Fishing Toxics

Mercury Contamination of Fish in West Bengal

Toxics Link
for a toxics free world

DISHA

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A Report by

Toxics Link & DISHA

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Foreword

Fish is a popular human food. Over two-and-a-half billion people globally obtain their daily nutrient intake from fish. Over 100 million tones of fish is consumed every year globally. In India, it is a major dietary component for over 50 percent, and source of livelihood for over 30 percent of its 1.2 billion population. It is a particularly important nutrition source for the poor. However, its wholesomeness is probably the least explored in developing countries. Contamination of this vital food is a key issue.

Fish in polluted water bodies accumulate methylmercury – a toxic pollutant of high potency that crosses the blood brain barrier and placental barrier, making it an intergenerational toxin. It enters the food chain both from point and non-point sources. Effluent pipes from industrial processes often contain mercury or mercury compounds. Emissions and ash from coal-fired power plants also contain mercury. It is well known that mercury circulates globally and deposits in water, bioaccumulating in the food chain through algae and fish. The higher the pecking order of a fish in the food chain, greater is the amount of mercury it is likely to contain. Advisories on fish consumption are quite common in developed countries, especially for pregnant women. However, India has little data and awareness, or even attention paid to the problem.

Toxics Link, in association with Disha in West Bengal, undertook this study to widen the scope of scientific investigation into this issue. As fish is a major constituent of daily dietary intake across economic strata in West Bengal, it was our effort to assess the extent and amount of mercury contamination in a wide variety of fish species in various forms of water bodies in the state. The study also estimates human exposure to mercury through fish intake. The results are startling.

In developing countries, issues like food contamination rarely draw attention. Mere availability of food is argued to be of foremost concern. In this scenario of poverty and hunger, system of industrial production has largely remained unaccountable to society and the environmental pollution it causes. Article 21 of the Constitution of India guarantees the Right to Life, read as a Right to a Healthy Life. Food contamination leads to the contrary. It is criminal that those who are meant to safeguard our environment, check the effluent pipes and control emissions etc., allow such toxic discharge in our environment, either through negligence or through design. Hence, while we should be grateful that there is food available, it is also true that this does not have to be contaminated.

We do hope that through this, and similar such studies undertaken by Toxics Link, there will be a greater consciousness about the fact that we live in an interlinked ecology. The 'short term' today is the immediate tomorrow. There is no escape, and procrastination is no answer.

Ravi Agarwal
Director

About Toxics Link

Toxics Link is an environmental advocacy and information outreach organisation. It was set up in 1996 with a special emphasis on reaching out to grassroots groups and community based organisations. The area of its engagement includes research, outreach and policy advocacy on issues of communities and urban waste, toxics free healthcare, hazardous waste and pesticides.

Toxics Link works closely with all stakeholders, and has been supportive in the formation of several common platforms for them. It also networks internationally and is part of international networks working on similar issues.

The mission of the organisation is to:

"Work together for the environmental justice and freedom from toxins. We have taken upon ourselves to collect and share both information about the sources and dangers of poisons in our environment and bodies, and information about clean and sustainable alternatives for India and rest of the world."

About DISHA

Society for Direct Initiative for Social and Health Action (DISHA) is a Kolkata based NGO active in different areas concerning environment and environmental health in West Bengal for over a decade. Municipal waste management, bio-medical waste management, hazardous waste, materials policy, industrial pollution, environmental toxins, coastal environment, biodiversity and energy issues etc. are the priority areas of DISHA.

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Toxics Link and DISHA

Executive Summary

Mercury is a deadly environmental pollutant, both in its elemental form and in combination with other chemicals. When released into the environment it is transformed into methylmercury through microbial action. Methylmercury is the most pernicious form of mercury. It bioaccumulates in fish, and enters human body with the consumption of contaminated fish. It is a major health concern as fish is a key food for large populations. Methylmercury permeates anatomical defence mechanisms such as the blood brain barrier and the placenetal barrier. Human exposure to such toxins therefore assumes significance.

Objectives

- Quantify the level of mercury in fish and crustacean samples from five prominent markets in Kolkata and select waterbodies in West Bengal.
- Study the nature and extent of mercury contamination, and reach a reasonable conclusion through laboratory analysis.
- Assess health risk from intake of contaminated fish (based on level of contamination).
- Provide recommendations on the basis of results and analysis.

Sampling Locations

Samples for the study were collected from fish markets in Kolkata as well as from various waterbodies spread across the state to get a broad view of mercury contamination of fish in West Bengal.

Kolkata Markets

The samples were collected from the following markets:

Sl. no.	Market	Location in Kolkata
1	Gariahat	South
2	Sahababu Bazaar	Central
3	Manicktala	North
4	Sealdah	Central
5	Behala	South-West

A total of 60 samples were collected from Kolkata markets.

Samples from select waterbodies across West Bengal

The table below gives a list of areas and waterbodies from where the samples were collected. This is followed by a brief discussion on nature, mode and constraints in sample collection.

Sl. no.	Area	Waterbody
1	Farakka (thermal power plant)	River - Ganga and feeder canal
2	Durgapur - Asansol (industrial belt)	River - Damodar
3	Kolkata (metropolis) and nearby area	Pond - East Kolkata Wetland and Mudiali; River - Ganga at Budge Budge - downstream from Kolkata
4	Haldia (industrial belt)	Estuary - Haldi and Hooghly Rivers
5	Kolaghat (thermal power plant)	Ponds
6	Digha (tourist spot)	Sea - Bay of Bengal
7	Kakdwip (fishing site)	Sea - Bay of Bengal
8	Jharkhali, Sunderban Biosphere Reserve	River - Matla, Vidyadhari, Herobhanga
9	Hugli (agricultural belt)	Ponds
10	North Bengal - plains area in Darjeeling district	Confluence of Mahananda, Teesta Canal and Balashon River
11	North Bengal - plains area in Darjeeling district near tea garden	Pond - Ruidasa
12	North Bengal - agricultural belt in Jalpaiguri district	Pond - Dolua
13	North Bengal - agricultural belt in Jalpaiguri district	Pond - Kanchansiri
14	North Bengal - Jalpaiguri district	River - Korola
15	North Bengal - plains area in Darjleeing district	Pond - Ranijjot

A total of 204 samples of fish and crustaceans were collected from select waterbodies across West Bengal.

A total of 264 samples (204 from West Bengal waterbodies and 60 from Kolkata markets) of 56 popular fish and crustacean comestible varieties were submitted to the laboratory for analysis of their mercury content.

Lab Methodology

All samples were submitted to SGS India Pvt Ltd., an NABL accredited laboratory located at Behala, Kolkata, for mercury digestion and analysis. AOAC 977.15 was followed for determining total mercury concentration.

Standards

The Joint FAO-WHO Expert Committee recommended methylmercury Provisional Tolerable Weekly Intake (PTWI) is taken as the standard. The standard is 1.6 µg/kg of body weight of an individual per week or 0.228571 µg/kg of body weight/day.

The Joint FAO-WHO Expert Committee clearly states that although its PTWI may be exceeded somewhat in case of adults, it needs to be strictly followed in the case of pregnant mothers (to prevent exposure of developing foetus) and children or young adolescents.

The study also compares its findings with the standard given under the Prevention of Food Adulteration Act and Rules, 1954, which gives mercury and methylmercury threshold value in food as 0.5 ppm and 0.25 ppm by weight, respectively. In this context ppm is mg/kg, or µg/gm.

Fish Consumption

Our survey of 43 families in Kolkata and outlying areas, with incomes as diverse as

Rs. 8,000 per month (four-member family), Rs. 10,000 per month (nine-member family) and 90,000 per month (four-member family), came up with the following findings of average weekly individual consumption.

- Only two families reported less than 300 gm per person per week consump tion.
- 12 families consumed 300-500 gm per person per week.
- 29 families consumed more than 500 gm per person per week.
- 24 families consumed more than 650 gm per person per week.

Using a conversion factor of 0.75 to estimate the amount of flesh in the fish purchased, based on the actual weighing of inedible parts in different fish samples, the investigators concluded that typical fish flesh consumption among residents of West Bengal, particularly in the middle income groups, ranges between 300 to 500 gm per week per person. The combination of high levels of mercury in fish and high consumption rates raises serious health concerns in West Bengal.

Another important finding of the survey is that children of five years and above, if they didn't have a particular dislike for fish, consume fish at adult rates; indeed this is encouraged as fish is the region's traditional food and is known for high nutrient value in the development of body and brain.

Although several experts tend to take the total mercury detected in fish flesh as methylmercury, investigators in this study have been more conservative. On the basis of reported research findings, we have taken 80 percent of the total mercury as the average level of methylmercury in all fish and the few crab samples; for shrimps, 40 percent of total mercury content is taken as methylmercury.

Results

Samples from Kolkata Markets

A total of 60 samples were tested.

- 16 samples showed mercury levels above PFA stipulations.
- 24 had methylmercury levels above PFA stipulations.
- In five of 16 samples with high mercury content, mercury levels were 50 per cent in excess of PFA stipulations; in two samples, mercury levels were over 100 percent above PFA stipulations.
- In 24 cases of high methylmercury content, 18 samples showed more than 50 percent exceedance over PFA stipulations.
- 7 cases showed methylmercury excess of more than 100 percent above PFA stipulations.

Samples from Select Fishing Locations in West Bengal

A total of 204 samples were tested.

- In 62 samples mercury levels and in 105 samples methylmercury levels were in excess of the PFA stipulations.
- 35 of these 62 cases exhibited mercury exceedance of over 50 percent and 19 cases showed exceedance of over 100 percent of PFA stipulations.
- In 105 cases of excess methylmercury levels, 70 cases exhibited exceedance by more than 50 percent and 45 cases showed exceedance by more than 100 percent of PFA stipulations.
- In 18 cases, methylmercury levels were 200 percent above PFA stipulations.

Applying WHO-FAO Criterion to Our Findings

For applying the WHO-FAO methylmercury PTWI criterion, one needs to consider individual body weight and intake quantities.

If the laboratory results are applied to two general intake scenarios:

i A child of 25 kg and weekly fish flesh consumption of 250 gm and ii An adolescent/adult of 60 kg and weekly fish flesh consumption of 500 gm

One finds that the PTWI exceeds in 181 of 264 samples in scenario (i)

- For 105 samples, the PTWI exceeds by more than 100 percent and for 54 samples by over 200 percent.

In consumption scenario ii, the PTWI exceeds in 155 samples

- For 80 samples, the PTWI exceeds by over 100 percent and for 37 samples by over 200 percent.

Comparing the averages of methylmercury from each sample site against PTWI one gets the following results:

Kolkata Markets – Methylmercury levels in fish samples and PTWI percent exceedance under two usual consumption scenarios*

Market	Average MeHg (µg/ kg)	A child of 25 kg PTWI = 40 µg			An adult of 60 kg PTWI = 96 µg		
		MeHg intake (µg) for 0.25 kg fish flesh consumption/ week	Whether exceeds PTWI	Percent exceedance	MeHg intake (µg) for 0.50 kg fish flesh consumption/ week	Whether exceeds PTWI	Percent exceedance
Gariahat	479	119.75	Yes	199.38	239.50	Yes	149.48
Sahababu	119	29.75	No	Nil	59.50	No	Nil
Sealdah	298	74.50	Yes	86.25	149.00	Yes	55.21
Manicktala	248	62.00	Yes	55.00	124.00	Yes	29.17
Behala	240	60.00	Yes	50.00	120.00	Yes	25.00
Average for 5 Markets	277	69.25	Yes	73.13	138.50	Yes	44.27

* Note: In this and following tables, 'percent exceedance' expresses the extent by which the laboratory finding exceeds the standard (PTWI). Thus, if the standard is 40 units and the lab finding is 80 units, the exceedance is expressed as 100%.

West Bengal waterbodies – Methylmercury levels in fish samples and PTWI percentage exceedance under general consumption scenarios

Locality	Average MeHg (µg/kg)	A child of 25 kg PTWI = 40 µg			An adult of 60 kg PTWI = 96 µg		
		MeHg intake (µg) for 0.25 kg fish flesh consumption/ week	Whether exceeds PTWI	Percent exceedance	MeHg intake (µg) for 0.50 kg fish flesh consumption/ week	Whether exceeds PTWI	Percent exceedance
Hugli	309	77.25	Yes	93.13	154.50	Yes	60.94
Budge Budge	451	112.75	Yes	181.88	225.50	Yes	134.90
Jharkhali	1023	255.75	Yes	539.38	511.50	Yes	432.81
Haldia	261	65.25	Yes	63.13	130.50	Yes	35.94
Digha	382	95.50	Yes	138.75	191.00	Yes	98.96
East Kolkata Wetlands	345	86.25	Yes	115.63	172.50	Yes	79.69
Kakdwip	569	142.25	Yes	255.63	284.50	Yes	196.35
Mudiali	161	40.25	Yes	0.63	80.50	No	nil
Farakka	364	91.00	Yes	127.50	182.00	Yes	89.58
North Bengal	52	13.00	No	nil	26.00	No	nil
Kolaghat	127	31.75	No	nil	63.50	No	nil
Durgapur	103	25.75	No	nil	51.50	No	nil
Average	328	82.00	Yes	105.00	164.00	Yes	70.83

Methylmercury average and PTWI exceedance summary for all samples

Sample size = 264	Average MeHg (µg/kg)	A child of 25 kg PTWI = 40 µg			An adult of 60 kg PTWI = 96 µg		
		MeHg intake (µg) for 0.25 kg fish flesh consumption/ week	Whether exceeds PTWI	Percent exceedance	MeHg intake (µg) for 0.50 kg fish flesh consumption/ week	Whether exceeds PTWI	Percent exceedance
Average for all samples	317	79.25	Yes	98.13	158.50	Yes	65.10

What happens when we look at the species averages and apply them to our two scenarios?

In the first scenario, 44 of the 56 species tested show methylmercury PTWI exceedance; 27 species showed methylmercury PTWI exceedance of more than 100 percent and 14 species showed exceedance of more than 200 percent.

In second scenario, 39 of the 56 species tested show methylmercury PTWI exceedance; 23 species showed methylmercury PTWI exceedance of more than 100 percent and 10 species showed exceedance of more than 200 percent.

Recommendations

That fish in West Bengal have significant, and often alarming, levels of mercury contamination is evident from this study. Both the government and civil society should wake up to this problem.

- The Health and Environment Departments of the government should undertake a thorough investigation of the scale, intensity and sources of mercury pollution.
- Not only fish, but water and soil samples as also blood and hair samples of the population need to be tested to judge the levels of contamination.
- Immediate release of advisories on fish consumption guiding citizens about relatively safe/unsafe fish species and sources.
- The scientific community should independently and in collaboration with the government, undertake such investigation.
- Once the sources of pollution are identified, efforts must be made to bring mercury pollution down to safe levels.
- Mercury and other pollutants of similar severity should become an important item in civil society initiatives.
- Medical practitioners should include pollutant-induced pathology as a key item in their diagnostic and therapeutic procedures.

Tables and Appendices

The main text contains tables numbered in Indo-Arabic numerals, from 1 to 20. These tables are crucial for they provide the basic data on which all the arguments and inferences of this study are based.

The main text of the report is followed by another set of larger tables. Enumerated in Roman numerals (I to VIII A) and occasionally referred to in the main text, these tables give sample wise/ species description of the study findings.

Table I. Description of samples collected from Kolkata markets

Table II Description of samples collected from other locations (identified waterbodies across West Bengal)

Table III. Mercury concentration and species average for samples from Kolkata Markets

Table IV. Mercury concentration and species average for samples from other locations

Table V. Methylmercury levels and PTWI exceedance in samples from Kolkata Markets

Table VI. Methylmercury levels and PTWI exceedance in samples from other locations

Table VI A. PTWI exceedance for samples from Kolkata Markets at marginally higher intake levels

Table VI B. PTWI exceedance for samples from other locations at marginally higher intake levels

Table VII. Species averages of Hg and MeHg and their exceedance from PFA standards

Table VII A. Species averages and PTWI exceedance in four prevalent intake situations

Table VIII. Species averages (minus North Bengal) and their PFA percentage exceedance

Table VIII A. Species averages (minus North Bengal) and PTWI exceedance in four prevalent intake situations

The above tables are followed by a set of Appendices, from 1 through 5. They are as follows.

Appendix 1. Brief account of locations of samples collected

Appendix 2. Sample locations on Map

Appendix 3. Fish Intake Survey

Appendix 4. Fish Flesh as a proportion of fish body weight

Appendix 5. Applying EPA 'Reference Dose' to the results

The appendices contain tables of their own, but these are well contained within the appendical space, so as to create no confusion with other tables.

Introduction

Elemental mercury is a heavy silvery-white metal that is liquid at normal temperature and pressure. It is the only metal known that has this characteristic. The vapour pressure of mercury is dependent on temperature, and it vaporizes readily at room temperature. Mercury encountered in the earth's atmosphere is elemental mercury vapour. Mercury can exist in three oxidation states: Hg0 (metallic), Hg1+ (mercurous) and Hg2+ (mercuric). The properties and behaviour of mercury depends on its oxidation state. Mercury in water, soil, sediments, or biota (i.e., all environmental media except the atmosphere) occurs either as inorganic mercury salts or organic forms.

Mercury is widely used in industrial processes and products because of its unique properties. In very small quantities, it conducts electricity. The fact that it responds uniformly to temperature changes, and is liquid over a considerable temperature range (MP -38.870 C and BP 356.580 C at standard atmospheric pressure) makes it a desirable thermometric liquid. It forms alloys with almost all metals. In the electrical industry, mercury is used in components such as fluorescent lamps (including CFLs), wiring devices and switches (e.g., thermostats) and mercuric oxide batteries. Mercury is also used in navigational devices, healthcare sector, in instruments that measure temperature and pressure and other related applications. It is also a component of dental amalgams used in treatment of dental caries.

In addition to specific products, mercury is used in numerous industrial processes. Globally, the largest quantity of mercury is used in the production of chlorine and caustic soda by mercury cell chlor-alkali plants. Other functions for which mercury is used include amalgamation, nuclear reactors, wood processing (as an anti-fungal agent), as a solvent for reactive and precious metals and as a catalyst. As a preservative, mercury compounds are frequently added to many pharmaceutical products. [1]

Mercury in Environment

As an element mercury cannot be created or destroyed through chemical processes. Therefore, it has existed in same amount all through. However, it can cycle in the environment as part of both natural and anthropogenic activities: certain portions of the planetary space thus acquire enhanced amounts of mercury. Modelling results indicate that the amount of mercury mobilised and released into the biosphere has increased since the beginning of industrialisation.

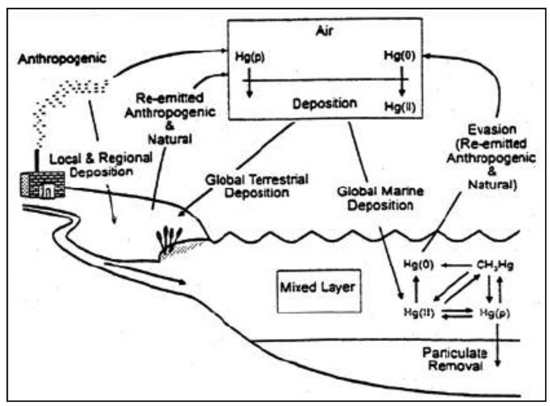
Natural sources of atmospheric mercury are rocks, including coal, from where it enters the atmosphere through weathering and volcanic emissions. Another source is volatilisation from the oceans. Anthropogenic sources of mercury in the environment include coal combustion, mercury uses in cathodes, metal processing, chlor-alkali industries, pharmaceuticals and mining of gold and mercury. Of these, the most powerful anthropogenic source of mercury pollution for many countries is coal combustion: e.g., coal-fired power plants in the United States account for over 40 percent of all domestic mercury emissions. Once in the atmosphere, mercury is widely disseminated and can circulate for years, accounting for its widespread distribution.2 The distances it travels and eventual deposition depends on the chemical and physical form of mercury emissions. Studies indicate that the residence time of elemental mercury in the atmosphere is about a year, allowing its dispersion over long distances, both regionally and globally, before being deposited to the earth.

The residence time of oxidised mercury compounds in the atmosphere is uncertain, but is generally believed to be of the order of a few days or less. Even after it is deposited, mercury is commonly emitted back to the atmosphere either as a gas or in association with particulates to be re-deposited elsewhere. Mercury undergoes a series of complex chemical and physical transformations as it cycles in the biosphere. Humans, plants and animals are routinely exposed to mercury and accumulate it during this cycle, resulting in a variety of health impacts.[2]

A basic diagram of the global mercury cycle is presented in figure 1. As indicated, mercury is emitted in the atmosphere by a variety of sources, dispersed and transported by air, deposited to the earth, and stored in or transferred between the land, water and air.

Figure 1

The Global Mercury Cycle



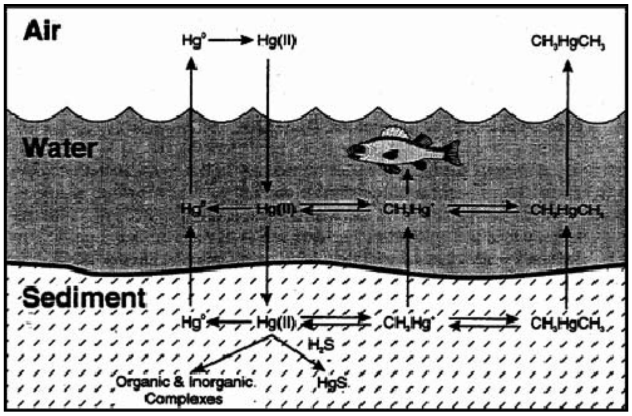
Cited from EPA Mercury Study Report to Congress. Adapted from Mason, R.P., Fitzgerald, W.F., and Morel, M.M. 1994. The Biogeochemical Cycling of Elemental Mercury: Anthropogenic Influences. Geochim Cosmochim. Acta, 58(15): 3191-3198

Environmental Mercury: Transport and Destinations

The movement and distribution of mercury in the environment can, at the present state of our knowledge, be described only in general terms. There are differences of opinion on some of the routes and destinations of mercury in the environment. Mercury cycle in figure 2 below illustrates the major physical and chemical transformation expected to occur in mercury in freshwater lakes. These processes include a number of infinite and/or indefinite loops.

Figure 2

Mercury Cycle in Freshwater Lakes



Cited from EPA Mercury Study Report to Congress. Adapted from Winfrey, M.R. and Rudd, J.W.M. 1990. Review – Environmental Factors Affecting the Formation of Methylmercury in Low pH Lakes. Environ. Toxicol. Chem. 9:853-869.

Health Impacts of Mercury

Humans

The effect of mercury on human health depends on the form of mercury exposure. The three possible forms of mercury exposure are elemental mercury, inorganic mercury and organic mercury. Each of them has specific effects on human health. Of these, methylated mercury (organic mercury) is of the greatest concern.

Elemental (metallic) mercury primarily causes health effects when its vapours are inhaled. In such case it can be absorbed into the bloodstream directly through the lungs. Such exposures occur when elemental mercury is spilled or products that contain elemental mercury break and expose mercury to the air, particularly in warm or poorly ventilated indoor spaces.

The symptoms of exposure to elemental mercury are tremors, emotional changes (e.g., mood swings, irritability, nervousness, excessive shyness), insomnia, neuromuscular changes (such as weakness, muscle atrophy, twitching), headaches, changes in nerve responses, performance deficit in cognitive function. Higher exposure can result in the failure of vital organ systems or death.

Exposure to inorganic mercury can damage the gastrointestinal tract, the nervous system and the kidneys. Symptoms of its high exposure include skin rashes, dermatitis, mood swings, memory loss, mental disturbances and muscle weakness. Both inorganic and organic mercury compounds are absorbed through the gastrointestinal tract and affect other systems via this route. However, organic mercury compounds are more readily absorbed via ingestion than inorganic mercury compounds.

Methylated mercury is the most toxic of all organic mercury compounds. Of its two common forms – monomethyl mercury and dimethylmercury, the latter is extremely toxic. However, dimethylmercury is very unstable and its occurrence in non-laboratory environment is rare. In nature, it quickly degrades into monomethyl mercury. Monomethyl mercury constitutes the greatest hazard, as it is highly toxic and bioaccumulates in organisms and biomagnifies as it climbs the trophic ladder. It's a neurotoxin that causes a wide array of neurological disorders and can easily be fatal at higher concentrations.[3]

Other Organisms

Mercury has adverse effects on a wide range of organisms. High exposure in fish leads to death, reduced reproductive rate, impaired growth, and development and behavioural abnormalities. Reproductive effects are the primary concern in case of mercury poisoning at dietary concentrations well below what causes overt toxicity.

Effects of mercury on birds and mammals include death, reduced reproductive success, impaired growth and development and behavioural abnormalities. Sublethal effects of mercury on birds and mammals include liver damage, kidney damage and neurobehavioral effects. Effects of mercury on plants include death, plant senescence, growth inhibition, decreased chlorophyll content, leaf injury, root damage and inhibited root growth and function.

Mercury concentrations in the tissues of wildlife have been reported at levels associated with adverse effects. Toxic effects in piscivorous avian and mammalian wildlife have been associated with point source releases of mercury in the environment. However, field data are insufficient to conclude whether wildlife has suffered adverse effects due to airborne mercury.[4]

Mercury Methylation, Bioaccumulation and Exposure Pathways

Mercury methylation is a key step in mercury absorption in food chains. The biotransformation of inorganic mercury into methylated mercury occurs in the sediments of water bodies. Not all mercury compounds entering an aquatic ecosystem, however, are methylated; demethylation reactions as well as degradation of dimethylmercury occur, and these reactions decrease the amount of methylmercury available in the aquatic environment. Greater clarity is needed regarding the rate at which these reactions take place. There is scientific consensus, however, on the environmental factors that influence variability in mercury methylation in waterbodies.

Often, almost 100 percent of mercury that bioaccumulates in fish tissue is methylated. Numerous factors influence bioaccumulation of mercury in aquatic biota. These include the acidity of the water (pH), the length of the aquatic food chain, temperature and dissolved organic material. Physical and chemical characteristics of a watershed, such as soil type and erosion, affect the amount of mercury that is transported from soils to water bodies. Interplay of these factors and their effects on the rate of mercury bioaccumulation however are not completely understood.

Mercury accumulates in an organism when the rate of uptake exceeds the rate of elimination. Although all forms of mercury accumulate to some degree, methylmercury has a higher propensity for bio-accumulation. Its half-life ranges from months to years in different organisms. Elimination of methylmercury from fish is extremely slow. Inorganic mercury on the other hand has lower absorption rate, resulting in reduced levels of accumulation.

Plants, animals and humans are exposed to methylmercury either by direct contact with contaminated environments or ingestion of mercury contaminated water and food. Generally, mercury builds up more in the higher trophic levels of aquatic food chains (biomagnification). At the top are piscivores, such as humans, eagles, hawks, brahminy kites, cormorants and other fish-eating species. These species prey on fish, such as the bronze featherback (Notopterus notopterus) or the long-whiskered catfish (Sperata aor), which in turn feed on smaller forage fish. Smaller piscivorous wildlife (e.g., kingfishers) feed on the smaller forage fish, which in turn feed on zooplankton or benthic invertebrates. Zooplanktons feed on phytoplankton and the smaller benthic invertebrates feed on algae and detritus. Thus, mercury is transmitted and accumulated through several trophic levels.[5]

Methylmercury production and accumulation in freshwater ecosystem exhibits high efficiency, and life at higher trophic levels has a relatively greater percentage of the total mercury content. Accordingly, mercury exposure and accumulation is of particular concern for animals at the highest trophic levels in aquatic food webs and for animals and humans that feed on these organisms.[6]

Methylmercury – Human Exposure Pathways

Humans are most likely to be exposed to methylmercury through fish consumption. Exposure may occur through other pathways as well (e.g., the ingestion of methylmercury-contaminated drinking water and food sources other than fish, and uptake from soil and water through the skin). However, for humans and other animals that eat fish, methylmercury uptake through fish consumption dominates these other routes.

There is a great deal of variability in fish-eating populations with respect to fish sources and fish consumption rates. As a result, there is a great deal of variability in exposure to methylmercury in these populations. The presence of methylmercury in fish is, in part, the result of anthropogenic mercury releases from industrial sources. As a consequence of human consumption of the affected fish, there is a risk of human exposure to methylmercury.

Methylmercury is a known human toxicant. Clinical neurotoxicity has been observed following exposure to high amounts of mercury (for example, Mad Hatter's Disease). Consumption of mercury contaminated food has produced overt neurotoxicity. Generally, the most subtle indicators of methylmercury toxicity are neurological changes. The neurotoxic effects range from less immediately observable weakening of motor skills and sensory ability at comparatively low doses to tremors, inability to walk, convulsions and death at very high exposures.[7]

Methylmercury - Absorption and Excretion

Absorption resulting from oral intake of elemental or inorganic mercury is rather poor. However, methylmercury is rapidly absorbed through the gastrointestinal tract and distributed throughout the body. It penetrates the blood-brain and placental barriers in humans and animals. It is relatively stable and only slowly demethylated to form mercuric mercury in rats. Methylmercury has a relatively long biological half-life in humans: estimates range from 44 to 80 days. Excretion occurs via the faeces, breast milk and urine. The knowledge of mercury absorption from inhalation is limited.[8]

Methylmercury - Health Effects

Human exposure to elemental mercury occurs in some occupations, and exposure to inorganic mercury can arise from mercury amalgams used in dental restorative materials. People, however, are primarily exposed to methylmercury through dietary intake of fish. The main concern with methylmercury is neurotoxicity, which can have severe results, particularly in the young.

Methylmercury-induced neurotoxicity is of the greatest concern when exposure occurs to the developing foetus, as it easily penetrates the placental and blood-brain barrier. Post-natal brain development continues well into childhood. Methylmercury exposure at early developmental stages adversely affects a number of cellular events in the developing brain both in utero and post-natally. The post-natal age when the development of various regions of the brain is completed varies, and development of many functions continues through the first six years of life.[9]

Methylmercury Disasters

The most notorious methylmercury incident occurred among people and wildlife of Minamata, on the shores of Minamata Bay, Kyushu, Japan. The source of methylmercury was a chemical factory that used mercury as a catalyst in the production of acetyldehyde. A series of chemical analyses identified methylmercury in the factory's waste sludge, which drained into Minamata Bay, as a toxicant affecting the people and wildlife in the region. This methylmercury accumulated in the tissue of the Minamata Bay fish and shellfish that were routinely consumed by wildlife and human populations in the region.

The first case of poisoning was reported in 1956, when a six-year-old girl came to a hospital with symptoms characteristic of nervous system damage. The symptoms included:

- Impairment of peripheral vision
- Disturbing sensations (feeling of "pins and needles" pricks, numbness) usually in the hands and feet and sometimes around the mouth
- Difficulty in movement coordination as in writing
- Speech impairment
- Hearing impairment
- Difficulty in walking
- Mental disturbances

It took several years before people realised that they were developing the signs and symptoms of methylmercury poisoning. Over the next 20 years the number of people known to be affected with what came to be known as Minamata disease increased to thousands. In time, the disease was recognized to result from methylmercury occurring in fish in the Minamata Bay. Deaths occurred among both adults and children. It was also recognized as a potent toxin that could damage the nervous system of growing foetus, if the mother ate fish contaminated with high concentrations of methylmercury during pregnancy.

The nervous system damage from severe methylmercury poisoning among infants was very similar to congenital cerebral palsy. In the fishing villages of this region, the occurrence of congenital cerebral palsy due to methylmercury was very high compared to the incidence for Japan in general. After the source of toxic contamination was identified, mercury release into the bay was checked. Over time the symptoms were seen to reduce in the local population.

Another methylmercury poisoning outbreak occurred in Japan, in the area of Niigata, in 1965. Again, investigations identified the source to be an acetaldehyde producing chemical factory releasing methylmercury into the Agano river. The signs and symptoms of the disease in Niigata were those of methylmercury poisoning – similar to the Minamata disease.[10]

Effects of methylmercury on nervous system are well established. Pathological signs similar to Minamata disease were identified in other countries as well where methylmercury poisonings had occurred. Consumption of methylmercury contaminated food products (including grains and pork products) has also resulted in severe poisoning with pathological changes in the nervous system and clinical symptoms identical to Minamata disease.

These developments brought to the fore two major points of concern:

- Methylmercury in fish is the most prevalent source of mercury poisoning
- Methylmercury in fish is the most important source of mercury poisoning among humans. We are therefore required to ascertain its effects at lower levels of contamination. That is, how low a level of contamination can be considered safe?

Methylmercury – Safe levels

The concern of methylmercury contamination of food has gradually led to the emergence of permissible or tolerable methylmercury dose standards in different countries including India. Although India now has the Food Safety and Standards Act, specific food standards on the basis of the said Act are not yet in place, and moreover, its standards are not meant to apply to products of farming, fishing and aquaculture.

Food standards in terms of permissible levels of contamination are only available with the Prevention of Food Adulteration Act and Rules, 1954. This gives the limit of mercury in fish as 0.5 ppm by weight and that of methylmercury (calculated as an element) in the case of all foods (including fish) as 0.25 ppm by weight.[11] The fact that the aforesaid Act and Rules mention methylmercury, has tremendous import for this study: for it is the mercury in the methylated form that is of the greatest toxic significance and its presence in our food chain needs to be checked and contained. The study also compares its findings with the PFA standards.

However, it is not enough to determine methylmercury contents in fish, it is also important to know people's average dietary fish intake. It is only when one combines methylmercury contents in fish with the average fish intake that one can assess mercury exposure. This is because the body flushes out methylmercury at a very slow rate, and if the rate of methylmercury intake exceeds the rate of its excretion, it starts building up, causing poisoning. The degree of poisoning per unit intake of methylmercury depends on the body weight: for the same amount of intake, poisoning is less severe in people of higher weight. And finally, young people and pregnant women (the foetus) are most vulnerable, and therefore methylmercury stipulations are of the greatest importance in their case.

Nowadays, standards for the tolerable doses of methylmercury account for its total intake over a period (e.g. per week) or the average daily intake. Of these, the most stringent standard is that of the US EPA, which explicitly factors in the body weight of the recipient. The EPA reference dose for methylmercury is 0.1 μg/kg of body weight/day and this standard has been supported by the US National Research Council as well.[12] The US Agency for Toxic Substances and Disease Registry (ATSDR) has a less stringent standard or MRL (minimal risk level) of 0.3 μg / kg of body weight / day.[13]

The US FDA has a different standard. It does not speak in terms of body weight of the recipient, but of total permissible dose per week. For one-ppm methylmercury in fish, it advises fish consumption below 198.4465 gm per week and for 0.5-ppm methylmercury in fish it advises consumption below 396.893 gm per week. The FDA has been criticised for its relatively lenient standards.[14]

In year 2004, the Joint FAO-WHO Expert Committee on Food Additives developed a norm for tolerable levels of methylmercury in fish. The said Expert Committee reconfirmed this standard in 2006.[15] Its Provisional Tolerable Weekly Intake (PTWI), the tolerable limit of exposure, is given as 1.6 μg/kg of body weight/per week or around 0.228571 μg/kg of body weight/day. Although it is less stringent than the EPA's, is more stringent than that of the ATSDR and far more stringent than that of the FDA.

It is important in this context that the European Food Safety Authority (EFSA) has issued a guideline based on both the Joint FAO-WHO Expert Committee On Food Additives recommendations of PTWI (1.6μg/kg body weight) and the US National Research Council's reference dose of 0.1 μg/kg body weight/day, which is the same as the US EPA's and leads to 0.7 μg/kg body weight PTWI. Essentially the EFSA's recommendations tend to ask vulnerable groups to cut down on their fish consumption.[16]

Since the Joint FAO-WHO Expert Committee standard has been developed by an internationally recognised body and is used by the EFSA, the present study has taken its recommendations as the reference. The use of far more stringent EPA standard could lead to drastic conclusions. It is, therefore, avoided in the main body of this report. However, the EPA has international repute, and it would be germane to see the implications of using its reference dose to the results of this study. An exercise to this end has been attempted in Appendix 5.

Study Objectives and Methodology

Study Objectives

- To quantify and assess the level of mercury in fish collected from –
    a. Select waterbodies in West Bengal
    b. Five prominent markets in Kolkata
- To try and arrive at a reasonable conclusion regarding the nature and extent of mercury contamination of fish, on the basis of laboratory analyses.
- To make a risk assessment of mercury contaminated fish intake on the basis of detected contamination levels.
- To put forth recommendations on the basis of study findings.

Study Site

West Bengal is at the centre of the eastern region of India. It borders the states of Orissa, Jharkhand, Bihar, Sikkim and Assam. It is spread over 700 km, from the Bay of Bengal in the South to the Himalayas in the North,[17] encompassing a wide variation in geographical and ecological locales – mountains and foothills, Terai forests, riverine plains, forested plains, very high rainfall areas as well as drier areas in the western districts, deltaic and estuarine zones and coastal stretches.

West Bengal is one of the major economies in the country. The service sector is the largest contributor of the gross domestic product of the state, contributing 51 percent of the state domestic product compared to 27 percent from agriculture and 22 percent from industry.[18]

The majority of the population is dependent on agriculture. Rice is the state's principal food crop. Other important crops are pulses, oil seeds, wheat, tobacco, sugarcane and potato. Jute is the leading cash crop of the region. Darjeeling and Jalpaiguri are major tea producing areas of India.

The Asansol - Durgapur region is located 150 km north of Kolkata. The region is rich in mineral resources like coal, iron ore, copper and bauxite, and has industrial units producing iron and steel, engineering goods, electrical equipments, etc. Prominent industrial units in the region include a steel plant at Durgapur, an alloy steel plant and railway locomotive plant at Chittaranjan.[19]

There are over 10,000 registered factories in the state,[20] manufacturing chemicals, cotton textiles, steel products, heavy and light engineering products, leather and leather products, paper, tea, jute products, breweries, drugs and other pharma products, electrical and electronic products, plastics, software and infotech goods, locomotives, vegetable oils, gems and jewellery and poultry products.[21]

The port city of Haldia is home to national and global giants like Indian Oil Corporation, Indian Oil Petronas Ltd., Hindusthan Fertiliser Corporation, Tata Chemicals Ltd., Haldia Petrochemicals Ltd., Mitsubishi Chemical Corporation, Hindustan Lever, Shamon Ispat Ltd., Ambo Agro Products Ltd., Exide Industries and others.

Kolkata, the capital of West Bengal and the main commercial and financial hub of the eastern and north-eastern India, has strategic importance for the industrial development of the region. It has an international airport and a port complex; its vast suburbs and the twin city of Howrah have traditionally been home to a number of industries. The metropolis is now emerging as a major electronics and IT industrial hub. There are a number of industrial parks or special economic zones in and around the city. It is home to numerous domestic and foreign firms engaged in banking, insurance, tea, electronics, IT etc.[22]

Kharagpur, the prime railway junction in West Bengal about 120 km from Kolkata on National Highway 6, is home to a large number of engineering units with major players such as Tata Mettalics, Flender Mcneil and others. It is well connected to the rest of the country.[23]

West Bengal has a large numb er of thermal power plants, including the NTPC power plant at Farakka and the WBPDCL power plant at Kolaghat.

With a broad array of industrial activity capable of emitting mercury in the environment – coal mines, chlor-alkali plants, paints and pigments manufactories, coal-fired power plants and steel plants, plantations and agriculture using pesticides and fungicides in great quantities, West Bengal offers a fit site for conducting investigations on mercury contamination.

Sampling

A total of 264 samples were collected and submitted to the laboratory for total mercury analysis. This included 60 samples from Kolkata markets. The samples comprised 56 varieties of fish and crustaceans. Tables I and II give details of the samples and their locations.

The sampling strategy required to support thoroughgoing analysis of mercury contamination of edible fish, shrimp and crabs (crustaceans) across West Bengal. The locations were selected to represent wide geographical spread, influences of industrial installations and land use practices. Samples were also collected from five major markets of Kolkata as they get fish from the most variegated sources in the state. Therefore, the samples from Kolkata market were thought to widen samples quality. Also, Kolkata being the largest metropolitan city in the eastern region and second largest metropolitan city in the country, it was deemed important to analyse the quality of fish available here.

The following criteria were adopted in selecting markets in Kolkata for collecting samples.

i) Location – Markets were chosen from the different parts of the city, from North to South.
ii) Large markets – all selected markets catered to a fairly wide area.

A list of markets from where samples in Kolkata were collected is given in Table 1.

Table 1. List of markets in Kolkata from where samples were collected

Sl. no.	Market	Location in Kolkata
1	Gariahat	South
2	Sahababu Bazaar	Central
3	Manicktala	North
4	Sealdah	Central
5	Behala	South-west

Six common varieties of fish/crustaceans were identified for collection from each market. For each variety two samples were collected. Thus, 12 samples each were collected from the five markets

In identifying waterbodies for sample collection from across West Bengal the following criteria were adopted:

i) Possible sources of mercury emission/discharge nearby
ii) Represent different geographical and land use pattern

Table 2. Locations of select waterbodies across West Bengal from where samples were collected

Sl. no.	Area	Waterbody
1	Farakka (thermal power plant)	River - Ganga and feeder canal
2	Durgapur - Asansol (industrial belt)	River - Damodar
3	Kolkata (metropolis) and nearby area	Pond - East Kolkata Wetland and udiali; River - Ganga at Budge Budge - downstream from Kolkata
4	Haldia (industrial belt)	Estuary - Haldi and Hooghly Rivers
5	Kolaghat (thermal power plant)	Ponds
6	Digha (tourist spot)	Sea - Bay of Bengal
7	Kakdwip (fishing site)	Sea - Bay of Bengal
8	Jharkhali, Sunderban Biosphere Reserve	River - Matla, Vidyadhari, Herobhanga
9	Hugli (agricultural belt)	Ponds
10	North Bengal - plains area in Darjeeling district	Confluence of Mahananda, Teesta Canal and Balashon River
11	North Bengal - plains area in Darjeeling district near tea garden	Pond - Ruidasa
12	North Bengal - agricultural belt, Jalpaiguri district	Pond - Dolua
13	North Bengal - agricultural belt, Jalpaiguri district	Pond - Kanchansiri
14	North Bengal - Jalpaiguri district	River - Korola
15	North Bengal - plains area in Darjeeling district	Pond - Ranijjot

Samples were collected at the point of time and the place where the fishers brought in their catch. This norm was followed in all locations with the exception of Jharkhali, where only a few varieties could be picked from the fishers' catch of the day. A few other varieties that had been brought in earlier and stocked with the Aaratdar (fish wholesaler) in the market were thus also included. All the samples were taken only after a careful cross-questioning about their sources.

It was decided to collect a minimum of eight verities of fish/crustaceans from each location. However, a few locations didn't yield desired number of common and popular varieties. Crustacean varieties could be collected only from a few locations.

A brief account of sample collection from different locations as well as the general introduction of the locations is given in Appendix 1. Appendix 2 indicates the locations on a map of West Bengal.

It is important to clarify that the term 'location' here specifies a certain geographical entity and not a particular pond or a river. For instance, the eight varieties caught from the Hugli agricultural belt have come from different ponds within a radius of about two kilometre. Each pond constitutes a different ecosystem and therefore it can be argued that the Hugli fish have come from different locations. But, in this study the term 'location' implies a particular area; in this example Hugli agricultural belt. Tables I and II give the complete description of samples along with their respective locations.

Fish and crustaceans (shrimps and crabs) samples were chosen on the basis of the following criteria:

i) Preference for commonly eaten varieties (mercury in these is the greatest hazard for fish eating people)
ii) Matured specimens (mercury bio-accumulates with age)
iii) To analyse mercury bio-accumulation in different species, eight varieties of fish/crustaceans with two samples each were collected for all locations.

Sampling from Kolkata markets involved the following norms:

i) Six species from each market
ii) Two samples for each species from all markets
iii) All samples to be collected from fish stalls

Sampling from waterbodies across West Bengal involved the following norms:

i) Eight species from each location.
ii) Two samples for each species from all locations
iii) Samples to be collected at the point of time and place where the fishers unload their catch in order to be certain of sample source.

After collection, the samples were identified in the following manner:

i) By local name of the species / variety
ii) By scientific name of the species (in so far as scientific species identification was possible)
iii) By photographing each sample (for future identification, if necessary)
iv) By weighing and measuring the length of each sample (for estimating age)

Each sample was kept in a separate insulated box at zero degree Celcius, during the period from collection to delivery to the laboratory, in order to protect it from all possible contaminants. All samples were transferred to the laboratory within 30 hours of the collection. Only in the case of North Bengal samples did the delivery to the laboratory take about 48 hours after the collection, but the fish was kept in freezing conditions during the entire period.

Each sample was identified and listed according to its common and scientific name and location. The laboratory, when it take charge of the samples, attached its own code label to each sample and the personnel from DISHA recorded laboratory code against identification tags that were given at the time of sample packaging.

Lab Methodology

All samples were sent to SGS India Private Limited, Behala, Kolkata, an NABL accredited laboratory, for the analysis of total mercury concentration.

The total mercury concentration was determined using the AOAC 977.15 method. For each sample, the flesh tissues were taken from different parts of the sample body, cut into small pieces, homogenized and digested through acid digestion method. Their mercury concentration was determined via ICP-OES (hydride generation) using iCAP 6300 and the results were taken in five replicates. The final results were calculated in mg/kg (wet weight).

A Note on Units Used

The lab results were determined in ppm, expressed as mg/kg. However, this unit often needed conversion to micrograms per kg (µg/kg) readings, as we shall see later in the course of the analysis and discussion. Therefore, all major tables in this study also have the µg/kg readings of the lab results. Whenever, the findings have been referred to in terms of mg/kg, the same may, if required, be converted to µg/kg values by a simple multiplication by 1000.

Results and Discussion

The total mercury concentrations of samples collected from Kolkata markets and other locations in West Bengal, including the species average for each location/ market, are given in Tables III and IV, respectively.

The reliable detection limit of the instrument and methodology was 0.20 mg/kg. That is, for the given methodology and instrumentation, mercury values arrived at below the aforesaid value may not be accepted with a high degree of confidence. Therefore, in this study any value indicated by <0.20 mg/kg implies a value x: $0<x<0.20$ mg/kg (here x is understood to be always, even if slightly, greater than 0, as mercury naturally occurs in the environment and faint traces are present in all organisms). This factor creates obvious problems in working with the data, for example, even at the simplest level of working out mean values. There are statistical methods for addressing such problems, but we have eschewed that course as it needlessly complicates the situation without helping significantly in data interpretation.

Yet, there was an urgent need to bring the values denoted by <0.20 within the ambit of computability. Only 61 of 264 samples exhibited such values. One could arbitrarily ascribe any value between 0 and 0.20 to those values but, interestingly, it was found that variation in these values does not lead to any serious variation in the overall scenario. Taking all the <0.20 values as 0.1 we get 0.442 as the average for the whole set of samples. On the other hand, taking 0 instead of 0.1, one gets 0.418 as the average value – a difference of around five percent. In case of other averages, for example location averages or species averages, the difference is often less. In the context of estimating the hazardousness of the contamination levels, therefore, the significance of the difference is negligible. Under these circumstances, for purposes of computation, the lower limit of 0 was chosen to stand for all <0.20 mg/kg values. Since the study has not required employing geometrical mean, therefore using 0 did not pose a problem. On the other hand this approach gives us somewhat conservative figures for the averages.

Eight of 60 Kolkata market samples had total mercury concentrations below 0.20 mg/kg (see Table III), while 53 of 204 samples from other locations showed mercury level below 0.20 mg/kg (see Table-IV). In all, 77 percent of 264 fish and crustaceans samples showed total mercury concentration greater than 0.20 mg/kg.

Discussion

Various levels of toxicity exposure emerge based on Provisional Tolerable Weekly Intake (PTWI) limits and weekly fish consumption by different age/weight groups (see Table 3). Throughout this study, mercury values in samples refer to fish-flesh; organs such as liver and brain are also eaten and have mercury too, but are not in the purview of this report. Fish-flesh constitutes the most widely eaten part of fish, and the overwhelming bulk of what is actually eaten.

The Joint FAO-WHO Expert Committee clearly recommends that although its PTWI may be exceeded somewhat in case of adults (to about twice the tolerable intake per week), this is not recommended in the case of pregnant mothers (where foetus can suffer irreversible development anomalies) or in the case of children or young adolescents; in all such cases the PTWI should be followed.[24]

An example will illustrate the nature of information in Table 3. In the case of a child or a young adolescent of 40 kg, the PTWI is 64 µg: at the rate of 1.6 µg / kg of body weight. At a weekly fish-flesh consumption rate of 300 gm or 0.30 kg, methylmercury concentration in fish-flesh consumed should not exceed 213.33 µg/kg, or 0.21333 mg/kg. At a higher concentration for the same consumption level, the PTWI will exceed tolerable exposure.

Table 3. Permissible levels of methylmercury for different body weights and fish intake situations

Fish flesh intake (gm per week)			100	150	200	250	300	350	400	450	500	600	700
Fish flesh intake (kg per week)			0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.6	0.7
			Methylmercury concentration (µg / kg) which should not be exceeded (rounded to whole numbers)										
Body Weight (kg)	PTWI (µg)		A	B	C	D	E	F	G	H	I	J	K
25	40	a	400	267	200	160	133	114	100	89	80	67	57
30	48	b	480	320	240	192	160	137	120	107	96	80	69
35	56	c	560	373	280	224	187	160	140	124	112	93	80
40	64	d	640	427	320	256	213	183	160	142	128	107	91
45	72	e	720	480	360	288	240	206	180	160	144	120	103
50	80	f	800	533	400	320	267	229	200	178	160	133	114
55	88	g	880	587	440	352	293	251	220	196	176	147	126
60	96	h	960	640	480	384	320	274	240	213	192	160	137
65	104	i	1040	693	520	416	347	297	260	231	208	173	149

Table 3 covers the following information:

i) For each weight and associated PTWI, the possible range of fish flesh intake per week.

ii) And for each weight cum PTWI and possible fish flesh intake per week, the methylmercury concentration in fish flesh (in µg/kg) which should not be exceeded (from aA to iK).

It may be noted that since PTWI is related to individual's body weight, the permissible limit of methylmercury concentration in fish-flesh decreases with increase in weekly fish consumption.

On the other hand, if we know methylmercury concentration in fish, we can calculate the permissible maximum level of weekly consumption for an individual of given body weight. A sample set of such information is given in Table 4.

Table 4. Permissible levels of fish flesh consumption (gm) per week per levels of body weight (kg)

MeHg Concentration in Fish Flesh (μg /kg)			200	300	400	500	600	700	800	900	1000	1200	1400	1600	1800	2000
			Permissible levels of fish flesh consumption (gm) per week per levels of body weight													
Body Wt. (kg)	PTWI (μg)		A	B	C	D	E	F	G	H	I	J	K	L	M	N
25	40	a	200	133	100	80	67	57	50	44	40	33	29	25	22	20
30	48	b	240	160	120	96	80	69	60	53	48	40	34	30	27	24
35	56	c	280	187	140	112	93	80	70	62	56	47	40	35	31	28
40	64	d	320	213	160	128	107	91	80	71	64	53	46	40	36	32
45	72	e	360	240	180	144	120	103	90	80	72	60	51	45	40	36
50	80	f	400	267	200	160	133	114	100	89	80	67	57	50	44	40
55	88	g	440	293	220	176	147	126	110	98	88	73	63	55	49	44
60	96	h	480	320	240	192	160	137	120	107	96	80	69	60	53	48
65	104	i	520	347	260	208	173	149	130	116	104	87	74	65	58	52

Here the topmost row indicates values of methylmercury concentration in fish flesh in μg/kg. The cells from aA to iN give the various quantities of fish-flesh (in gm) that may be consumed per week so as not to exceed the PTWI. Exceeding these values, for given body weights and MeHg concentrations, would lead to toxic exposure. Here the rows a to d are the most important, for the bulk of children (age 7 years onwards) and early adolescents in India belong to this weight range, and they are most susceptible groups identified by the FAO/WHO Joint Expert Committee.

A preliminary survey carried out to enquire fish intake of families in West Bengal revealed consumption of 300-500 gm fish flesh per person per week. The survey included families with incomes as diverse as Rs. 8,000 per month for a four-member family, Rs. 10,000 per month for a nine-member family and Rs 90,000 per month for a four-member family and queried about fish flesh consumed as a proportion of fish purchased. It was also found that children of five years and above consumed fish at adult rates (if they did not have a particular dislike for fish), as fish consumption by children is encouraged given its high nutrient value.

Based on the detailed examination of each sample (weighing various parts of fish like head, fins, bones and flesh), consumption of flesh, the main repository of methylmercury, was calculated. It was found that over a wide range of fish varieties eaten, fish flesh constituted not less than 75 percent of the fish eaten. Therefore per head weekly consumption of 400 gm of fish would tend to indicate an overall consumption of not less than 300 gm of fish flesh (Appendix 4)). However, it should be noted here that fish head is also popular among those who eat fish regularly. Therefore, the actual consumption of fish would be more than consumption of fish flesh. It is noteworthy that methylmercury is found in fish brains as well. However, this aspect has been left out from the discussion here, as the brains were not tested for total mercury contamination in the present study.

Before interpreting the results as per the above discussion, one has to find the concentration of methylmercury as a proportion of total mercury in fish, as the results obtained were for total mercury and the PTWI standards are in respect to methylmercury concentration.

Studies indicate that more than 80 percent of total mercury in fish is in the form of methylmercury. More often than not, methylmercury as a proportion of the total mercury is close to 100 percent.[25] The discussion that follows takes a somewhat more conservative estimate, so as to reduce the possibilities of error. Methylmercury concen tration in crustaceans varies across genus and species. In case of crabs, methylmercury level can go up to 100 percent of the total mercury, while in case of shrimps it could be 50 percent or less (even 35 percent).[26] Therefore, for all fish and crab samples, the methylmercury concentration has been assumed to be 80 percent of the total mercury concentration, while for shrimps methylmercury concentration is assumed to be 40 percent of the total mercury concentration.

Total mercury concentration for each sample, from Kolkata markets and select fishing locations across West Bengal, are given in Tables III and IV, respectively. Methylmercury values for the same are given in Tables V and VI. Table V (for Kolkata markets) and Table VI (for samples brought from various water bodies in West Bengal) also show percentage exceedance of PTWI in two common consumption situations given below:

a) A child of 25 kg consuming just 200 gm of fish flesh in an entire week (PTWI 40 µg, permissible level of methylmercury in fish 200 µg/kg).

b) An adolescent or pregnant mother of 50 kg consuming 300 gm of fish flesh in an entire week (PTWI 80 µg, permissible level of methylmercury in fish 267 µg/kg; see Table 3). [The average weight of Indian women is around 50 kg].

In Table V (samples from Kolkata markets), 29 of 60 samples exceeded the PTWI for a child of 25 kg consuming 200 gm of fish flesh in a week, while 23 samples exceeded the PTWI for an adolescent or pregnant mother of 50 kg consuming 300 gm of fish flesh in a week. Similarly, in Table VI (samples from select fishing locations in West Bengal), 121 of 204 samples exceeded the PTWI for a child of 25 kg consuming 200 gm of fish flesh in a week and 100 samples exceeded the PTWI for an adolescent or pregnant mother of 50 kg consuming 300 gm of fish flesh in a week. Combining the two tables (total samples), 150 samples exceeded the PTWI limits for a child of 25 kg, while 123 samples exceeded the PTWI limits for an adolescent or pregnant mother for the given consumption rate and body weight. The combined results are presented in Table 5 below.

Table 5. Number and percentage of samples exceeding PTWI limits for two common situations

Exceedance for given body wt and consumption level	No. of Kolkata market samples showing MeHg exceedance (see Table V)	No. of samples from other locations showing MeHg exceedance (see Table VI)	Total	Total number of samples	Percentage of samples showing PTWI exceedance
A child of 25 kg consuming 200 gm of fish flesh per week	29	121	150	264	56.82
An adolescent or pregnant mother of 50 kg consuming 300 gm of fish flesh per week	23	100	123	264	46.59

It is observed that 57 percent of 264 samples exceed methylmercury PTWI for a child of 25 kg and below consuming just about 200 gm of fish flesh in an entire week. Likewise, 47 percent samples show methylmercury at levels that exceeds PTWI for an adolescent or pregnant woman of 50 kg consuming 300 gm fish flesh in the same period.

Although Tables V and VI refer to PTWI exceedance only, one can easily use them to count instances of PFA exceedance, as has been done and displayed in Table 6 below.

Table 6. Percentage of samples exceeding PFA standards

PFA Stipulations	PFA exceedance in number of samples in Table V	Total samples in Table V	Percentage of samples in Table V with excess values	PFA exceedance in number of samples in Table VI	Total samples in Table VI	Percentage of samples in Table VI with excess values	Total number of samples in two tables with excess values	Grand total of samples in the two Tables	Percentage of samples with excess values
PFA stipulation for mercury (Hg) exceeded	16	60	26.67	62	204	30.39	78	264	29.55
PFA stipulation for methylmercury (MeHg) exceeded	24	60	40	105	204	51.47	129	264	48.86

Tables 7 and 8 present similar information with respect to sampling locations. However, it is desirable to elaborate on a feature of these two tables as well as the succeeding table, Table 9. These tables mention percentage of exceedance from PTWI and PFA standards. Here it is important to understand that the percentage figures associated with 'Exceeded by' are best understood by attending to the following examples. Let us assume that the standard of reference is 50 units and the lab results indicate 75 units. Then the excess is calculated as 25 above 50, that is 50%. Similarly if the lab result is 52, then the excess is 2 over 50, which amounts to 4%. Where the lab value is the same as or less than the standard, the result has been simply denoted as 'Not exceeded' and the extent of exceedance has been denoted as 'nil'. (See also the Note preceding Table V.)

Table 7. Percentage exceedance over PTWI and PFA standards in samples collected from Kolkata Markets

Market	Average Hg (mg/kg)	Average MeHg (mg/kg)	Average MeHg (µg/kg)	Child of 25 kg, Intake 200 gm. PTWI Exceeded By %		Person of 50 kg, Intake 300 gm. PTWI Exceeded By %		PFA Act & Rules for Hg/ Exceeded By %		PFA Act & Rules for MeHg/ Exceeded By %	
Gariahat	0.618	0.479	479	Exceeded	139.50	Exceeded	79.40	Exceeded	23.6	Exceeded	91.6
Sahababu	0.184	0.119	119	Not exceeded	nil	Not exceeded	nil	Not Exceeded	nil	Not Exceeded	nil
Sealdah	0.413	0.298	298	Exceeded	49.00	Exceeded	11.61	Not Exceeded	nil	Exceeded	19.2
Manicktala	0.326	0.248	248	Exceeded	24.00	Not exceeded	nil	Not Exceeded	nil	Not Exceeded	nil
Behala	0.315	0.240	240	Exceeded	20.00	Not exceeded	nil	Not Exceeded	nil	Not Exceeded	nil
The average for 5 Markets	0.371	0.277	277	Exceeded	38.50	Exceeded	3.75	Not Exceeded	nil	Exceeded	10.8

Table 8. Percentage exceedance over PTWI and PFA standards in samples collected from fishing location in West Bengal

Locality	Average Total Hg (mg/kg)	Average for MeHg (mg/kg)	Average MeHg (µg/kg)	Child of 25 kg, Intake 200 gm. PTWI Exceeded By %		Person of 50 kg, Intake 300 gm. PTWI Exceeded By %		PFA Act & Rules for Hg/ Exceeded By %		PFA Act & Rules for MeHg/ Exceeded By %	
Hugli	0.386	0.309	309	Exceeded	54.5	Exceeded	15.73	Not Exceeded	nil	Exceeded	23.6
Budge Budge	0.563	0.451	451	Exceeded	125.5	Exceeded	68.91	Exceeded	12.6	Exceeded	80.4
Jharkhali	1.452	1.023	1023	Exceeded	411.5	Exceeded	283.15	Exceeded	190.4	Exceeded	309.2
Haldia	0.327	0.261	261	Exceeded	30.5	Not exceeded	nil	Not Exceeded	nil	Exceeded	4.4
Digha	0.562	0.382	382	Exceeded	91	Exceeded	43.07	Exceeded	12.4	Exceeded	52.8
East Kolkata Wetlands	0.432	0.345	345	Exceeded	72.5	Exceeded	29.21	Not Exceeded	nil	Exceeded	38
Kakdwip	0.711	0.569	569	Exceeded	184.5	Exceeded	113.11	Exceeded	42.2	Exceeded	127.6
Mudiali	0.202	0.161	161	Not exceed-ed	nil	Not exceeded	nil	Not Exceeded	nil	Not Exceeded	nil
Farakka	0.455	0.364	364	Exceeded	82	Exceeded	36.33	Not Exceeded	nil	Exceeded	45.6
North Bengal	0.066	0.052	52	Not exceed-ed	nil	Not exceeded	nil	Not Exceeded	nil	Not Exceeded	nil
Kolaghat	0.159	0.127	127	Not exceed-ed	nil	Not exceeded	nil	Not Exceeded	nil	Not Exceeded	nil
Durgapur	0.129	0.103	103	Not exceed-ed	nil	Not exceeded	nil	Not Exceeded	nil	Not Exceeded	nil
Average	0.432	0.328	328	Exceeded	64	Exceeded	22.85	Not Exceeded	nil	Exceeded	31.2

Table 9 shows averages for mercury and methylmercury percentage exceedance over their respective PTWI and PFA standards for all 264 samples.

Table 9. Average mercury and methylmercury percentage exceedance over PTWI and PFA standards for all samples

	Average Hg (mg/kg)	Average MeHg (mg/kg)	Average MeHg (µg/kg)	Child of 25 kg intake 200 gm % of PTWI exceedance		Person of 50 kg Intake 300 gm % of PTWI exceedance		PFA Act & Rules % of Hg exceedance		PFA Act & Rules % of MeHg exceedance	
Entire Study	0.418	0.317	317	Exceeded	58.36	Exceeded	18.62	Not Exceeded	nil	Exceeded	26.68

Since people eat a variety of fish, methylmercury level in an individual fish variety does not give complete picture of their exposure. People's intake of methylmercury depends on a variety of fish in their food and methylmercury contamination levels of these fish. The average methylmercury level of the study samples thus gains significance here. Tables 7 and 8 delve into this aspect of the study for each sampling location.

Furthermore, fish in the markets come from variegated sources. A consumer buying her fish from a local market is exposed to contaminated catch coming from different places. Therefore, the state average for mercury contamination of fish would be a good indicator of people's risk of exposure. Table 9 reveals this aspect of the study findings.

It may be noted here that the two scenarios described above depict relatively low levels of fish consumption, and that fish consumption could easily be higher, particularly in families with higher incomes, costal populations or areas in the vicinity of large waterbodies. The risk of exposure increases with increase in fish-flesh consumption for a given body weight.

- A child of 25 kg consuming just 250 gm of fish flesh in an entire week (PTWI 40 µg; Permissible level 160 µg/kg; see Table 3).
- An adolescent or pregnant mother of 60 kg consuming 500 gm of fish flesh in an entire week (PTWI 96 µg; Permissible level 192 µg/kg; see Table 3).

The research shows that methylmercury levels in 69 percent samples exceed PTWI for a child weighing 25 kg and consuming 250 gm fish flesh in an entire week. Likewise, 59 percent samples exceed PTWI for women/adolescents of 60 kg consuming 500 gm fish flesh in a week (see Table 10).

Table 10. Number and percentage of samples exceeding PTWI limits

Given body wt and consumption level	No. of Kolkata market samples showing MeHg exceedance Over PTWI (see Table VI A)	No. of samples from other locations showing MeHg exceedance Over PTWI (see Table VI B)	Total	Total samples	Percentage of samples showing PTWI exceedance
A child of 25 kg consuming just 250 gm of fish flesh in a week	40	141	181	264	68.56
An adolescent or pregnant woman of 60 kg consuming 500 gm of fish flesh in a week	30	125	155	264	58.71

The significance of the above table is made evident when we compare it with Table 5: An increase of only 50 gm fish flesh consumption in an entire week results in a dramatic increase in PTWI exceedance – from 56.82 percent to 68.56 percent in one case and from 46.59 percent to 58.71 percent in the other.

Similarly, the two situations above can be tested against the different average values, in the tables below.

Table 11. Averages of methylmercury levels in five Kolkata Market samples and their PTWI exceedance in relation to consumption scenarios

		A child of 25 kg PTWI = 40 µg Consumption = 0.25 kg			An adult of 60 kg PTWI = 96 µg Consumption = 0.50 kg		
Market	**Average MeHg (µg/kg)**	**MeHg intake (µg)**	**Whether exceeded**	**Percent exceedance over PTWI**	**MeHg intake (µg)**	**Whether exceeded**	**Percent exceedance over PTWI**
Gariahat	479	119.75	Yes	199.38	239.50	Yes	149.48
Sahababu	119	29.75	No	nil	59.50	No	nil
Sealdah	298	74.50	Yes	86.25	149.00	Yes	55.21
Manicktala	248	62.00	Yes	55.00	124.00	Yes	29.17
Behala	240	60.00	Yes	50.00	120.00	Yes	25.00
The average for 5 Markets	277	69.25	Yes	73.13	138.50	Yes	44.27

Table 12. Averages of methylmercury levels in samples from other locations and their PTWI exceedance in relation to consumption scenarios

		A child of 25 kg PTWI = 40 µg Consumption = 0.25 kg			An adult of 60 kg PTWI = 96 µg Consumption = 0.50 kg		
Sample locations	**Average of MeHg (µg/kg)**	**MeHg intake (µg)**	**Whether exceeded**	**Percent exceedance over PTWI**	**MeHg intake (µg)**	**Whether exceeded**	**Percent exceedance over PTWI**
Hugli	309	77.25	Yes	93.13	154.50	Yes	60.94
Budge Budge	451	112.75	Yes	181.88	225.50	Yes	134.90
Jharkhali	1023	255.75	Yes	539.38	511.50	Yes	432.81
Haldia	261	65.25	Yes	63.13	130.50	Yes	35.94
Digha	382	95.50	Yes	138.75	191.00	Yes	98.96
East Kolkata Wetlands	345	86.25	Yes	115.63	172.50	Yes	79.69
Kakdwip	569	142.25	Yes	255.63	284.50	Yes	196.35
Mudiali	161	40.25	Yes	0.63	80.50	No	nil
Farakka	364	91.00	Yes	127.50	182.00	Yes	89.58
North Bengal	52	13.00	No	nil	26.00	No	nil
Kolaghat	127	31.75	No	nil	63.50	No	nil
Durgapur	103	25.75	No	nil	51.50	No	nil
Average	328	82.00	Yes	105.00	164.00	Yes	70.83

Table 13. Average methylmercury concentration for all samples and percentage exceedance over PTWI standard in two consumption scenarios

		A child of 25 kg PTWI = 40 µg Consumption = 0.25 kg			An adult of 60 kg PTWI = 96 µg Consumption = 0.50 kg		
Market	**Average MeHg (µg/kg)**	**MeHg intake (µg)**	**Whether exceeded**	**Percent exceedance over PTWI**	**MeHg intake (µg)**	**Whether exceeded**	**Percent exceedance over PTWI**
Average for all 264 samples	317	79.25	Yes	98.13	158.50	Yes	65.10

When we compare Tables 13 and 9, we find that mere 50 gm increase in fish flesh consumption over a week for a child of 25 kg almost doubles the risk of exposure (see Table 14).

Table 14. Result of 50 gm increase in fish flesh intake

	Average of PTWI percent exceedance for a child of 25 kg, consuming 200 gm of fish flesh in a week	**Average of PTWI percent exceedance for a child of 25 kg, consuming 250 gm of fish flesh in a week**	**Increase in PTWI percentage exceedance for increase in 50 gm fish intake in a week**
Kolkata Market samples	38.50 (table 7)	73.13 (table 11)	34.63
Samples from other locations	64 (table 8)	105.00 (table 12)	41
Average for all samples	58.36	98.13	39.77

It is observed from Table 6 that the samples from the North Bengal show relatively low values for mercury contamination. However, it is of little consequence for South Bengal as it usually does not get fish from North Bengal. Therefore, it is pertinent to work out an average of the values excluding the samples from North Bengal.

The average value for mercury and methylmercury contamination in samples from the select waterbodies in West Bengal (minus North Bengal) was 0.511 mg/kg and 0.388 mg/kg, respectively. For all samples (minus North Bengal but including samples from Kolkata markets) mercury and methylmercury averages were 0.474 mg/kg and MeHg value is 0.358 mg/kg.

Table 15 indicates the significance of the above values. It is observed that the risk is greatly enhanced if North Bengal samples are not included in calculating the averages. This suggests that the risk of exposure to methylmercury is far greater in South Bengal than in North Bengal

Table 15. The four intake situations with North Bengal factored out

The Averages	Average mercury (mg/kg)	Average MeHg (mg/kg)	Average MeHg (µg/kg)	Child of 25 kg Intake 200 gm PTWI Exceedance in percent	Child of 25 kg Intake 250 gm PTWI Exceedance in percent	Person of 50 kg Intake 300 gm PTWI Exceedance in percent	Person of 60 kg Intake 500 gm PTWI Exceedance in percent
West Bengal Locations (minus North Bengal)	0.511	0.388	388	94	142.5	45.50	102.08
The average for the whole (minus North Bengal)	0.474	0.358	358	79	123.75	34.25	86.46

Specieswise average of total mercury and methylmercury concetration and their exceedance over PFA standards is given in Table VII. Table VIII gives total mercury and methylmercury concentration after omitting the values for North Bengal. The table also gives information on the feeding habits of the species sampled.

Out of 56 species, 23 show mercury exceedance and 35 show methylmercury exceedance over their respective PFA standards. If North Bengal samples are factored out, the fish varieties are reduced to 53. But this considerably increases the average exceedance of mercury and methylmercury in the set of samples from South Bengal.

Table VII A shows species averages for mercury and methylmercury and their percentage exceedance over PTWI in four common consumption scenarios described above. Scanning the table one finds that:

- For a child of 25 kg body weight and 200 gm of fish-flesh intake per week, 38 of 56 species tested show exceedance over PTWI; average methylmercury exceedance in 22 of these 38 species was 100 percent above PTWI. In 9 cases the exceedance was over 200 percent.
- For a child of 25 kg with weekly fish-flesh consumption of 250 gm, 44 species show PTWI exceedance. The average exceedance is over 100 percent in case of 27 species and more than 200 percent in 14 species.
- For an adult or adolescent of 50 kg with 300 gm of fish intake per week, PTWI exceeds in 34 species; in 10 species the average exceedance was more than 100 percent, in another three exceedance was over 200 percent.
- For an adult/adolescent of 60 kg body weight and 500 gm of fish intake per week, 39 species show exceedance over PTWI; the average exceedance in 23 of these species was over 100 percent while for 10 species it was over 200 percent.

It is abundantly clear from the findings that a large number of samples have alarmingly high levels of methylmercury. Especially samples collected from some of the fishing locations across West Bengal show disturbingly high mercury and methylmercury averages. It is to be noted however that samples from Jalpaiguri and Darjeeling (North Bengal) have much lower values for mercury and methylmercury. This can be related to near absence of industrial and manufacturing units in the area. Agriculture, tea plantations and tourism are the main economic activities of this region.

By the same token, the Durgapur region, hub of industrial activity, should be showing relatively high mercury levels. But it does not. The average for Durgapur is low. Similar is the case for Kolaghat, which has the WBPDCL thermal power plant.

One interesting pattern emerges from the study. The coastal/estuarine areas of Jharkhali, Kakdwip and Digha show high mercury levels. So does Budge Budge, very close to and downstream of Kolkata in the Hooghly estuary. The Hooghly estuary and the coastal waters of West Bengal are the recipients of industrial effluents, untreated urban sewage and agricultural wash-offs, containing an extraordinarily large variety of toxins from a number of sites across densely populated South Bengal.

Mercury concentration in fish samples from Haldia (Haldi river), an industrial area abutting estuarine site, though high for safe consumption was relatively low in comparison to estuarine samples. The explanation for this anomaly may lie in the fact that Haldi river, which flows into the Hooghly at Haldia and from where many of the samples came, is not as polluted as Hooghly.

The results can be further analysed by comparing the species/variety averages displayed in Tables VII & VIII with their feeding habits. It is observed that predatorial and carnivorous species tend to show significantly higher values for mercury in comparison to mainly herbivores or omnivores varieties. A striking example is *Harpadon neherus,* described as an 'aggressive predator', which shows very high mercury and methylmercury values. Other examples are *Epinephelous sp.* and *Eleutheronema tetradactylum,* which feed on small fish and crustaceans, show high mercury values. On the other hand *Catla catla*, basically a phytoplankton, detritus and insect feeder, shows quite low mercury values, and so do *Oreochromis nilotica*, *Labeo bata* and *Labeo rohita*. This reaffirms that methylmercury undergoes biomagnification at higher trophic levels, and therefore predator species show higher concentration of mercury. However, a few anomalies also exist. In our study a few herbivorous species like *Liza parsia* were also found to show high mercury values.

It is interesting to look at the distribution of fish species. Table 16 provides the fish varieties and the corresponding mercury and methylmercury values for Jharkhali. It is to be observed that except for *Coilia sp.* all other varieties are carnivorous. The Table 17 shows the situation for Digha, Kakdwip and Budge Budge. Once again there is a predominance of carnivorous types, though perhaps a little less pronounced than that of Jharkhali.

Table 16. Mercury and methylmercury in sample species from Jharkhali

Jharkhali		
Species scientific name	**Hg (mg/kg)**	**MeHg (mg/kg)**
Trichurus sp.	2.66	2.128
Trichurus sp.	2.05	1.64
Coilia sp.	1.36	1.088
Coilia sp.	0.92	0.736
Harpadon nehereus	1.72	1.376
Harpadon nehereus	0.59	0.472
Macrobrachium rosenbergii	1.31	0.524
Macrobrachium rosenbergii	1.52	0.608
Pampus chinesis	2.08	1.664
Pampus chinesis	2.03	1.624
Penaeus monodon	1.42	0.568
Penaeus monodon	1.29	0.516
Panna microdon	1.09	0.872
Panna microdon	1.61	1.288
Epinephelous sp.	0.85	0.68
Epinephelous sp.	0.73	0.584

Table 17. Mercury and methyl mercury in sample species from Digha, Kakdwip and Budge Budge

Digha			Kakdwip			Budge Budge		
Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)
Otolithoides sp.	0.63	0.504	*Otolithoides sp.*	0.45	0.36	*Ompok pabda*	0.20	0.160
Otolithoides sp.	0.39	0.312	*Otolithoides sp.*	0.50	0.4	*Ompok pabda*	0.20	0.160
Apolectus niger	0.40	0.32	*Sillaginopsis panijus*	0.42	0.336	*Sillago sihama*	0.37	0.296
Apolectus niger	0.42	0.336	*Sillaginopsis panijus*	0.36	0.288	*Sillago sihama*	0.56	0.448
Pellona sp.	<0.20	<0.20	*Platycephalous sp.*	0.48	0.384	*Tenualosa ilisha*	0.70	0.560
Pellona sp.	<0.20	<0.20	*Platycephalous sp.*	0.69	0.552	*Tenualosa ilisha*	0.58	0.464
Devario devario	0.60	0.48	*Arius sp.*	0.60	0.48	*Eleutheronema tetradactylum*	0.56	0.448
Devario devario	0.72	0.576	*Arius sp.*	0.58	0.464	*Eleutheronema tetradactylum*	0.82	0.656
Sillago sihama	0.26	0.208	*Raconda russiliana*	0.83	0.664	*Polydactylus sexfilis*	0.69	0.552
Sillago sihama	0.24	0.192	*Raconda russiliana*	0.71	0.568	*Polydactylus sexfilis*	0.59	0.472
Liza parsia	0.26	0.208	*Setipinna phasa*	0.96	0.768	*Harpadon nehereus*	0.45	0.360
Liza parsia	0.29	0.232	*Setipinna phasa*	1.09	0.872	*Harpadon nehereus*	0.42	0.336
Portumus pelagius	0.50	0.4	*Devario devario*	0.84	0.672	*Panna microdon*	0.61	0.488
Portumus pelagius	0.48	0.384	*Devario devario*	0.96	0.768	*Panna microdon*	0.44	0.352
Eleutheronema tetradactylum	1.14	0.912	*Liza parsia*	0.96	0.768	*Otolithoides sp.*	1.03	0.824
Eleutheronema tetradactylum	1.10	0.88	*Liza parsia*	0.94	0.752	*Otolithoides sp.*	0.46	0.368
Penaeus sp.	1.39	0.556				*Nibea soldado*	0.83	0.664
Penaeus sp.	1.99	0.796				*Nibea soldado*	0.63	0.504
Trichurus lepturus	0.43	0.344						
Trichurus lepturus	<0.20	<0.20						

Table 18. Mercury and methylmercury in sample species from Kolaghat and Durgapur

Kolaghat			Durgapur		
Species scientific name	**Hg (mg/kg)**	**MeHg (mg/kg)**	**Species scientific name**	**Hg (mg/kg)**	**MeHg (mg/kg)**
Pangasius pangasius	0.41	0.328	*Wallagonia attu*	0.25	0.2
Pangasius pangasius	0.22	0.176	*Wallagonia attu*	0.21	0.168
Catla catla	0.60	0.48	*Sperata aor*	<0.20	<0.20
Catla catla	<0.20	<0.20	*Sperata aor*	0.22	0.176
Hypophthalmichthys molitrix	<0.20	<0.20	*Ophisternon bengalense*	0.20	0.16
Hypophthalmichthys molitrix	0.20	0.16	*Ophisternon bengalense*	0.21	0.168
Cirrhinus cirrhosus	0.27	0.216	*Cyprinus carpio*	<0.20	<0.20
Cirrhinus cirrhosus	<0.20	<0.20	*Cyprinus carpio*	<0.20	<0.20
Labeo bata	0.24	0.192	*Eutropichthys vacha*	<0.20	<0.20
Labeo bata	<0.20	<0.20	*Eutropichthys vacha*	0.20	0.16
Macrobrachium rosenbergii	<0.20	<0.20			
Macrobrachium rosenbergii	<0.20	<0.20			
Oreochromis nilotica	<0.20	<0.20			
Oreochromis nilotica	0.29	0.232			

In the case of Kolaghat, except for two species, all others were herbivorous or mostly herbivorous. But in the case of Durgapur, all varieties except *Cyprinus carpio* were carnivorous. Yet, the average mercury value for Durgapur is lower than that of Kolaghat (see Table 18).

The other possible factor for variation in mercury concentration in fish across species and locations can be its size and weight. Fish of greater body weight are likely to show higher levels of mercury bioconcentration. Table 19 shows correlation coefficient between the mean catch weight and mercury bioconcentration.

Table 19. Mean sample weight and total mercury concentration across the locations and their correlation coefficients

I	II	III	IV	V	VI	VII	VIII
Place	Mean Weight (kg)	Hg mean (mg/kg)	MeHg mean (mg/kg)	Correl. mean wt. / mean Hg	Correl. mean wt. / mean MeHg	Correl. mean wt. / mean Mehg	Correl. mean wt. / mean MeHg
Jharkhali	0.315	1.450	1.023	0.9912	0.9910	-0.40819	-0.43873
Kakdwip	0.167	0.711	0.569				
Digha	0.109	0.560	0.382				
Budgebudge	0.102	0.560	0.451				
Kolaghat	0.624	0.160	0.127	1	1		
Durgapur	0.470	0.130	0.103				

It is observed that within the estuarine coastal cluster, constituted by Jharkhali, Kakdwip, Digha and Budge Budge, reductions in mean weight correspond to lower mercury concentrations. A similar pattern can also be seen between the two inland sites of Kolaghat and Durgapur. In fact in both these cases, the correlation coefficient between mean weight and mercury concentration is found to be pronouncedly positive; in case of the estuarine cluster it is > 0.99 and in the case of the two inland sites it is 1 (see column VI). But it is also evident that the pattern does not hold true in case of the whole set of samples and the correlation coefficients are not only weak but also negative. That the body weight of fish does not appear to be a factor in determining varying mercury concentration across locations can be also observed from Table 20.

Table 20. Mean weight and mercury and methylmercury values for samples from fishing locations in West Bengal

Places	Mean Wt (kg)	Hg (mg/kg)	MeHg (mg/kg)
Kolaghat	0.624	0.160	0.127
Mudiali	0.502	0.200	0.161
Farakka	0.471	0.460	0.364
Durgapur	0.470	0.130	0.103
East Kolkata	0.407	0.430	0.345
Hugli	0.405	0.390	0.309
Haldia	0.239	0.327	0.261
Jharkhali	0.315	1.450	1.023
Kakdwip	0.167	0.711	0.569
North Bengal	0.113	0.070	0.052
Digha	0.109	0.560	0.382
Budgebudge	0.102	0.560	0.451

It is evident that neither the feeding habits of the species nor the weight of the catch is sufficient to explain the wide range of variation in mercury values across different sampling locations in general.

The other possible explanation may be in the character of the locations. The fish samples from Durgapur, which is a major industrial site, do not show high levels of mercury, whereas coastal/estuarine sites, often far removed from industrial areas, show high levels. The point is that mercury emitted from thermal power plants may not necessarily end up in the local water bodies. On the contrary, once in the air, mercury is dispersed and transported thousands of kilometre from its likely emission sources.[27] On the other hand, Mercury used in industrial processes can get into water bodies only if it is discharged as waste with effluents.[28] This is precisely what happened in Minamata and Niigata.

The mean MeHg value for Hugli is considerably high given the fact samples were collected from a purely agricultural zone. A possible source of mercury may be pesticides used in the agricultural fields. Mercury is a known constituent of a large number of fungicides and rodenticides. The known inorganic mercury fungicides are mercurous chloride, mercuric chloride and mercuric oxide, while there are a host of organomercury fungicides.[29] However, samples from North Bengal, which is also a predominantly agricultural zone, do not show high mercury values. The tea gardens are known to use pesticides abundantly. Maybe the nature of pesticides used and the total annual consumption per unit area have a role to play here.

In order to locate the possible sources of the contamination, a larger study of the areas is needed – one that investigates mercury concentration not only in the aquatic fauna, but also in the local water bodies, blood and hair samples of the local populations, and complements it with a study of the pesticides and fungicides used locally.

In fact, there are other questions that remain to be explored. When mercury is tested in aquatic fauna, the testing is done on uncooked samples. Yet, there is every likelihood of various changes during the process of cooking. What happens when mercury/ methylmercury contaminated fish is fried, roasted, boiled or curried? These aspects need to be investigated for fuller assessment of possible mercury intake from contaminated fish.

Conclusion

The main conclusions of the study are:

Samples from Kolkata Markets

Total number of samples is 60.

- 16 samples have mercury levels above PFA stipulations.
- 24 samples have methylmercury levels above PFA stipulations.
- In 5 out of 16 cases Hg levels exceeded by more than 50 percent over PFA stipulations and in 2 cases exceedance was more than 100 percent above PFA stipulations.
- In 24 cases of methylmercury excess, 18 cases showed MeHg excess of more than 50 percent above PFA stipulations.
- 7 cases showed MeHg exceedance of more than 100 percent above PFA stipulations.

Samples from fishing locations across West Bengal

Total number of samples is 204.

- In 62 cases Hg levels and in 105 cases MeHg levels exceed PFA stipulations.
- In 35 of 62 cases Hg levels exceed by more than 50 percent of PFA stipula tions and 19 cases by more than 100 percent of PFA stipulations.
- Of the 105 cases where MeHg levels exceeded, 70 cases exhibit excess by more than 50 percent of PFA stipulations and 45 cases show excess by more than 100 percent of PFA stipulations.
- 18 cases showed MeHg exceedance of over 200 percent above PFA stipula tions.

Comparison with FAO-WHO standard

For applying the FAO-WHO criterion one needs to consider body weight and fish flesh intake values.

Two hypothetical instances showing very moderate consumption levels have been considered:

- A child of 25 kg consuming just 200 gm of fish flesh in an entire week.
- An adolescent or pregnant mother of 50 kg consuming 300 gm of fish flesh in an entire week. [The average weight of Indian women is around 50 kg].

The results show that:

In the first scenario (a) 150 samples showed MeHg exceedance

- 77 of 150 samples showed exceedance over PTWI by more than 100 percent; 37 samples showed exceedance of over 200 percent.

In the second scenario (b) 123 samples showed MeHg exceedance

- 46 of 123 samples showed exceedance over PTWI by more than 100 percent; 15 samples showed exceedance of over 200 percent.

Effect of increase in consumption –

i. A child of 25 kg with weekly fish flesh consumption of 250 gm

ii. An adolescent/adult of 60 kg and weekly fish flesh consumption of 500 gm.

We find –

The PTWI is exceeded in 181 samples in the first scenario.

- In 84 of these 181 samples showed MeHg exceedance by over 100 percent of PTWI; and 47 samples showed exceedance of over 200 percent.

In the second scenario, it exceeded in 155 samples

- In 80 of these 155 samples, the PTWI exceeded by more than 100 percent; in 37 samples it exceeded by more than 200 percent.

Recommendations

That fish in West Bengal have significant, and often alarming, levels of mercury contamination is evident from this study. Both the government and civil society should wake up to this problem.

- The Health and Environment Departments should undertake a thorough investigation of the scale, intensity and sources of mercury pollution. There is a need for an extensive investigation into the quality of aquatic food.
- Water and soil as also blood and hair samples of the population living in areas showing high levels of contamination should be examined.
- The scientific community should independently and in collaboration with the government, undertake such investigation.
- Once the sources of contamination are identified, efforts must be made to check their occurrence.
- Pending this long term solution, and drawing upon thoroughgoing studies of mercury contamination in fish, fish advisories should be prepared by the concerned authorities instructing citizens about relatively safe and unsafe species and fish sources.
- Mercury and other pollutants of similar severity should become an important item in civil society initiatives.
- Medical practitioners should include the subject of pollutant-induced pathology as a key item in their diagnostic and therapeutic procedures.

Study findings for samples/species

Table I. Description of samples collected from Kolkata markets

Kolkata Markets						
Sl. no.	**Location**	**Sample code**	**Species local name**	**Species scientific name**	**Sample weight (kg)**	**Sample length (cm)**
1	Gariahat	MG1A	Rui	*Labeo rohita*	1.400	49.5
2	Gariahat	MG1B	Rui	*Labeo rohita*	1.450	50.0
3	Gariahat	MG2A	Katla	*Catla catla*	2.450	54.0
4	Gariahat	MG2B	Katla	*Catla catla*	1.990	50.0
5	Gariahat	MG3A	Aar	*Sperata aor*	1.125	60.0
6	Gariahat	MG3B	Aar	*Sperata aor*	1.070	55.0
7	Gariahat	MG4A	Bhetki	*Lates calcarifer*	1.100	43.0
8	Gariahat	MG4B	Bhetki	*Lates calcarifer*	1.200	43.5
9	Gariahat	MG5A	Tangra	*Mystus gulio*	0.075	19.5
10	Gariahat	MG5B	Tangra	*Mystus gulio*	0.070	18.0
11	Gariahat	MG6A	Bagda	*Penaeus monodon*	0.060	19.5
12	Gariahat	MG6B	Bagda	*Penaeus monodon*	0.055	19.0
13	Sahababu	MSa1A	Rui	*Labeo rohita*	1.275	48.5
14	Sahababu	MSa1B	Rui	*Labeo rohita*	1.325	48.0
15	Sahababu	MSa2A	Katla	*Catla catla*	1.075	43.0
16	Sahababu	MSa2B	Katla	*Catla catla*	1.025	42.0
17	Sahababu	MSa3A	Aar	*Sperata aor*	0.520	46.0
18	Sahababu	MSa3B	Aar	*Sperata aor*	0.670	47.0
19	Sahababu	MSa4A	Bhetki	*Lates calcarifer*	0.670	36.0
20	Sahababu	MSa4B	Bhetki	*Lates calcarifer*	0.690	37.0
21	Sahababu	MSa5A	Tangra	*Mystus gulio*	0.054	17.0
22	Sahababu	MSa5B	Tangra	*Mystus gulio*	0.064	17.0
23	Sahababu	MSa6A	Bagda	*Penaeus monodon*	0.048	18.0
24	Sahababu	MSa6B	Bagda	*Penaeus monodon*	0.045	17.5
25	Sealdah	MSd1A	Rui	*Labeo rohita*	1.130	46.0
26	Sealdah	MSd1B	Rui	*Labeo rohita*	1.140	46.5
27	Sealdah	MSd2A	Katla	*Catla catla*	1.820	49.0

Kolkata Markets						
Sl. no.	Location	Sample code	Species local name	Species scientific name	Sample weight (kg)	Sample length (cm)
28	Sealdah	MSd2B	Katla	*Catla catla*	2.085	52.5
29	Sealdah	MSd3A	Aar	*Sperata aor*	0.920	57.0
30	Sealdah	MSd3B	Aar	*Sperata aor*	0.770	52.0
31	Sealdah	MSd4A	Bhetki	*Lates calcarifer*	0.690	39.0
32	Sealdah	MSd4B	Bhetki	*Lates calcarifer*	0.775	38.5
33	Sealdah	MSd5A	Tangra	*Mystus gulio*	0.050	16.8
34	Sealdah	MSd5B	Tangra	*Mystus gulio*	0.080	19.5
35	Sealdah	MSd6A	Bagda	*Penaeus monodon*	0.030	16.2
36	Sealdah	MSd6B	Bagda	*Penaeus monodon*	0.035	17.5
37	Maniktala	MMn1A	Rui	*Labeo rohita*	1.360	48.5
38	Maniktala	MMn1B	Rui	*Labeo rohita*	1.330	46.5
39	Maniktala	MMn2A	Katla	*Catla catla*	1.790	49.5
40	Maniktala	MMn2B	Katla	*Catla catla*	2.050	54.0
41	Maniktala	MMn3A	Aar	*Sperata aor*	0.755	44.0
42	Maniktala	MMn3B	Aar	*Sperata aor*	0.735	48.0
43	Maniktala	MMn4A	Bhetki	*Lates calcarifer*	0.600	34.3
44	Maniktala	MMn4B	Bhetki	*Lates calcarifer*	0.665	36.5
45	Maniktala	MMn5A	Tangra	*Mystus gulio*	0.065	17.6
46	Maniktala	MMn5B	Tangra	*Mystus gulio*	0.055	18.4
47	Maniktala	MMn6A	Bagda	*Penaeus monodon*	0.040	18.2
48	Maniktala	MMn6B	Bagda	*Penaeus monodon*	0.035	17.0
49	Behala	MBe1A	Rui	*Labeo rohita*	1.100	45.5
50	Behala	MBe1B	Rui	*Labeo rohita*	1.010	45.3
51	Behala	MBe2A	Katla	*Catla catla*	1.735	48.4
52	Behala	MBe2B	Katla	*Catla catla*	1.670	49.0
53	Behala	MBe3A	Aar	*Sperata aor*	0.955	57.5
54	Behala	MBe3B	Aar	*Sperata aor*	0.870	52.0
55	Behala	MBe4A	Bhetki	*Lates calcarifer*	0.970	39.7
56	Behala	MBe4B	Bhetki	*Lates calcarifer*	1.280	42.5
57	Behala	MBe5A	Tangra	*Mystus gulio*	0.075	18.0
58	Behala	MBe5B	Tangra	*Mystus gulio*	0.075	18.2
59	Behala	MBe6A	Bagda	*Penaeus monodon*	0.045	18.0
60	Behala	MBe6B	Bagda	*Penaeus monodon*	0.065	22.0

Table II. Description of samples collected from select waterbodies across West Bengal

Select Fishing Locations in West Bengal						
Sl. no.	**Location**	**Sample code**	**Species local name**	**Species scientific name**	**Sample weight (kg)**	**Sample length (cm)**
1	Hugli	HG1A	Rui	*Labeo rohita*	0.490	34.5
2	Hugli	HG1B	Rui	*Labeo rohita*	0.530	36.5
3	Hugli	HG2A	Katla	*Catla catla*	0.425	31.4
4	Hugli	HG2B	Katla	*Catla catla*	0.480	30.6
5	Hugli	HG3A	Magur	*Clarias batrachus*	0.267	32.0
6	Hugli	HG3B	Magur	*Clarias batrachus*	0.160	28.0
7	Hugli	HG4A	Shingi	*Heteropneustes fossilis*	0.055	22.5
8	Hugli	HG4B	Shingi	*Heteropneustes fossilis*	0.048	21.1
9	Hugli	HG5A	Pangash	*Pangasius pangasius*	0.810	46.1
10	Hugli	HG5B	Pangash	*Pangasius pangasius*	0.870	46.9
11	Hugli	HG6A	Koi	*Anabas testudineus*	0.072	15.0
12	Hugli	HG6B	Koi	*Anabas testudineus*	0.085	16.5
13	Hugli	HG7A	Lyata	*Chanos chanos*	0.093	20.4
14	Hugli	HG7B	Lyata	*Chanos chanos*	0.105	22.5
15	Hugli	HG8A	American Rui	*Cyprinus carpio*	0.935	34.0
16	Hugli	HG8B	American Rui	*Cyprinus carpio*	1.050	38.0
17	Budgebudge	BJ1A	Pabda	*Ompok pabda*	0.100	26.0
18	Budgebudge	BJ1B	Pabda	*Ompok pabda*	0.098	25.0
19	Budgebudge	BJ2A	Bele	*Sillago sihama*	0.180	33.0
20	Budgebudge	BJ2B	Bele	*Sillago sihama*	0.195	32.5
21	Budgebudge	BJ3A	Ilish	*Tenualosa ilisha*	0.172	25.0
22	Budgebudge	BJ3B	Ilish	*Tenualosa ilisha*	0.170	26.0
23	Budgebudge	BJ4A	Gurjaoli	*Eleutheronema tetradactylum*	0.178	28.0
24	Budgebudge	BJ4B	Gurjaoli	*Eleutheronema tetradactylum*	0.160	27.0
25	Budgebudge	BJ5A	Topshe	*Polydactylus sexfilis*	0.043	20.5
26	Budgebudge	BJ5B	Topshe	*Polydactylus sexfilis*	0.055	21.0
27	Budgebudge	BJ6A	Nihere	*Harpadon nehereus*	0.045	20.0
28	Budgebudge	BJ6B	Nihere	*Harpadon nehereus*	0.050	21.5
29	Budgebudge	BJ7A	Norke Bhola	*Panna microdon*	0.048	19.0
30	Budgebudge	BJ7B	Norke Bhola	*Panna microdon*	0.040	18.0
31	Budgebudge	BJ8A	Madhu Bhola	*Otolithoides sp.*	0.085	22.5
32	Budgebudge	BJ8B	Madhu Bhola	*Otolithoides sp.*	0.080	21.0
33	Budgebudge	BJ9A	Bhetki Bhola	*Nibea soldado*	0.065	18.0

Select Fishing Locations in West Bengal						
Sl. no.	**Location**	**Sample code**	**Species local name**	**Species scientific name**	**Sample weight kg)**	**Sample length (cm)**
34	Budgebudge	BJ9B	Bhetki Bhola	*Nibea soldado*	0.075	19.5
35	Jharkhali	JHK1A	Sitapati	*Trichurus sp.*	0.080	41
36	Jharkhali	JHK1B	Sitapati	*Trichurus sp.*	0.070	41
37	Jharkhali	JHK2A	Amudi	*Coilia sp.*	0.035	21
38	Jharkhali	JHK2B	Amudi	*Coilia sp.*	0.040	21.2
39	Jharkhali	JHK3A	Lote/Nihere	*Harpadon nehereus*	0.100	25
40	Jharkhali	JHK3B	Lote/Nihere	*Harpadon nehereus*	0.100	24.2
41	Jharkhali	JHK4A	Mocha Galda	*Macrobrachium rosenbergii*	0.240	29.5
42	Jharkhali	JHK4B	Mocha Galda	*Macrobrachium rosenbergii*	0.130	25.5
43	Jharkhali	JHK5A	Baul	*Pampus chinesis*	0.270	23.5
44	Jharkhali	JHK5B	Baul	*Pampus chinesis*	0.300	24
45	Jharkhali	JHK6A	Bagda	*Penaeus monodon*	0.040	19
46	Jharkhali	JHK6B	Bagda	*Penaeus monodon*	0.070	22
47	Jharkhali	JHK7A	Lathi Bhola	*Panna microdon*	0.600	45.5
48	Jharkhali	JHK7B	Lathi Bhola	*Panna microdon*	0.560	44.5
49	Jharkhali	JHK8A	Koibol	*Epinephelous sp.*	1.450	48
50	Jharkhali	JHK8B	Koibol	*Epinephelous sp.*	0.950	43
51	Haldia	HD1A	Ilish	*Tenualosa ilisha*	0.830	42.0
52	Haldia	HD1B	Ilish	*Tenualosa ilisha*	0.850	42.5
53	Haldia	HD2A	Tul /Karrma	*Sillaginopsis panijus*	0.250	33.0
54	Haldia	HD2B	Tul /Karrma	*Sillaginopsis panijus*	0.240	33.0
55	Haldia	HD3A	Banspata	*Devario devario*	0.095	32.0
56	Haldia	HD3B	Banspata	*Devario devario*	0.078	29.0
57	Haldia	HD4A	Topshe	*Polydactylus sexfilis*	0.068	22.5
58	Haldia	HD4B	Topshe	*Polydactylus sexfilis*	0.065	20.5
59	Haldia	HD5A	Tarui	*Rhinomugil corsula*	0.033	15.5
60	Haldia	HD5B	Tarui	*Rhinomugil corsula*	0.035	15.0
61	Haldia	HD6A	Tampra	*Setipinna phasa*	0.190	31.5
62	Haldia	HD6B	Tampra	*Setipinna phasa*	0.135	28.0
63	Digha	DIG1A	Bhola	*Otolithoides sp.*	0.180	30.0
64	Digha	DIG1B	Bhola	*Otolithoides sp.*	0.160	25.0
65	Digha	DIG2A	Baul	*Apolectus niger*	0.160	20.5
66	Digha	DIG2B	Baul	*Apolectus niger*	0.135	19.5
67	Digha	DIG3A	Padre	*Pellona sp.*	0.140	27.0
68	Digha	DIG3B	Padre	*Pellona sp.*	0.140	26.5

Select Fishing Locations in West Bengal						
Sl. no.	**Location**	**Sample code**	**Species local name**	**Species scientific name**	**Sample weight kg)**	**Sample length (cm)**
69	Digha	DIG4A	Banspata	*Devario devario*	0.070	21.5
70	Digha	DIG4B	Banspata	*Devario devario*	0.068	21.0
71	Digha	DIG5A	Karrma	*Sillago sihama*	0.060	21.5
72	Digha	DIG5B	Karrma	*Sillago sihama*	0.043	18.0
73	Digha	DIG6A	Parshe	*Liza parsia*	0.045	16.0
74	Digha	DIG6B	Parshe	*Liza parsia*	0.040	15.0
75	Digha	DIG7A	Samudra Kankra	*Portunus pelagicus*	0.320	16.5
76	Digha	DIG7B	Samudra Kankra	*Portunus pelagicus*	0.305	17.0
77	Digha	DIG8A	Gurjaoli	*Eleutheronema tetradactylum*	0.070	22.0
78	Digha	DIG8B	Gurjaoli	*Eleutheronema tetradactylum*	0.065	21.5
79	Digha	DIG9A	Motka Chingri	*Penaeus sp.*	0.035	17.0
80	Digha	DIG9B	Motka Chingri	*Penaeus sp.*	0.030	17.0
81	Digha	DIG10A	Phitemaach	*Trichurus lepturus*	0.040	35.0
82	Digha	DIG10B	Phitemaach	*Trichurus lepturus*	0.080	38
83	East Kolkata	EKO1A	American Rui	*Cyprinus carpio*	1.000	36.0
84	East Kolkata	EKO1B	American Rui	*Cyprinus carpio*	0.750	35.5
85	East Kolkata	EKO2A	Lilentika	*Oreochromis nilotica*	0.300	27.0
86	East Kolkata	EKO2B	Lilentika	*Oreochromis nilotica*	0.195	24.0
87	East Kolkata	EKO3A	Chara Pona (Fingerling)	*Labeo rohita*	0.125	24.0
88	East Kolkata	EKO3B	Chara Pona (Fingerling)	*Labeo rohita*	0.070	20.5
89	Kakdwip	KAK1A	Bhola	*Otolithoides sp.*	0.525	38.0
90	Kakdwip	KAK1B	Bhola	*Otolithoides sp.*	0.425	36.0
91	Kakdwip	KAK2A	Tul	*Sillaginopsis panijus*	0.205	32.0
92	Kakdwip	KAK2B	Tul	*Sillaginopsis panijus*	0.135	28.5
93	Kakdwip	KAK3A	Bele	*Platycephalous sp.*	0.525	41.0
94	Kakdwip	KAK3B	Bele	*Platycephalous sp.*	0.065	23.0
95	Kakdwip	KAK4A	Tangra	*Arius sp.*	0.195	29.0
96	Kakdwip	KAK4B	Tangra	*Arius sp.*	0.130	24.0
97	Kakdwip	KAK5A	Shadapata	*Raconda russiliana*	0.030	18.0
98	Kakdwip	KAK5B	Shadapata	*Raconda russiliana*	0.030	18.0
99	Kakdwip	KAK6A	Phyasa	*Setipinna phasa*	0.078	23.5
100	Kakdwip	KAK6B	Phyasa	*Setipinna phasa*	0.080	24.0

Select Fishing Locations in West Bengal

Sl. no.	Location	Sample code	Species local name	Species scientific name	Sample weight kg)	Sample length (cm)
101	Kakdwip	KAK7A	Banspata	*Devario devario*	0.060	21.5
102	Kakdwip	KAK7B	Banspata	*Devario devario*	0.055	20.0
103	Kakdwip	KAK8A	Parshe	*Liza parsia*	0.070	18.0
104	Kakdwip	KAK8B	Parshe	*Liza parsia*	0.070	18.5
105	Mudiali	MUD1A	Rui	*Labeo rohita*	0.480	34.0
106	Mudiali	MUD1B	Rui	*Labeo rohita*	0.520	34.5
107	Mudiali	MUD2A	Katla	*Catla catla*	0.560	33.0
108	Mudiali	MUD2B	Katla	*Catla catla*	0.575	31.5
109	Mudiali	MUD3A	Mrigel	*Cirrhinus cirrhosus*	0.495	35.5
110	Mudiali	MUD3B	Mrigel	*Cirrhinus cirrhosus*	0.475	36.0
111	Mudiali	MUD4A	Bata	*Labeo bata*	0.170	25.5
112	Mudiali	MUD4B	Bata	*Labeo bata*	0.140	24.0
113	Mudiali	MUD5A	Lilentika	*Oreochromis nilotica*	0.750	35.5
114	Mudiali	MUD5B	Lilentika	*Oreochromis nilotica*	0.650	32.0
115	Mudiali	MUD6A	Silver Carp	*Hypophthalmichthys molitrix*	0.465	33.5
116	Mudiali	MUD6B	Silver Carp	*Hypophthalmichthys molitrix*	0.425	32.0
117	Mudiali	MUD7A	American Rui	*Cyprinus carpio*	0.840	35.5
118	Mudiali	MUD7B	American Rui	*Cyprinus carpio*	0.800	35.0
119	Mudiali	MUD8A	Pholi	*Notopterus notopterus*	0.220	30.0
120	Mudiali	MUD8B	Pholi	*Notopterus notopterus*	0.150	26.0
121	Mudiali	MUD9A	Grass Carp	*Ctenopharyngodon idella*	0.660	37.5
122	Mudiali	MUD9B	Grass Carp	*Ctenopharyngodon idella*	0.660	38.0
123	Farakka	FKF1A	Katla	*Catla catla*	1.080	40.0
124	Farakka	FKF1B	Katla	*Catla catla*	1.530	44.5
125	Farakka	FKF2A	Mrigel	*Cirrhinus cirrhosus*	1.500	50.0
126	Farakka	FKF2B	Mrigel	*Cirrhinus cirrhosus*	1.400	51.0
127	Farakka	FKF3A	Shol	*Channa striatus*	0.500	38.0
128	Farakka	FKF3B	Shol	*Channa striatus*	0.470	38.5
129	Farakka	FKF4A	Bacha	*Eutropichthys vacha*	0.120	25.0
130	Farakka	FKF4B	Bacha	*Eutropichthys vacha*	0.090	24.5
131	Farakka	FKF5A	Ghere	*Silonia silondia*	0.070	22.0
132	Farakka	FKF5B	Ghere	*Silonia silondia*	0.050	19.0
133	Farakka	FKF6A	Aar	*Sperata aor*	0.530	48.0
134	Farakka	FKF6B	Aar	*Sperata aor*	0.450	43.0
135	Farakka	FKF7A	Tel Ghagra	*Mystus sp.*	0.220	29.0

Select Fishing Locations in West Bengal						
Sl. no.	**Location**	**Sample code**	**Species local name**	**Species scientific name**	**Sample weight kg)**	**Sample length (cm)**
136	Farakka	FKF7B	Tel Ghagra	*Mystus sp.*	0.120	23.5
137	Farakka	FKF8A	Sarpnuti	*Puntius sarana*	0.085	17.5
138	Farakka	FKF8B	Sarpnuti	*Puntius sarana*	0.080	17.0
139	Farakka	FKG9A	Pholi	*Notopterus notopterus*	0.250	31.0
140	Farakka	FKG9B	Pholi	*Notopterus notopterus*	0.140	25.5
141	Farakka	FKG10A	Bam	*Mastacembelus armatus*	0.320	48.0
142	Farakka	FKG10B	Bam	*Mastacembelus armatus*	0.095	33.5
143	Farakka	FKG11A	Shol	*Channa stiatus*	0.700	43.5
144	Farakka	FKG11B	Shol	*Channa stiatus*	0.570	40.5
145	North Bengal	NBB1A	Bata	*Labeo bata*	0.155	26.0
146	North Bengal	NBB1B	Bata	*Labeo bata*	0.110	22.5
147	North Bengal	NBB2A	Shingi	*Heteropneustes fossilis*	0.040	17.0
148	North Bengal	NBB2B	Shingi	*Heteropneustes fossilis*	0.030	16.0
149	North Bengal	NBB3A	Tangra	*Mystus bleekeri*	0.022	12.0
150	North Bengal	NBB3B	Tangra	*Mystus bleekeri*	0.025	12.5
151	North Bengal	NBB4A	Bacha	*Eutropichthys vacha*	0.090	24.0
152	North Bengal	NBB4B	Bacha	*Eutropichthys vacha*	0.065	20.0
153	North Bengal	NBB6A	Baan	*Ophisternon bengalense*	0.070	31.0
154	North Bengal	NBB6B	Baan	*Ophisternon bengalense*	0.040	23.0
155	North Bengal	NBB7A	Lyata*	*Channa punctatus*	0.070	19.5
156	North Bengal	NBB7B	Lyata*	*Channa punctatus*	0.080	18.5
157	North Bengal	NBB8A	Taki*	*Channa punctatus*	0.055	16.0
158	North Bengal	NBB8B	Taki*	*Channa punctatus*	0.045	15.0
159	North Bengal	NBPB9A	American Rui	*Cyprinus carpio*	1.140	38.0
160	North Bengal	NBPB9B	American Rui	*Cyprinus carpio*	0.050	15.0
161	North Bengal	NBPB10A	Lyata	*Channa striatus*	0.100	24.0
162	North Bengal	NBPB10B	Lyata	*Channa punctatus*	0.080	20.5
163	North Bengal	NBPB11A	Mrigel	*Cirrhinus cirrhosus*	0.150	26.5
164	North Bengal	NBPB11B	Mrigel	*Cirrhinus cirrhosus*	0.140	26.0
165	North Bengal	NBPR12A	Silver Carp	*Hypophthalmichthys molitrix*	0.230	27.5
166	North Bengal	NBPR12B	Silver Carp	*Hypophthalmichthys molitrix*	0.160	26.0
167	North Bengal	NBPR13A	American Rui	*Cyprinus carpio*	0.135	19.5
168	North Bengal	NBPR13B	American Rui	*Cyprinus carpio*	0.140	19.0
169	North Bengal	NBPR14A	Mrigel	*Cirrhinus cirrhosus*	0.060	18.0

Select Fishing Locations in West Bengal						
Sl. no.	**Location**	**Sample code**	**Species local name**	**Species scientific name**	**Sample weight kg)**	**Sample length (cm)**
170	North Bengal	NBPR14B	Mrigel	*Cirrhinus cirrhosus*	0.050	17.5
171	North Bengal	NBPK15A	Shingi	*Heteropneustes fossilis*	0.050	19.5
172	North Bengal	NBPK15B	Shingi	*Heteropneustes fossilis*	0.040	18.0
173	North Bengal	NBPK16A	Koi	*Anabas testudineus*	0.100	17.0
174	North Bengal	NBPK16B	Koi	*Anabas testudineus*	0.080	16.5
175	North Bengal	NBPK17A	Taki†	*Channa punctatus*	0.055	17.0
176	North Bengal	NBPK17B	Taki†	*Channa punctatus*	0.050	16.0
177	North Bengal	NBPD18A	Lyata†	*Channa punctatus*	0.100	21.0
178	North Bengal	NBPD18B	Lyata†	*Channa punctatus*	0.080	19.0
179	North Bengal	NBRC19A	Baan	*Mastacembelus sp.*	0.090	35.5
180	North Bengal	NBRC19B	Baan	*Mastacembelus sp.*	0.080	34.0
181	Kolaghat	KOG1A	Pangash	*Pangasius pangasius*	1.250	50.0
182	Kolaghat	KOG1B	Pangash	*Pangasius pangasius*	1.530	54.0
183	Kolaghat	KOG2A	Katla	*Catla catla*	0.800	37.0
184	Kolaghat	KOG2B	Katla	*Catla catla*	1.000	39.5
185	Kolaghat	KOG3A	Silver Carp	*Hypophthalmichthys molitrix*	1.100	46.0
186	Kolaghat	KOG3B	Silver Carp	*Hypophthalmichthys molitrix*	0.880	42.0
187	Kolaghat	KOG4A	Mrigel	*Cirrhinus cirrhosus*	0.270	30.0
188	Kolaghat	KOG4B	Mrigel	*Cirrhinus cirrhosus*	0.250	30.5
189	Kolaghat	KOG5A	Bata	*Labeo bata*	0.130	24.0
190	Kolaghat	KOG5B	Bata	*Labeo bata*	0.135	23.5
191	Kolaghat	KOG6A	Galda Chingdi	*Macrobrachium rosenbergii*	0.100	23.0
192	Kolaghat	KOG6B	Galda Chingdi	*Macrobrachium rosenbergii*	0.900	22.0
193	Kolaghat	KOG7A	Lilentika	*Oreochromis nilotica*	0.190	22.5
194	Kolaghat	KOG7B	Lilentika	*Oreochromis nilotica*	0.200	22.0
195	Durgapur	DGP1A	Boal	*Wallagonia attu*	1.040	58.0
196	Durgapur	DGP1B	Boal	*Wallagonia attu*	0.915	55.0
197	Durgapur	DGP2A	Aar	*Sperata aor*	0.550	48.0
198	Durgapur	DGP2B	Aar	*Sperata aor*	0.450	46.0
199	Durgapur	DGP3A	Baan	*Ophisternon bengalense*	0.140	38.0
200	Durgapur	DGP3B	Baan	*Ophisternon bengalense*	0.125	37.0
201	Durgapur	DGP4A	American Rui	*Cyprinus carpio*	0.640	29.5
202	Durgapur	DGP4B	American Rui	*Cyprinus carpio*	0.575	27.5
203	Durgapur	DGP5A	Bacha	*Eutropichthys vacha*	0.160	28.0
204	Durgapur	DGP5B	Bacha	*Eutropichthys vacha*	0.100	23.0

TABLE III. Mercury concentration in fish samples and species averages for Kolkata Markets

Kolkata Markets Species Averages					
Sl. no.	Location	Sample code	Hg (mg/kg)	Species local name	Species/ variety average (values <0.20 mg /kg treated at 0)
1	Gariahat	MG1A	0.51	Rui	0.495
2	Gariahat	MG1B	0.48	Rui	
3	Gariahat	MG2A	0.59	Katla	0.49
4	Gariahat	MG2B	0.39	Katla	
5	Gariahat	MG3A	0.84	Aar	0.98
6	Gariahat	MG3B	1.12	Aar	
7	Gariahat	MG4A	1.27	Bhetki	1.075
8	Gariahat	MG4B	0.88	Bhetki	
9	Gariahat	MG5A	0.45	Tangra	0.445
10	Gariahat	MG5B	0.44	Tangra	
11	Gariahat	MG6A	0.21	Bagda	0.22
12	Gariahat	MG6B	0.23	Bagda	
13	Sahababu	MSa1A	0.24	Rui	0.12
14	Sahababu	MSa1B	<0.20	Rui	
15	Sahababu	MSa2A	<0.20	Katla	0
16	Sahababu	MSa2B	<0.20	Katla	
17	Sahababu	MSa3A	0.32	Aar	0.16
18	Sahababu	MSa3B	<0.20	Aar	
19	Sahababu	MSa4A	<0.20	Bhetki	0.145
20	Sahababu	MSa4B	0.29	Bhetki	
21	Sahababu	MSa5A	0.22	Tangra	0.26
22	Sahababu	MSa5B	0.30	Tangra	
23	Sahababu	MSa6A	0.34	Bagda	0.42
24	Sahababu	MSa6B	0.50	Bagda	
25	Sealdah	MSd1A	0.50	Rui	0.35
26	Sealdah	MSd1B	0.20	Rui	
27	Sealdah	MSd2A	0.20	Katla	0.1
28	Sealdah	MSd2B	<0.20	Katla	
29	Sealdah	MSd3A	0.20	Aar	0.21
30	Sealdah	MSd3B	0.22	Aar	
31	Sealdah	MSd4A	0.65	Bhetki	0.675
32	Sealdah	MSd4B	0.70	Bhetki	
33	Sealdah	MSd5A	0.47	Tangra	
34	Sealdah	MSd5B	0.85	Tangra	0.66
35	Sealdah	MSd6A	0.57	Bagda	
36	Sealdah	MSd6B	0.39	Bagda	0.48

Kolkata Markets Species Averages					
Sl. no.	Location	Sample code	Hg (mg/kg)	Species local name	Species/ variety average (values <0.20 mg /kg treated at 0)
37	Maniktala	MMn1A	0.24	Rui	0.35
38	Maniktala	MMn1B	0.46	Rui	
39	Maniktala	MMn2A	0.52	Katla	0.36
40	Maniktala	MMn2B	0.20	Katla	
41	Maniktala	MMn3A	0.58	Aar	0.56
42	Maniktala	MMn3B	0.54	Aar	
43	Maniktala	MMn4A	0.22	Bhetki	0.23
44	Maniktala	MMn4B	0.24	Bhetki	
45	Maniktala	MMn5A	0.22	Tangra	0.265
46	Maniktala	MMn5B	0.31	Tangra	
47	Maniktala	MMn6A	<0.20	Bagda	0.19
48	Maniktala	MMn6B	0.38	Bagda	
49	Behala	MBe1A	0.59	Rui	0.555
50	Behala	MBe1B	0.52	Rui	
51	Behala	MBe2A	0.38	Katla	0.3
52	Behala	MBe2B	0.22	Katla	
53	Behala	MBe3A	0.56	Aar	0.435
54	Behala	MBe3B	0.31	Aar	
55	Behala	MBe4A	0.24	Bhetki	0.22
56	Behala	MBe4B	0.20	Bhetki	
57	Behala	MBe5A	0.21	Tangra	0.205
58	Behala	MBe5B	0.20	Tangra	
59	Behala	MBe6A	0.35	Bagda	0.175
60	Behala	MBe6B	<0.20	Bagda	

Table IV. Mercury concentration in fish samples and species average for select fishing locations in West Bengal

Species Averages for Select Fishing Locations in West Bengal					
Sl. no.	**Location**	**Sample code**	**Hg (mg/kg)**	**Species local name**	**Species/variety average (values <0.20 mg /kg treated at 0)**
1	Hugli	HG1A	0.36	Rui	
2	Hugli	HG1B	0.20	Rui	0.28
3	Hugli	HG2A	0.33	Katla	
4	Hugli	HG2B	0.33	Katla	0.33
5	Hugli	HG3A	0.55	Magur	
6	Hugli	HG3B	0.41	Magur	0.48
7	Hugli	HG4A	0.36	Shingi	
8	Hugli	HG4B	0.47	Shingi	0.415
9	Hugli	HG5A	0.52	Pangash	
10	Hugli	HG5B	0.36	Pangash	0.44
11	Hugli	HG6A	0.28	Koi	
12	Hugli	HG6B	0.40	Koi	0.34
13	Hugli	HG7A	0.47	Lyata	
14	Hugli	HG7B	0.40	Lyata	0.435
15	Hugli	HG8A	0.42	American Rui	
16	Hugli	HG8B	0.32	American Rui	0.37
17	Budgebudge	BJ1A	0.20	Pabda	
18	Budgebudge	BJ1B	0.20	Pabda	0.2
19	Budgebudge	BJ2A	0.37	Bele	
20	Budgebudge	BJ2B	0.56	Bele	0.465
21	Budgebudge	BJ3A	0.70	Ilish	
22	Budgebudge	BJ3B	0.58	Ilish	0.64
23	Budgebudge	BJ4A	0.56	Gurjaoli	
24	Budgebudge	BJ4B	0.82	Gurjaoli	0.69
25	Budgebudge	BJ5A	0.69	Topshe	
26	Budgebudge	BJ5B	0.59	Topshe	0.64
27	Budgebudge	BJ6A	0.45	Nihere	
28	Budgebudge	BJ6B	0.42	Nihere	0.435
29	Budgebudge	BJ7A	0.61	Norke Bhola	
30	Budgebudge	BJ7B	0.44	Norke Bhola	0.525
31	Budgebudge	BJ8A	1.03	Madhu Bhola	
32	Budgebudge	BJ8B	0.46	Madhu Bhola	0.745
33	Budgebudge	BJ9A	0.83	Bhetki Bhola	
34	Budgebudge	BJ9B	0.63	Bhetki Bhola	0.73

Species Averages for Select Fishing Locations in West Bengal					
Sl. no.	**Location**	**Sample code**	**Hg (mg/kg)**	**Species local name**	**Species/variety average (values <0.20 mg /kg treated at 0)**
35	Jharkhali	JHK1A	2.66	Sitapati	
36	Jharkhali	JHK1B	2.05	Sitapati	2.355
37	Jharkhali	JHK2A	1.36	Amudi	
38	Jharkhali	JHK2B	0.92	Amudi	1.14
39	Jharkhali	JHK3A	1.72	Lote/Nihere	
40	Jharkhali	JHK3B	0.59	Lote/Nihere	1.155
41	Jharkhali	JHK4A	1.31	Mocha Galda	
42	Jharkhali	JHK4B	1.52	Mocha Galda	1.415
43	Jharkhali	JHK5A	2.08	Baul	
44	Jharkhali	JHK5B	2.03	Baul	2.055
45	Jharkhali	JHK6A	1.42	Bagda	
46	Jharkhali	JHK6B	1.29	Bagda	1.355
47	Jharkhali	JHK7A	1.09	Lathi Bhola	
48	Jharkhali	JHK7B	1.61	Lathi Bhola	1.35
49	Jharkhali	JHK8A	0.85	Koibol	
50	Jharkhali	JHK8B	0.73	Koibol	0.79
51	Haldia	HD1A	0.83	Ilish	
52	Haldia	HD1B	0.55	Ilish	0.69
53	Haldia	HD2A	0.37	Tul /Karrma	
54	Haldia	HD2B	0.26	Tul /Karrma	0.315
55	Haldia	HD3A	0.20	Banspata	
56	Haldia	HD3B	0.22	Banspata	0.21
57	Haldia	HD4A	0.29	Topshe	
58	Haldia	HD4B	0.53	Topshe	0.41
59	Haldia	HD5A	0.25	Tarui	
60	Haldia	HD5B	0.21	Tarui	0.23
61	Haldia	HD6A	0.21	Tampra	
62	Haldia	HD6B	<0.20	Tampra	0.105
63	Digha	DIG1A	0.63	Bhola	
64	Digha	DIG1B	0.39	Bhola	0.51
65	Digha	DIG2A	0.40	Baul	
66	Digha	DIG2B	0.42	Baul	0.41
67	Digha	DIG3A	<0.20	Padre	

Species Averages for Select Fishing Locations in West Bengal					
Sl. no.	**Location**	**Sample code**	**Hg (mg/kg)**	**Species local name**	**Species/variety average (values <0.20 mg /kg treated at 0)**
68	Digha	DIG3B	<0.20	Padre	0
69	Digha	DIG4A	0.60	Banspata	
70	Digha	DIG4B	0.72	Banspata	0.66
71	Digha	DIG5A	0.26	Karrma	
72	Digha	DIG5B	0.24	Karrma	0.25
73	Digha	DIG6A	0.26	Parshe	
74	Digha	DIG6B	0.29	Parshe	0.275
75	Digha	DIG7A	0.50	Samudra Kankra	
76	Digha	DIG7B	0.48	Samudra Kankra	0.49
77	Digha	DIG8A	1.14	Gurjaoli	
78	Digha	DIG8B	1.10	Gurjaoli	1.12
79	Digha	DIG9A	1.39	Motka Chingri	
80	Digha	DIG9B	1.99	Motka Chingri	1.69
81	Digha	DIG10A	0.43	Phitemaach	
82	Digha	DIG10B	<0.20	Phitemaach	0.215
83	East Kolkata	EKO1A	0.45	American Rui	
84	East Kolkata	EKO1B	0.28	American Rui	0.365
85	East Kolkata	EKO2A	0.76	Lilentika	
86	East Kolkata	EKO2B	0.40	Lilentika	0.58
87	East Kolkata	EKO3A	0.30	Chara Pona (Fingerling)	
88	East Kolkata	EKO3B	0.40	Chara Pona (Fingerling)	0.35
89	Kakdwip	KAK1A	0.45	Bhola	
90	Kakdwip	KAK1B	0.50	Bhola	0.475
91	Kakdwip	KAK2A	0.42	Tul	
92	Kakdwip	KAK2B	0.36	Tul	0.39
93	Kakdwip	KAK3A	0.48	Bele	
94	Kakdwip	KAK3B	0.69	Bele	0.585
95	Kakdwip	KAK4A	0.60	Tangra	
96	Kakdwip	KAK4B	0.58	Tangra	0.59
97	Kakdwip	KAK5A	0.83	Shadapata	
98	Kakdwip	KAK5B	0.71	Shadapata	0.77
99	Kakdwip	KAK6A	0.96	Phyasa	
100	Kakdwip	KAK6B	1.09	Phyasa	1.025

Species Averages for Select Fishing Locations in West Bengal					
Sl. no.	**Location**	**Sample code**	**Hg (mg/kg)**	**Species local name**	**Species/variety average (values <0.20 mg /kg treated at 0)**
101	Kakdwip	KAK7A	0.84	Banspata	
102	Kakdwip	KAK7B	0.96	Banspata	0.9
103	Kakdwip	KAK8A	0.96	Parshe	
104	Kakdwip	KAK8B	0.94	Parshe	0.95
105	Mudiali	MUD1A	<0.20	Rui	
106	Mudiali	MUD1B	0.20	Rui	0.1
107	Mudiali	MUD2A	<0.20	Katla	
108	Mudiali	MUD2B	0.20	Katla	0.1
109	Mudiali	MUD3A	0.25	Mrigel	
110	Mudiali	MUD3B	<0.20	Mrigel	0.125
111	Mudiali	MUD4A	<0.20	Bata	
112	Mudiali	MUD4B	<0.20	Bata	0
113	Mudiali	MUD5A	0.24	Lilentika	
114	Mudiali	MUD5B	<0.20	Lilentika	0.12
115	Mudiali	MUD6A	<0.20	Silver Carp	
116	Mudiali	MUD6B	0.32	Silver Carp	0.16
117	Mudiali	MUD7A	0.21	American Rui	
118	Mudiali	MUD7B	0.36	American Rui	0.285
119	Mudiali	MUD8A	0.64	Pholi	
120	Mudiali	MUD8B	0.42	Pholi	0.53
121	Mudiali	MUD9A	0.32	Grass Carp	
122	Mudiali	MUD9B	0.47	Grass Carp	0.395
123	Farakka	FKF1A	0.27	Katla	
124	Farakka	FKF1B	0.20	Katla	0.235
125	Farakka	FKF2A	0.24	Mrigel	
126	Farakka	FKF2B	0.23	Mrigel	0.235
127	Farakka	FKF3A	0.79	Shol	
128	Farakka	FKF3B	0.52	Shol	0.655
129	Farakka	FKF4A	0.27	Bacha	
130	Farakka	FKF4B	0.41	Bacha	0.34
131	Farakka	FKF5A	0.24	Ghere	
132	Farakka	FKF5B	0.29	Ghere	0.265
133	Farakka	FKF6A	0.37	Aar	

Species Averages for Select Fishing Locations in West Bengal					
Sl. no.	**Location**	**Sample code**	**Hg (mg/kg)**	**Species local name**	**Species/variety average (values <0.20 mg /kg treated at 0)**
134	Farakka	FKF6B	0.26	Aar	0.315
135	Farakka	FKF7A	0.24	Tel Ghagra	
136	Farakka	FKF7B	0.30	Tel Ghagra	0.27
137	Farakka	FKF8A	0.48	Sarpnuti	
138	Farakka	FKF8B	0.60	Sarpnuti	0.54
139	Farakka	FKG9A	0.39	Pholi	
140	Farakka	FKG9B	0.83	Pholi	0.61
141	Farakka	FKG10A	0.39	Bam	
142	Farakka	FKG10B	0.83	Bam	0.61
143	Farakka	FKG11A	0.62	Shol	
144	Farakka	FKG11B	1.25	Shol	0.935
145	North Bengal	NBB1A	<0.20	Bata	
146	North Bengal	NBB1B	<0.20	Bata	0
147	North Bengal	NBB2A	<0.20	Shingi	
148	North Bengal	NBB2B	<0.20	Shingi	0
149	North Bengal	NBB3A	<0.20	Tangra	
150	North Bengal	NBB3B	<0.20	Tangra	0
151	North Bengal	NBB4A	<0.20	Bacha	
152	North Bengal	NBB4B	<0.20	Bacha	0
153	North Bengal	NBB6A	<0.20	Baan	
154	North Bengal	NBB6B	<0.20	Baan	0
155	North Bengal	NBB7A	<0.20	Lyata*	
156	North Bengal	NBB7B	<0.20	Lyata*	
157	North Bengal	NBB8A	<0.20	Taki*	
158	North Bengal	NBB8B	<0.20	Taki*	0
159	North Bengal	NBPB9A	<0.20	American Rui	
160	North Bengal	NBPB9B	<0.20	American Rui	0
161	North Bengal	NBPB10A	<0.20	Lyata	‡
162	North Bengal	NBPB10B	<0.20	Lyata	‡
163	North Bengal	NBPB11A	0.22	Mrigel	
164	North Bengal	NBPB11B	<0.20	Mrigel	0.11
165	North Bengal	NBPR12A	0.26	Silver Carp	
166	North Bengal	NBPR12B	<0.20	Silver Carp	0.13

Species Averages for Select Fishing Locations in West Bengal					
Sl. no.	**Location**	**Sample code**	**Hg (mg/kg)**	**Species local name**	**Species/variety average (values <0.20 mg /kg treated at 0)**
167	North Bengal	NBPR13A	<0.20	American Rui	
168	North Bengal	NBPR13B	<0.20	American Rui	0
169	North Bengal	NBPR14A	<0.20	Mrigel	
170	North Bengal	NBPR14B	<0.20	Mrigel	0
171	North Bengal	NBPK15A	<0.20	Shingi	
172	North Bengal	NBPK15B	<0.20	Shingi	0
173	North Bengal	NBPK16A	<0.20	Koi	
174	North Bengal	NBPK16B	<0.20	Koi	0
175	North Bengal	NBPK17A	0.71	Taki†	
176	North Bengal	NBPK17B	0.25	Taki†	0.48
177	North Bengal	NBPD18A	0.92	Lyata†	
178	North Bengal	NBPD18B	<0.20	Lyata†	0.46
179	North Bengal	NBRC19A	<0.20	Baan	
180	North Bengal	NBRC19B	<0.20	Baan	0
181	Kolaghat	KOG1A	0.41	Pangash	
182	Kolaghat	KOG1B	0.22	Pangash	0.315
183	Kolaghat	KOG2A	0.60	Katla	
184	Kolaghat	KOG2B	<0.20	Katla	0.3
185	Kolaghat	KOG3A	<0.20	Silver Carp	
186	Kolaghat	KOG3B	0.20	Silver Carp	0.1
187	Kolaghat	KOG4A	0.27	Mrigel	
188	Kolaghat	KOG4B	<0.20	Mrigel	0.135
189	Kolaghat	KOG5A	0.24	Bata	
190	Kolaghat	KOG5B	<0.20	Bata	0.12
191	Kolaghat	KOG6A	<0.20	Galda Chingdi	
192	Kolaghat	KOG6B	<0.20	Galda Chingdi	0
193	Kolaghat	KOG7A	<0.20	Lilentika	
194	Kolaghat	KOG7B	0.29	Lilentika	0.145
195	Durgapur	DGP1A	0.25	Boal	
196	Durgapur	DGP1B	0.21	Boal	0.23
197	Durgapur	DGP2A	<0.20	Aar	
198	Durgapur	DGP2B	0.22	Aar	0.11
199	Durgapur	DGP3A	0.20	Baan	

Species Averages for Select Fishing Locations in West Bengal					
Sl. no.	**Location**	**Sample code**	**Hg (mg/kg)**	**Species local name**	**Species/variety average (values <0.20 mg /kg treated at 0)**
200	Durgapur	DGP3B	0.21	Baan	0.205
201	Durgapur	DGP4A	<0.20	American Rui	
202	Durgapur	DGP4B	<0.20	American Rui	0
203	Durgapur	DGP5A	<0.20	Bacha	
204	Durgapur	DGP5B	0.20	Bacha	0.1

[Note: Serial numbers 155 through 158 have been marked with an * in the slot species local name. The asterisk indicates difficulty in identification at the point of collection. The fish varieties were identified by the local names of Lyata and Taki, respectively. However, it was determined later that all of these belonged to the same species, namely Channa punctatus. Since all the 4 are from the same specific location, there combined averages have been worked out, which is incidentally 0, and placed against serial no. 58. A somewhat similar situation arose for the samples with the serial numbers from 175 to 178, marked with a † against the species local names. Here we seem to have 2 different sets of samples, Taki and Lyata. However, these have been subsequently identified as the same species, Channa punctatus. Nevertheless, in working out the average in this case, the two sets have been separately treated as they are from two separate sub-locations, which are at considerable distance from each other. Under the circumstances, working out an average for the combined values of the two does not arise. A different problem arose in the case of samples in serial no. 161 and 162. Here both the fish have been identified as Lyata, but subsequently were found to belong to different species, namely Channa striatus and Channa punctatus. In this case working out the species average does not arise. These samples have been identified with ‡.]

Table V. Methylmercury levels in Kolkata market samples and their comparison with PTWI for the given consumption scenario

[Note: In this and the following table, the sample code and sampling sites have not been shown for the same can be read from the earlier tables simply from the context (Kolkata markets or other locations) and serial number. Also, there are two columns indicating MeHg values, one indicates values in mg/kg and the other in µg/kg. Further, where Hg values are <0.21 mg/kg, the corresponding MeHg values have been shown as 0 (see Chapter Results and Discussion). The figures associated with 'Percentage exceedance' show MeHg exposure above its Provisional Tolerable Weekly Intake for a certain body weight and fish flesh consumption scenario. E.g., if the PTWI standard of reference is 200 units for a given weight and the lab result indicates 340 units, the 'Percentage exceedance' is derived calculated as 140 above 200 or 70 percent.. Similarly, if the lab result is 202, then the excess is 2 over 200, and is expressed as 1 percent. Where the lab value is the same or less than the PTWI standard, the result is denoted as 'not exceeded' and 'nil'.]

Kolkata Market Samples and their Comparison with PTWI for the Given Consumption Scenario									
Sl. no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Intake 200 gm Percentage of PTWI exccedance		Person of 50 kg. Intake 300 gm Percentage of PTWI exccedance	
1	Rui	*Labeo rohita*	0.51	0.408	408	Exceeded	104.00	Exceeded	52.81
2	Rui	*Labeo rohita*	0.48	0.384	384	Exceeded	92.00	Exceeded	43.82
3	Katla	*Catla catla*	0.59	0.472	472	Exceeded	136.00	Exceeded	76.78
4	Katla	*Catla catla*	0.39	0.312	312	Exceeded	56.00	Exceeded	16.85
5	Aar	*Sperata aor*	0.84	0.672	672	Exceeded	236.00	Exceeded	151.69
6	Aar	*Sperata aor*	1.12	0.896	896	Exceeded	348.00	Exceeded	235.58
7	Bhetki	*Lates calcarifer*	1.27	1.016	1016	Exceeded	408.00	Exceeded	280.52
8	Bhetki	*Lates calcarifer*	0.88	0.704	704	Exceeded	252.00	Exceeded	163.67
9	Tangra	*Mystus gulio*	0.45	0.36	360	Exceeded	80.00	Exceeded	34.83
10	Tangra	*Mystus gulio*	0.44	0.352	352	Exceeded	76.00	Exceeded	31.84
11	Bagda	*Penaeus monodon*	0.21	0.084	84	Not exceeded	nil	Not exceeded	nil
12	Bagda	*Penaeus monodon*	0.23	0.092	92	Not exceeded	nil	Not exceeded	nil
13	Rui	*Labeo rohita*	0.24	0.192	192	Not exceeded	nil	Not exceeded	nil
14	Rui	*Labeo rohita*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
15	Katla	*Catla catla*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
16	Katla	*Catla catla*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
17	Aar	*Sperata aor*	0.32	0.256	256	Exceeded	28.00	Not exceeded	nil
18	Aar	*Sperata aor*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil

Kolkata Market Samples and their Comparison with PTWI for the Given Consumption Scenario									
Sl. no.	**Species local name**	**Species scientific name**	**Hg (mg/kg)**	**MeHg (mg/kg)**	**MeHg (µg/kg)**	**Child of 25 kg. Intake 200 gm Percentage of PTWI exccedance**		**Person of 50 kg. Intake 300 gm Percentage of PTWI exccedance**	
19	Bhetki	*Lates calcarifer*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
20	Bhetki	*Lates calcarifer*	0.29	0.232	232	Exceeded	16.00	Not exceeded	nil
21	Tangra	*Mystus gulio*	0.22	0.176	176	Not exceeded	nil	Not exceeded	nil
22	Tangra	*Mystus gulio*	0.30	0.24	240	Exceeded	20.00	Not exceeded	nil
23	Bagda	*Penaeus monodon*	0.34	0.136	136	Not exceeded	nil	Not exceeded	nil
24	Bagda	*Penaeus monodon*	0.50	0.2	200	Not exceeded	nil	Not exceeded	nil
25	Rui	*Labeo rohita*	0.50	0.4	400	Exceeded	100.00	Exceeded	49.81
26	Rui	*Labeo rohita*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
27	Katla	*Catla catla*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
28	Katla	*Catla catla*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
29	Aar	*Sperata aor*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
30	Aar	*Sperata aor*	0.22	0.176	176	Not exceeded	nil	Not exceeded	nil
31	Bhetki	*Lates calcarifer*	0.65	0.52	520	Exceeded	160.00	Exceeded	94.76
32	Bhetki	*Lates calcarifer*	0.70	0.56	560	Exceeded	180.00	Exceeded	109.74
33	Tangra	*Mystus gulio*	0.47	0.376	376	Exceeded	88.00	Exceeded	40.82
34	Tangra	*Mystus gulio*	0.85	0.68	680	Exceeded	240.00	Exceeded	154.68
35	Bagda	*Penaeus monodon*	0.57	0.228	228	Exceeded	14.00	Not exceeded	nil
36	Bagda	*Penaeus monodon*	0.39	0.156	156	Not exceeded	nil	Not exceeded	nil
37	Rui	*Labeo rohita*	0.24	0.192	192	Not exceeded	nil	Not exceeded	nil
38	Rui	*Labeo rohita*	0.46	0.368	368	Exceeded	84.00	Exceeded	37.83
39	Katla	*Catla catla*	0.52	0.416	416	Exceeded	108.00	Exceeded	55.81
40	Katla	*Catla catla*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
41	Aar	*Sperata aor*	0.58	0.464	464	Exceeded	132.00	Exceeded	73.78

Kolkata Market Samples and their Comparison with PTWI for the Given Consumption Scenario

Sl. no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Intake 200 gm Percentage of PTWI exccedance		Person of 50 kg. Intake 300 gm Percentage of PTWI exccedance	
42	Aar	*Sperata aor*	0.54	0.432	432	Exceeded	116.00	Exceeded	61.80
43	Bhetki	*Lates calcarifer*	0.22	0.176	176	Not exceeded	nil	Not exceeded	nil
44	Bhetki	*Lates calcarifer*	0.24	0.192	192	Not exceeded	nil	Not exceeded	nil
45	Tangra	*Mystus gulio*	0.22	0.176	176	Not exceeded	nil	Not exceeded	nil
46	Tangra	*Mystus gulio*	0.31	0.248	248	Exceeded	24.00	Not exceeded	nil
47	Bagda	*Penaeus monodon*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
48	Bagda	*Penaeus monodon*	0.38	0.152	152	Not exceeded	nil	Not exceeded	nil
49	Rui	*Labeo rohita*	0.59	0.472	472	Exceeded	136.00	Exceeded	76.78
50	Rui	*Labeo rohita*	0.52	0.416	416	Exceeded	108.00	Exceeded	55.81
51	Katla	*Catla catla*	0.38	0.304	304	Exceeded	52.00	Exceeded	13.86
52	Katla	*Catla catla*	0.22	0.176	176	Not exceeded	nil	Not exceeded	nil
53	Aar	*Sperata aor*	0.56	0.448	448	Exceeded	124.00	Exceeded	67.79
54	Aar	*Sperata aor*	0.31	0.248	248	Exceeded	24.00	Not exceeded	nil
55	Bhetki	*Lates calcarifer*	0.24	0.192	192	Not exceeded	nil	Not exceeded	nil
56	Bhetki	*Lates calcarifer*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
57	Tangra	*Mystus gulio*	0.21	0.168	168	Not exceeded	nil	Not exceeded	nil
58	Tangra	*Mystus gulio*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
59	Bagda	*Penaeus monodon*	0.35	0.14	140	Not exceeded	nil	Not exceeded	nil
60	Bagda	*Penaeus monodon*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil

Table VI. Methylmercury levels in samples from select waterbodies across West Bengal and their comparison with PTWI for the given consumption scenarios

Methylmercury in Samples from Select Waterbodies Across West Bengal and a Comparison with PTWI									
Sl. no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Intake 200 gm Percentage of PTWI exccedance		Person of 50 kg. Intake 300 gm Percentage of PTWI exccedance	
1	Rui	*Labeo rohita*	0.36	0.288	288	Exceeded	44.00	Exceeded	7.87
2	Rui	*Labeo rohita*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
3	Katla	*Catla catla*	0.33	0.264	264	Exceeded	32.00	Not exceeded	nil
4	Katla	*Catla catla*	0.33	0.264	264	Exceeded	32.00	Not exceeded	nil
5	Magur	*Clarias batrachus*	0.55	0.44	440	Exceeded	120.00	Exceeded	64.79
6	Magur	*Clarias batrachus*	0.41	0.328	328	Exceeded	64.00	Exceeded	22.85
7	Shingi	*Heteropneustes fossilis*	0.36	0.288	288	Exceeded	44.00	Exceeded	7.87
8	Shingi	*Heteropneustes fossilis*	0.47	0.376	376	Exceeded	88.00	Exceeded	40.82
9	Pangash	*Pangasius pangasius*	0.52	0.416	416	Exceeded	108.00	Exceeded	55.81
10	Pangash	*Pangasius pangasius*	0.36	0.288	288	Exceeded	44.00	Exceeded	7.87
11	Koi	*Anabas testudineus*	0.28	0.224	224	Exceeded	12.00	Not exceeded	nil
12	Koi	*Anabas testudineus*	0.40	0.32	320	Exceeded	60.00	Exceeded	19.85
13	Lyata	*Chanos chanos*	0.47	0.376	376	Exceeded	88.00	Exceeded	40.82
14	Lyata	*Chanos chanos*	0.40	0.32	320	Exceeded	60.00	Exceeded	19.85
15	American Rui	*Cyprinus carpio*	0.42	0.336	336	Exceeded	68.00	Exceeded	25.84
16	American Rui	*Cyprinus carpio*	0.32	0.256	256	Exceeded	28.00	Not exceeded	nil
17	Pabda	*Ompok pabda*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
18	Pabda	*Ompok pabda*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
19	Bele	*Sillago sihama*	0.37	0.296	296	Exceeded	48.00	Exceeded	10.86
20	Bele	*Sillago sihama*	0.56	0.448	448	Exceeded	124.00	Exceeded	67.79
21	Ilish	*Tenualosa ilisha*	0.70	0.56	560	Exceeded	180.00	Exceeded	109.74
22	Ilish	*Tenualosa ilisha*	0.58	0.464	464	Exceeded	132.00	Exceeded	73.78
23	Gurjaoli	*Eleutheronema tetradactylum*	0.56	0.448	448	Exceeded	124.00	Exceeded	67.79
24	Gurjaoli	*Eleutheronema tetradactylum*	0.82	0.656	656	Exceeded	228.00	Exceeded	145.69
25	Topshe	*Polydactylus sexfilis*	0.69	0.552	552	Exceeded	176.00	Exceeded	106.74

Methylmercury in Samples from Select Waterbodies Across West Bengal and a Comparison with PTWI									
Sl. no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Intake 200 gm Percentage of PTWI exccedance		Person of 50 kg. Intake 300 gm Percentage of PTWI exccedance	
26	Topshe	*Polydactylus sexfilis*	0.59	0.472	472	Exceeded	136.00	Exceeded	76.78
27	Nihere	*Harpadon nehereus*	0.45	0.36	360	Exceeded	80.00	Exceeded	34.83
28	Nihere	*Harpadon nehereus*	0.42	0.336	336	Exceeded	68.00	Exceeded	25.84
29	Norke Bhola	*Panna microdon*	0.61	0.488	488	Exceeded	144.00	Exceeded	82.77
30	Norke Bhola	*Panna microdon*	0.44	0.352	352	Exceeded	76.00	Exceeded	31.84
31	Madhu Bhola	*Otolithoides sp.*	1.03	0.824	824	Exceeded	312.00	Exceeded	208.61
32	Madhu Bhola	*Otolithoides sp.*	0.46	0.368	368	Exceeded	84.00	Exceeded	37.83
33	Bhetki Bhola	*Nibea soldado*	0.83	0.664	664	Exceeded	232.00	Exceeded	148.69
34	Bhetki Bhola	*Nibea soldado*	0.63	0.504	504	Exceeded	152.00	Exceeded	88.76
35	Sitapati	*Trichurus sp.*	2.66	2.128	2128	Exceeded	964.00	Exceeded	697.00
36	Sitapati	*Trichurus sp.*	2.05	1.64	1640	Exceeded	720.00	Exceeded	514.23
37	Amudi	*Coilia sp.*	1.36	1.088	1088	Exceeded	444.00	Exceeded	307.49
38	Amudi	*Coilia sp.*	0.92	0.736	736	Exceeded	268.00	Exceeded	175.66
39	Lote/Nihere	*Harpadon nehereus*	1.72	1.376	1376	Exceeded	588.00	Exceeded	415.36
40	Lote/Nihere	*Harpadon nehereus*	0.59	0.472	472	Exceeded	136.00	Exceeded	76.78
41	Mocha Galda	*Macrobrachium rosenbergii*	1.31	0.524	524	Exceeded	162.00	Exceeded	96.25
42	Mocha Galda	*Macrobrachium rosenbergii*	1.52	0.608	608	Exceeded	204.00	Exceeded	127.72
43	Baul	*Pampus chinesis*	2.08	1.664	1664	Exceeded	732.00	Exceeded	523.22
44	Baul	*Pampus chinesis*	2.03	1.624	1624	Exceeded	712.00	Exceeded	508.24
45	Bagda	*Penaeus monodon*	1.42	0.568	568	Exceeded	184.00	Exceeded	112.73
46	Bagda	*Penaeus monodon*	1.29	0.516	516	Exceeded	158.00	Exceeded	93.26
47	Lathi Bhola	*Panna microdon*	1.09	0.872	872	Exceeded	336.00	Exceeded	226.59
48	Lathi Bhola	*Panna microdon*	1.61	1.288	1288	Exceeded	544.00	Exceeded	382.40
49	Koibol	*Epinephelous sp.*	0.85	0.68	680	Exceeded	240.00	Exceeded	154.68
50	Koibol	*Epinephelous sp.*	0.73	0.584	584	Exceeded	192.00	Exceeded	118.73
51	Ilish	*Tenualosa ilisha*	0.83	0.664	664	Exceeded	232.00	Exceeded	148.69
52	Ilish	*Tenualosa ilisha*	0.55	0.44	440	Exceeded	120.00	Exceeded	64.79
53	Tul /Karrma	*Sillaginopsis panijus*	0.37	0.296	296	Exceeded	48.00	Exceeded	10.86

Methylmercury in Samples from Select Waterbodies Across West Bengal and a Comparison with PTWI									
Sl. no.	Species local name	Species scientific name	Hg (mg/ kg)	MeHg (mg/kg)	MeHg (µg/ kg)	Child of 25 kg. Intake 200 gm Percentage of PTWI exccedance		Person of 50 kg. Intake 300 gm Percentage of PTWI exccedance	
54	Tul /Karrma	*Sillaginopsis panijus*	0.26	0.208	208	Exceeded	4.00	Not exceeded	nil
55	Banspata	*Devario devario*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
56	Banspata	*Devario devario*	0.22	0.176	176	Not exceeded	nil	Not exceeded	nil
57	Topshe	*Polydactylus sexfilis*	0.29	0.232	232	Exceeded	16.00	Not exceeded	nil
58	Topshe	*Polydactylus sexfilis*	0.53	0.424	424	Exceeded	112.00	Exceeded	58.80
59	Tarui	*Rhinomugil corsula*	0.25	0.2	200	Not exceeded	nil	Not exceeded	nil
60	Tarui	*Rhinomugil corsula*	0.21	0.168	168	Not exceeded	nil	Not exceeded	nil
61	Tampra	*Setipinna phasa*	0.21	0.168	168	Not exceeded	nil	Not exceeded	nil
62	Tampra	*Setipinna phasa*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
63	Bhola	*Otolithoides sp.*	0.63	0.504	504	Exceeded	152.00	Exceeded	88.76
64	Bhola	*Otolithoides sp.*	0.39	0.312	312	Exceeded	56.00	Exceeded	16.85
65	Baul	*Apolectus niger*	0.40	0.32	320	Exceeded	60.00	Exceeded	19.85
66	Baul	*Apolectus niger*	0.42	0.336	336	Exceeded	68.00	Exceeded	25.84
67	Padre	*Pellona sp.*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
68	Padre	*Pellona sp.*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
69	Banspata	*Devario devario*	0.60	0.48	480	Exceeded	140.00	Exceeded	79.78
70	Banspata	*Devario devario*	0.72	0.576	576	Exceeded	188.00	Exceeded	115.73
71	Karrma	*Sillago sihama*	0.26	0.208	208	Exceeded	4.00	Not exceeded	nil
72	Karrma	*Sillago sihama*	0.24	0.192	192	Not exceeded	nil	Not exceeded	nil
73	Parshe	*Liza parsia*	0.26	0.208	208	Exceeded	4.00	Not exceeded	nil
74	Parshe	*Liza parsia*	0.29	0.232	232	Exceeded	16.00	Not exceeded	nil
75	Samudra Kankra	*Portunus pelagicus*	0.50	0.4	400	Exceeded	100.00	Exceeded	49.81
76	Samudra Kankra	*Portunus pelagicus*	0.48	0.384	384	Exceeded	92.00	Exceeded	43.82
77	Gurjaoli	*Eleutheronema tetradactylum*	1.14	0.912	912	Exceeded	356.00	Exceeded	241.57

Methylmercury in Samples from Select Waterbodies Across West Bengal and a Comparison with PTWI									
Sl. no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Intake 200 gm Percentage of PTWI exccedance		Person of 50 kg. Intake 300 gm Percentage of PTWI exccedance	
78	Gurjaoli	*Eleutheronema tetradactylum*	1.10	0.88	880	Exceeded	340.00	Exceeded	229.59
79	Motka Chingri	*Penaeus sp.*	1.39	0.556	556	Exceeded	178.00	Exceeded	108.24
80	Motka Chingri	*Penaeus sp.*	1.99	0.796	796	Exceeded	298.00	Exceeded	198.13
81	Phitemaach	*Trichurus lepturus*	0.43	0.344	344	Exceeded	72.00	Exceeded	28.84
82	Phitemaach	*Trichurus lepturus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
83	American Rui	*Cyprinus carpio*	0.45	0.36	360	Exceeded	80.00	Exceeded	34.83
84	American Rui	*Cyprinus carpio*	0.28	0.224	224	Exceeded	12.00	Not exceeded	nil
85	Lilentika	*Oreochromis nilotica*	0.76	0.608	608	Exceeded	204.00	Exceeded	127.72
86	Lilentika	*Oreochromis nilotica*	0.40	0.32	320	Exceeded	60.00	Exceeded	19.85
87	Chara Pona	*Labeo rohita*	0.30	0.24	240	Exceeded	20.00	Not exceeded	nil
88	Chara Pona	*Labeo rohita*	0.40	0.32	320	Exceeded	60.00	Exceeded	19.85
89	Bhola	*Otolithoides sp.*	0.45	0.36	360	Exceeded	80.00	Exceeded	34.83
90	Bhola	*Otolithoides sp.*	0.50	0.4	400	Exceeded	100.00	Exceeded	49.81
91	Tul	*Sillaginopsis panijus*	0.42	0.336	336	Exceeded	68.00	Exceeded	25.84
92	Tul	*Sillaginopsis panijus*	0.36	0.288	288	Exceeded	44.00	Exceeded	7.87
93	Bele	*Platycephalous sp.*	0.48	0.384	384	Exceeded	92.00	Exceeded	43.82
94	Bele	*Platycephalous sp.*	0.69	0.552	552	Exceeded	176.00	Exceeded	106.74
95	Tangra	*Arius sp.*	0.60	0.48	480	Exceeded	140.00	Exceeded	79.78
96	Tangra	*Arius sp.*	0.58	0.464	464	Exceeded	132.00	Exceeded	73.78
97	Shadapata	*Raconda russiliana*	0.83	0.664	664	Exceeded	232.00	Exceeded	148.69
98	Shadapata	*Raconda russiliana*	0.71	0.568	568	Exceeded	184.00	Exceeded	112.73
99	Phyasa	*Setipinna phasa*	0.96	0.768	768	Exceeded	284.00	Exceeded	187.64
100	Phyasa	*Setipinna phasa*	1.09	0.872	872	Exceeded	336.00	Exceeded	226.59
101	Banspata	*Devario devario*	0.84	0.672	672	Exceeded	236.00	Exceeded	151.69
102	Banspata	*Devario devario*	0.96	0.768	768	Exceeded	284.00	Exceeded	187.64
103	Parshe	*Liza parsia*	0.96	0.768	768	Exceeded	284.00	Exceeded	187.64

Methylmercury in Samples from Select Waterbodies Across West Bengal and a Comparison with PTWI

Sl. no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Intake 200 gm Percentage of PTWI exccedance		Person of 50 kg. Intake 300 gm Percentage of PTWI exccedance	
104	Parshe	*Liza parsia*	0.94	0.752	752	Exceeded	276.00	Exceeded	181.65
105	Rui	*Labeo rohita*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
106	Rui	*Labeo rohita*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
107	Katla	*Catla catla*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
108	Katla	*Catla catla*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
109	Mrigel	*Cirrhinus cirrhosus*	0.25	0.2	200	Not exceeded	nil	Not exceeded	nil
110	Mrigel	*Cirrhinus cirrhosus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
111	Bata	*Labeo bata*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
112	Bata	*Labeo bata*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
113	Lilentika	*Oreochromis nilotica*	0.24	0.192	192	Not exceeded	nil	Not exceeded	nil
114	Lilentika	*Oreochromis nilotica*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
115	Silver Carp	*Hypophthalmichthys molitrix*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
116	Silver Carp	*Hypophthalmichthys molitrix*	0.32	0.256	256	Exceeded	28.00	Not exceeded	nil
117	American Rui	*Cyprinus carpio*	0.21	0.168	168	Not exceeded	nil	Not exceeded	nil
118	American Rui	*Cyprinus carpio*	0.36	0.288	288	Exceeded	44.00	Exceeded	7.87
119	Pholi	*Notopterus notopterus*	0.64	0.512	512	Exceeded	156.00	Exceeded	91.76
120	Pholi	*Notopterus notopterus*	0.42	0.336	336	Exceeded	68.00	Exceeded	25.84
121	Grass Carp	*Ctenopharyngodon idella*	0.32	0.256	256	Exceeded	28.00	Not exceeded	nil
122	Grass Carp	*Ctenopharyngodon idella*	0.47	0.376	376	Exceeded	88.00	Exceeded	40.82
123	Katla	*Catla catla*	0.27	0.216	216	Exceeded	8.00	Not exceeded	nil
124	Katla	*Catla catla*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
125	Mrigel	*Cirrhinus cirrhosus*	0.24	0.192	192	Not exceeded	nil	Not exceeded	nil
126	Mrigel	*Cirrhinus cirrhosus*	0.23	0.184	184	Not exceeded	nil	Not exceeded	nil
127	Shol	*Channa striatus*	0.79	0.632	632	Exceeded	216.00	Exceeded	136.70

Methylmercury in Samples from Select Waterbodies Across West Bengal and a Comparison with PTWI									
Sl. no.	**Species local name**	**Species scientific name**	**Hg (mg/kg)**	**MeHg (mg/kg)**	**MeHg (µg/kg)**	**Child of 25 kg. Intake 200 gm Percentage of PTWI exccedance**		**Person of 50 kg. Intake 300 gm Percentage of PTWI exccedance**	
128	Shol	*Channa striatus*	0.52	0.416	416	Exceeded	108.00	Exceeded	55.81
129	Bacha	*Eutropichthys vacha*	0.27	0.216	216	Exceeded	8.00	Not exceeded	nil
130	Bacha	*Eutropichthys vacha*	0.41	0.328	328	Exceeded	64.00	Exceeded	22.85
131	Ghere	*Silonia silondia*	0.24	0.192	192	Not exceeded	nil	Not exceeded	nil
132	Ghere	*Silonia silondia*	0.29	0.232	232	Exceeded	16.00	Not exceeded	nil
133	Aar	*Sperata aor*	0.37	0.296	296	Exceeded	48.00	Exceeded	10.86
134	Aar	*Sperata aor*	0.26	0.208	208	Exceeded	4.00	Not exceeded	nil
135	Tel Ghagra	*Mystus sp.*	0.24	0.192	192	Not exceeded	nil	Not exceeded	nil
136	Tel Ghagra	*Mystus sp.*	0.30	0.24	240	Exceeded	20.00	Not exceeded	nil
137	Sarpnuti	*Puntius sarana*	0.48	0.384	384	Exceeded	92.00	Exceeded	43.82
138	Sarpnuti	*Puntius sarana*	0.60	0.48	480	Exceeded	140.00	Exceeded	79.78
139	Pholi	*Notopterus notopterus*	0.39	0.312	312	Exceeded	56.00	Exceeded	16.85
140	Pholi	*Notopterus notopterus*	0.83	0.664	664	Exceeded	232.00	Exceeded	148.69
141	Bam	*Mastacembelus armatus*	0.39	0.312	312	Exceeded	56.00	Exceeded	16.85
142	Bam	*Mastacembelus armatus*	0.83	0.664	664	Exceeded	232.00	Exceeded	148.69
143	Shol	*Channa stiatus*	0.62	0.496	496	Exceeded	148.00	Exceeded	85.77
144	Shol	*Channa stiatus*	1.25	1	1000	Exceeded	400.00	Exceeded	274.53
145	Bata	*Labeo bata*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
146	Bata	*Labeo bata*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
147	Shingi	*Heteropneustes fossilis*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
148	Shingi	*Heteropneustes fossilis*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
149	Tangra	*Mystus bleekeri*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
150	Tangra	*Mystus bleekeri*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
151	Bacha	*Eutropichthys vacha*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil

Methylmercury in Samples from Select Waterbodies Across West Bengal and a Comparison with PTWI									
Sl. no.	**Species local name**	**Species scientific name**	**Hg (mg/kg)**	**MeHg (mg/kg)**	**MeHg (µg/kg)**	**Child of 25 kg. Intake 200 gm Percentage of PTWI exccedance**		**Person of 50 kg. Intake 300 gm Percentage of PTWI exccedance**	
152	Bacha	*Eutropichthys vacha*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
153	Baan	*Mastacembelus sp.*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
154	Baan	*Mastacembelus sp.*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
155	Lyata	*Channa punctatus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
156	Lyata	*Channa punctatus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
157	Taki	*Channa punctatus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
158	Taki	*Channa punctatus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
159	American Rui	*Cyprinus carpio*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
160	American Rui	*Cyprinus carpio*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
161	Lyata	*Channa striatus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
162	Lyata	*Channa punctatus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
163	Mrigel	*Cirrhinus cirrhosus*	0.22	0.176	176	Not exceeded	nil	Not exceeded	nil
164	Mrigel	*Cirrhinus cirrhosus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
165	Silver Carp	*Hypophthalmichthys molitrix*	0.26	0.208	208	Exceeded	4.00	Not exceeded	nil
166	Silver Carp	*Hypophthalmichthys molitrix*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
167	American Rui	*Cyprinus carpio*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
168	American Rui	*Cyprinus carpio*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
169	Mrigel	*Cirrhinus cirrhosus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
170	Mrigel	*Cirrhinus cirrhosus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
171	Shingi	*Heteropneustes fossilis*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
172	Shingi	*Heteropneustes fossilis*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
173	Koi	*Pseudosphromenus cupanus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil

Methylmercury in Samples from Select Waterbodies Across West Bengal and a Comparison with PTWI									
Sl. no.	**Species local name**	**Species scientific name**	**Hg (mg/kg)**	**MeHg (mg/kg)**	**MeHg (µg/kg)**	**Child of 25 kg. Intake 200 gm Percentage of PTWI exccedance**		**Person of 50 kg. Intake 300 gm Percentage of PTWI exccedance**	
174	Koi	*Pseudosphromenus cupanus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
175	Taki	*Channa punctatus*	0.71	0.568	568	Exceeded	184.00	Exceeded	112.73
176	Taki	*Channa punctatus*	0.25	0.2	200	Not exceeded	nil	Not exceeded	nil
177	Lyata	*Channa punctatus*	0.92	0.736	736	Exceeded	268.00	Exceeded	175.66
178	Lyata	*Channa punctatus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
179	Baan	*Ophisternon bengalense*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
180	Baan	*Ophisternon bengalense*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
181	Pangash	*Pangasius pangasius*	0.41	0.328	328	Exceeded	64.00	Exceeded	22.85
182	Pangash	*Pangasius pangasius*	0.22	0.176	176	Not exceeded	nil	Not exceeded	nil
183	Katla	*Catla catla*	0.60	0.48	480	Exceeded	140.00	Exceeded	79.78
184	Katla	*Catla catla*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
185	Silver Carp	*Hypophthalmichthys molitrix*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
186	Silver Carp	*Hypophthalmichthys molitrix*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
187	Mrigel	*Cirrhinus cirrhosus*	0.27	0.216	216	Exceeded	8.00	Not exceeded	nil
188	Mrigel	*Cirrhinus cirrhosus*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
189	Bata	*Labeo bata*	0.24	0.192	192	Not exceeded	nil	Not exceeded	nil
190	Bata	*Labeo bata*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
191	Galda Chingdi	*Macrobrachium rosenbergii*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
192	Galda Chingdi	*Macrobrachium rosenbergii*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
193	Lilentika	*Oreochromis nilotica*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
194	Lilentika	*Oreochromis nilotica*	0.29	0.232	232	Exceeded	16.00	Not exceeded	nil
195	Boal	*Wallagonia attu*	0.25	0.2	200	Not exceeded	nil	Not exceeded	nil

Methylmercury in Samples from Select Waterbodies Across West Bengal and a Comparison with PTWI

Sl. no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Intake 200 gm Percentage of PTWI exccedance		Person of 50 kg. Intake 300 gm Percentage of PTWI exccedance	
196	Boal	*Wallagonia attu*	0.21	0.168	168	Not exceeded	nil	Not exceeded	nil
197	Aar	*Sperata aor*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
198	Aar	*Sperata aor*	0.22	0.176	176	Not exceeded	nil	Not exceeded	nil
199	Baan	*Ophisternon bengalense*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
200	Baan	*Ophisternon bengalense*	0.21	0.168	168	Not exceeded	nil	Not exceeded	nil
201	American Rui	*Cyprinus carpio*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
202	American Rui	*Cyprinus carpio*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
203	Bacha	*Eutropichthys vacha*	<0.20	0	0	Not exceeded	nil	Not exceeded	nil
204	Bacha	*Eutropichthys vacha*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil

Table VI A. PTWI exceedance in Kolkata Market samples at higher consumption levels

PTWI Exceedance in Kolkata Market Samples at Higher Consumption Levels									
Sl no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (μg/kg)	Child of 25 kg. Intake 250 gm Percentage of PTWI exccedance		Person of 60 kg. Intake 500 gm Percentage of PTWI exccedance	
1	Rui	*Labeo rohita*	0.51	0.408	408	Exceeded	155.00	Exceeded	112.50
2	Rui	*Labeo rohita*	0.48	0.384	384	Exceeded	140.00	Exceeded	100.00
3	Katla	*Catla catla*	0.59	0.472	472	Exceeded	195.00	Exceeded	145.83
4	Katla	*Catla catla*	0.39	0.312	312	Exceeded	95.00	Exceeded	62.50
5	Aar	*Sperata aor*	0.84	0.672	672	Exceeded	320.00	Exceeded	250.00
6	Aar	*Sperata aor*	1.12	0.896	896	Exceeded	460.00	Exceeded	366.67
7	Bhetki	*Lates calcarifer*	1.27	1.016	1016	Exceeded	535.00	Exceeded	429.17
8	Bhetki	*Lates calcarifer*	0.88	0.704	704	Exceeded	340.00	Exceeded	266.67
9	Tangra	*Mystus gulio*	0.45	0.36	360	Exceeded	125.00	Exceeded	87.50
10	Tangra	*Mystus gulio*	0.44	0.352	352	Exceeded	120.00	Exceeded	83.33
11	Bagda	*Penaeus monodon*	0.21	0.084	84	Not exceeded	nil	Not exceeded	nil
12	Bagda	*Penaeus monodon*	0.23	0.092	92	Not exceeded	nil	Not exceeded	nil
13	Rui	*Labeo rohita*	0.24	0.192	192	Exceeded	20.00	Not exceeded	nil
14	Rui	*Labeo rohita*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
15	Katla	*Catla catla*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
16	Katla	*Catla catla*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
17	Aar	*Sperata aor*	0.32	0.256	256	Exceeded	60.00	Exceeded	33.33
18	Aar	*Sperata aor*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
19	Bhetki	*Lates calcarifer*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
20	Bhetki	*Lates calcarifer*	0.29	0.232	232	Exceeded	45.00	Exceeded	20.83
21	Tangra	*Mystus gulio*	0.22	0.176	176	Exceeded	10.00	Not exceeded	nil
22	Tangra	*Mystus gulio*	0.30	0.24	240	Exceeded	50.00	Exceeded	25.00
23	Bagda	*Penaeus monodon*	0.34	0.136	136	Not exceeded	nil	Not exceeded	nil
24	Bagda	*Penaeus monodon*	0.50	0.2	200	Exceeded	25.00	Exceeded	4.17
25	Rui	*Labeo rohita*	0.50	0.4	400	Exceeded	150.00	Exceeded	108.33
26	Rui	*Labeo rohita*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
27	Katla	*Catla catla*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
28	Katla	*Catla catla*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
29	Aar	*Sperata aor*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
30	Aar	*Sperata aor*	0.22	0.176	176	Exceeded	10.00	Not exceeded	nil
31	Bhetki	*Lates calcarifer*	0.65	0.52	520	Exceeded	225.00	Exceeded	170.83

PTWI Exceedance in Kolkata Market Samples at Higher Consumption Levels									
Sl no.	**Species local name**	**Species scientific name**	**Hg (mg/kg)**	**MeHg (mg/kg)**	**MeHg (µg/kg)**	**Child of 25 kg. Intake 250 gm Percentage of PTWI exccedance**		**Person of 60 kg. Intake 500 gm Percentage of PTWI exccedance**	
32	Bhetki	*Lates calcarifer*	0.70	0.56	560	Exceeded	250.00	Exceeded	191.67
33	Tangra	*Mystus gulio*	0.47	0.376	376	Exceeded	135.00	Exceeded	95.83
34	Tangra	*Mystus gulio*	0.85	0.68	680	Exceeded	325.00	Exceeded	254.17
35	Bagda	*Penaeus monodon*	0.57	0.228	228	Exceeded	42.50	Exceeded	18.75
36	Bagda	*Penaeus monodon*	0.39	0.156	156	Not exceeded	nil	Not exceeded	nil
37	Rui	*Labeo rohita*	0.24	0.192	192	Exceeded	20.00	Not exceeded	nil
38	Rui	*Labeo rohita*	0.46	0.368	368	Exceeded	130.00	Exceeded	91.67
39	Katla	*Catla catla*	0.52	0.416	416	Exceeded	160.00	Exceeded	116.67
40	Katla	*Catla catla*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
41	Aar	*Sperata aor*	0.58	0.464	464	Exceeded	190.00	Exceeded	141.67
42	Aar	*Sperata aor*	0.54	0.432	432	Exceeded	170.00	Exceeded	125.00
43	Bhetki	*Lates calcarifer*	0.22	0.176	176	Exceeded	10.00	Not exceeded	nil
44	Bhetki	*Lates calcarifer*	0.24	0.192	192	Exceeded	20.00	Not exceeded	nil
45	Tangra	*Mystus gulio*	0.22	0.176	176	Exceeded	10.00	Not exceeded	nil
46	Tangra	*Mystus gulio*	0.31	0.248	248	Exceeded	55.00	Exceeded	29.17
47	Bagda	*Penaeus monodon*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
48	Bagda	*Penaeus monodon*	0.38	0.152	152	Not exceeded	nil	Not exceeded	nil
49	Rui	*Labeo rohita*	0.59	0.472	472	Exceeded	195.00	Exceeded	145.83
50	Rui	*Labeo rohita*	0.52	0.416	416	Exceeded	160.00	Exceeded	116.67
51	Katla	*Catla catla*	0.38	0.304	304	Exceeded	90.00	Exceeded	58.33
52	Katla	*Catla catla*	0.22	0.176	176	Exceeded	10.00	Not exceeded	nil
53	Aar	*Sperata aor*	0.56	0.448	448	Exceeded	180.00	Exceeded	133.33
54	Aar	*Sperata aor*	0.31	0.248	248	Exceeded	55.00	Exceeded	29.17
55	Bhetki	*Lates calcarifer*	0.24	0.192	192	Exceeded	20.00	Not exceeded	nil
56	Bhetki	*Lates calcarifer*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
57	Tangra	*Mystus gulio*	0.21	0.168	168	Exceeded	5.00	Not exceeded	nil
58	Tangra	*Mystus gulio*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
59	Bagda	*Penaeus monodon*	0.35	0.14	140	Not exceeded	nil	Not exceeded	nil
60	Bagda	*Penaeus monodon*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil

Table VI B. PTWI exceedance in samples from select waterbodies across West Bengal at higher consumption levels

PTWI Exceedance in Samples from Select Waterbodies Across West Bengal at Higher Consumption Levels									
Sl. no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Intake 250 gm Percentage of PTWI exceedance		Person of 60 kg. Intake 500 gm Percentage of PTWI exceedance	
1	Rui	*Labeo rohita*	0.36	0.288	288	Exceeded	80.00	Exceeded	50.00
2	Rui	*Labeo rohita*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
3	Katla	*Catla catla*	0.33	0.264	264	Exceeded	65.00	Exceeded	37.50
4	Katla	*Catla catla*	0.33	0.264	264	Exceeded	65.00	Exceeded	37.50
5	Magur	*Clarias batrachus*	0.55	0.44	440	Exceeded	175.00	Exceeded	129.17
6	Magur	*Clarias batrachus*	0.41	0.328	328	Exceeded	105.00	Exceeded	70.83
7	Shingi	*Heteropneustes fossilis*	0.36	0.288	288	Exceeded	80.00	Exceeded	50.00
8	Shingi	*Heteropneustes fossilis*	0.47	0.376	376	Exceeded	135.00	Exceeded	95.83
9	Pangash	*Pangasius pangasius*	0.52	0.416	416	Exceeded	160.00	Exceeded	116.67
10	Pangash	*Pangasius pangasius*	0.36	0.288	288	Exceeded	80.00	Exceeded	50.00
11	Koi	*Anabas testudineus*	0.28	0.224	224	Exceeded	40.00	Exceeded	16.67
12	Koi	*Anabas testudineus*	0.40	0.32	320	Exceeded	100.00	Exceeded	66.67
13	Lyata	*Chanos chanos*	0.47	0.376	376	Exceeded	135.00	Exceeded	95.83
14	Lyata	*Chanos chanos*	0.40	0.32	320	Exceeded	100.00	Exceeded	66.67
15	American Rui	*Cyprinus carpio*	0.42	0.336	336	Exceeded	110.00	Exceeded	75.00
16	American Rui	*Cyprinus carpio*	0.32	0.256	256	Exceeded	60.00	Exceeded	33.33
17	Pabda	*Ompok pabda*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
18	Pabda	*Ompok pabda*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
19	Bele	*Sillago sihama*	0.37	0.296	296	Exceeded	85.00	Exceeded	54.17
20	Bele	*Sillago sihama*	0.56	0.448	448	Exceeded	180.00	Exceeded	133.33
21	Ilish	*Tenualosa ilisha*	0.70	0.56	560	Exceeded	250.00	Exceeded	191.67
22	Ilish	*Tenualosa ilisha*	0.58	0.464	464	Exceeded	190.00	Exceeded	141.67
23	Gurjaoli	*Eleutheronema tetradactylum*	0.56	0.448	448	Exceeded	180.00	Exceeded	133.33
24	Gurjaoli	*Eleutheronema tetradactylum*	0.82	0.656	656	Exceeded	310.00	Exceeded	241.67
25	Topshe	*Polydactylus sexfilis*	0.69	0.552	552	Exceeded	245.00	Exceeded	187.50
26	Topshe	*Polydactylus sexfilis*	0.59	0.472	472	Exceeded	195.00	Exceeded	145.83

PTWI Exceedance in Samples from Select Waterbodies Across West Bengal at Higher Consumption Levels									
Sl. no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Intake 250 gm Percentage of PTWI exceedance		Person of 60 kg. Intake 500 gm Percentage of PTWI exceedance	
27	Nihere	*Harpadon nehereus*	0.45	0.36	360	Exceeded	125.00	Exceeded	87.50
28	Nihere	*Harpadon nehereus*	0.42	0.336	336	Exceeded	110.00	Exceeded	75.00
29	Norke Bhola	*Panna microdon*	0.61	0.488	488	Exceeded	205.00	Exceeded	154.17
30	Norke Bhola	*Panna microdon*	0.44	0.352	352	Exceeded	120.00	Exceeded	83.33
31	Madhu Bhola	*Otolithoides sp.*	1.03	0.824	824	Exceeded	415.00	Exceeded	329.17
32	Madhu Bhola	*Otolithoides sp.*	0.46	0.368	368	Exceeded	130.00	Exceeded	91.67
33	Bhetki Bhola	*Nibea soldado*	0.83	0.664	664	Exceeded	315.00	Exceeded	245.83
34	Bhetki Bhola	*Nibea soldado*	0.63	0.504	504	Exceeded	215.00	Exceeded	162.50
35	Sitapati	*Trichurus sp.*	2.66	2.128	2128	Exceeded	1230.00	Exceeded	1008.33
36	Sitapati	*Trichurus sp.*	2.05	1.64	1640	Exceeded	925.00	Exceeded	754.17
37	Amudi	*Coilia sp.*	1.36	1.088	1088	Exceeded	580.00	Exceeded	466.67
38	Amudi	*Coilia sp.*	0.92	0.736	736	Exceeded	360.00	Exceeded	283.33
39	Lote/Nihere	*Harpadon nehereus*	1.72	1.376	1376	Exceeded	760.00	Exceeded	616.67
40	Lote/Nihere	*Harpadon nehereus*	0.59	0.472	472	Exceeded	195.00	Exceeded	145.83
41	Mocha Galda	*Macrobrachium rosenbergii*	1.31	0.524	524	Exceeded	227.50	Exceeded	172.92
42	Mocha Galda	*Macrobrachium rosenbergii*	1.52	0.608	608	Exceeded	280.00	Exceeded	216.67
43	Baul	*Pampus chinesis*	2.08	1.664	1664	Exceeded	940.00	Exceeded	766.67
44	Baul	*Pampus chinesis*	2.03	1.624	1624	Exceeded	915.00	Exceeded	745.83
45	Bagda	*Penaeus monodon*	1.42	0.568	568	Exceeded	255.00	Exceeded	195.83
46	Bagda	*Penaeus monodon*	1.29	0.516	516	Exceeded	222.50	Exceeded	168.75
47	Lathi Bhola	*Panna microdon*	1.09	0.872	872	Exceeded	445.00	Exceeded	354.17
48	Lathi Bhola	*Panna microdon*	1.61	1.288	1288	Exceeded	705.00	Exceeded	570.83
49	Koibol	*Epinephelous sp.*	0.85	0.68	680	Exceeded	325.00	Exceeded	254.17
50	Koibol	*Epinephelous sp.*	0.73	0.584	584	Exceeded	265.00	Exceeded	204.17
51	Ilish	*Tenualosa ilisha*	0.83	0.664	664	Exceeded	315.00	Exceeded	245.83

PTWI Exceedance in Samples from Select Waterbodies Across West Bengal at Higher Consumption Levels									
Sl. no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Intake 250 gm Percentage of PTWI exceedance		Person of 60 kg. Intake 500 gm Percentage of PTWI exceedance	
52	Ilish	*Tenualosa ilisha*	0.55	0.44	440	Exceeded	175.00	Exceeded	129.17
53	Tul /Karrma	*Sillaginopsis panijus*	0.37	0.296	296	Exceeded	85.00	Exceeded	54.17
54	Tul /Karrma	*Sillaginopsis panijus*	0.26	0.208	208	Exceeded	30.00	Exceeded	8.33
55	Banspata	*Devario devario*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
56	Banspata	*Devario devario*	0.22	0.176	176	Exceeded	10.00	Not exceeded	nil
57	Topshe	*Polydactylus sexfilis*	0.29	0.232	232	Exceeded	45.00	Exceeded	20.83
58	Topshe	*Polydactylus sexfilis*	0.53	0.424	424	Exceeded	165.00	Exceeded	120.83
59	Tarui	*Rhinomugil corsula*	0.25	0.2	200	Exceeded	25.00	Exceeded	4.17
60	Tarui	*Rhinomugil corsula*	0.21	0.168	168	Exceeded	5.00	Not exceeded	nil
61	Tampra	*Setipinna phasa*	0.21	0.168	168	Exceeded	5.00	Not exceeded	nil
62	Tampra	*Setipinna phasa*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
63	Bhola	*Otolithoides sp.*	0.63	0.504	504	Exceeded	215.00	Exceeded	162.50
64	Bhola	*Otolithoides sp.*	0.39	0.312	312	Exceeded	95.00	Exceeded	62.50
65	Baul	*Apolectus niger*	0.40	0.32	320	Exceeded	100.00	Exceeded	66.67
66	Baul	*Apolectus niger*	0.42	0.336	336	Exceeded	110.00	Exceeded	75.00
67	Padre	*Pellona sp.*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
68	Padre	*Pellona sp.*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
69	Banspata	*Devario devario*	0.60	0.48	480	Exceeded	200.00	Exceeded	150.00
70	Banspata	*Devario devario*	0.72	0.576	576	Exceeded	260.00	Exceeded	200.00
71	Karrma	*Sillago sihama*	0.26	0.208	208	Exceeded	30.00	Exceeded	8.33
72	Karrma	*Sillago sihama*	0.24	0.192	192	Exceeded	20.00	Not exceeded	nil
73	Parshe	*Liza parsia*	0.26	0.208	208	Exceeded	30.00	Exceeded	8.33
74	Parshe	*Liza parsia*	0.29	0.232	232	Exceeded	45.00	Exceeded	20.83
75	Samudra Kankra	*Portunus pelagicus*	0.50	0.4	400	Exceeded	150.00	Exceeded	108.33
76	Samudra Kankra	*Portunus pelagicus*	0.48	0.384	384	Exceeded	140.00	Exceeded	100.00
77	Gurjaoli	*Eleutheronema tetradactylum*	1.14	0.912	912	Exceeded	470.00	Exceeded	375.00
78	Gurjaoli	*Eleutheronema tetradactylum*	1.10	0.88	880	Exceeded	450.00	Exceeded	358.33

PTWI Exceedance in Samples from Select Waterbodies Across West Bengal at Higher Consumption Levels									
Sl. no.	**Species local name**	**Species scientific name**	**Hg (mg/ kg)**	**MeHg (mg/ kg)**	**MeHg (µg/ kg)**	**Child of 25 kg. Intake 250 gm Percentage of PTWI exceedance**		**Person of 60 kg. Intake 500 gm Percentage of PTWI exceedance**	
79	Motka Chingri	*Penaeus sp.*	1.39	0.556	556	Exceeded	247.50	Exceeded	189.58
80	Motka Chingri	*Penaeus sp.*	1.99	0.796	796	Exceeded	397.50	Exceeded	314.58
81	Phitemaach	*Trichurus lepturus*	0.43	0.344	344	Exceeded	115.00	Exceeded	79.17
82	Phitemaach	*Trichurus lepturus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
83	American Rui	*Cyprinus carpio*	0.45	0.36	360	Exceeded	125.00	Exceeded	87.50
84	American Rui	*Cyprinus carpio*	0.28	0.224	224	Exceeded	40.00	Exceeded	16.67
85	Lilentika	*Oreochromis nilotica*	0.76	0.608	608	Exceeded	280.00	Exceeded	216.67
86	Lilentika	*Oreochromis nilotica*	0.40	0.32	320	Exceeded	100.00	Exceeded	66.67
87	Chara Pona	*Labeo rohita*	0.30	0.24	240	Exceeded	50.00	Exceeded	25.00
88	Chara Pona	*Labeo rohita*	0.40	0.32	320	Exceeded	100.00	Exceeded	66.67
89	Bhola	*Otolithoides sp.*	0.45	0.36	360	Exceeded	125.00	Exceeded	87.50
90	Bhola	*Otolithoides sp.*	0.50	0.4	400	Exceeded	150.00	Exceeded	108.33
91	Tul	*Sillaginopsis panijus*	0.42	0.336	336	Exceeded	110.00	Exceeded	75.00
92	Tul	*Sillaginopsis panijus*	0.36	0.288	288	Exceeded	80.00	Exceeded	50.00
93	Bele	*Platycephalous sp.*	0.48	0.384	384	Exceeded	140.00	Exceeded	100.00
94	Bele	*Platycephalous sp.*	0.69	0.552	552	Exceeded	245.00	Exceeded	187.50
95	Tangra	*Arius sp.*	0.60	0.48	480	Exceeded	200.00	Exceeded	150.00
96	Tangra	*Arius sp.*	0.58	0.464	464	Exceeded	190.00	Exceeded	141.67
97	Shadapata	*Raconda russiliana*	0.83	0.664	664	Exceeded	315.00	Exceeded	245.83
98	Shadapata	*Raconda russiliana*	0.71	0.568	568	Exceeded	255.00	Exceeded	195.83
99	Phyasa	*Setipinna phasa*	0.96	0.768	768	Exceeded	380.00	Exceeded	300.00
100	Phyasa	*Setipinna phasa*	1.09	0.872	872	Exceeded	445.00	Exceeded	354.17
101	Banspata	*Devario devario*	0.84	0.672	672	Exceeded	320.00	Exceeded	250.00
102	Banspata	*Devario devario*	0.96	0.768	768	Exceeded	380.00	Exceeded	300.00
103	Parshe	*Liza parsia*	0.96	0.768	768	Exceeded	380.00	Exceeded	300.00
104	Parshe	*Liza parsia*	0.94	0.752	752	Exceeded	370.00	Exceeded	291.67

PTWI Exceedance in Samples from Select Waterbodies Across West Bengal at Higher Consumption Levels

Sl. no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Intake 250 gm Percentage of PTWI exceedance		Person of 60 kg. Intake 500 gm Percentage of PTWI exceedance	
105	Rui	*Labeo rohita*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
106	Rui	*Labeo rohita*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
107	Katla	*Catla catla*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
108	Katla	*Catla catla*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
109	Mrigel	*Cirrhinus cirrhosus*	0.25	0.2	200	Exceeded	25.00	Exceeded	4.17
110	Mrigel	*Cirrhinus cirrhosus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
111	Bata	*Labeo bata*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
112	Bata	*Labeo bata*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
113	Lilentika	*Oreochromis nilotica*	0.24	0.192	192	Exceeded	20.00	Not exceeded	nil
114	Lilentika	*Oreochromis nilotica*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
115	Silver Carp	*Hypophthalmichthys molitrix*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
116	Silver Carp	*Hypophthalmichthys molitrix*	0.32	0.256	256	Exceeded	60.00	Exceeded	33.33
117	American Rui	*Cyprinus carpio*	0.21	0.168	168	Exceeded	5.00	Not exceeded	nil
118	American Rui	*Cyprinus carpio*	0.36	0.288	288	Exceeded	80.00	Exceeded	50.00
119	Pholi	*Notopterus notopterus*	0.64	0.512	512	Exceeded	220.00	Exceeded	166.67
120	Pholi	*Notopterus notopterus*	0.42	0.336	336	Exceeded	110.00	Exceeded	75.00
121	Grass Carp	*Ctenopharyngodon idella*	0.32	0.256	256	Exceeded	60.00	Exceeded	33.33
122	Grass Carp	*Ctenopharyngodon idella*	0.47	0.376	376	Exceeded	135.00	Exceeded	95.83
123	Katla	*Catla catla*	0.27	0.216	216	Exceeded	35.00	Exceeded	12.50
124	Katla	*Catla catla*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
125	Mrigel	*Cirrhinus cirrhosus*	0.24	0.192	192	Exceeded	20.00	Not exceeded	nil
126	Mrigel	*Cirrhinus cirrhosus*	0.23	0.184	184	Exceeded	15.00	Not exceeded	nil
127	Shol	*Channa striatus*	0.79	0.632	632	Exceeded	295.00	Exceeded	229.17
128	Shol	*Channa striatus*	0.52	0.416	416	Exceeded	160.00	Exceeded	116.67

PTWI Exceedance in Samples from Select Waterbodies Across West Bengal at Higher Consumption Levels									
Sl. no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Intake 250 gm Percentage of PTWI exceedance		Person of 60 kg. Intake 500 gm Percentage of PTWI exceedance	
129	Bacha	*Eutropichthys vacha*	0.27	0.216	216	Exceeded	35.00	Exceeded	12.50
130	Bacha	*Eutropichthys vacha*	0.41	0.328	328	Exceeded	105.00	Exceeded	70.83
131	Ghere	*Silonia silondia*	0.24	0.192	192	Exceeded	20.00	Not exceeded	nil
132	Ghere	*Silonia silondia*	0.29	0.232	232	Exceeded	45.00	Exceeded	20.83
133	Aar	*Sperata aor*	0.37	0.296	296	Exceeded	85.00	Exceeded	54.17
134	Aar	*Sperata aor*	0.26	0.208	208	Exceeded	30.00	Exceeded	8.33
135	Tel Ghagra	*Mystus sp.*	0.24	0.192	192	Exceeded	20.00	Not exceeded	nil
136	Tel Ghagra	*Mystus sp.*	0.30	0.24	240	Exceeded	50.00	Exceeded	25.00
137	Sarpnuti	*Puntius sarana*	0.48	0.384	384	Exceeded	140.00	Exceeded	100.00
138	Sarpnuti	*Puntius sarana*	0.60	0.48	480	Exceeded	200.00	Exceeded	150.00
139	Pholi	*Notopterus notopterus*	0.39	0.312	312	Exceeded	95.00	Exceeded	62.50
140	Pholi	*Notopterus notopterus*	0.83	0.664	664	Exceeded	315.00	Exceeded	245.83
141	Bam	*Mastacembelus armatus*	0.39	0.312	312	Exceeded	95.00	Exceeded	62.50
142	Bam	*Mastacembelus armatus*	0.83	0.664	664	Exceeded	315.00	Exceeded	245.83
143	Shol	*Channa stiatus*	0.62	0.496	496	Exceeded	210.00	Exceeded	158.33
144	Shol	*Channa stiatus*	1.25	1	1000	Exceeded	525.00	Exceeded	420.83
145	Bata	*Labeo bata*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
146	Bata	*Labeo bata*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
147	Shingi	*Heteropneustes fossilis*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
148	Shingi	*Heteropneustes fossilis*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
149	Tangra	*Mystus bleekeri*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
150	Tangra	*Mystus bleekeri*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
151	Bacha	*Eutropichthys vacha*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
152	Bacha	*Eutropichthys vacha*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
153	Baan	*Mastacembelus sp.*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
154	Baan	*Mastacembelus sp.*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil

PTWI Exceedance in Samples from Select Waterbodies Across West Bengal at Higher Consumption Levels

Sl. no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Intake 250 gm Percentage of PTWI exceedance		Person of 60 kg. Intake 500 gm Percentage of PTWI exceedance	
155	Lyata	*Channa punctatus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
156	Lyata	*Channa punctatus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
157	Taki	*Channa punctatus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
158	Taki	*Channa punctatus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
159	American Rui	*Cyprinus carpio*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
160	American Rui	*Cyprinus carpio*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
161	Lyata	*Channa striatus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
162	Lyata	*Channa punctatus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
163	Mrigel	*Cirrhinus cirrhosus*	0.22	0.176	176	Exceeded	10.00	Not exceeded	nil
164	Mrigel	*Cirrhinus cirrhosus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
165	Silver Carp	*Hypophthalmichthys molitrix*	0.26	0.208	208	Exceeded	30.00	Exceeded	8.33
166	Silver Carp	*Hypophthalmichthys molitrix*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
167	American Rui	*Cyprinus carpio*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
168	American Rui	*Cyprinus carpio*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
169	Mrigel	*Cirrhinus cirrhosus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
170	Mrigel	*Cirrhinus cirrhosus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
171	Shingi	*Heteropneustes fossilis*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
172	Shingi	*Heteropneustes fossilis*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
173	Koi	*Pseudosphromenus cupanus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
174	Koi	*Pseudosphromenus cupanus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
175	Taki	*Channa punctatus*	0.71	0.568	568	Exceeded	255.00	Exceeded	195.83
176	Taki	*Channa punctatus*	0.25	0.2	200	Exceeded	25.00	Exceeded	4.17
177	Lyata	*Channa punctatus*	0.92	0.736	736	Exceeded	360.00	Exceeded	283.33

PTWI Exceedance in Samples from Select Waterbodies Across West Bengal at Higher Consumption Levels

Sl. no.	Species local name	Species scientific name	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Intake 250 gm Percentage of PTWI exceedance		Person of 60 kg. Intake 500 gm Percentage of PTWI exceedance	
178	Lyata	*Channa punctatus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
179	Baan	*Ophisternon bengalense*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
180	Baan	*Ophisternon bengalense*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
181	Pangash	*Pangasius pangasius*	0.41	0.328	328	Exceeded	105.00	Exceeded	70.83
182	Pangash	*Pangasius pangasius*	0.22	0.176	176	Exceeded	10.00	Not exceeded	nil
183	Katla	*Catla catla*	0.60	0.48	480	Exceeded	200.00	Exceeded	150.00
184	Katla	*Catla catla*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
185	Silver Carp	*Hypophthalmichthys molitrix*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
186	Silver Carp	*Hypophthalmichthys molitrix*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
187	Mrigel	*Cirrhinus cirrhosus*	0.27	0.216	216	Exceeded	35.00	Exceeded	12.50
188	Mrigel	*Cirrhinus cirrhosus*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
189	Bata	*Labeo bata*	0.24	0.192	192	Exceeded	20.00	Not exceeded	nil
190	Bata	*Labeo bata*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
191	Galda Chingdi	*Macrobrachium rosenbergii*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
192	Galda Chingdi	*Macrobrachium rosenbergii*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
193	Lilentika	*Oreochromis nilotica*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
194	Lilentika	*Oreochromis nilotica*	0.29	0.232	232	Exceeded	45.00	Exceeded	20.83
195	Boal	*Wallagonia attu*	0.25	0.2	200	Exceeded	25.00	Exceeded	4.17
196	Boal	*Wallagonia attu*	0.21	0.168	168	Exceeded	5.00	Not exceeded	nil
197	Aar	*Sperata aor*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
198	Aar	*Sperata aor*	0.22	0.176	176	Exceeded	10.00	Not exceeded	nil
199	Baan	*Ophisternon bengalense*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil
200	Baan	*Ophisternon bengalense*	0.21	0.168	168	Exceeded	5.00	Not exceeded	nil
201	American Rui	*Cyprinus carpio*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil

PTWI Exceedance in Samples from Select Waterbodies Across West Bengal at Higher Consumption Levels									
Sl. no.	**Species local name**	**Species scientific name**	**Hg (mg/ kg)**	**MeHg (mg/ kg)**	**MeHg (µg/ kg)**	**Child of 25 kg. Intake 250 gm Percentage of PTWI exceedance**		**Person of 60 kg. Intake 500 gm Percentage of PTWI exceedance**	
202	American Rui	*Cyprinus carpio*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
203	Bacha	*Eutropichthys vacha*	<0.21	0	0	Not exceeded	nil	Not exceeded	nil
204	Bacha	*Eutropichthys vacha*	0.20	0.16	160	Not exceeded	nil	Not exceeded	nil

Table VII. Species averages of Hg and MeHg concentration and their percentage exceedance from PFA standards

Species Averages and a Comparison with PFA Standard									
Sl. No.	**No. of samples**	**Species /Kind**	**Hg (mg/kg)**	**MeHg (mg/kg)**	**Hg exceeded as per PFA**	**Percentage exceedance**	**MeHg exceeded as per PFA**	**Percentage exceedance**	**Feeding habits**
1	4	*Anabas testudineus*	0.170	0.136	Not exceeded	nil	Not exceeded	nil	Feeds on macrophytic vegetation, shrimps and fish fry.
2	2	*Apolectus niger*	0.410	0.328	Not exceeded	nil	Exceeded	31.20	Feeds on zooplankton.
3	2	*Arius sp.*	0.590	0.472	Exceeded	18.00	Exceeded	88.80	Fish of this genus tend to range from omnivores to carnivores.
4	18	*Catla catla*	0.246	0.197	Not exceeded	nil	Not exceeded	nil	Feeds on phytoplankton, detritus and aquatic and terrestrial insects.
5	9	*Channa punctatus*	0.209	0.167	Not exceeded	nil	Not exceeded	nil	Feeds on worms, insects and small fish.
6	5	*Channa stiatus*	0.636	0.509	Exceeded	27.20	Exceeded	103.52	Pronouncedly predatory. Feeds on fish, frogs, snakes, insects, earthworms, tadpoles.
7	2	*Chanos chanos*	0.435	0.348	Not exceeded	nil	Exceeded	39.20	Omnivorous, Larvae eat zooplankton; juveniles and adults eat cyanobacteria, soft algae, small benthic invertebrates, and even pelagic fish eggs and larvae.
8	10	*Cirrhinus cirrhosus*	0.121	0.097	Not exceeded	nil	Not exceeded	nil	Juveniles are omnivorous, adults are almost entirely herbivorous. Feeds on plankton, but also grazes on algae.
9	2	*Clarias batrachus*	0.480	0.384	Not exceeded	nil	Exceeded	53.60	Feeds on insect larvae, earthworms, shells, shrimps, small fish, aquatic plants and debris.
10	2	*Coilia sp.*	1.140	0.912	Exceeded	128.00	Exceeded	264.80	The fish of this genus feeds mainly on plankton and fry.
11	2	*Ctenopharyngodon idella*	0.395	0.316	Not exceeded	nil	Exceeded	26.40	Feeds on higher aquatic plants and submerged grasses; takes also detritus, insects and other invertebrates.

Species Averages and a Comparison with PFA Standard

Sl. No.	No. of samples	Species /Kind	Hg (mg/kg)	MeHg (mg/kg)	Hg exceeded as per PFA	Percentage exceedance	MeHg exceeded as per PFA	Percentage exceedance	Feeding habits
12	12	*Cyprinus carpio*	0.170	0.136	Not exceeded	nil	Not exceeded	nil	Omnivorous, feeds mainly on aquatic insects, crustaceans, annelids, molluscs, weed and tree seeds, wild rice, aquatic plants and algae; mainly by grubbing in sediments.
13	6	*Devario devario*	0.590	0.472	Exceeded	18.00	Exceeded	88.80	Feeds on worms, small crustaceans and insects.
14	4	*Eleutheronema tetradactylum*	0.905	0.724	Exceeded	81.00	Exceeded	189.60	Pronouncedly Predatory. Feeds on prawns and fish (largely members of Mugilidae, Engraulidae, and Sciaenidae) with occasional polychaetes.
15	2	*Epinephelous sp.*	0.790	0.632	Exceeded	58.00	Exceeded	152.80	Fish of this genus are predatory and often feed on crustaceans and other fish.
16	6	*Eutropichthys vacha*	0.147	0.117	Not exceeded	nil	Not exceeded	nil	Carnivorous. Feed on small fish and insects.
17	4	*Harpadon nehereus*	0.795	0.636	Exceeded	59.00	Exceeded	154.40	An aggressive predator.
18	6	*Heteropneustes fossilis*	0.138	0.111	Not exceeded	nil	Not exceeded	nil	Omnivorous.
19	6	*Hypophthalmichthys molitrix*	0.130	0.104	Not exceeded	nil	Not exceeded	nil	Feeds on phytoplankton and zooplankton.
20	6	*Labeo bata*	0.040	0.032	Not exceeded	nil	Not exceeded	nil	Feeds mainly on plants and detritus.
21	16	*Labeo rohita*	0.325	0.260	Not exceeded	nil	Exceeded	4.00	Feeds on plants.
22	10	*Lates calcarifer*	0.469	0.375	Not exceeded	nil	Exceeded	50.08	Predatory. Feeds on fish and crustaceans. Juveniles also feed on insects.
23	4	*Liza parsia*	0.613	0.490	Exceeded	22.50	Exceeded	96.00	Feeds on small algae, diatoms, and other organic matter.
24	4	*Macrobrachium rosenbergii*	0.708	0.283	Exceeded	41.50	Exceeded	13.20	Carnivorous with omnivorous tendencies.

Species Averages and a Comparison with PFA Standard

Sl. No.	No. of samples	Species /Kind	Hg (mg/kg)	MeHg (mg/kg)	Hg exceeded as per PFA	Percentage exceedance	MeHg exceeded as per PFA	Percentage exceedance	Feeding habits
25	2	*Mastacembelus armatus*	0.610	0.488	Exceeded	22.00	Exceeded	95.20	Forages at night on benthic insect larvae, worms and some submerged plant material.
26	2	*Mastacembelus sp.*	Negligible	Negligible	Not exceeded	nil	Not exceeded	nil	Fish of this species tend to be feed mainly on benthic larvae and worms.
27	2	*Mystus bleekeri*	Negligible	Negligible	Not exceeded	nil	Not exceeded	nil	Omnivorous with carnivorous preferences.
28	2	*Mystus sp.*	0.270	0.216	Not exceeded	nil	Not exceeded	nil	Omnivorous with carnivorous preferences.
29	10	*Mystus gulio*	0.367	0.294	Not exceeded	nil	Exceeded	17.44	Omnivorous with carnivorous preferences.
30	2	*Nibea soldado*	0.730	0.584	Exceeded	46.00	Exceeded	133.60	Carnivorous. Feeds on small fishes and invertebrates.
31	4	*Notopterus notopterus*	0.570	0.456	Exceeded	14.00	Exceeded	82.40	Mainly carnivorous. Feeds on insects, fish, crustaceans and some young roots of aquatic plants.
32	2	*Ompok pabda*	0.200	0.160	Not exceeded	nil	Not exceeded	nil	Insects, larvae, fry and parts of aquatic plants.
33	4	*Ophisternon bengalense*	0.103	0.082	Not exceeded	nil	Not exceeded	nil	Insect larvae, worms and submerged plant material.
34	6	*Oreochromis nilotica*	0.282	0.225	Not exceeded	nil	Not exceeded	nil	Feeds mainly on phytoplankton or benthic algae.
35	6	*Otolithoides sp.*	0.577	0.461	Exceeded	15.33	Exceeded	84.53	Fish of this genus tend to be decisively carnivorous.
36	2	*Pampus chinesis*	2.055	1.644	Exceeded	311.00	Exceeded	557.60	Feeds on ctenophores, salps, medusae, and other zooplankton groups but will also prey on small benthic animals.
37	4	*Pangasius pangasius*	0.378	0.302	Not exceeded	nil	Exceeded	20.80	Feeds on snails, other molluscs and plants.
38	4	*Panna microdon*	0.938	0.750	Exceeded	87.50	Exceeded	200.00	Not certain.

Species Averages and a Comparison with PFA Standard

Sl. No.	No. of samples	Species /Kind	Hg (mg/kg)	MeHg (mg/kg)	Hg exceeded as per PFA	Percentage exceedance	MeHg exceeded as per PFA	Percentage exceedance	Feeding habits
39	2	*Pellona sp.*	Negligible	Negligible	Not exceeded	nil	Not exceeded	nil	Fishes of this genus are usually herbivorous, but may occasionally feed on insects and small crustaceans.
40	12	*Penaeus monodon*	0.473	0.189	Not exceeded	nil	Not exceeded	nil	Predator of slow moving benthic macro-invertebrates. Feeds mainly on small crabs, shrimps, molluscs and also small fish.
41	2	*Penaeus sp.*	1.690	0.676	Exceeded	238.00	Exceeded	170.40	Organisms of this genus are omnivorous with strong carnivorous preferences.
42	2	*Platycephalous sp.*	0.585	0.468	Exceeded	17.00	Exceeded	87.20	Fish of this genus tend to be carnivorous, often feeding on crustaceans and other fish.
43	4	*Polydactylus sexfilis*	0.525	0.420	Exceeded	5.00	Exceeded	68.00	Predatory. Feeds mainly on crustaceans (shrimps and crabs), polychaete worms, other benthic invertebrates.
44	2	*Portunus pelagicus*	0.490	0.392	Not exceeded	nil	Exceeded	56.80	Carnivorous. Feeds on benthic invertebrates and sometimes fish.
45	2	*Puntius sarana*	0.540	0.432	Exceeded	8.00	Exceeded	72.80	Feeds on aquatic insects, fish, algae and shrimps.
46	2	*Raconda russiliana*	0.770	0.616	Exceeded	54.00	Exceeded	146.40	Feeds mainly on prawns (especially Acetes), but also on copepods.
47	2	*Rhinomugil corsula*	0.230	0.184	Not exceeded	nil	Not exceeded	nil	Illiophagous and omnivorous, consumes detritus and organic mud consisting of diatoms, blue green algae, desmids, macrovegetation, small crustaceans, rotifers and larvae of oligochetes, nematodes and dipterans.
48	4	*Setipinna phasa*	0.565	0.452	Exceeded	13.00	Exceeded	80.80	Adults feed mainly on mysids and small prawns (reduced feeding during breeding), juveniles mainly on copepods.

Species Averages and a Comparison with PFA Standard

Sl. No.	No. of samples	Species /Kind	Hg (mg/kg)	MeHg (mg/kg)	Hg exceeded as per PFA	Percentage exceedance	MeHg exceeded as per PFA	Percentage exceedance	Feeding habits
49	4	*Sillaginopsis panijus*	0.353	0.282	Not exceeded	nil	Exceeded	12.80	Feeds on algae, plants, detritus, fish and crustaceans.
50	4	*Sillago sihama*	0.358	0.286	Not exceeded	nil	Exceeded	14.40	Feed mainly on polychaete worms, small prawns, shrimps and amphipods.
51	2	*Silonia silondia*	0.265	0.212	Not exceeded	nil	Not exceeded	nil	Carnivorous.
52	14	*Sperata aor*	0.396	0.317	Not exceeded	nil	Exceeded	26.63	Predatory, adults feed on small fish and worms.
53	4	*Tenualosa ilisha*	0.665	0.532	Exceeded	33.00	Exceeded	112.80	Feeds on plankton, mainly by filtering, but apparently also by grubbing on muddy bottoms.
54	2	*Trichurus lepturus*	0.215	0.172	Not exceeded	nil	Not exceeded	nil	Juveniles feed mostly on euphausiids, small pelagic planktonic crustaceans and small fish; adults feed mainly on fish and occasionally on squids and crustaceans.
55	2	*Trichurus sp.*	2.355	1.884	Exceeded	371.00	Exceeded	653.60	Fish of this genus tend to be predatory
56	2	*Wallagonia attu*	0.230	0.184	Not exceeded	nil	Not exceeded	nil	Predatory. Juveniles feed mainly on insects; adults feed on smaller fish, crustaceans, and molluscs.

Table VII A. Species Averages and PTWI exceedance in four intake situations

Species Averages and PTWI Exceedance in Four Intake Situations									
Sl. no.	**No. of samples**	**Species /kind**	**Hg (mg/kg)**	**MeHg (mg/kg)**	**MeHg (µg/kg)**	**Child of 25 kg. Fish intake 200 gm per week. percentage of PTWI exceedance**	**Child of 25 kg. Fish intake 250 gm per week. percentage of PTWI exceedance**	**Person of 50 kg. Fish intake 300 gm per week. percentage of PTWI exceedance**	**Person of 60 kg. Fish intake 500 gm per week. percentage of PTWI exceedance**
1	4	*Anabas testudineus*	0.17	0.136	136	Not exceeded	Not exceeded	Not exceeded	Not exceeded
2	2	*Apolectus niger*	0.41	0.328	328	64.00	105.00	23.00	70.83
3	2	*Arius sp.*	0.59	0.472	472	136.00	195.00	77.00	145.83
4	18	*Catla catla*	0.246	0.197	197	Not exceeded	23.13	Not exceeded	2.60
5	9	*Channa punctatus*	0.209	0.167	167	Not exceeded	4.38	Not exceeded	Not exceeded
6	5	*Channa stiatus*	0.636	0.509	509	154.50	218.13	90.87	165.10
7	2	*Chanos chanos*	0.435	0.348	348	74.00	117.50	30.50	81.25
8	10	*Cirrhinus cirrhosus*	0.121	0.097	97	Not exceeded	Not exceeded	Not exceeded	Not exceeded
9	2	*Clarias batrachus*	0.48	0.384	384	92.00	140.00	44.00	100.00
10	2	*Coilia sp.*	1.14	0.912	912	356.00	470.00	242.00	375.00
11	2	*Ctenopharyngodon idella*	0.395	0.316	316	58.00	97.50	18.50	64.58
12	12	*Cyprinus carpio*	0.17	0.136	136	Not exceeded	Not exceeded	Not exceeded	Not exceeded
13	6	*Devario devario*	0.59	0.472	472	136.00	195.00	77.00	145.83
14	4	*Eleutheronema tetradactylum*	0.905	0.724	724	262.00	352.50	171.50	277.08

Species Averages and PTWI Exceedance in Four Intake Situations

Sl. no.	No. of samples	Species /kind	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Fish intake 200 gm per week. percentage of PTWI exceedance	Child of 25 kg. Fish intake 250 gm per week. percentage of PTWI exceedance	Person of 50 kg. Fish intake 300 gm per week. percentage of PTWI exceedance	Person of 60 kg. Fish intake 500 gm per week. percentage of PTWI exceedance
15	2	*Epinephelous sp.*	0.79	0.632	632	216.00	295.00	137.00	229.17
16	6	*Eutropichthys vacha*	0.147	0.117	117	Not exceeded	Not exceeded	Not exceeded	Not exceeded
17	4	*Harpadon nehereus*	0.795	0.636	636	218.00	297.50	138.50	231.25
18	6	*Heteropneustes fossilis*	0.138	0.111	111	Not exceeded	Not exceeded	Not exceeded	Not exceeded
19	6	*Hypophthalmichthys molitrix*	0.13	0.104	104	Not exceeded	Not exceeded	Not exceeded	Not exceeded
20	6	*Labeo bata*	0.04	0.032	32	Not exceeded	Not exceeded	Not exceeded	Not exceeded
21	16	*Labeo rohita*	0.325	0.26	260	30.00	62.50	Not exceeded	35.42
22	10	*Lates calcarifer*	0.469	0.375	375	87.50	134.38	40.62	95.31
23	4	*Liza parsia*	0.613	0.49	490	145.00	206.25	83.75	155.21
24	4	*Macrobrachium rosenbergii*	0.708	0.283	283	41.50	76.88	6.12	47.40
25	2	*Mastacembelus armatus*	0.61	0.488	488	144.00	205.00	83.00	154.17
26	2	*Mastacembelus sp.*	Negligible	0	0	Not exceeded	Not exceeded	Not exceeded	Not exceeded
27	2	*Mystus bleekeri*	Negligible	0	0	Not exceeded	Not exceeded	Not exceeded	Not exceeded
28	2	*Mystus sp.*	0.27	0.216	216	8.00	35.00	Not exceeded	12.50
29	10	*Mystus gulio*	0.367	0.294	294	47.00	83.75	10.25	53.13
30	2	*Nibea soldado*	0.73	0.584	584	192.00	265.00	119.00	204.17
31	4	*Notopterus notopterus*	0.57	0.456	456	128.00	185.00	71.00	137.50
32	2	*Ompok pabda*	0.2	0.16	160	Not exceeded	Not exceeded	Not exceeded	Not exceeded

Species Averages and PTWI Exceedance in Four Intake Situations

Sl. no.	No. of samples	Species /kind	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Fish intake 200 gm per week. percentage of PTWI exceedance	Child of 25 kg. Fish intake 250 gm per week. percentage of PTWI exceedance	Person of 50 kg. Fish intake 300 gm per week. percentage of PTWI exceedance	Person of 60 kg. Fish intake 500 gm per week. percentage of PTWI exceedance
33	4	*Ophisternon bengalense*	0.103	0.082	82	Not exceeded	Not exceeded	Not exceeded	Not exceeded
34	6	*Oreochromis nilotica*	0.282	0.225	225	12.50	40.63	Not exceeded	17.19
35	6	*Otolithoides sp.*	0.577	0.461	461	130.50	188.13	72.87	140.10
36	2	*Pampus chinesis*	2.055	1.644	1644	722.00	927.50	516.49	756.25
37	4	*Pangasius pangasius*	0.378	0.302	302	51.00	88.75	13.25	57.29
38	4	*Panna microdon*	0.938	0.75	750	275.00	368.75	181.25	290.63
39	2	*Pellona sp.*	Negligible	0	0	Not exceeded	Not exceeded	Not exceeded	Not exceeded
40	12	*Penaeus monodon*	0.473	0.189	189	Not exceeded	18.13	Not exceeded	Not exceeded
41	2	*Penaeus sp.*	1.69	0.676	676	238.00	322.50	153.50	252.08
42	2	*Platycephalous sp.*	0.585	0.468	468	134.00	192.50	75.50	143.75
43	4	*Polydactylus sexfilis*	0.525	0.42	420	110.00	162.50	57.50	118.75
44	2	*Portunus pelagicus*	0.49	0.392	392	96.00	145.00	47.00	104.17
45	2	*Puntius sarana*	0.54	0.432	432	116.00	170.00	62.00	125.00
46	2	*Raconda russiliana*	0.77	0.616	616	208.00	285.00	131.00	220.83
47	2	*Rhinomugil corsula*	0.23	0.184	184	Not exceeded	15.00	Not exceeded	Not exceeded
48	4	*Setipinna phasa*	0.565	0.452	452	126.00	182.50	69.50	135.42
49	4	*Sillaginopsis panijus*	0.353	0.282	282	41.00	76.25	5.75	46.88
50	4	*Sillago sihama*	0.358	0.286	286	43.00	78.75	7.25	48.96
51	2	*Silonia silondia*	0.265	0.212	212	6.00	32.50	Not exceeded	10.42
52	14	*Sperata aor*	0.396	0.317	317	58.50	98.13	18.87	65.10

Species Averages and PTWI Exceedance in Four Intake Situations

Sl. no.	No. of samples	Species /kind	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg. Fish intake 200 gm per week. percentage of PTWI exceedance	Child of 25 kg. Fish intake 250 gm per week. percentage of PTWI exceedance	Person of 50 kg. Fish intake 300 gm per week. percentage of PTWI exceedance	Person of 60 kg. Fish intake 500 gm per week. percentage of PTWI exceedance
53	4	*Tenualosa ilisha*	0.665	0.532	532	166.00	232.50	99.50	177.08
54	2	*Trichurus lepturus*	0.215	0.172	172	Not exceeded	7.50	Not exceeded	Not exceeded
55	2	*Trichurus sp.*	2.355	1.884	1884	842.00	1077.50	606.49	881.25
56	2	*Wallagonia attu*	0.23	0.184	184	Not exceeded	15.00	Not exceeded	Not exceeded

Table VIII. Species averages (minus North Bengal) and their percentage exceedance over PFA standards

Species Averages (minus North Bengal) and their Percentage Exceedance over PFA Standards										
Sl. No.	**No. of samples**	**Species /Kind**	**Hg (mg/kg)**	**MeHg (mg/kg)**	**MeHg (µg/kg)**	**Hg exceedance as per PFA stipulation**	**Percentage of exceedance**	**MeHg exceedance as per PFA stipulation**	**Percentage of exceedance**	**Feeding habits**
1	2	*Anabas testudineus*	0.340	0.272	272	Not exceeded	nil	Exceeded	8.80	Feeds on macrophytic vegetation, shrimps and small fish.
2	2	*Apolectus niger*	0.410	0.328	328	Not exceeded	nil	Exceeded	31.20	Feeds mainly on zooplankton.
3	2	*Arius sp.*	0.590	0.472	472	Exceeded	18	Exceeded	88.80	Fish of this genus tend to range from omnivores to carnivores.
4	18	*Catla catla*	0.246	0.197	197	Not exceeded	nil	Not exceeded	nil	Feeds on phytoplankton, detritus and aquatic and terrestrial insects.
5	4	*Channa striatus*	0.795	0.636	636	Exceeded	59	Exceeded	154.40	Pronouncedly predatory. Feeds on fish, frogs, snakes, insects, earthworms, tadpoles.
6	2	*Chanos chanos*	0.435	0.348	348	Not exceeded	nil	Exceeded	39.20	Omnivorous. Larvae eat zooplankton; juveniles and adults eat cyanobacteria, soft algae, small benthic invertebrates, and even pelagic fish eggs and larvae.
7	6	*Cirrhinus cirrhosus*	0.165	0.132	132	Not exceeded	nil	Not exceeded	nil	Juveniles are omnivorous, adults are almost entirely herbivorous. Feeds on plankton, but also grazes on algae.
8	2	*Clarias batrachus*	0.480	0.384	384	Not exceeded	nil	Exceeded	53.60	Feeds on insect larvae, earthworms, shells, shrimps, small fish, aquatic plants and debris.
9	2	*Coilia sp.*	1.140	0.912	912	Exceeded	128	Exceeded	264.80	The fish of this genus feeds mainly on plankton and fry.

Species Averages (minus North Bengal) and their Percentage Exceedance over PFA Standards										
Sl. No.	No. of samples	Species /Kind	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Hg exceedance as per PFA stipulation	Percentage of exceedance	MeHg exceedance as per PFA stipulation	Percentage of exceedance	Feeding habits
10	2	*Ctenopharyngodon idella*	0.395	0.316	316	Not exceeded	nil	Exceeded	26.40	Feeds on higher aquatic plants and submerged grasses; takes also detritus, insects and other invertebrates.
11	8	*Cyprinus carpio*	0.255	0.204	204	Not exceeded	nil	Not exceeded	nil	Omnivorous, feeds mainly on aquatic insects, crustaceans, annelids, mollusks, weed and tree seeds, wild rice, aquatic plants and algae; mainly by grubbing in sediments
12	6	*Devario devario*	0.505	0.404	404	Exceeded	0.98	Exceeded	61.58	Feeds on worms, small crustaceans and insects.
13	4	*Eleutheronema tetradactylum*	0.905	0.724	724	Exceeded	81	Exceeded	189.60	Pronouncedly Predatory. Feeds on prawns and fish (largely members of Mugilidae, Engraulidae, and Sciaenidae) with occasional polychaetes.
14	2	*Epinephelous sp.*	0.790	0.632	632	Exceeded	58	Exceeded	152.80	Fish of this genus are predatory and often feed on crustaceans and other fish.
15	4	*Eutropichthys vacha*	0.220	0.176	176	Not exceeded	nil	Not exceeded	nil	Carnivorous. Feed on small fish and insects.
16	4	*Harpadon nehereus*	0.795	0.636	636	Exceeded	59	Exceeded	154.40	An aggressive predator.
17	2	*Heteropneustes fossilis*	0.415	0.332	332	Not exceeded	nil	Exceeded	32.80	Omnivorous.
18	4	*Hypophthalmichthys molitrix*	0.130	0.104	104	Not exceeded	nil	Not exceeded	nil	Feeds on phytoplankton and zooplankton.
19	4	*Labeo bata*	0.060	0.048	48	Not exceeded	nil	Not exceeded	nil	Feeds mainly on plants and detritus.
20	16	*Labeo rohita*	0.325	0.260	260	Not exceeded	nil	Exceeded	4	Feeds on plants.

Species Averages (minus North Bengal) and their Percentage Exceedance over PFA Standards

Sl. No.	No. of samples	Species /Kind	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Hg exceedance as per PFA stipulation	Percentage of exceedance	MeHg exceedance as per PFA stipulation	Percentage of exceedance	Feeding habits
21	10	*Lates calcarifer*	0.469	0.375	375	Not exceeded	nil	Exceeded	50.08	Predatory. Feeds on fish and crustaceans. Juveniles also feed on insects.
22	4	*Liza parsia*	0.613	0.490	490	Exceeded	22.50	Exceeded	96	Feeds on small algae, diatoms, and other organic matter.
23	4	*Macrobrachium rosenbergii*	0.708	0.283	283	Exceeded	41.50	Exceeded	13.20	Carnivorous with omnivorous tendencies.
24	2	*Mastacembelus armatus*	0.610	0.488	488	Exceeded	22	Exceeded	95.20	Forages at night on benthic insect larvae, worms and some submerged plant material.
25	2	*Mystus sp.*	0.270	0.216	216	Not exceeded	nil	Not exceeded	nil	Omnivorous with carnivorous preferences.
26	10	*Mystus gulio*	0.367	0.294	294	Not exceeded	nil	Exceeded	17.44	Omnivorous with carnivorous preferences.
27	2	*Nibea soldado*	0.730	0.584	584	Exceeded	46	Exceeded	133.60	Carnivorous. Feeds on small fishes and invertebrates.
28	4	*Notopterus notopterus*	0.570	0.456	456	Exceeded	14	Exceeded	82.40	Feeds on insects, fish, crustaceans and some young roots of aquatic plants.
29	2	*Ompok pabda*	0.200	0.160	160	Not exceeded	nil	Not exceeded	nil	Insects, larvae, fry and parts of aquatic plants.
30	2	*Ophisternon bengalense*	0.205	0.164	164	Not exceeded	nil	Not exceeded	nil	Insect Larvae, worms and submerged plant material.
31	4	*Oreochromis nilotica*	0.282	0.225	225	Not exceeded	nil	Not exceeded	nil	Feeds mainly on phytoplankton or benthic algae.
32	6	*Otolithoides sp.*	0.577	0.461	461	Exceeded	15.33	Exceeded	84.53	Fish of this genus tend to be carnivorous.
33	2	*Pampus chinesis*	2.055	1.644	1644	Exceeded	311	Exceeded	557.60	Feeds on ctenophores, salps, medusae, and other zooplankton groups but will also prey on small benthic animals.
34	4	*Pangasius pangasius*	0.378	0.302	302	Not exceeded	nil	Exceeded	20.80	Feeds on snails, other molluscs and plants.

Species Averages (minus North Bengal) and their Percentage Exceedance over PFA Standards

Sl. No.	No. of samples	Species /Kind	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Hg exceedance as per PFA stipulation	Percentage of exceedance	MeHg exceedance as per PFA stipulation	Percentage of exceedance	Feeding habits
35	4	*Panna microdon*	0.938	0.750	750	Exceeded	87.50	Exceeded	200	Carnivorous.
36	2	*Pellona sp.*	0.000	0.000	0	Not exceeded	nil	Not exceeded	nil	Fish of this genus are usually herbivorous, but may occasionally feed on insects and small crustaceans.
37	12	*Penaeus monodon*	0.473	0.189	189	Not exceeded	nil	Not exceeded	nil	Carnivorous.
38	2	*Penaeus sp.*	1.690	0.676	676	Exceeded	238	Exceeded	170.40	Organisms of this genus are omnivorous with strong carnivorous preferences.
39	2	*Platycephalous sp.*	0.585	0.468	468	Exceeded	17	Exceeded	87.20	Fish of this genus tend to be carnivorous, often feeding on crustaceans and other fish.
40	4	*Polydactylus sexfilis*	0.525	0.420	420	Exceeded	5	Exceeded	68	Predatory. Feeds mainly on crustaceans (shrimps and crabs), polychaete worms, other benthic invertebrates.
41	2	*Portunus pelagicus*	0.490	0.392	392	Not exceeded	nil	Exceeded	56.80	Carnivorous. Feeds on benthic invertebrates and sometimes fish.
42	2	*Puntius sarana*	0.540	0.432	432	Exceeded	8	Exceeded	72.80	Feeds on aquatic insects, fish, algae and shrimps.
43	2	*Raconda russiliana*	0.770	0.616	616	Exceeded	54	Exceeded	146.40	Feeds mainly on prawns (especially Acetes), but also on copepods.
44	2	*Rhinomugil corsula*	0.230	0.184	184	Not exceeded	nil	Not exceeded	nil	Illiophagous and omnivorous, consume detritus and organic mud consisting of diatoms, blue green algae, desmids, macrovegetation, small crustaceans, rotifers and larvae of oligochetes, nematodes and dipterans.
45	4	*Setipinna phasa*	0.565	0.452	452	Exceeded	13	Exceeded	80.80	Carnivorous. Adults feed mainly on mysids and small prawns, juveniles mainly on copepods.
46	2	*Sillaginopsis panijus*	0.353	0.282	282	Not exceeded	nil	Exceeded	12.80	Feeds on algae, plants, detritus, fish and crustaceans.

Species Averages (minus North Bengal) and their Percentage Exceedance over PFA Standards

Sl. No.	No. of samples	Species /Kind	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Hg exceedance as per PFA stipulation	Percentage of exceedance	MeHg exceedance as per PFA stipulation	Percentage of exceedance	Feeding habits
47	4	*Sillago sihama*	0.358	0.286	286	Not exceeded	nil	Exceeded	14.40	Feed mainly on polychaete worms, small prawns, shrimps and amphipods.
48	2	*Silonia silondia*	0.265	0.212	212	Not exceeded	nil	Not exceeded	nil	Carnivorous.
49	14	*Sperata aor*	0.396	0.317	317	Not exceeded	nil	Exceeded	26.62	Predatory, adults feed on small fishes and worms.
50	4	*Tenualosa ilisha*	0.665	0.532	532	Exceeded	33	Exceeded	112.80	Feeds on plankton, mainly by filtering, but apparently also by grubbing on muddy bottoms.
51	2	*Trichurus lepturus*	0.215	0.172	172	Not exceeded	nil	Not exceeded	nil	Juveniles feed mostly on euphausiids, small pelagic planktonic crustaceans and small fish; adults feed mainly on fish and occasionally on squids and crustaceans.
52	2	*Trichurus sp.*	2.355	1.884	1884	Exceeded	371	Exceeded	653.60	Fish of this genus tend to be predatory
53	2	*Wallagonia attu*	0.230	0.184	184	Not exceeded	nil	Not exceeded	nil	Juveniles feed mainly on insects; adults feed on smaller fish, crustaceans, and molluscs.

Table VIII A. Species Averages (minus samples from North Bengal) and PTWI exceedance in intake four situations

Species Averages (minus North Bengal) and PTWI Exceedance in Four Intake Situations									
Sl. no.	No. of samples	Species /Kind	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg Fish intake 200 gm per week Percentage of PTWI exceedance	Child of 25 kg Fish intake 250 gm per week. Percentage of PTWI exceedance	Person of 50 kg Fish intake 300 gm per week. Percentage of PTWI exceedance	Person of 60 kg Fish intake 500 gm per week. Percentage of PTWI exceedance
1	2	*Anabas testudineus*	0.34	0.27	272.00	36.00	70.00	2.00	41.67
2	2	*Apolectus niger*	0.41	0.33	328.00	64.00	105.00	23.00	70.83
3	2	*Arius sp.*	0.59	0.47	472.00	136.00	195.00	77.00	145.83
4	18	*Catla catla*	0.25	0.20	197.00	Not exceeded	23.13	Not exceeded	2.60
5	4	*Channa striatus*	0.80	0.64	636.00	218.00	297.50	138.50	231.25
6	2	*Chanos chanos*	0.44	0.35	348.00	74.00	117.50	30.50	81.25
7	6	*Cirrhinus cirrhosus*	0.17	0.13	132.00	Not exceeded	Not exceeded	Not exceeded	Not exceeded
8	2	*Clarias batrachus*	0.48	0.38	384.00	92.00	140.00	44.00	100.00
9	2	*Coilia sp.*	1.14	0.91	912.00	356.00	470.00	242.00	375.00
10	2	*Ctenopharyngodon idella*	0.40	0.32	316.00	58.00	97.50	18.50	64.58
11	8	*Cyprinus carpio*	0.26	0.20	204.00	2.00	27.50	Not exceeded	6.25
12	6	*Devario devario*	0.51	0.40	404.00	102.00	152.50	51.50	110.42
13	4	*Eleutheronema tetradactylum*	0.91	0.72	724.00	262.00	352.50	171.50	277.08

Species Averages (minus North Bengal) and PTWI Exceedance in Four Intake Situations

Sl. no.	No. of samples	Species /Kind	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg Fish intake 200 gm per week Percentage of PTWI exceedance	Child of 25 kg Fish intake 250 gm per week. Percentage of PTWI exceedance	Person of 50 kg Fish intake 300 gm per week. Percentage of PTWI exceedance	Person of 60 kg Fish intake 500 gm per week. Percentage of PTWI exceedance
14	2	*Epinephelous sp.*	0.79	0.63	632.00	216.00	295.00	137.00	229.17
15	4	*Eutropichthys vacha*	0.22	0.18	176.00	Not exceeded	10.00	Not exceeded	Not exceeded
16	4	*Harpadon nehereus*	0.80	0.64	636.00	218.00	297.50	138.50	231.25
17	2	*Heteropneustes fossilis*	0.42	0.33	332.00	66.00	107.50	24.50	72.92
18	4	*Hypophthalmichthys molitrix*	0.13	0.10	104.00	Not exceeded	Not exceeded	Not exceeded	Not exceeded
19	4	*Labeo bata*	0.06	0.05	48.00	Not exceeded	Not exceeded	Not exceeded	Not exceeded
20	16	*Labeo rohita*	0.33	0.26	260.00	30.00	62.50	Not exceeded	35.42
21	10	*Lates calcarifer*	0.47	0.38	375.00	87.50	134.38	40.62	95.31
22	4	*Liza parsia*	0.61	0.49	490.00	145.00	206.25	83.75	155.21
23	4	*Macrobrachium rosenbergii*	0.71	0.28	283.00	41.50	76.88	6.12	47.40
24	2	*Mastacembelus armatus*	0.61	0.49	488.00	144.00	205.00	83.00	154.17
25	2	*Mystus sp.*	0.27	0.22	216.00	8.00	35.00	Not exceeded	12.50
26	10	*Mystus gulio*	0.37	0.29	294.00	47.00	83.75	10.25	53.13
27	2	*Nibea soldado*	0.73	0.58	584.00	192.00	265.00	119.00	204.17

Species Averages (minus North Bengal) and PTWI Exceedance in Four Intake Situations

Sl. no.	No. of samples	Species /Kind	Hg (mg/kg)	MeHg (mg/kg)	MeHg (μg/kg)	Child of 25 kg Fish intake 200 gm per week Percentage of PTWI exceedance	Child of 25 kg Fish intake 250 gm per week. Percentage of PTWI exceedance	Person of 50 kg Fish intake 300 gm per week. Percentage of PTWI exceedance	Person of 60 kg Fish intake 500 gm per week. Percentage of PTWI exceedance
28	4	*Notopterus notopterus*	0.57	0.46	456.00	128.00	185.00	71.00	137.50
29	2	*Ompok pabda*	0.20	0.16	160.00	Not exceeded	Not exceeded	Not exceeded	Not exceeded
30	2	*Ophisternon bengalense*	0.21	0.16	164.00	Not exceeded	2.50	Not exceeded	Not exceeded
31	4	*Oreochromis nilotica*	0.28	0.23	225.00	12.50	40.63	Not exceeded	17.19
32	6	*Otolithoides sp.*	0.58	0.46	461.00	130.50	188.13	72.87	140.10
33	2	*Pampus chinesis*	2.06	1.64	1644.00	722.00	927.50	516.49	756.25
34	4	*Pangasius pangasius*	0.38	0.30	302.00	51.00	88.75	13.25	57.29
35	4	*Panna microdon*	0.94	0.75	750.00	275.00	368.75	181.25	290.63
36	2	*Pellona sp.*	0.00	0.00	0.00	Not exceeded	Not exceeded	Not exceeded	Not exceeded
37	12	*Penaeus monodon*	0.47	0.19	189.00	Not exceeded	18.13	Not exceeded	Not exceeded
38	2	*Penaeus sp.*	1.69	0.68	676.00	238.00	322.50	153.50	252.08
39	2	*Platycephalous sp.*	0.59	0.47	468.00	134.00	192.50	75.50	143.75
40	4	*Polydactylus sexfilis*	0.53	0.42	420.00	110.00	162.50	57.50	118.75
41	2	*Portunus pelagicus*	0.49	0.39	392.00	96.00	145.00	47.00	104.17

Species Averages (minus North Bengal) and PTWI Exceedance in Four Intake Situations

Sl. no.	No. of samples	Species /Kind	Hg (mg/kg)	MeHg (mg/kg)	MeHg (µg/kg)	Child of 25 kg Fish intake 200 gm per week Percentage of PTWI exceedance	Child of 25 kg Fish intake 250 gm per week. Percentage of PTWI exceedance	Person of 50 kg Fish intake 300 gm per week. Percentage of PTWI exceedance	Person of 60 kg Fish intake 500 gm per week. Percentage of PTWI exceedance
42	2	*Puntius sarana*	0.54	0.43	432.00	116.00	170.00	62.00	125.00
43	2	*Raconda russiliana*	0.77	0.62	616.00	208.00	285.00	131.00	220.83
44	2	*Rhinomugil corsula*	0.23	0.18	184.00	Not exceeded	15.00	Not exceeded	Not exceeded
45	4	*Setipinna phasa*	0.57	0.45	452.00	126.00	182.50	69.50	135.42
46	2	*Sillaginopsis panijus*	0.35	0.28	282.00	41.00	76.25	5.75	46.88
47	4	*Sillago sihama*	0.36	0.29	286.00	43.00	78.75	7.25	48.96
48	2	*Silonia silondia*	0.27	0.21	212.00	6.00	32.50	Not exceeded	10.42
49	14	*Sperata aor*	0.40	0.32	317.00	58.50	98.13	18.87	65.10
50	4	*Tenualosa ilisha*	0.67	0.53	532.00	166.00	232.50	99.50	177.08
51	2	*Trichurus lepturus*	0.22	0.17	172.00	Not exceeded	7.50	Not exceeded	Not exceeded
52	2	*Trichurus sp.*	2.36	1.88	1884.00	842.00	1077.50	606.49	881.25
53	2	*Wallagonia attu*	0.23	0.18	184.00	Not exceeded	15.00	Not exceeded	Not exceeded

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ence_type)=entry_id,audience_id,type_id&entry_id(entry_audience_type)=86&audience_id(entry_audience_type)=6&type_id(entry_audience_type)=2. See also http://scifun.chem.wisc.edu/chemweek/mercury/mercury.htm. Often the proportion of methylmercury to total mercury in shellfish is taken as high as 75%. See http://cat.inist.fr/?aModele=afficheN&cpsidt=2102433. Some studies report higher concentrations for shrimps; see for example, Neff, JM, Bioaccumulation in Marine Organisms, Elsevier, 2002, p. 123-24.

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Appendix 1

Brief Account of Sampling Locations

North Bengal

The region comprises districts of Darjeeling, Jalpaiguri, Coochbihar, Uttar Dinajpur, Dakhsin Dinajpur and Malda. The area is less industrialised, less populated and less polluted compared to South Bengal. A considerable part is hilly terrain (Siwalik Range). Swift flowing rivers from the mountains reach the plains in this region. The foothills, called Terai, are forested. Tea is cultivated in large swathes of land in Darjeeling and Jalpaiguri, both in the hills and the Terai. Tea gardens, in most cases, use good amount of chemical pesticides. Agriculture, particularly in the plains, also uses considerable amount of chemical fertilisers.

Samples were collected from two districts of North Bengal, viz, Darjeeling and Jalpaiguri, on 14 and 15 of April 2008, and delivered to the laboratory on 16 April. The general code of the samples was NB. However, as samples were collected from different sites, each set of samples had a different code-suffix depending on the collection site and a distinct subcode.

One set of samples was collected from the waters at Mahananda Barrage, the confluence of Mahananda River, Balashon River and the Tista Canal. Six varieties were collected from this site. However, instead of 12 samples, 14 samples were collected – 4 samples of Channa punctatus were picked instead of 2 due to an error of judgment. However, all the samples were submitted for testing. This set of samples was coded as NBB.

Another set of samples was collected from a pond at Banijjot, in the plains of Darjeeling district. This set of samples was coded as NBPB. Only 3 suitable varieties or 6 samples were collected from this site. In this set of samples, NBPB 10A and NBPB 10B were both described by the common local name Lyata. However, subsequent re-examination showed that these were actually two different species – NBPB 10A being Channa striatus and NBPB 10B being Channa punctatus. So, in this case we could take only one sample each for the two species from the location. However, all the samples were submitted for testing.

Another set of samples was collected from Ruidasa pond in the plains of Darjeeling district. The significance of this pond is its location adjacent to tea gardens. Once again, on account of not getting suitable samples, only 3 varieties or 6 samples were collected. This set of samples was coded as NBPR.

More pond samples were collected from Kanchanshiri and Dolua pond near Chaulghati, both in Jalpaiguri district. Three varieties or 6 samples from Kanchanshiri, and 2 varieties or 4 samples from Dolua pond near Chaulghati were collected. The code given was NBPK.

Samples were also collected from Korola river. However, due to paucity of variety, only one variety or 2 samples were collected. The code given was NBPC.

A total of 38 samples were submitted from North Bengal for testing mercury in their flesh.

Farakka

Farakka is located in the central West Bengal, in the district of Murshidabad. It is famous for the Farakka Barrage on the river Ganga. The barrage is constructed where the Ganga bifurcates into the Padma flowing into Bangladesh and Bhagirathi flowing towards South Bengal. It connects South Bengal with North Bengal. Murshidabad district is flood prone and agriculture is main occupation. There are a good number of small and cottage industries too. There is no heavy industry except an NTPC thermal power station of 1600 MW capacity.

The NTPC thermal power plant is located very close to the Ganga feeder canal and is about 2.5 km from the nearest point of the Ganga mainstream. Therefore, it was decided to take most of the catch from the feeder canal (which is also a major source of fish coming to Farakka and neighbouring markets) in order to test for possible pollution effects of the thermal power plant. The rest of the catch was taken from the Ganga mainstream. In all 8 varieties, i.e. 16 samples were taken from the feeder canal and 3 varieties, i.e. 6 samples from the Ganga mainstream. The general Farakka code was FK. Samples from the feeder Canal were coded as FKF and those from the Ganga mainstream were coded as FKG. The collection took place on the 3 April 2008 and the delivery was done on the next day, the 4 April 2008.

Durgapur Asansol Region

This is the most important heavy industry region in the state. The western part of the district is dry and has a large number of industries and mines; agriculture dominates in the eastern part. Steel plants and coal mining are the most important features of this region. Apart from DPL thermal power plant of 395 MW there are several captive power generating stations. Many heavy industries are situated near the river Damodor. There is also a barrage on Damodor connecting Bardhaman with Bankura district.

The catch from Damodor River, off Durgapur–Asansol industrial belt in Bardhaman district, resulted in 10 samples, 5 varieties of fish. The samples were collected on 2 May 2008 and the submitted to the laboratory the next day. The samples' code was DGP.

Hugli

Hugli district is adjacent to Kolkata. Eastern part of the district, lying on the western side of the Hooghly river, is under Kolkata Metropolitan Area. A large number of industries are situated in the district, mostly by the side of the river. The eastern part of the district, which has wonderfully rich alluvial deposits as well as excellent irrigation facilities, is famous for its agricultural production. A considerable amount of chemical fertilizers and pesticides are used.

The catch for laboratory analysis included 8 varieties or 16 samples of local, commonly consumed fish. The collections were made 9 December 2007, and the samples were delivered to laboratory on 10 December 2007. This set of samples was coded as HG with a distinct subcode for each sample in the set.

Kolaghat

Kolaghat is in East Midnapore district, adjacent to western border of Howrah district. It is on the bank of Rupnarayan River, which is the border line of Howrah and East Midnapore district. Kolaghat has 1260 MW thermal power plant.

It was initially decided to take fish samples from a pond near WBPDCL power plant as well as Rupnarayan River near Kolaghat. However, repeated visits to Kolaghat failed to yield samples from the Rupnarayan River such as would be considered adequate for testing purposes. Therefore, samples were taken only from the ponds. In all 7 varieties were collected, i.e. 14 samples. The collection was made on 11 April 2008 and the submission to the laboratory took place on the next day. The code for this set of samples was KOG.

Kolkata

Kolkata is one of the most densely populated cities in the world. Once the capital of India, it is one of the earliest industrial hubs in Asia. A large number of heavy, medium and small industries are situated in and around the city. Fish samples were collected from the following points:

Mudiali Nature Park: Adjacent to Hooghly river in the western part of the city, the Mudiali Nature Park has several ponds which act as natural settling and treatment tanks for industrial sewerage coming from Khidirpore industrial zone. A fishworkers' cooperative takes care of the park.

The catch from Mudiali aquaculture ponds included 9 varieties, i.e. 18 samples. Sample collection from Mudiali and their delivery to laboratory took place on 31 March 2008. This set of samples was coded as MUD.

East Kolkata Wetland (EKW): It is situated in the eastern side of the city, where the city sewage flows into Bidyadhari river. The area has a large number of sewage fed ponds. These ponds also act as settling tanks.

The East Kolkata wetlands proved to be a disappointment on two counts. One, the varieties seen on repeated visits were limited to a few commonly eaten fish, and their size was small for lab analysis. Only 3 varieties could be collected, i.e. a total of 6 samples. The samples were collected on 28 February 2008, and submitted for analysis the same day. This set of samples was coded as EKO.

Budge Budge: It is an industrial hub adjacent to southern Kolkata by the side of the Hooghly river. The area has several oil depots of different companies and a thermal power plant of 500 MW are capacity.

Instead of taking fish samples from Hugli/Ganga, directly adjacent to the Kolkata Metropolitan Area, it was seen fit to collect samples from a little downstream – the Budge Budge area – so as to take into account pollution from Kolkata and neighbouring urban-industrial complex. In all 9 common varieties of fish or 18 samples were collected. The samples were collected and delivered to the laboratory on the 4 January 2008. The set of samples was coded as BJ.

Haldia

Haldia is an industrial port town in East Midnapore district. It is situated on the western bank of Hooghly river, where the latter meets the Haldi river. The town has a number of petro-chemical, chemical, oil refinery units.

The sampling from Haldia proceeded somewhat as initially planned. However, more catch tended to come from the Haldi rather than from the area exactly at the confluence of the Hooghly and Haldi. Only 6 varieties were collected, 2 samples per variety. The collection was undertaken on 7 February 2008 and delivered to the laboratory on the 8 Februrary. This set of samples was coded as HD.

Kakdwip

Kakdwip is situated on the eastern bank of the Hooghly estuary and is almost on the Bay of Bengal. The area is in South 24 Parganas district, one of the gateways to the Sundarban. There is no big industry. Agriculture and fishing are the main occupations.

The catch from Kakdwip (estuarine-coastal site) proceeded as planned. Eight varieties of fish, 16 samples, were sampled. The collection at Kakdwip was undertaken on 29 February and samples were delivered to the laboratory on the same day. This set of samples was coded as KAK.

Jharkhali

Jharkhali is located in the Sundarban area right at the border of core forest area, surrounded by tidal rivers, creeks and mangroves. The estuarine site is also close to the sea. The area is an important breeding ground of fish. There is no industry. Agriculture is also weak. People mostly depend on fishing and forest products. In all 8 varieties of fish were collected, a total of 16 samples. The samples were collected on 11 and 12 January 2008, and delivered to the laboratory in the afternoon of 12 January 2008. This set of samples was coded as JHK.

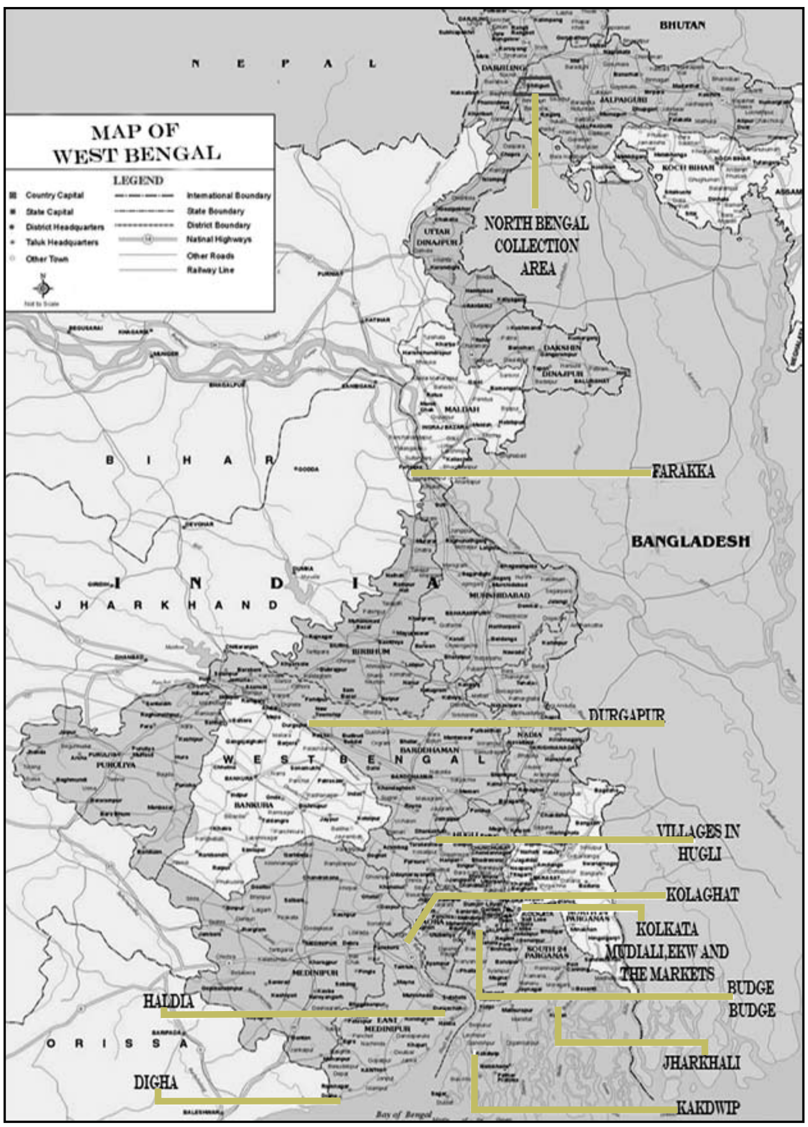
Digha

Digha is the most important sea resort of West Bengal, situated in East Midnapore district, adjacent to Orissa border. It has a fishing harbour.

More varieties were collected from Digha as this was the only purely marine site in our study. In all 10 varieties of sea fish and crustaceans were taken, a total of 20 samples. The collection was made on 11 February 2008 and submitted to the laboratory on 12 Februrary 2008. This set of samples was coded as DIG.

Appendix 2

Collection Locations



Appendix 3

Fish intake survey

The survey was conducted in Kolkata and near by areas to get a general idea of fish consumption among families with different income levels. No similar survey was conducted in rural areas with ponds, rivers or the sea owing to difficulty in ascertaining actual consumption, as a significant portion of fish intake in such areas comes from non-market sources.

However, the necessity of such a survey, conducted in a methodologically rigorous manner, is obvious if one has to get a clear picture of fish intake patterns in West Bengal

If we compare the first three tables with Table 4 there is a slight difference in the presentation of the data. This is because the interviewer in the case of Table 4 asked slightly different questions. However, as this did not appear to undermine the value of the basic data sought, i.e. rates of fish consumed, no effort was made to redo the survey and the data supplied is being presented as it is.

It is evident that the data given below on weekly purchase as well as monthly income are essentially approximate and could not be based on documentary evidence. However, in all the cases the interviewees were personally known to the surveyors, and the surveyors took care to insist upon correct answers. Therefore, the data can be taken to be reliable, at least in an indicative way.

The monthly income per member has been given. It will often be seen that fish intake often is not quite proportional to the income per head, and occasionally people in lower income brackets have given higher intake figures than would be expected and vice versa. In this case, as it may be pointed out, fish intake is as much dependent on dietary preference as on income.

Table A-3-1. Survey in and around Tangra Area, East Kolkata

Sl. no.	Head of the family	No. of family members	How many members have normal intake of fish*	Fish varieties consumed (local names)	Approximate monthly income (in Rs.)	Total weekly purchase (gm)	Per head weekly consumption (gm)	Approximate per head monthly income (Rs.)
1	Sushil Muhuri	4	4	Ruhi, Katla, Bhola, Tangra, Charapona.	8000	1800	450	2000.00
2	Bikash Mondal	9	7	Tilapia, Charapona, Bhola, Maurala, Ruhi, Katla.	10000	3500	500	1111.11
3	Laxmi	4	4	Charapona, Bhola, Tilapia, Rui	3500	1350	337	875.00
4	Sankar	5	4	Maurala, Bata, Lyata, Katla, Rui, Aar	9000	2200	550	1800.00
5	Bapi Das	8	8	Bhola, Baan, Maurala, Tangra, Rui, Katla, charapona	15000	3500	438	1875.00
6	Laltu	4	3	Ruhi, Katla, Bhola, Bata, Tilapia, Aar	10000	1400	467	2500.00
7	Sandip Ghosh	5	4	Bata, Gula, Porn, Ruhi, Ban	6000	1500	375	1200.00
8	Bapi Ghosh	15	11	Chuno, Tangra, Maurala, Kay, Katla, Ruhi, Bhetki	20000	6000	545	1333.33

Table A-3-2. Survey in Mathpukur / Dhapa Area, East Kolkata

Sl. no.	Head of the family	No. of family members	How many members have normal fish intake*	Fish varieties consumed (local names)	Approximate monthly income (Rs.)	Average weekly purchase (gm)	Per head weekly consumption (gm)	Approximate per head monthly income (Rs.)
1	Badal Dolui	4	4	Kata Rui, Katla, Galda, Hilsa, Pomfret etc.	22000	3600	900.00	5500
2	Narayan Haldar	8	7	American rui, Silver Carp, Telapia, Loita, Charapona, Rui, Katla	5500	2750	393	687
3	Sanker Dey	4	3	Rui, Katla, Chingri, Bhola, Koi, Shingi, Magur, Maurala, puthi.	8000	1500	500	2000
4	Pravas Ghoroi	3	3	Hilsa, Pamplet, Chingri, Bhola, Kata Rui, Khara.	6000	1400	467	2000
5	Gopal Khatua	5	5	Puti, Galda, Pakal, Katla, Rui, Bhola, Chingri	10000	2500	500	2000
6	Madhusudan Ghosh	6	6	Katla, Maurala, Pakal, American Rui, SilverCarp	10000	4300	717	1667
7	Khokon Dolui	5	3	Rui, Katla, Hilsa, Bata, Silver, Chingri, Phyasa, Aar	3500	1800	600	700
8	Bishu Sahoo	4	4	Phyasa, Chela, Rui, Mrigel, charapona, Tangra, tilapia.	6500	1200	300	1625
9	Prasanta Mondal	4	4	Rui, Katla, Mrigel, Chara Pona, Bata, Hilsa, Tangra, etc.	12000	2200	550	3000
10	Pradip Singha	3	3	Katla, Rui, Tangra, Pona, Bata, chingri etc.	8000	800	267	2667

Table A-3-3. Survey of families from different parts of Kolkata

Sl. no.	Head of the family	Locality	No. of family members	Number of members with normal fish intake*	Fish varieties consumed (local names)	Approximate Monthly income (in Rs.)	Total weekly purchase (gm)	Per head weekly consumption (gm)	Approximate monthly income per head
1	Utpal Dutta	Ramgarh	5	5	Rui, Tangra, choto chingri	24000	5500	1100	4800
2	Probal Bagchi	Kankur gachi	6	5	Rui, Tangra, Parshe, Pabda, Choto chingri	30000	3750	750	5000
3	Kaushik Chattopadhyay	Garia	4	4	Mainly Rui and Katla	70000	2500	625	17500
4	Biswarup Roy	Dhakuria	7	6	Different kinds with predominance of Rui and Katla	60000	5500	917	8571
5	Nimai Chakraborty	Salt Lake	8	8	Rui and Katla, also chingri, parshe, bele, pabda	35000	2000	250	4375
6	Madhusudan Ghosh	6	6	Katla, Maurala, Pakal, American Rui, SilverCarp	10000	4300	717	1667	
7	Khokon Dolui	5	3	Rui, Katla, Hilsa, Bata, Silver, Chingri, Phyasa, Aar	3500	1800	600	700	
8	Bishu Sahoo	4	4	Phyasa, Chela, Rui, Mrigel, charapona, Tangra, tilapia.	6500	1200	300	1625	
9	Prasanta Mondal	4	4	Rui, Katla, Mrigel, Chara Pona, Bata, Hilsa, Tangra, etc.	12000	2200	550	3000	
10	Pradip Singha	3	3	Katla, Rui, Tangra, Pona, Bata, chingri etc.	8000	800	267	2667	

Table A-3-4. Survey of families from localities near Kolkata

Families	Name of family member interviewed	Locality	Family size	Number of members with normal fish intake	Approximate monthly income (Rs.)	Average total weekly purchase (gm)	Per head weekly consumption (gm)	Per head monthly income (Rs.)
Family 1	Partho Das	Budge Budge	6	5	35,000	4000	800	5833
Family 2	C.R. Bhuinya	Budge Budge	3	3	40,000	2000	667	13333
Family 3	Sanchari Khan	Budge Budge	5	5	18,000	2500	500	3600
Family 4	Niranjan Bhuinya	Tehatta, Hwh	7	6	20,000	7000	1167	2857
Family 5	Uday Bhuinya	Tehatta, Hwh	9	8	17,500	8000	1000	1944
Family 6	Pratip Bhuinya	Tehatta, Hwh	5	5	7,000	3500	700	1400
Family 7	Pankaj Ganguly	Budge Budge	5	3	55,000	3000	1000	11000
Family 8	Bijoy Chatterjee	Budge Budge	4	4	25,000	3500	875	6250
Family 9	Gautam Ganguly	Budge Budge	4	4	50,000	4000	1000	12500
Family 10	Sujata Roy	Bata Nagar	6	6	18,000	4000	667	3000
Family 11	Moumita Chaudhury	Bata Nagar	6	6	14,000	5000	833	2333
Family 12	Pijush Banerjee	Banerjee Hat	5	4	19,000	3500	875	3800
Family 13	Badal Chakrabarty	Banerjee Hat	4	4	12,000	4000	1000	3000
Family 14	Pradyut Jana Roy	Birlapore	8	6	12,000	6000	1000	1500
Family 15	Nishikanta Jana Roy	Birlapore	7	7	9,000	7000	1285	1000
Family 16	Ashim Bhattacharjee	Budge Budge	4	4	13,000	5000	1250	3250
Family 17	Satyaki Sarkar	Budge Budge	5	5	16,000	3500	700	3200

Families	Name of family member interviewed	Locality	Family size	Number of members with normal fish intake	Approximate monthly income (Rs.)	Average total weekly purchase (gm)	Per head weekly consumption (gm)	Per head monthly income (Rs.)
Family 18	Sayani Ghosh	Budge Budge	6	5	65,000	5000	1000	10833
Family 19	Manashi Ganguly	Budge Budge	2	2	10,000	3000	1500	5000
Family 20	Gopal Ghosh	Budge Budge	4	4	12,000	4000	1000	3000

* This column shows the number of members with normal adult intake and this usually includes children over 5 years. Adults who do not take fish for any reason and children with negligible or almost negligible intake have been discounted.

APPENDIX 4

Fish Flesh as a proportion of fish body weight

Table A-4-1

Sl.no.	Fish variety (local name)	Wt.(during purchasing) in gm	Bones in gm	Deductibles (Head, fins etc.)	Flesh	Flesh as percentage of the whole
1	Tilapia	40	10	6	24	60.00
2	Tangra	14	2	3	9	64.29
3	Katla peti*	75	2	2	71	94.67
4	Katla gada**	65	4	2	59	90.77
5	Ruhi peti	65	2	2	61	93.85
6	Ruhi gada	90	12	3	75	83.33
7	Lyata	190	6	64	120	63.16

- * peti - piece from anterior portion of the fish
- ** gada - piece from posterior portion of the fish

Note: The above data was obtained by actual weighing of the whole and the parts of some commonly consumed fish varieties. It is meant to be indicative only. It may also be noted that very often, in fact more often than not, head of the fish is also consumed. Therefore, it should not be seen as a pure deductible, although it was included in that column in order to cull out the proportion of pure flesh.

Appendix 5

Applying EPA 'Weekly Reference Dose' to the Results

The findings of this study are analysed for methylmercury PTWI recommended by the FAO-WHO Joint Committee. In the following table we compare the implications of our findings if one applies the EPA 'Reference Dose' of 0.1µg /kg/day or what amounts to 0.7µg /kg /week.

Table A-5-1. A Comparison with EPA's Weekly Reference Dose

Fish flesh intake (gm per week)			100	150	200	250	300	350	400	450	500	600	700
Fish flesh intake (kg per week)			0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.6	0.7
			Methylmercury concentration (µg/kg) which should not be exceeded										
Body weight (kg)	**WRD (in µg)**		A	B	C	D	E	F	G	H	I	J	K
25	17.5	a	175	117	88	70	58	50	44	39	35	29	25
30	21	b	210	140	105	84	70	60	53	47	42	35	30
35	24.5	c	245	163	123	98	82	70	61	54	49	41	35
40	28	d	280	187	140	112	93	80	70	62	56	47	40
45	31.5	e	315	210	158	126	105	90	79	70	63	53	45
50	35	f	350	233	175	140	117	100	88	78	70	58	50
55	38.5	g	385	257	193	154	128	110	96	86	77	64	55
60	42	h	420	280	210	168	140	120	105	93	84	70	60
65	45.5	i	455	303	228	182	152	130	114	101	91	76	65

The above table covers the following items of information:

i) The weekly reference dose (WRD), in µg, of persons 25 - 65 kg at intervals of 5 kg.

ii) The range of weights cover a broad spectrum of Indian age groups, starting from a child of about 7 years or so (when the fish intake easily becomes equal to adult intake) and covering young adolescents and adults.

iii) For each bodyweight and associated WRD, the possible range of safe fish flesh intake per week.

iv) For each weight cum WRD and possible fish flesh intake per week, the methylmercury concentration in fish flesh which should not be exceeded (from aA to iK).

v) It may be noted that for a person of certain bodyweight the PTWI or weekly reference dose is fixed. Therefore, the permissible limit of methylmercury concentration in fish flesh must decrease in proportion to increase in weekly fish intake.

Two examples from the above table are enough to bring out the drastic nature of the implications. A child weighing 25 kg and eating 250 gm of fish flesh per week has a permissible methylmercury exposure of 70 µg/kg (i.e. 0.07 mg/kg) and an adult of 60 kg, consuming 500 gm of fish flesh per week has a permissible methylmercury exposure of 84 µg/kg (i.e. 0.084 mg/kg). However, for most samples from Kolkata markets and select fishing locations across West Bengal the exposure increases way beyond permissible limits. See the tables below for a comparison with WRD against methylmercury values of our samples.

Table A-5-2. Methylmercury in samples from the Kolkata Markets

Sl. No.	Sample Code	MeHg (mg/kg)	MeHg (µg/kg)	A child of 25 kg body weight consuming 250 gm of fish flesh per week		An adult of 60 kg body weight consuming 500 gm of fish flesh per week	
				Whether exceeded	Percentage of Exceedance	Whether exceeded	Percentage of Exceedance
1	MG1A	0.408	408	Exceeded	482.86	Exceeded	385.71
2	MG1B	0.384	384	Exceeded	448.57	Exceeded	357.14
3	MG2A	0.472	472	Exceeded	574.29	Exceeded	461.90
4	MG2B	0.312	312	Exceeded	345.71	Exceeded	271.43
5	MG3A	0.672	672	Exceeded	860.00	Exceeded	700.00
6	MG3B	0.896	896	Exceeded	1180.00	Exceeded	966.67
7	MG4A	1.016	1016	Exceeded	1351.43	Exceeded	1109.52
8	MG4B	0.704	704	Exceeded	905.71	Exceeded	738.10
9	MG5A	0.36	360	Exceeded	414.29	Exceeded	328.57
10	MG5B	0.352	352	Exceeded	402.86	Exceeded	319.05
11	MG6A	0.084	84	Exceeded	20.00	Not exceeded	nil
12	MG6B	0.092	92	Exceeded	31.43	Exceeded	9.52
13	MSa1A	0.192	192	Exceeded	174.29	Exceeded	128.57
14	MSa1B	0	0	Not exceeded	nil	Not exceeded	nil
15	MSa2A	0	0	Not exceeded	nil	Not exceeded	nil
16	MSa2B	0	0	Not exceeded	nil	Not exceeded	nil
17	MSa3A	0.256	256	Exceeded	265.71	Exceeded	204.76
18	MSa3B	0	0	Not exceeded	nil	Not exceeded	nil
19	MSa4A	0	0	Not exceeded	nil	Not exceeded	nil
20	MSa4B	0.232	232	Exceeded	231.43	Exceeded	176.19
21	MSa5A	0.176	176	Exceeded	151.43	Exceeded	109.52
22	MSa5B	0.24	240	Exceeded	242.86	Exceeded	185.71
23	MSa6A	0.136	136	Exceeded	94.29	Exceeded	61.90
24	MSa6B	0.2	200	Exceeded	185.71	Exceeded	138.10
25	MSd1A	0.4	400	Exceeded	471.43	Exceeded	376.19
26	MSd1B	0.16	160	Exceeded	128.57	Exceeded	90.48
27	MSd2A	0.16	160	Exceeded	128.57	Exceeded	90.48
28	MSd2B	0	0	Not exceeded	nil	Not exceeded	nil
29	MSd3A	0.16	160	Exceeded	128.57	Exceeded	90.48
30	MSd3B	0.176	176	Exceeded	151.43	Exceeded	109.52
31	MSd4A	0.52	520	Exceeded	642.86	Exceeded	519.05
32	MSd4B	0.56	560	Exceeded	700.00	Exceeded	566.67
33	MSd5A	0.376	376	Exceeded	437.14	Exceeded	347.62

Methylmercury in samples from the Kolkata Markets							
Sl. No.	Sample Code	MeHg (mg/kg)	MeHg (µg/kg)	A child of 25 kg body weight consuming 250 gm of fish flesh per week		An adult of 60 Kg body weight consuming 500 gm of fish flesh per week	
				Whether exceeded	Percentage of Exceedance	Whether exceeded	Percentage of Exceedance
34	MSd5B	0.68	680	Exceeded	871.43	Exceeded	709.52
35	MSd6A	0.228	228	Exceeded	225.71	Exceeded	171.43
36	MSd6B	0.156	156	Exceeded	122.86	Exceeded	85.71
37	MMn1A	0.192	192	Exceeded	174.29	Exceeded	128.57
38	MMn1B	0.368	368	Exceeded	425.71	Exceeded	338.10
39	MMn2A	0.416	416	Exceeded	494.29	Exceeded	395.24
40	MMn2B	0.16	160	Exceeded	128.57	Exceeded	90.48
41	MMn3A	0.464	464	Exceeded	562.86	Exceeded	452.38
42	MMn3B	0.432	432	Exceeded	517.14	Exceeded	414.29
43	MMn4A	0.176	176	Exceeded	151.43	Exceeded	109.52
44	MMn4B	0.192	192	Exceeded	174.29	Exceeded	128.57
45	MMn5A	0.176	176	Exceeded	151.43	Exceeded	109.52
46	MMn5B	0.248	248	Exceeded	254.29	Exceeded	195.24
47	MMn6A	0	0	Not exceeded	nil	Not exceeded	nil
48	MMn6B	0.152	152	Exceeded	117.14	Exceeded	80.95
49	MBe1A	0.472	472	Exceeded	574.29	Exceeded	461.90
50	MBe1B	0.416	416	Exceeded	494.29	Exceeded	395.24
51	MBe2A	0.304	304	Exceeded	334.29	Exceeded	261.90
52	MBe2B	0.176	176	Exceeded	151.43	Exceeded	109.52
53	MBe3A	0.448	448	Exceeded	540.00	Exceeded	433.33
54	MBe3B	0.248	248	Exceeded	254.29	Exceeded	195.24
55	MBe4A	0.192	192	Exceeded	174.29	Exceeded	128.57
56	MBe4B	0.16	160	Exceeded	128.57	Exceeded	90.48
57	MBe5A	0.168	168	Exceeded	140.00	Exceeded	100.00
58	MBe5B	0.16	160	Exceeded	128.57	Exceeded	90.48
59	MBe6A	0.14	140	Exceeded	100.00	Exceeded	66.67
60	MBe6B	0	0	Not exceeded	nil	Not exceeded	nil

Table A-5-3. Methylmercury in samples from select waterbodies across West Bengal

Sl. No.	Sample Code	MeHg (mg/kg)	MeHg (μg/kg)	A child of 25 kg body weight consuming 100 gm of fish flesh per week		A child of 30 kg body weight consuming 150 gm of fish flesh per week	
				Whether Exceeded	Percentage of Exceedance	Whether Exceeded	Percentage of Exceedance
1	HG1A	0.288	288	Exceeded	311.43	Exceeded	242.86
2	HG1B	0.16	160	Exceeded	128.57	Exceeded	90.48
3	HG2A	0.264	264	Exceeded	277.14	Exceeded	214.29
4	HG2B	0.264	264	Exceeded	277.14	Exceeded	214.29
5	HG3A	0.44	440	Exceeded	528.57	Exceeded	423.81
6	HG3B	0.328	328	Exceeded	368.57	Exceeded	290.48
7	HG4A	0.288	288	Exceeded	311.43	Exceeded	242.86
8	HG4B	0.376	376	Exceeded	437.14	Exceeded	347.62
9	HG5A	0.416	416	Exceeded	494.29	Exceeded	395.24
10	HG5B	0.288	288	Exceeded	311.43	Exceeded	242.86
11	HG6A	0.224	224	Exceeded	220.00	Exceeded	166.67
12	HG6B	0.32	320	Exceeded	357.14	Exceeded	280.95
13	HG7A	0.376	376	Exceeded	437.14	Exceeded	347.62
14	HG7B	0.32	320	Exceeded	357.14	Exceeded	280.95
15	HG8A	0.336	336	Exceeded	380.00	Exceeded	300.00
16	HG8B	0.256	256	Exceeded	265.71	Exceeded	204.76
17	BJ1A	0.16	160	Exceeded	128.57	Exceeded	90.48
18	BJ1B	0.16	160	Exceeded	128.57	Exceeded	90.48
19	BJ2A	0.296	296	Exceeded	322.86	Exceeded	252.38
20	BJ2B	0.448	448	Exceeded	540.00	Exceeded	433.33
21	BJ3A	0.56	560	Exceeded	700.00	Exceeded	566.67
22	BJ3B	0.464	464	Exceeded	562.86	Exceeded	452.38
23	BJ4A	0.448	448	Exceeded	540.00	Exceeded	433.33
24	BJ4B	0.656	656	Exceeded	837.14	Exceeded	680.95
25	BJ5A	0.552	552	Exceeded	688.57	Exceeded	557.14
26	BJ5B	0.472	472	Exceeded	574.29	Exceeded	461.90
27	BJ6A	0.36	360	Exceeded	414.29	Exceeded	328.57
28	BJ6B	0.336	336	Exceeded	380.00	Exceeded	300.00
29	BJ7A	0.488	488	Exceeded	597.14	Exceeded	480.95
30	BJ7B	0.352	352	Exceeded	402.86	Exceeded	319.05
31	BJ8A	0.824	824	Exceeded	1077.14	Exceeded	880.95
32	BJ8B	0.368	368	Exceeded	425.71	Exceeded	338.10

Methylmercury in Samples from Select Waterbodies Across West Bengal

Sl. No.	Sample Code	MeHg (mg/kg)	MeHg (µg/kg)	A child of 25 kg body weight consuming 100 gm of fish flesh per week		A child of 30 kg body weight consuming 150 gm of fish flesh per week	
				Whether Exceeded	Percentage of Exceedance	Whether Exceeded	Percentage of Exceedance
33	BJ9A	0.664	664	Exceeded	848.57	Exceeded	690.48
34	BJ9B	0.504	504	Exceeded	620.00	Exceeded	500.00
35	JHK1A	2.128	2128	Exceeded	2940.00	Exceeded	2433.33
36	JHK1B	1.64	1640	Exceeded	2242.86	Exceeded	1852.38
37	JHK2A	1.088	1088	Exceeded	1454.29	Exceeded	1195.24
38	JHK2B	0.736	736	Exceeded	951.43	Exceeded	776.19
39	JHK3A	1.376	1376	Exceeded	1865.71	Exceeded	1538.10
40	JHK3B	0.472	472	Exceeded	574.29	Exceeded	461.90
41	JHK4A	0.524	524	Exceeded	648.57	Exceeded	523.81
42	JHK4B	0.608	608	Exceeded	768.57	Exceeded	623.81
43	JHK5A	1.664	1664	Exceeded	2277.14	Exceeded	1880.95
44	JHK5B	1.624	1624	Exceeded	2220.00	Exceeded	1833.33
45	JHK6A	0.568	568	Exceeded	711.43	Exceeded	576.19
46	JHK6B	0.516	516	Exceeded	637.14	Exceeded	514.29
47	JHK7A	0.872	872	Exceeded	1145.71	Exceeded	938.10
48	JHK7B	1.288	1288	Exceeded	1740.00	Exceeded	1433.33
49	JHK8A	0.68	680	Exceeded	871.43	Exceeded	709.52
50	JHK8B	0.584	584	Exceeded	734.29	Exceeded	595.24
51	HD1A	0.664	664	Exceeded	848.57	Exceeded	690.48
52	HD1B	0.44	440	Exceeded	528.57	Exceeded	423.81
53	HD2A	0.296	296	Exceeded	322.86	Exceeded	252.38
54	HD2B	0.208	208	Exceeded	197.14	Exceeded	147.62
55	HD3A	0.16	160	Exceeded	128.57	Exceeded	90.48
56	HD3B	0.176	176	Exceeded	151.43	Exceeded	109.52
57	HD4A	0.232	232	Exceeded	231.43	Exceeded	176.19
58	HD4B	0.424	424	Exceeded	505.71	Exceeded	404.76
59	HD5A	0.2	200	Exceeded	185.71	Exceeded	138.10
60	HD5B	0.168	168	Exceeded	140.00	Exceeded	100.00
61	HD6A	0.168	168	Exceeded	140.00	Exceeded	100.00
62	HD6B	0	0	Not exceeded	nil	Not exceeded	nil
63	DIG1A	0.504	504	Exceeded	620.00	Exceeded	500.00
64	DIG1B	0.312	312	Exceeded	345.71	Exceeded	271.43

Methylmercury in Samples from Select Waterbodies Across West Bengal							
Sl. No.	Sample Code	MeHg (mg/kg)	MeHg (µg/kg)	A child of 25 kg body weight consuming 100 gm of fish flesh per week		A child of 30 kg body weight consuming 150 gm of fish flesh per week	
				Whether Exceeded	Percentage of Exceedance	Whether Exceeded	Percentage of Exceedance
65	DIG2A	0.32	320	Exceeded	357.14	Exceeded	280.95
66	DIG2B	0.336	336	Exceeded	380.00	Exceeded	300.00
67	DIG3A	0	0	Not exceeded	nil	Not exceeded	nil
68	DIG3B	0	0	Not exceeded	nil	Not exceeded	nil
69	DIG4A	0.48	480	Exceeded	585.71	Exceeded	471.43
70	DIG4B	0.576	576	Exceeded	722.86	Exceeded	585.71
71	DIG5A	0.208	208	Exceeded	197.14	Exceeded	147.62
72	DIG5B	0.192	192	Exceeded	174.29	Exceeded	128.57
73	DIG6A	0.208	208	Exceeded	197.14	Exceeded	147.62
74	DIG6B	0.232	232	Exceeded	231.43	Exceeded	176.19
75	DIG7A	0.4	400	Exceeded	471.43	Exceeded	376.19
76	DIG7B	0.384	384	Exceeded	448.57	Exceeded	357.14
77	DIG8A	0.912	912	Exceeded	1202.86	Exceeded	985.71
78	DIG8B	0.88	880	Exceeded	1157.14	Exceeded	947.62
79	DIG9A	0.556	556	Exceeded	694.29	Exceeded	561.90
80	DIG9B	0.796	796	Exceeded	1037.14	Exceeded	847.62
81	DIG10A	0.344	344	Exceeded	391.43	Exceeded	309.52
82	DIG10B	0	0	Not exceeded	nil	Not exceeded	nil
83	EKO1A	0.36	360	Exceeded	414.29	Exceeded	328.57
84	EKO1B	0.224	224	Exceeded	220.00	Exceeded	166.67
85	EKO2A	0.608	608	Exceeded	768.57	Exceeded	623.81
86	EKO2B	0.32	320	Exceeded	357.14	Exceeded	280.95
87	EKO3A	0.24	240	Exceeded	242.86	Exceeded	185.71
88	EKO3B	0.32	320	Exceeded	357.14	Exceeded	280.95
89	KAK1A	0.36	360	Exceeded	414.29	Exceeded	328.57
90	KAK1B	0.4	400	Exceeded	471.43	Exceeded	376.19
91	KAK2A	0.336	336	Exceeded	380.00	Exceeded	300.00
92	KAK2B	0.288	288	Exceeded	311.43	Exceeded	242.86
93	KAK3A	0.384	384	Exceeded	448.57	Exceeded	357.14
94	KAK3B	0.552	552	Exceeded	688.57	Exceeded	557.14
95	KAK4A	0.48	480	Exceeded	585.71	Exceeded	471.43
96	KAK4B	0.464	464	Exceeded	562.86	Exceeded	452.38

Methylmercury in Samples from Select Waterbodies Across West Bengal							
Sl. No.	Sample Code	MeHg (mg/kg)	MeHg (µg/kg)	A child of 25 kg body weight consuming 100 gm of fish flesh per week		A child of 30 kg body weight consuming 150 gm of fish flesh per week	
				Whether Exceeded	Percentage of Exceedance	Whether Exceeded	Percentage of Exceedance
97	KAK5A	0.664	664	Exceeded	848.57	Exceeded	690.48
98	KAK5B	0.568	568	Exceeded	711.43	Exceeded	576.19
99	KAK6A	0.768	768	Exceeded	997.14	Exceeded	814.29
100	KAK6B	0.872	872	Exceeded	1145.71	Exceeded	938.10
101	KAK7A	0.672	672	Exceeded	860.00	Exceeded	700.00
102	KAK7B	0.768	768	Exceeded	997.14	Exceeded	814.29
103	KAK8A	0.768	768	Exceeded	997.14	Exceeded	814.29
104	KAK8B	0.752	752	Exceeded	974.29	Exceeded	795.24
105	MUD1A	0	0	Not exceeded	nil	Not exceeded	nil
106	MUD1B	0.16	160	Exceeded	128.57	Exceeded	90.48
107	MUD2A	0	0	Not exceeded	nil	Not exceeded	nil
108	MUD2B	0.16	160	Exceeded	128.57	Exceeded	90.48
109	MUD3A	0.2	200	Exceeded	185.71	Exceeded	138.10
110	MUD3B	0	0	Not exceeded	nil	Not exceeded	nil
111	MUD4A	0	0	Not exceeded	nil	Not exceeded	nil
112	MUD4B	0	0	Not exceeded	nil	Not exceeded	nil
113	MUD5A	0.192	192	Exceeded	174.29	Exceeded	128.57
114	MUD5B	0	0	Not exceeded	nil	Not exceeded	nil
115	MUD6A	0	0	Not exceeded	nil	Not exceeded	nil
116	MUD6B	0.256	256	Exceeded	265.71	Exceeded	204.76
117	MUD7A	0.168	168	Exceeded	140.00	Exceeded	100.00
118	MUD7B	0.288	288	Exceeded	311.43	Exceeded	242.86
119	MUD8A	0.512	512	Exceeded	631.43	Exceeded	509.52
120	MUD8B	0.336	336	Exceeded	380.00	Exceeded	300.00
121	MUD9A	0.256	256	Exceeded	265.71	Exceeded	204.76
122	MUD9B	0.376	376	Exceeded	437.14	Exceeded	347.62
123	FKF1A	0.216	216	Exceeded	208.57	Exceeded	157.14
124	FKF1B	0.16	160	Exceeded	128.57	Exceeded	90.48
125	FKF2A	0.192	192	Exceeded	174.29	Exceeded	128.57
126	FKF2B	0.184	184	Exceeded	162.86	Exceeded	119.05
127	FKF3A	0.632	632	Exceeded	802.86	Exceeded	652.38
128	FKF3B	0.416	416	Exceeded	494.29	Exceeded	395.24

Methylmercury in Samples from Select Waterbodies Across West Bengal

Sl. No.	Sample Code	MeHg (mg/kg)	MeHg (µg/kg)	A child of 25 kg body weight consuming 100 gm of fish flesh per week		A child of 30 kg body weight consuming 150 gm of fish flesh per week	
				Whether Exceeded	Percentage of Exceedance	Whether Exceeded	Percentage of Exceedance
129	FKF4A	0.216	216	Exceeded	208.57	Exceeded	157.14
130	FKF4B	0.328	328	Exceeded	368.57	Exceeded	290.48
131	FKF5A	0.192	192	Exceeded	174.29	Exceeded	128.57
132	FKF5B	0.232	232	Exceeded	231.43	Exceeded	176.19
133	FKF6A	0.296	296	Exceeded	322.86	Exceeded	252.38
134	FKF6B	0.208	208	Exceeded	197.14	Exceeded	147.62
135	FKF7A	0.192	192	Exceeded	174.29	Exceeded	128.57
136	FKF7B	0.24	240	Exceeded	242.86	Exceeded	185.71
137	FKF8A	0.384	384	Exceeded	448.57	Exceeded	357.14
138	FKF8B	0.48	480	Exceeded	585.71	Exceeded	471.43
139	FKG9A	0.312	312	Exceeded	345.71	Exceeded	271.43
140	FKG9B	0.664	664	Exceeded	848.57	Exceeded	690.48
141	FKG10A	0.312	312	Exceeded	345.71	Exceeded	271.43
142	FKG10B	0.664	664	Exceeded	848.57	Exceeded	690.48
143	FKG11A	0.496	496	Exceeded	608.57	Exceeded	490.48
144	FKG11B	1	1000	Exceeded	1328.57	Exceeded	1090.48
145	NBB1A	0	0	Not exceeded	nil	Not exceeded	nil
146	NBB1B	0	0	Not exceeded	nil	Not exceeded	nil
147	NBB2A	0	0	Not exceeded	nil	Not exceeded	nil
148	NBB2B	0	0	Not exceeded	nil	Not exceeded	nil
149	NBB3A	0	0	Not exceeded	nil	Not exceeded	nil
150	NBB3B	0	0	Not exceeded	nil	Not exceeded	nil
151	NBB4A	0	0	Not exceeded	nil	Not exceeded	nil
152	NBB4B	0	0	Not exceeded	nil	Not exceeded	nil
153	NBB6A	0	0	Not exceeded	nil	Not exceeded	nil
154	NBB6B	0	0	Not exceeded	nil	Not exceeded	nil
155	NBB7A	0	0	Not exceeded	nil	Not exceeded	nil
156	NBB7B	0	0	Not exceeded	nil	Not exceeded	nil
157	NBB8A	0	0	Not exceeded	nil	Not exceeded	nil
158	NBB8B	0	0	Not exceeded	nil	Not exceeded	nil
159	NBPB9A	0	0	Not exceeded	nil	Not exceeded	nil
160	NBPB9B	0	0	Not exceeded	nil	Not exceeded	nil

Methylmercury in Samples from Select Waterbodies Across West Bengal							
Sl. No.	Sample Code	MeHg (mg/kg)	MeHg (µg/kg)	A child of 25 kg body weight consuming 100 gm of fish flesh per week		A child of 30 kg body weight consuming 150 gm of fish flesh per week	
				Whether Exceeded	Percentage of Exceedance	Whether Exceeded	Percentage of Exceedance
161	NBPB10A	0	0	Not exceeded	nil	Not exceeded	nil
162	NBPB10B	0	0	Not exceeded	nil	Not exceeded	nil
163	NBPB11A	0.176	176	Exceeded	151.43	Exceeded	109.52
164	NBPB11B	0	0	Not exceeded	nil	Not exceeded	nil
165	NBPR12A	0.208	208	Exceeded	197.14	Exceeded	147.62
166	NBPR12B	0	0	Not exceeded	nil	Not exceeded	nil
167	NBPR13A	0	0	Not exceeded	nil	Not exceeded	nil
168	NBPR13B	0	0	Not exceeded	nil	Not exceeded	nil
169	NBPR14A	0	0	Not exceeded	nil	Not exceeded	nil
170	NBPR14B	0	0	Not exceeded	nil	Not exceeded	nil
171	NBPK15A	0	0	Not exceeded	nil	Not exceeded	nil
172	NBPK15B	0	0	Not exceeded	nil	Not exceeded	nil
173	NBPK16A	0	0	Not exceeded	nil	Not exceeded	nil
174	NBPK16B	0	0	Not exceeded	nil	Not exceeded	nil
175	NBPK17A	0.568	568	Exceeded	711.43	Exceeded	576.19
176	NBPK17B	0.2	200	Exceeded	185.71	Exceeded	138.10
177	NBPD18A	0.736	736	Exceeded	951.43	Exceeded	776.19
178	NBPD18B	0	0	Not exceeded	nil	Not exceeded	nil
179	NBRC19A	0	0	Not exceeded	nil	Not exceeded	nil
180	NBRC19B	0	0	Not exceeded	nil	Not exceeded	nil
181	KOG1A	0.328	328	Exceeded	368.57	Exceeded	290.48
182	KOG1B	0.176	176	Exceeded	151.43	Exceeded	109.52
183	KOG2A	0.48	480	Exceeded	585.71	Exceeded	471.43
184	KOG2B	0	0	Not exceeded	nil	Not exceeded	nil
185	KOG3A	0	0	Not exceeded	nil	Not exceeded	nil
186	KOG3B	0.16	160	Exceeded	128.57	Exceeded	90.48
187	KOG4A	0.216	216	Exceeded	208.57	Exceeded	157.14
188	KOG4B	0	0	Not exceeded	nil	Not exceeded	nil
189	KOG5A	0.192	192	Exceeded	174.29	Exceeded	128.57
190	KOG5B	0	0	Not exceeded	nil	Not exceeded	nil
191	KOG6A	0	0	Not exceeded	nil	Not exceeded	nil
192	KOG6B	0	0	Not exceeded	nil	Not exceeded	nil

Methylmercury in Samples from Select Waterbodies Across West Bengal							
Sl. No.	Sample Code	MeHg (mg/kg)	MeHg (µg/kg)	A child of 25 kg body weight consuming 100 gm of fish flesh per week		A child of 30 kg body weight consuming 150 gm of fish flesh per week	
				Whether Exceeded	Percentage of Exceedance	Whether Exceeded	Percentage of Exceedance
193	KOG7A	0	0	Not exceeded	nil	Not exceeded	nil
194	KOG7B	0.232	232	Exceeded	231.43	Exceeded	176.19
195	DGP1A	0.2	200	Exceeded	185.71	Exceeded	138.10
196	DGP1B	0.168	168	Exceeded	140.00	Exceeded	100.00
197	DGP2A	0	0	Not exceeded	nil	Not exceeded	nil
198	DGP2B	0.176	176	Exceeded	151.43	Exceeded	109.52
199	DGP3A	0.16	160	Exceeded	128.57	Exceeded	90.48
200	DGP3B	0.168	168	Exceeded	140.00	Exceeded	100.00
201	DGP4A	0	0	Not exceeded	nil	Not exceeded	nil
202	DGP4B	0	0	Not exceeded	nil	Not exceeded	nil
203	DGP5A	0	0	Not exceeded	nil	Not exceeded	nil
204	DGP5B	0.16	160	Exceeded	128.57	Exceeded	90.48

In the table above MeHg values are indicated as 0 in cases where Hg value is either equivalent or below 0.20 mg/kg. Yet, notwithstanding this forced reduction the overwhelming majority of the MeHg values show clear excesses over the values permissible for the 2 instances. See the following table for the number of instances where our results have exceeded the reference dose.

Table A-5-4 . Average MeHg exceedance in relation to WRD

Instances	Number of samples where values are above the EPA reference dose for a week	Total number of samples	Average exceedance in percentage	How many samples exceed by more than 100%	Percentage of samples exceeding by more than 100%	How many samples exceed by more than 200%	Percentage of samples exceeding by more than 200%
A child of 25 kg consuming 250 gm of fish flesh per week	203	264	76.89	199	75.38	175	66.29
An adult of 60 kg consuming 500 gm of fish flesh per week	202	264	76.51	145	54.92	129	48.86

In both the instances more than three-fourths of our samples show the reference dose being exceeded. Further, the percentage of samples showing exceedance above 100% and 200% is very alarming.

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