20,000		7,000 to 8,000
Purba Medinipur	11,000 to 12,000		4,500 to 5,000

Now, let us combine this with mean and median fisher family sizes from the districts.

District	**During the months hilsa was available in quantities deemed significant by the fisher**		**During the months when hilsa was not available in quantities deemed significant by the fisher**	**Mean family size**	**Median family size**
Murshidabad	9,000 to 9,500		6000 to 6500	4.25	4
Nadia	9,000 to 9,500		6,000 to 6,500	3.33	3
Howrah	11,000 to 11,500		500 to 8,500	5.25	5.5
South 24 Parganas	17,000 to 20,000		7,000 to 8,000	4.1	4
Purba Medinipur	11,000 to 12,000		4,500 to 5,000	5.8	5

One sees that except for the fisher households in the South 24 Parganas, the most frequently reported incomes even in the hilsa season are grossly inadequate for the household.

Debts

An interesting aspect of the economic situation of the fishers is indicated by their debt profile.

District	No. of respondents	How many take loans	Source of loan: institutional, like bank or SHG	Non-institutional /private like wholesaler or moneylender	Has loan outstanding at the time of survey	% of respondents with loans	% of those with debts with loan outstanding
Murshidabad	20	20	12	8	20	100	100
Nadia	15	15	12	3	15	100	100
Howrah	20	12	4	8	12	60	100
South 24 Parganas	30	25	0	25	23	77	92
Purba Medinipur	18	17	15	2	14	78	82
All	103	89	43	46	84	82	94

The above figures are self explanatory.

Chapter 9—What the fishers do and don't, and know and do not know

All fishers across districts said that they used monofilament gill nets to catch hilsa. Most said that they targeted hilsa largely during two periods—during the Monsoon season, continuing up to October, and roughly in the period from January to March.

Fisherman on the Padma near Sekalipur, Murshidabad, with monofilament gill net

However, many fishers said they also caught other fish when hilsa was not available. Therefore, such fishers caught fish all around the year, provided they were not engaged in other occupation.

All fishers in Murshidabad and Nadia said that fishing was their round the year occupation. In Howrah, however, 13 out of the 20 fishers said that they caught fish other than hilsa and that they fished more or less around the year. However, 7 out of 20

said that they were primarily hilsa fishers and did not usually catch other fish. However, 4 of those did not have boats and went out to fish on others' boats, including on different kinds of mechanized boats, which implies participation in all kinds of fishing and not only hilsa.

The fishers of South 24 Parganas also said that they targeted hilsa during the major and minor hilsa season and during other parts of the year (mostly from November to mid January and from April to mid June) they used other nets (including behundi or bag net) to target other fish. *Bhola*, *Phyasa*, *Topse*, and shrimps dominate their catch during the non-hilsa months.

Similarly, the fishers from Purba Medinipur also declared that they caught other fish during the non-hilsa season, particularly mentioning the Bangla months of Kartik, Agrahayan, and Paush—i.e. from mid October to mid January. However, occasionally (as happened, this year, in 2020), hilsa, particularly smaller sized ones, became available in large numbers in January, when the fishers immediately switched to hilsa fishing.

Unlike in previous surveys (reported earlier), this survey did not try to estimate the proportion of the fishers' income from hilsa, as distinct from other fish. However, general discussions seemed to indicate that hilsa brought in more income than other fish and was coveted. It also seemed to emerge that hilsa dominated incomes more in South 24 Parganas, Purba Medinipur, and Howrah than it did in Murshidabad and Nadia, where the hilsa find was less.

Mesh sizes

The fishers were asked about the mesh size of their nets. The most frequently reported mesh size ranges (from more than 90% respondents) from each district were as follows:

District	Mesh size range (inches)	Mesh size range (mm)
Murshidabad	4 to 6 inches	101.6 to 152.4
Nadia	4 to 6 inches	101.6 to 152.4
Howrah	2.5 inch to 4 inches	63.5 to 101.6
South 24 Parganas	2.5 inch to 3 inches	63.5 to 76.2
Purba Medinipur	3 to 4 inches	76.2 to 101.6 mm

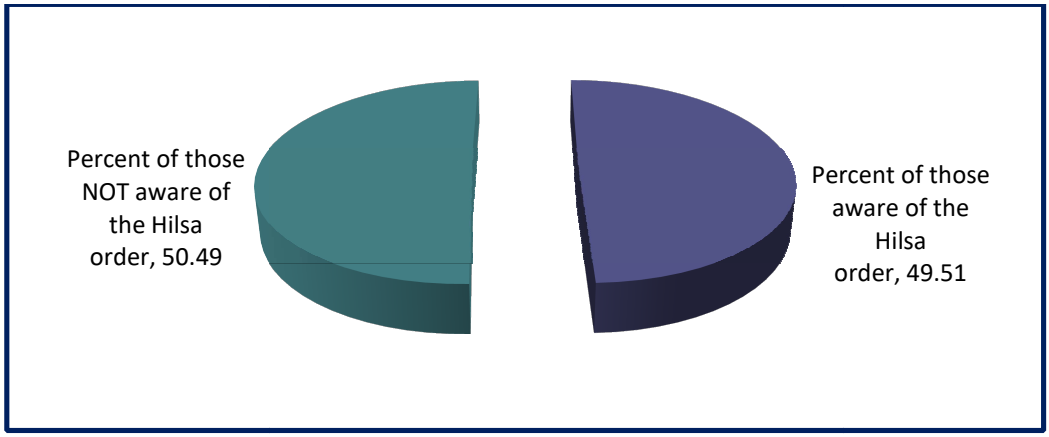
It must be noted, however, that the above refer to gill nets for hilsa. The fishers often also use behundi (bag) nets for other fish. Such nets are widely used in summer, winter, and late winter. Such nets are widely used in the estuarine waters (as testified by the survey responses from the fishers from South 24 Parganas) and also at the river mouth, as emerged during the FGDs, for catching shrimps and other fish. And, as we know from the literature, the journey to the sea of the juvenile hilsa (spawned during the major or minor hilsa season) takes place across several months, including winter and summer and they get caught in the bag nets—where the shape of the net and the miniscule mesh sizes at the tapering rear ensures that large mesh sizes at the front end does not make much difference.

Awareness of government order

Were the fishers aware of the government order and notification restricting the catching of hilsa? Let us look at the responses.

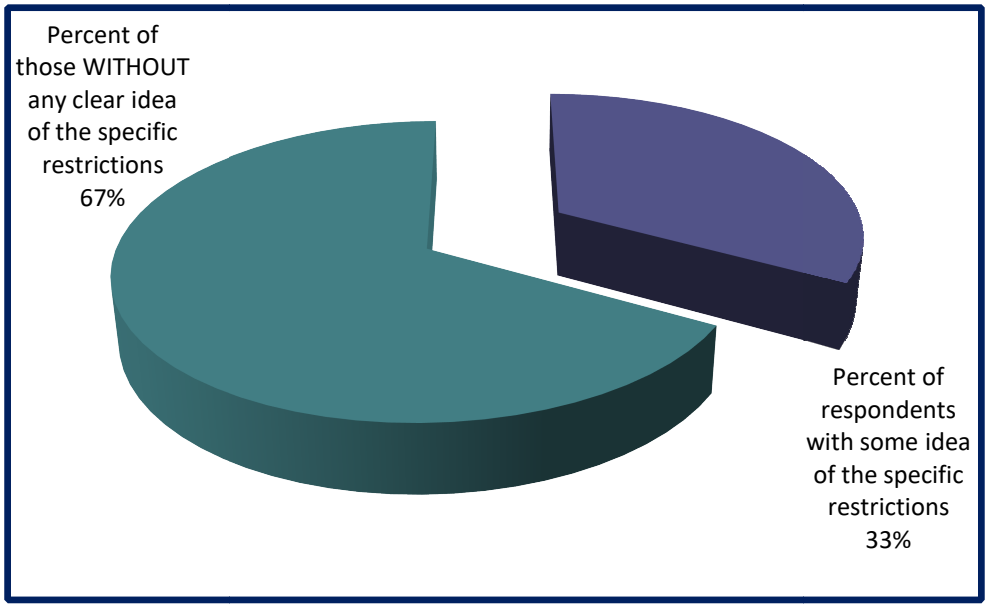
District	No. of responses	No. of those who were NOT Aware	No. of those who were aware	What did they know about the contents of the order?			How did they come to know		
				Restriction on catching Juvenile hilsa	Sanctuary declared	Anything else (size or weight or time of year)	Word of mouth	Awareness campaign	Other sources (e.g. newspaper, radio)
Murshidabad	20	17	3	3	0	0	3	2	0
Nadia	15	12	3	3	0	0	2	2	0
Howrah	20	5	15	15	0	11	13	1	2
South 24 Parganas	30	14	16	16	0	9	7	8	1
Purba Medinipur	18	4	14	14	0	14	12	2	0
All	103	52	51	51	0	34	37	15	3

As we can see that those who were not aware of the hilsa order is equal to (even marginally more than) those who were aware of the order.



Knowledge of the hilsa order

All of those who knew about the order knew at least that it contained restriction on catching hilsa. However, only 34 out of the 51 who knew had some specific idea of what the restriction was about in terms of mesh size or weight. Therefore, the share of the respondents with some concrete and correct information regarding the specific nature of the restrictions is reflected by the following broken pie:



Those with and those without concrete information

It is also revealing that those with concrete information had **no information** about hilsa sanctuaries. This is also borne out by another set of responses—those that pertain to the source of information. As we can see that of those who knew, most (37 out of 51) knew from other persons. Only 15 out of 51 testified of having being exposed to awareness campaigns. Therefore, if our samples are in any way indicative, then it is

safe to say that only a small proportion of hilsa fishers have received the benefit of awareness campaigns. We shall have more to say regarding this. Right now, let us move on to something else.

Hilsa spawning season according to the opinion of the fishers

Respondents were asked what according to them the spawning season of the hilsa was. There replies were as follows:

	Does not know or uncertain	Autumn *Aswin-Kartik* (15 Sep-15 Nov range)	Monsoon *Ashadh-Sravan* (15 June to 15 August range)	Spring *Phalgun* (mid Feb to mid March)	Any other specific time	Round the year
Murshidabad	9	7	2	0	0	2
Nadia	11	3	0	0	1	0
Howrah	0	16	10[147]	6[148]	0	0
South 24 Parganas	9	2	19	0	0	0
Purba Medinipur	2	12	0	6	0	0
All	**31**	**40**	**31**	**12**	**1**	**2**

It is interesting that the majority of responses (40) are close to what the studies on hilsa indicate about the major spawning season of hilsa. A substantial number of responses also tally with the studies suggest about the minor spawning period for hilsa and a significant number of responses tally with both.

[147] Many of these indicated several periods for the spawning of hilsa.

[148] As above.

Chapter 10: The Focused Group Discussions (FGD)

What emerged from the FGDs—Highlights

As recounted before, FGDs were conducted as follows:

- At Diamond Harbour, South 24 Parganas District, on 12 September 2018.
- At Kanthi (Contai), Purba Medinipur District, on 25 September 2018.
- At Godakhali, South 24 Parganas District, on 26 September 2018.
- At Nakol, Shyampur II Block, Howrah District, on 12 November 2018
- At Jagannathpur, near Uluberia, Howrah District on 06 July 2019.

A view from the Ghat at Jagannathpur

A moment during the FGD

As recounted before, FGDs were conducted as follows:

Surprisingly, or perhaps not so surprisingly, the themes common across all these FGDs were:

1. Fish catch had been generally decreasing during the last decade or more, with an occasional bountiful year.
2. In most areas of the river where one expected to get fish, there was fierce competition for fishing space.
3. The fishers largely blamed marine overfishing by mechanized craft and particularly trawlers (i.e. those using trawl nets, which were often described as 'trawlee' to distinguish them from other mechanized crafts) for the hilsa crisis.
4. They also blamed overfishing at the southernmost portions of the estuary.
5. They further blamed the juvenile fishing and general fishing using tiny-meshed or zero-meshed nets for reduction of catch.
6. The fishers said they used nets of 85 to 100 mm mesh size for hilsa; however, many of the fishers conceded that when catch became unavailable, they used nets of mesh size 60 to 65 mm to get hilsa of 100 to 150 gm; they said that they would not be able to survive if they were to avoid small-sized hilsa completely.

In addition to the above, the FGDs bring out the preparedness of the fishers for drastic actions against destructive activities like using poisons for fishing. The fishers were agreeable to implementable restrictions on juvenile fishing, banning of zero-meshed nets and brief period of bans targeting spawning periods, *provided the latter was accompanied by adequate compensations*—which they felt must be equal to their average earnings for that period. In the FGDS in the areas where fishers were acquainted with marine fishing, the participants repeatedly insisted on the need to seriously restrict marine depredations and destructive fishing.

Chapter 11: Summing up

This study came in response to the order and notification of 2013 on hilsa conservation in West Bengal.

Although dating back to 2013, there was no serious effort on the part of the administration to implement the measures spelled out in those instruments. It was only in subsequent years that some awareness programmes were launched and some feeble efforts were made to strongly discourage the fishing and sale of juvenile hilsa. However, as has been specifically noted in this work, not only had the fishers at no point been a party to their conception and designing, they came to have an inkling of these legal instruments much later and this, along with basic problems in the contents of these instruments, made implementation hugely problematic, in more ways than one, even setting aside the question of half-heartedness behind the measures.

The detailed discussions in the preceding chapter bring out some concerns and arguments. These might be summed up as follows:

Conservation efforts in Bangladesh and West Bengal

1. Hilsa conservation is a very important economic and livelihood concern in Bangladesh. Therefore, there is little wonder that the threat of declining catch became a major national issue and resulted in attempts to conserve hilsa. It is also heartening to observe that, at least on the face of it, the results have led to their desired goals—increased sustainability and better production prospects.
2. As compared to Bangladesh, hilsa plays a far smaller role in West Bengal's economy. This is possibly the reason that conservation efforts have been relatively half-hearted.
3. Nevertheless, hilsa is a major cultural icon in West Bengal, and has played an important role in its economy. Indeed, in terms of livelihood, studies show that hilsa contributes significantly, even majorly, to the livelihood of tens of thousands of fishers in West Bengal.
4. Therefore, hilsa conservation is in the best interests of the people of this state. It is also in the interests of the fishing community hugely dependent on it.

The IUCN moment

1. It so happened that the IUCN came to play a substantial role in inspiring a conservation-targeted project across Bangladesh and West Bengal during 2010-14, under the Ecosystem for Life (E4L) programme. The hilsa featured prominently in this inter-country programme across Bangladesh and India. The programme prominently included a research project on hilsa migration, spawning, threats, etc. and on outlining the possibilities of conservation. An inter-country joint research team, including noted researchers and working on a common methodology, was put in place. The research output, whose essentials were in place by 2012, appears to have inspired and contributed to the designing of the conservation measures in West Bengal.
2. The IUCN sponsored study, the studies on which it drew, and other studies thereafter have highlighted various aspects of hilsa biology, fecundity, population characteristics, migration, and spawning patterns in the Ganga-Brahmaputra-Meghna estuary. Many of these studies have also sought to find threats to the hilsa population and causes for catch and stock decline.
3. The IUCN sponsored study was one of the chief outputs of the E4L programme of the IUCN, which, reportedly placed importance to stakeholder consultation. However, there does not seem to be any evidence that small scale fishers were formally consulted regarding the goal and nature of the study being conducted and that its recommendations were genuinely shared with them.

What the Hilsa studies indicate

Studies on hilsa biology, feeding habits, fecundity, spawning migration and spawning habits of hilsa do not always agree on particulars. Nevertheless, the consensus regarding the hilsa stocks entering the Hooghly seem to agree on the following particulars:

a. The hilsa population found in the Bhagirathi-Hooghly belong wholly or overwhelmingly to the anadromous ecotype
b. The spawning migration of hilsa into Hooghly appears to depend on an assortment of factors—water temperature, depth of water, turbidity, degree of salinity, food availability, etc.

c. The hilsa seem to undertake spawning migration into the Bhagirathi-Hooghly system twice a year—one during June-July to October and another during January-March; the first is the major hilsa season in Hooghly and the second is the minor season

d. In the first season, peak spawning possibly occurs in the time bracket usually defined by the first full moon during the Bengali month of Aswin—beginning a few days before the full moon and continuing for several days after; most of these days usually fall in October; there seem to be less information regarding peak spawning period during the minor hilsa season; however, there is an opinion that it would be during late February-early March (an observation based on the high availability of gravid hilsa during that period)

e. Changes in the ambient factors that invite the hilsa into the river will cause less hilsa to enter the river

f. Some particular stretches of the Bhagirathi-Hooghly have been identified as "spawning ground" for hilsa—the Nishchintapur-Godakhali stretch, the Hooghly Ghat-Kalna stretch, and the Lalbagh to Farakka stretch. In addition, the sand bars near the Matla, Thakuran and Raimangal estuaries look promising as spawning grounds

The causes of decline of hilsa in the Bhagirathi-Hooghly system

1. Finding exact causes of complex processes can be difficult. However, in the case of the decline in hilsa in the Bhagirathi-Hooghly system, the causes are perhaps not very difficult to identify. First of all, as this study has argued (reiterating a well-known fact) that the overall volume of freshwater flowing out through the Lower Meghna channels (which combines the Padma-Brahmaputra-Meghna flows) is far greater than the volume of water flowing out through the Hooghly mouth, thus providing a far wider and inviting ambience for hilsa shoals out on their spawning migration. Therefore, compared to her larger and more voluminous eastern sisters, the Hooghly was always at a comparative disadvantage. Yet, the disadvantage was only a comparative one. For, compared to other rivers in India, the Hooghly, blessed by a considerable share of Ganga's flow, and further fortified by inputs from her other tributaries, brings a huge volume of water to the Bay of

Bengal and has always attracted huge shoals of Hilsa. Therefore, the causes of her decline must be sought elsewhere. The prime accused and convicted are as follows: Siltation at the mouth of the estuary causing reduction in the depth of water, impacts of barrages and dams, increased water abstraction (mostly for irrigation and industrial purpose), pollution, resulting in changes in water characteristics and food availability, huge impact of mechanized fishing on marine biodiversity and on the hilsa stock in the Bay of Bengal region close to the Hooghly mouth, lack of mesh size regulation, juvenile fishing, and overfishing including the exploitation of brood fish.

2. In connection with the above, this study argues that while it is fine to have a comprehensive list of important causes of decline, for conservation purposes it is important to indicate a hierarchy among the factors, on two axes—first, according to the degree of importance and, secondly, the ease of intervention and management. The present study is in no position to indicate a hierarchy along the *first* axis. However, it suggests that it is possible to indicate a hierarchy of factors along the second axis. Thus, myriad-point or non-point factors like river pollution and abstraction of river water, although they might be of huge importance, are less easy to address through intervention than siltation of river mouth, ban on juvenile fishing, or severe restriction on destructive gears

3. In enumerating and evaluating causes, it appears that sufficient importance is not being given to the destruction of hilsa stock in the marine environment. True, studies often mention trawling as causing damage to hilsa stock and do not always mince words in describing the negative impact on marine biodiversity and resources by poorly regulated mechanized fishing. Some have also mentioned or implied that mechanized overfishing has hugely impacted hilsa populations and that MSY for hilsa in northern Bay of Bengal is being exceeded. Most revealingly, studies show how the overwhelming bulk of hilsa catch and catch increase in the Bhagirathi-Hooghly system comes from marine sources. Nevertheless, the implications for these in the case of an anadromous stock seems gets relatively less importance and the impact of destructive fishing and overfishing in the river gets more attention. This evaluative imbalance needs to be addressed—without downplaying the seriously negative role of juvenile or brood fish destruction in rivers and estuaries.

Regarding the recommendations in various studies

1. An understanding of the nature of the hilsa biology and ethology and an understanding of the causes of decline have led to recommendations in various studies. We have examined in some detail the policy recommendations of the IUCN and also compared them to a minor set of recommendations made by the BOBLME study. Two recommendations in the BOBLME study appear to be of some importance. They are: 'routine collection of catch and effort information to update the current stock status periodically is highly indispensable' and 'more research regarding spawning ground survey and migration of Hilsa'. These are important because they suggest that our knowledge regarding these may not be secure or might require updating, given that we are dealing with highly dynamic systems. As regards the IUCN study, a few observations are suggested. First, the general tenor of the recommendations appears to be fine. However, and secondly, there should have been a much greater emphasis on strict regulation of mechanized fishing. Thirdly, the emphasis on ban on juvenile fishing and the principle of targeting the peak spawning period for fishing ban appear to be in order. Fourthly, stressing on the principle of "adequate compensation" to fishers for the ban period is also welcome.

2. One important aspect should be considered in prescribing recommendations. As studies on the reproductive biology of the hilsa makes clear, the hilsa is a highly fecund fish. Therefore, effective protection of juveniles and brood fish for even a brief period is likely to make a considerable difference to population size and catch statistics. This is indicated by the striking results attained in Bangladesh.

The hilsa conservation measures in West Bengal

1. The hilsa conservation measures embodied in the West Bengal government's notification (under the West Bengal Inland Fisheries Rules) and order (under the Marine Fishing Regulation Act), both issued in April 2013 leave much to be desired. The six-month ban on the estuarine and freshwater areas of the designated Hilsa Sanctuaries (extending to about 318 km) appears to have little rationale or science. Moreover, any attempt to implement such a ban without substantial compensation would lead to huge distress and massive protests. There are other aspects of these instruments that are unsatisfactory. Perhaps the most disturbing aspect of these instruments was that they emerged without prior consultation with

the stakeholders—at least members of the small-scale fishing community had no inkling that any such instruments were in the offing.

2. Anyway, there was no significant effort to implement the six-month ban. In the years following the issuance of these instruments, only some attempts to restrict juvenile fishing and control mesh size became noticeable in some areas. There were also some awareness campaigns in some areas as testified by the fishers interviewed in these surveys. Moreover, there was no offer of any compensation package. The entire exercise lacked the zest, motivation, direction, and teeth characterizing the Bangladesh instruments. Anyway, given the nature of the instruments, it is perhaps better that there was no serious effort to implement it.

The community in question: what existing studies indicate

Since it is the purpose of this investigation to look at conservation measures keeping in view the concerns of the small-scale fishers, it has examined some studies on the social and economic status and conditions of the small-scale fishing population and has discussed a few of them. These studies reveal that the majority of the artisanal of small-scale fishers are educationally and economically disadvantaged and most come from 'lower' caste backgrounds, which, more often than not, is synonymous to social and economic disadvantage.

The community in question: what our surveys and FGDs indicate

Our surveys corroborate the findings of the earlier study, perhaps bringing into sharper relief the social and economic disadvantages of the community in question. It shows that the overwhelming bulk of the respondents (93%) belonged to the SC category and that two very traditionally specific fishing castes, *Malo* and *Jeliya Kaibarta* accounted for 50 out of a total of 103 respondents (i.e. 48.54%), with other occupationally less well defined, but nevertheless castes also traditionally associated with fishing, made up the lion's share of the remaining respondents. The survey also provides data on their caste and literacy status and indicators of their income. It brings out a picture of indebtedness and their dependence on either merchant vendors or moneylenders for loans. The survey also brings out some interesting information about mesh sizes used in the gill nets by the professional hilsa fishers, the months in the year in which the fishers fished for hilsa and other fish, the fishers' knowledge of the government restrictions regarding hilsa, their knowledge of the possible spawning seasons for hilsa,

etc. What stands out is the low awareness of the community about governmental conservational concerns with only about half the respondents having some awareness of the government notification /order and only about a third having some notion of the specificities, even if very broadly.

The FGDs bring out the preparedness of the fishers for drastic actions against destructive activities like using poisons for fishing. The fishers were agreeable to implementable restrictions on juvenile fishing, banning of zero-meshed nets, and brief period of bans targeting spawning periods, provided the latter was accompanied by adequate compensations—which they felt must be equal to their average earnings for that period. In the FGDs in the areas where fishers were acquainted with marine fishing, the participants repeatedly insisted on the need to seriously restrict marine depredations and destructive fishing.

Recommendations

The following courses of action appear to be suggested by this study:

1) The inadequacy of the notification and order of 2013 appear to be evident. It is evident to academic experts and responsible members of the Fisheries Department, Government of West Bengal. Therefore, the need for a new policy and instruments appear to be evident.

2) As to what exactly the new policy and the contents of the new instruments should be, can only be decided through active consultation of the stakeholders, concerned experts, and other concerned members of the civil society. Perhaps, such a consultation could lead to the creation of a dedicated task force consisting of representatives drawn from the government, expert bodies, and stakeholder organizations—this time, including the representatives of small-scale fishers as a cardinal constituent.

3) Based on what this study seems to have found, perhaps the following could be the general direction of action:
    - Top priority must be given to reducing the impact of mechanized fishing in the northern Bay of Bengal. Following the Union Governmental direction of 61 days of fishing ban on the East Coast from 15 April to 14 June, the West Bengal Government also directs a ban on its territorial waters for the same duration. However, as inputs from our FGDs suggest, two months holiday on rampant depredation and destruction might not be sufficient to protect our marine and coastal resources. Perhaps, double the time might be more advisable. The exact duration, calendar, and zone of restriction must be determined through careful consideration and discussion. Since the state government's jurisdiction is limited to the territorial waters and the zone of protection must extend further, there is need to find ways and means to do so. And, under no circumstances must mechanized craft be allowed to fish within territorial waters and any breach of this restriction must result in severe penalties—beginning with but not confined to cancellation of license.
    - Certain areas have been marked as hilsa sanctuaries. This was done way back in 2013. These can be continued to be accepted on a provisional basis.

However, investigations should be periodically conducted to check the indicators to determine whether the designations need revision.

- As in Bangladesh, periods of fishing bans in the Hilsa sanctuaries would seem to be highly desirable. However, these periods should be short and targeted. The first period could be as follows: a spell of one month centred on the first full moon in the Bengali month of Aswin, or, alternatively, the Bijaya Dashami could be taken as a time marker for deciding the period (in which case, perhaps the Ephemerides based on the reformed Indian Calendar would be a better guide than the commercial *Panjika*s). A second ban during the lesser spawning season also seems advisable. The timing and duration of the ban should coincide with the highest incidence of Hilsa spawning. Whatever the period, the ban should be enforced across all the hilsa sanctuaries with unflinching strictness. Moreover, the ban should also be enforced at and near the *estuarine mouth*, irrespective of the fact whether that is included within a hilsa sanctuary.
- Appropriate monetary compensation (as distinct from food support or similar) should be given to bona fide fishers and the amount of compensation should be computed on the basis of the number of fishing days lost multiplied by the average daily earning of a hilsa fisher (an indication of such an amount may be found in this study and can be further verified by consultation with the fishers).
- The mesh size in gill nets should be strictly regulated. In fact, an effective gill net not only catches fish by gilling, snagging, or wedging, it also catches by ensnaring (which can help trap even the relatively smaller prey). Therefore, the size of the mesh should be determined based on these considerations and the minimum size might be determined as not less than 100 mm, perhaps even more. However, in determining minimum permissible mesh size, as in all other respects, decision must be based after taking into considerations the inputs from actual fishers.
- Mosquito nets and bag nets with zero-meshed rear ends must be banned.
- Strongest possible penal measures must be employed against applying poison for ‘fishing’, as reported by fishers.

- Bona fide artisanal fishers along the stretch of the Bhagirathi-Hooghly and the Indian Padma should be called upon to form people's vigilance committees for implementation of the fishing regulations.
- Although studies indicate that hilsa is a resilient species—a feature probably related to its anadromous life cycle—such resilience is bound to have limits. We know that the condition of hilsa and other fish stocks in rivers depend not only on fishing intensity and practices but on ambient conditions in the river, including water volume, water level, dissolved oxygen levels, other chemical and physical parameters, biotic components and conditions of the water, and so on—the long term population dynamics of hilsa and other stocks would depend on the state being able to ensure the overall health of our rivers. Specifically in the case of the Bhagirathi-Hooghly, which is a downstream channel of the Ganga, there must be efforts to link hilsa conservation with overall river protection.

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