Fisheries & Aquaculture News

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Hilsa fisheries
Fish reproduction
Live feed
Crab breeding
Sea weed
Dry fish

BFRF Bangladesh Fisheries Research Forum

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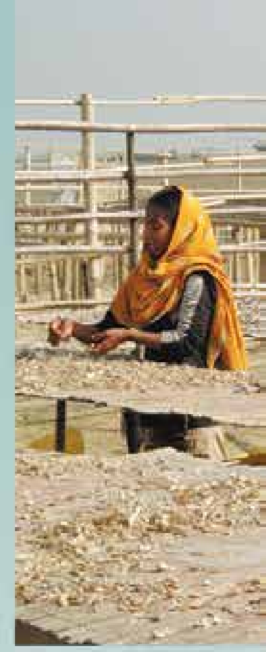

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Editor's Column

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Both aquaculture and fisheries have long been an integral part of life of the people of Bangladesh. The sector, second only to agriculture in the overall economy of the country, contributes nearly 4.5 % to the gross domestic product (GDP), 23 % of gross agriculture products and 2.46 % to the total export earnings. It accounts for about 60 % of animal protein intake in the diet of the people of Bangladesh with per capita fish consumption of 18.94 kg per annum. Now Bangladesh stands in 4th position for aquaculture production in the globe. The people of Bangladesh largely depend on fish to meet their protein needs in both the rural and urban areas.

BFRF has been playing a key role in maintaining the pace of the rapidly growing fisheries sector of Bangladesh. As the forum rightly identified, with the rapid growth, fisheries sector is threatened by a wide variety of factors including loss of aquatic habitat, urbanization, environmental degradation, pollution, overexploitation and climate as well as natural environmental change. The barriers to the development of fisheries sector that are constraining its growth are destruction of immature fish and shellfish (ova, larvae, breeding fish), use of illegal fishing gears, climate change impacts (erratic rainfall, drought, salinity intrusion, frequent cyclone), piracy, defying of spatial and seasonal ban, issue of governance, lack of regulation and management.

In this volume of BFRF's publication- FAN-Bangladesh, an array of ongoing issues pertinent to different sub-sectors of fisheries - from biology to culture, small fish to crustacean, live feed to biotechnology, value addition to overseas trade, and seaweed to fish parasites along with a number of regular columns have been presented.

It is hoped that the fisheries field personnel, extension workers, fish farmers, fishers, students, researchers, academicians, policy makers and all other stakeholders will be benefited from the articles and other information published in the FAN-Bangladesh. We hope that FAN-Bangladesh now and in future would play an effective role in the betterment of the sector. The e-version of the magazine is available in the webpage of the forum - www.bfrf.org.

We welcome your suggestions and feedback on the published materials. Please send us your research outcomes, innovations, new and fine-tuned technologies, project report and other materials for inclusion in the future issues of FAN-Bangladesh. We sincerely thank all our readers for their continuous support in our endeavor.

Mostafa A R Hossain

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What lesson we need to learn from Hilsa Shad (*Tenualosa ilisha*) biology!

What lesson we need to learn from Hilsa Shad (*Tenualosa ilisha*) biology!

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Hilsa shad (*Tenualosa ilisha*) is the national fish of Bangladesh just not for its delicacy but also for its contribution to country's fish production (about 11% of total), nutrition, economy and livelihoods. Owing its contribution to cultural heritage in Bangladesh and West Bengal of India, a transboundary research was recently led to some understandings on the conservation of the flagship fish. To conserve Hilsa, knowledge of its biology, life history, habitat, socioeconomics and implications of governnance are important. Usually the life cycle of Atlantic salmon was compared with Hilsa shad in the Ganges (=Padma) river system. This is ambiguous as the life history patterns of salmon, many ways, varied with the Hilsa. Present article addresses some of the interesting issues of the biology and life history of the Hilsa.

Spawning: The fish is marine, live in the Bay of Bengal and for spawning, migrate towards the freshwater habitat and the Padma (Ganges)-Meghna river system. Unlike salmon, Hilsa need deep water to migrate. They do not like to jump or even come up to the surface to move forward. Thus underwater barriers or chars could halt the migration of the adult Hilsa. On the other hand, juveniles can migrate through the relatively lower water level in river. That is why some juvenile migration occurs before rainy season to the upper Padma. The actual migration occurs after the rainy season as the flooded water started to drain and the river bed became deeper. The Hilsa spawn in freshwater in flowing river system. Unlike salmon the eggs are small in size, floating in nature and the spent fishes survive. The Meghna estuary is the important area for Hilsa spawning. The fish use to breed at the upper Padma river system in early 70's before the establishment of Farakka Barrage in India; later moves down to the upper Meghna river basins in 80's but recent investigation shows that the breeding occurs at the lower Meghna estuary.

Habitat dilemma: Though the Hilsa lead anadromous life style by living in marine water and breeding in freshwater, the real sketch of the juvenile and adult migration is not clear from Bangladesh. There are two other Hilsa-like species in the Bay of Bengal and coastal area- Chandana ilish (*T. toil*) and Gurta ilish (*Hilsa kelee*). Besides there are some other clupeid fishes available in the same habitat. However, the recent population status and distribution of these fishes in the coastal river system is not well known. Thus the habitat dependency of these fishes for nutrition, spawning, larval rearing and growth need to be thoroughly studied. The ecological/environmental parameters of the water flow are important to address for all rivers that were once foraged by the fish. Specially the Gorai river at Kustia and the Padma at Bagha and Paba upazillas of Rajshahi hamper Hilsa fish migration in the lean season due to low water depth and river connectivity. The impact of low water flow at the river Padma due to the Farakka Barrage is an important issue. Detailed information of the migration in different habitats is important for conservation and management of this fish.

Tenualosa ilisha

T. toil

Hilsa kelee

Egg and larvae: Hilsa like majority of fishes of the world lay eggs. The fecundity varied from 3-35 million eggs with two distinct breeding seasons. The major spawning migration occurs in August-September while another spawning migration occurs in March-April each year. The spawning migration of the fishes needs to be accurately addressed with the abundance of predator of the same habitat. Though the predator of Hilsa is not reported, it is predicted that the juveniles i.e. jatka are predated by the minks, aquatic birds, larger predator fishes like pangasiids, river catfishes, perches and eels. Understanding what drives the life history of the fish and the knowledge of survival of eggs, larvae and juveniles (i.e. jatka) is important so sustainable and effective conservation plan could be made accordingly.

Jatka rearing: The number of jatka is eventually the backbone support for the future mature fish to be recruited. The survival of jatka in the river system and their migration pathway is important. Good governance towards rearing jatka in river beds is imperative tusk for the fish.

Anadromy: The return to the sea to get mature is very important stage of the life of Hilsa. Now the question is how many fish are able to return to the sea? The saving of juvenile helps them to safe return to the sea. This is a major event as they get mature and to be contributing to the future breeding efforts. Beside the answer may lay in how the fishery governance is helping the issue?

The major thrust of knowledgebase of saving Hilsa fisheries

The sustainable management of Hilsa fish depends upon the knowledge on the birth, growth, maturation, reproduction and mortality (natural and fishing) of the fish in Bangladesh river system. Hilsa as a major fisheries components and scale of its contribution of fishermen livelihoods of Bangladesh, proper direction for the conservation of the fish is expected. Researcher, policy makers, GOs and NGOs, fishers and others stakeholders should come forwards to save the fish for future.

A tale of zebrafish on ecotoxicology

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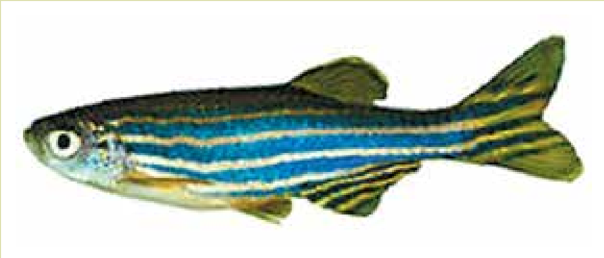
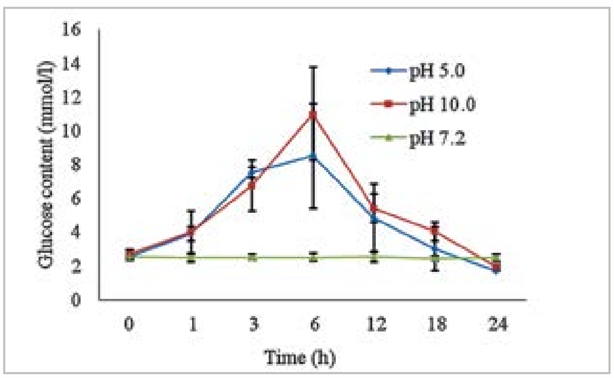
The zebrafish, *Danio rerio* (Hamilton, 1822) is a small (Max. length 5 cm) cyprinid and it is widely distributed in shallow, slow-flowing waters on the Indian subcontinent. The natural range of the zebrafish is centered around the Ganges and Brahmaputra River basins in Bangladesh, north-eastern India, Myanmar and Nepal. The zebrafish is most commonly encountered in shallow ponds and standing water bodies, often connected to inundated paddy field.

Over the past three decades, zebrafish has been a very popular aquarium fish and an important research model in several fields of biology (e.g., developmental biology and toxicology). Zebrafish has many attributes that makes it a popular model organism for biological research. They are small, have a short generation time, and are easy to raise and breed in captivity. Additionally, in comparison to other vertebrates, zebrafish produce a large number of eggs per mating event. Zebrafish undergoes external fertilization which allows all stages of development to be easily observed and manipulated. Zebrafish embryos are transparent, making them particularly useful for developmental and embryological research.



Zebrafish in acidic and basic pH

Behavior observation is considered a promising tool in toxicity assessments in many species, including fish. Our research group found that the median lethal toxicity of the zebrafish at 72 h were pH 3.9 and 10.8 in the acidic and basic media, respectively. Acute acid exposure of zebrafish showed resistance to pH levels from 7.0 down to 5.0 and high to 10.0. Almost no death or about 10% deaths occurred at pH 5.0 or at higher pH levels and pH 9.0 or at lower levels. At very low pH levels (i.e. pH 3.0 and below) and at very high (i.e. pH 11.5 and higher) they lose the balance, float with the bodies turned upside down and finally die. At pH levels of 4.0 and below and 11.0 and higher they suffer from respiratory distress, markedly shown by the gaping of the mouth, forced expansion of gill opercula and reduction in swimming activity. At pH 5.0 and 10.0 these symptoms last for a period of 6 to 12 h, then the fish gradually recover from the stress, and respond normally. Blood glucose is a highly reliable secondary stress response parameter that is strongly influenced by environmental parameters. In our research it was found that the glucose level of the exposed fish in the pH 5.0 and 10.0 increased within an hour and reached the highest at about 6 h and then gradually decreased and reached to its original states within 24 h. Hematological parameters are often subjected to vary depending upon pH stress and various other environmental factors.

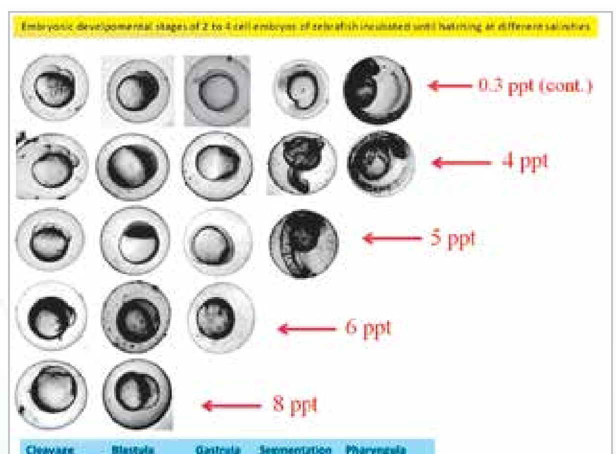


Ecotoxic research on zebrafish in the lab

Zebrafish egg in saline condition

hatching at 4 ppt salinity. However, very low hatching rate (23%) was observed at 4 ppt and no embryos hatched at salinity above 4 ppt. The embryos incubated at 4, 6, 8, and 10 ppt cleaved synchronously only during the initial stage, i.e. up to 16 to 32 cell stage, then the cleavage became asynchronous and embryos turned opaque.

In conclusion, zebrafish is a model for assessment of chemicals, which may interfere with different parts of the life cycle, act over consecutive generations, physiology, behavior, and with a potential to have impact on populations, are essential for risk assessment and environmental protection.



No females tilapias, more profit: Monosex production approach in tilapia using DNA markers

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Tilapias are important food fish all over the world. Farming tilapia is now in a dynamic state of expansion to satisfy both domestic and international markets and currently they are cultured in about 100 countries. Among all, the Nile tilapia, *Oreochromis niloticus* is the most dominant cultured species (~75% of all tilapia).

There are many advantages that favour Nile tilapia farming. They can be cultured in freshwater, brackishwater and even in full-strength seawater and can tolerate poor water quality and environmental fluctuations. They may grow well at high density, feed low in the food chain, either as column feeders or benthic omnivores and can be grown using many by-products. However, the main disadvantage of tilapia culture is its prolific breeding. The females of this species start breeding within about four months (or even less) and result in huge number of fry that later compete for food and space with others. The culture area becomes saturated with vast number of uneven sized fish. The farmers get lower price compared to the aspect where single sex (in Nile tilapia, the male) culture can be performed.

In single- or monosex culture, farmers get rid of uncontrolled reproduction, get bigger size fish (the females of Nile tilapia are slow-grower) and gain good profit. The technique of producing all male using androgen hormone (particularly 17-?-methyl-testosterone) is being widely used in Bangladesh. However, the use of hormone in the direct food chain is prohibited in many countries of the world because of the potential adverse physiological effects. Manual separation of male fish at sexual maturity can be done based on the observation of genital papilla but very time consuming.

A very promising research in Nile tilapia is production of so-called super-males (YYs) that are considered as 'father of only males'. In this technology, YY super-males need to be produced and verified with genetic markers. Without 'strong sex-linked' DNA markers, the YY nature of the species cannot be assured. Finding strong sex-linked markers or sex-specific markers is still a great challenge in this regards but some recent works have discovered the tilapia genome with 'mapped markers'. Good DNA markers are those that can give more information and identify

No females tilapias, more profit: Monosex production approach in tilapia using DNA markers

variation (polymorphism). Microsatellite DNA markers and SNP (Single nucleotide polymorphism) markers are such markers that can detect small level variation in species. In this regard, our aim of study is to observe if such markers can assist selection of YY males in tilapia for the production of genetically male offspring. Under this research, initially mixed sex fry (XX females and XY males) are treated with an estrogen hormone, diethylstilbestrol (DES) to convert the sex of XY males to 'XY females' (neofemales). The swim up fry are fed with the hormone mixed diet from the very first day of weaning (immediately after absorption of yolk sac) for a period of four weeks. After the completion of the hormonal trial, normal feed is provided to grow them up to sexual maturity. There should not be any male after DES treatment should the hormones work. However if any male is found to be present, is discarded after final screening at sexual maturity. Now there are XX females and 'XY' females. XX females are normal females and 'XY' females are called neofemales. Neofemales are those males that can produce ova (without any hormone treatment the neofemales would have been normal XY males). The neofemales are then crossed with normal XY males that should produce three different types of genotypes. Those are: XX females (25%), XY males (50%) and YY males (25%). XX females can easily be separated on or before maturity. However, to identify the 25% YY super-males, we need sex-linked very informative markers. We are using polymorphic markers so far present in the tilapia genome. PCR and DNA genotyping techniques should show distinct pattern of inheritance of alleles with these markers in putative super-males. As we hope, successful findings of SEX-flanked markers in our study are likely to open new era for healthy and safe tilapia aquaculture practice in the country. All male tilapia produced without hormone application is likely to give more profit to fish famers than hormone treated ones as it will fetch much higher price in national and international markets.

Neuroendocrine regulation of reproduction in teleosts

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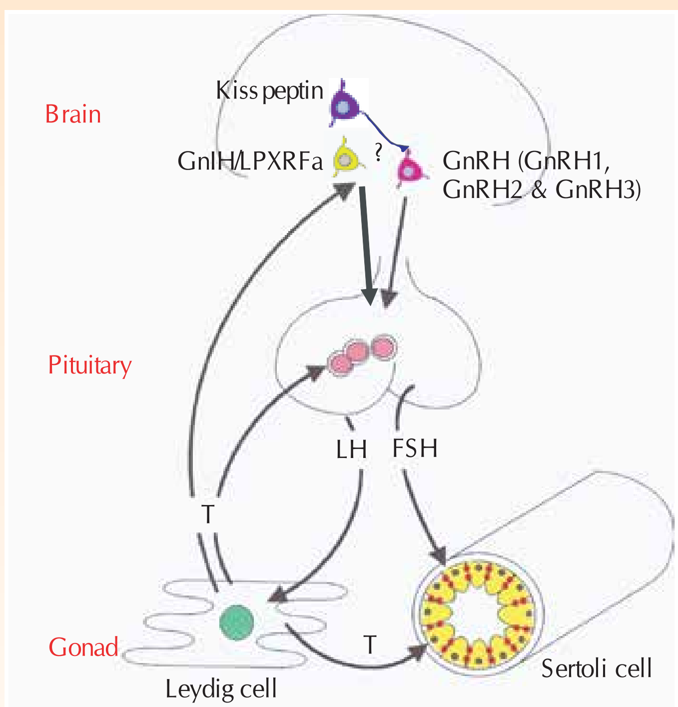
Reproduction in fish is controlled by both environmental and genetic/molecular factors. Different kinds of neuropeptide genes control the pathway of reproduction in fish. In teleosts, as in other vertebrates, the brain-pituitary-gonad (BPG) axis controls sexual development and reproduction. The external and internal signals involved in the regulation of reproductive function are integrated in the central nervous system in vertebrates.

GnRH-GTH axis and neuropeptides related to reproduction

Gonadotropin-releasing hormone (GnRH) produced in the brain governs the release of two kinds of gonadotropins (GTHs)- follicle-stimulating hormone (FSH) and luteinizing hormone (LH), from the pituitary, and then they act on the gonads to stimulate gonadal development via secretion of sex steroid hormones. These steroids, in turn, feed back to the brain and the pituitary to complete the BPG axis and to regulate the reproductive cycle. FSH and LH are heterodimeric glycoproteins that share a common α subunit (GPα) and possess a hormone-specific β subunit (FSHβ and LHβ). Although their roles during the reproductive cycle in fish have not yet been sufficiently established, there may be two different trends in expression pattern in association to their functions. First, single spawners, like salmonids, have shown a predominance of FSH during early gonadal recrudescence and gametogenesis and a clear prevalence of LH expression at the final stage of gonadal maturation. Secondly, multiple spawners seem to express a progressive and simultaneous increase in both FSH and LH expression during the gonadal maturation.

There are two or three GnRH forms in a single vertebrate species. One form of GnRH is hypophysiotropic GnRH, GnRH1, which regulates GTH secretion from the pituitary. The second form of GnRH is GnRH2 (formerly known as chicken GnRH-II), which is highly conserved from fish through mammals. GnRH2 neurons are localized in the midbrain tegmentum and project their axons widely throughout the brain. GnRH2 regulates sexual and feeding behavior. In some groups of teleosts such as perciformes, pleuronoctiformes and tetraodontiformes, GnRH3 (formerly known as salmon GnRH) is produced as the third form in the neuronal groups that are localized in the ventral forebrain along the terminal nerve. These neurons project their axons throughout the brain, and GnRH3 plays a neuromodulatory role in relation to sexual behavior.



Brain-pituitary-gonad axis and neuropeptides control reproduction in vertebrates.

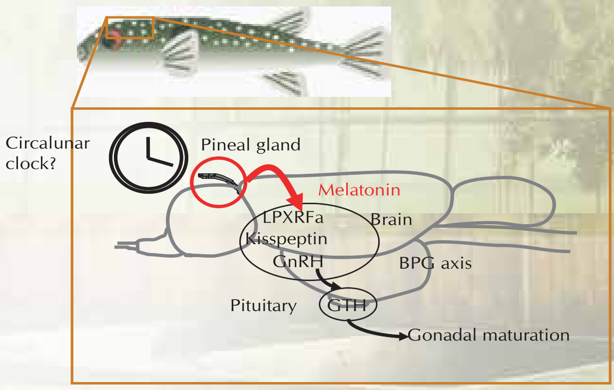
Recent studies on the RFamide peptides containing a C terminal -Arg-Phe-NH2 sequence have revealed that there are five groups of RFamide peptide family and several members of the family play an important role in the control of GnRH secretion in vertebrates. Kisspeptin and its receptor, G-protein coupled receptor 54 (GPR54), activate GnRH neurons to stimulate GnRH release in mammals. The ortholog genes for kisspetin and GPR54 have been identified in teleosts, and studies on their neuroanatomical structure, expression profiles and gene regulation showed that the kisspeptin/GPR54 system is also important in the control of reproduction in teleosts, possibly through the control of GnRH secretion. The second group of the RFamide peptide family involved in the control of reproduction is LPXRFamide peptide (LPXRFa) group, including gonadotropin-inhibitory hormone (GnIH) and RFamide-related peptide (RFRP). LPXRFa regulates GTH secretion directly, and indirectly via GnRH neurons. However, the effect of LPXRFa on GTH secretion varies distinctly among animal classes. LPXRFa inhibits LH secretion in goldfish, quail, and rats, whereas it stimulates the release of LH and FSH in sockeye salmon and the expression of FSHβ and LHβ genes in grass puffer. The third group is PQRFa peptide group, including neuropeptide FF (NPFF), neuropeptide AF (NPAF) and neuropeptide SF (NPSF). PQRFa has recently been shown to be involved in the regulation of reproduction in lower vertebrates.

Cyclic expression of genes for reproductive neuropeptides and their receptors

We first determined magnitudes of changes in the brain amounts of mRNAs for GnRH1, GnRH2, GnRH3, kisspeptin, GPR54, LPXRFa, LPXRFa receptor (LPXRFa-R) over several months during the reproductive cycle. The expression levels of these genes significantly varied depending on reproductive stage and gender. In both sexes, kisspeptin gene (kiss2) was predominantly expressed during the course of sexual maturation with a significant elevation from the pre-spawning to post-spawning stages. Kisspeptin most probably plays a central role in the control of gonadal maturation from the early stage of gametogenesis to the post-spawning stage. It should be also noted that kisspeptin and GPR54 genes showed similar expression patterns during the gonadal maturation, suggesting a common regulatory mechanism of gene transcription for the ligand and receptor. On the other hand, the expression pattern of the three GnRH genes was quite different from each other.

The levels of GnRH1 gene expression were extensively increased from the pre-spawning to spawning stages and decreased to almost no expression in the post-spawning stage in both sexes, in association with the substantial increases in FSHβ and LHβ subunit gene expression and the plasma sex steroids in the spawning stage. GnRH1 plays a crucial role in the regulation of final sexual maturation through activation of GTH secretion. In contrast, GnRH2 showed no noticeable changes during the gonadal maturation, and GnRH3 showed an apparent sexually dimorphic expression: in the males the expression of GnRH3 gene was significantly increased in the spawning stage like GnRH1, whereas in the females it increased along with the gonadal maturation and reached a maximum in the post-spawning stage. LPXRFa and LPXRFa-R genes were synchronously expressed with a gradual increase during the gonadal maturation and a decrease in the post-spawning stage in both sexes, suggesting their roles in gonadal maturation. Actually, we showed that LPXRFa stimulated the expression of FSHβ and LHβ subunit genes in the pituitary of grass puffer.

The augmented expression of these neuropeptide and its receptor genes in the spawning stage is indicative of their essentiality in the semilunar spawning rhythm. It is of considerable importance to examine whether they show cyclic expression in relation to diurnal and lunar changes. LPXRFa and LPXRFa-R genes showed diurnal and circadian variations under LD and DD conditions, respectively. Under DD conditions, both LPXRFa and LPXRFa-R genes showed one peak at CT15 during the subjective nighttime. The synchronous and diurnal variations of LPXRFa, LPXRFa-R and melatonin receptor genes suggest that the expression of LPXRFa and LPXRFa-R genes is regulated by melatonin. The photoperiodic regulation of LPXRFa gene through melatonin has been reported in quail and Syrian hamster. Considering that melatonin could be a signal molecule that transmits the information of moonlight intensity, melatonin may have a pivotal role in the control of the semilunar-synchronized spawning in grass puffer.



Schematic representation of the proposed mechanisms underlying the neuroendocrine control of semilunar-synchronized spawning rhythm in grass puffer.

CONSERVATION OF THE RIVER HALDA BY ECA DECLARATION

Conservation of the River Halda by ECA Declaration

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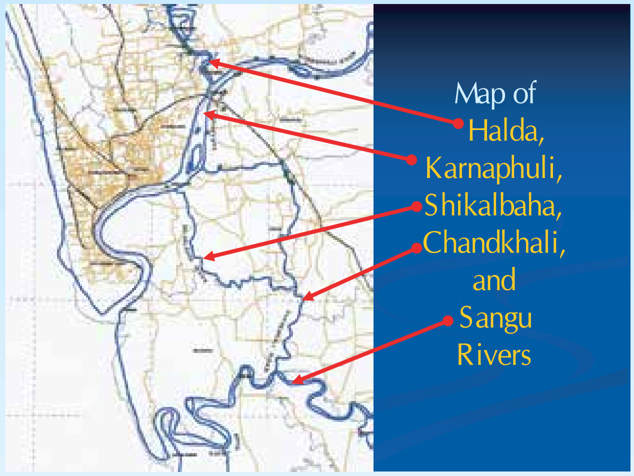
The River Halda- one of the tributaries of the River Karnaphuli, is linked with the River Sangu through the River Chandkhali and Shikalbaha. This river is well known as a major spawning ground of native major carps. It is not only the natural spawning ground of major carps in the world, but the only tidal river from where fertilized eggs of major carps are collected (during April-June) traditionally and hatched and reared (up to 4-6 days) in the mud scoop on the river bank. From a few of other rivers of India and Bangladesh, spawn (fry) of major carps are collected after 15 to 30 days of hatching. Fry production in the River Halda has declined alarmingly from 2,470 kg in 1945 to 508 kg in 2014 and only about 30 kg produced in April 2015 (no spawning occurred in May, one more spawning may occur in June 2015, if rainfall and other favourable conditions prevail during spawning schedule in lunar phase). To protect and conserve this important River, a meeting was held in the Office of the Honourable Prime Minister on 21 August 2014 and as per decision of the meeting, the Department of Environment was requested to take necessary measures to declare the Halda River as Ecologically Critical Area (ECA). In this connection an 'opinion exchange meeting' was conducted by the Department of Environment on 10 May 2015 in the Chittagong Circuit House.

As previously recommended, (1) Twenty kilometer area from Sartaghat Bridge to Madunaghat Bridge of Halda River (where four spawning zones are present) was declared fish Sanctuary (year round no fishing) in 2007 by the Government of Bangladesh (Bangladesh Gazette 2007) (2) Fishing ban regulation was declared from Nazirhat Bridge (on the Halda River) to Kalurghat Bridge (on the Karnaphuli River) and in 16 tributaries (from Sarta khal North to the South Sakarda Khal) of Halda river during February to July and from March to July in the four Halda linked Rivers (Karnaphuli, Sangu, Shikalbaha and Chand khali) for easy migration of major carps, (3) operation of engine boats/mechanized boats are prohibited during spawning time from March to June in the Halda river. Later on in 2010 whole fishing areas of the Halda river from Nazirhat bridge to Kalurghat bridge (some portion of Karnaphuli river) was declared fish sanctuary (year round no fishing) (Bangladesh Gazette 2010).

Despite the declaration of sanctuary and fishing banned regulations, fishing was not completely stopped in the Halda River and its tributaries, and yet no implementation of regulations were observed in the Sangu, Chandkhali, Shikalbaha and most part of the River Karnaphuli. Besides 16 sluice gates on the 16 main tributaries within the 20 km spawning area, two factories effluents (Peking power plant and paper mill at Hathazari), and some tanneries and lot of brickfields wastes are coming to the River Halda (untreated). Very alarming is that recently two rubber dams are established in the upstream of the River Halda (in Fatickchari area), which block the normal water flow of the river mainly during summer.



River Halda and its adjacent linked four Rivers (Karnaphuli, Shikalbaha, Chandkhali and Sangu) from where major carps migrate to the Halda river during spawning period.

Effective implementation of ECA for 83 km area of Halda River staring from Badnatali Union, Ramgarh Upazilla of Khagrachari district to the Halda Mouth, joining point with the River Karnaphuli following measures (short term and long term) should be taken:

- Awareness programme on the drastic reduction of major carps egg and fry production should be taken among the students, teachers and guardians of schools, colleges, madrasas, universities; club members, fishermen, carps egg collectors, and all levels of peoples of Halda River Area (and also in the Halda linked four rivers area i.e. Karnaphuli, Sangu, Chandkhali, and Shikalba).
- Random and sudden vigilance (by the properly formed powerful team with Police personnel) to check and arrest the illegal fishers in main fishing zones of the River Halda and to stop fishing using detrimental fishing gears in four Halda adjacent rivers (Karnaphuli, Sangu, Chandkhali and Shikalbaha). Vigilance in the factories (including poultry) to stop the release and/or dumping of any pollutant in the river without treatment.
- Unused sluice-gates of Halda River should be removed and set fish friendly pass in the active sluice-gates. Two rubber dams at upstream of the Halda River should be removed. Silted tributaries should be scientifically excavated to revive the original flow of the catchment area.
- Post larvae (PL) of shrimp collection should be banned in the River Halda and its adjacent rivers (Karnaphuli, Sangu and Chandkhali).
- There should be a yearly major carps (Halda origin fingerlings and sub adult) stocking programme not only in the river Halda but also in the four rivers adjacent to Halda.
- No industry should be established in the Halda vicinity and adjacent areas and no effluents, pollutants, or wastes (municipal, city corporation, industrial, poultry etc.) should be drained to the Halda and its adjacent four rivers without proper treatment.
- Oxbow-bend or loop cutting, establishment of dam, and sluice gates construction should be banned in the Halda and its adjacent Rivers.
- Excavation measures should be taken with the recommendation from the trained, experienced river hydro-biologist and fish biologist, not from the untrained so called experts.
- Due to ECA declaration and implementation dislodged fishermen should be rehabilitated by providing support and alternative income generating jobs.

On the basis of my experience and research (since 1977) I can say that declaration of ECA only in the River Halda will not protect and conserve the River Halda and its major carps. Halda adjacent rivers should be taken into consideration to conserve the 'Chittagong-Halda Stock major carps' and important 'Tidal-River carp spawning ground Halda'. Keeping most of the adjacent organs (linked rivers) exposed to hazards, single organ (Halda) protection (by ECA) will not sustain the Halda spawning environment and Halda major carps activities (migratory) in normal condition. Therefore, for proper protection of the spawning and spawning ground of the River Halda, ECA should be declared on Halda and part of four Halda linked rivers - Karnaphuli, Sangu, Chandkhali and Shikalbaha.

Importance of mycotoxins in aquaculture feeds

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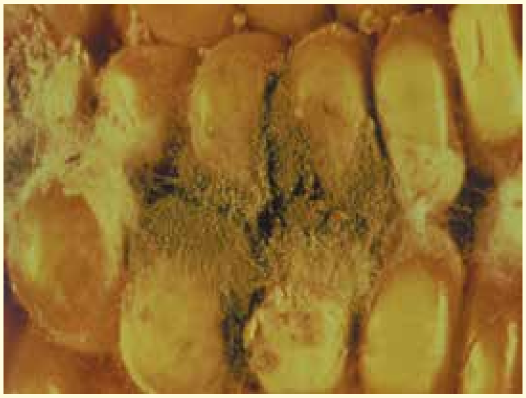
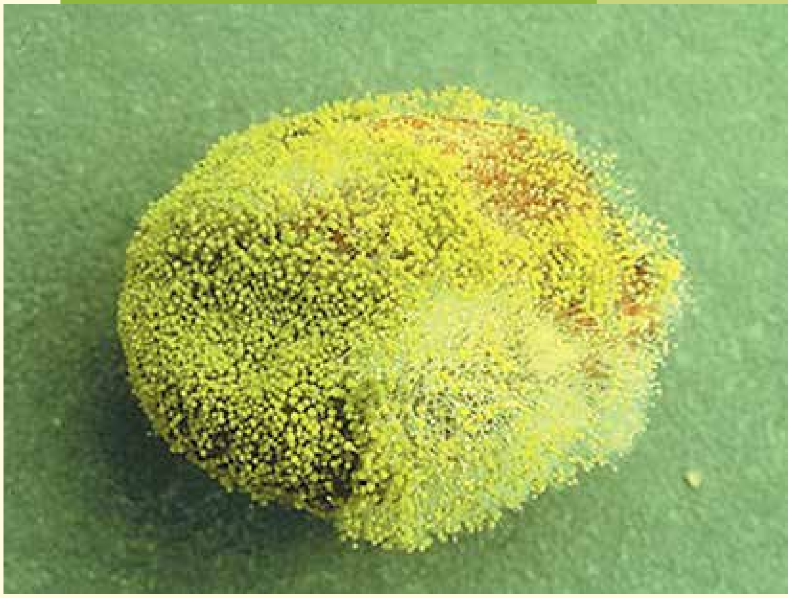
Importance of mycotoxins in aquaculture feeds

Mycotoxins are a diverse group of toxic secondary metabolites produced by certain moulds when they grow on agricultural products. They do not belong to a single class of chemical compounds, and they differ in their toxicological effects. Some mycotoxicoses, the toxic manifestations of mycotoxins in humans or animals, have been known for hundreds of years (e.g. ergotism). Mycotoxins are also has been labeled a phytoestrogen, a mycoestrogen, and a growth promotant.


The fungus *Aspergillus flavus* sporulating on corn

The importance of mycotoxins to aquaculture and animal agriculture first became apparent during the early 1960s with outbreaks of aflatoxicosis in young turkeys in the United Kingdom and hatchery-reared rainbow trout (*Onchorynchus mykiss*) in the United States. In both cases the origin of aflatoxicosis was aflatoxin-contaminated feed (peanut meal for turkeys and cottonseed meal for trout). Other mycotoxins described since then include ochratoxin A, deoxynivalenol, T-2 toxin, zearalenone, moniliformin, cyclopiazonic acid and fumonisin.


Aspergillus flavus and A. parasiticus may cause a disease of peanuts known as yellow mold


Aspergillus ear rot of corn, caused by *Aspergillus flavus*. (Courtesy G. Munkvold)

Major mycotoxins

Aflatoxins: The four major aflatoxins are called B1, B2, G1, and G2 based on their fluorescence under UV light (blue or green) and relative chromatographic mobility during thin-layer chromatography. Aflatoxin B1 is the most potent natural carcinogen known and is usually the major aflatoxin produced by toxigenic strains. However, well over a dozen other aflatoxins (e.g., P1. Q1, B2a, and G2a) have been described, especially as mammalian biotransformation products of the major metabolites. While rainbow trout are very sensitive to the presence of aflatoxin in their diets, with as little as 0.4 ppb (µg/kg of diet) dietary aflatoxin producing heptocellular carcinoma (HCC) in 14 percent of trout over a period of 15 months, warm water fish do not appear to be as sensitive to dietary aflatoxin. In an aquarium study, channel catfish (Ictalurus punctatus) fed diets containing up to 275 ppb total aflatoxins from moldy corn for 12 weeks showed no reductions in weight gain or survival. In a pond experiment, catfish fed a practical diet containing 50 percent moldy corn and at least 88 ppb aflatoxin for 130 days showed no reductions in pond productivity, feed efficiency, or hematocrit values in comparison to catfish fed diets containing 50 percent clean corn and 1 ppb aflatoxin. In a recent study, channel catfish were fed practical diets that contained up to 135 ppb aflatoxin from moldy corn for 10 weeks and subsequently challenged with the catfish pathogen Edwardsiella ictaluri, which causes enteric septicemia of catfish (ESC). At 21 days post-challenge, these fish did not have higher mortality than catfish fed the control diet (0 ppb aflatoxin). Channel catfish appear to be able to detoxify dietary aflatoxin. Tilapia (Oreochromis nilotica) did have lower weight gains, poorer feed conversion (FCR) values, and lower hematocrit values when fed diets containing 2,500 ppb or more aflatoxin. A diet with 250 ppb aflatoxin did not produce these responses. Other research showed that tilapia had reduced growth rates when fed a diet with 1,880 ppb aflatoxin for 25 days, but not when fed a diet with 940 ppb aflatoxin. Therefore, both channel catfish and tilapia appear to be much less vulnerable to aflatoxin than rainbow trout.

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Citrinin: Citrinin was first isolated from Penicillium citrinum prior to World War II; subsequently, it was identified in over a dozen species of Penicillium and several species of Aspergillus (e.g., *Aspergillus terreus* and *Aspergillus niveus)*, including certain strains of Penicillium camemberti (used to produce cheese) and Aspergillus oryzae (used to produce sake, miso, and soy sauce). Wheat, oats, rye, corn, barley, and rice have all been reported to contain citrinin. Citrinin has also been found in naturally fermented sausages from Italy. Although citrinin is regularly associated with foods, its significance for fish health is unknown.

Ergot Alkaloids: The ergot alkaloids are among the most fascinating of fungal metabolites. They are classified as indole alkaloids and are derived from a tetracyclic ergoline ring system. Lysergic acid, a structure common to all ergot alkaloids, was first isolated in 1934. The clavines have ergoline as a basic structure but lack peptide components; the lysergic acid alkaloids include ergotamine and lysergic acid amide (ergine). Two forms of ergotism are usually recognized, gangrenous and convulsive. The gangrenous form affects the blood supply to the extremities, while convulsive ergotism affects the central nervous system.

Fumonisins: Fumonisins were first described and characterized in 1988. The most abundantly produced member of the family is fumonisin B1. They are thought to be synthesized by condensation of the amino acid alanine into an acetate-derived precursor. The major species of economic importance is Fusarium verticillioides, which grows as a corn endophyte in both vegetative and reproductive tissues, often without causing disease symptoms in the plant. Fusarium verticillioides is present in virtually all corn samples. Most strains do not produce the toxin, so the presence of the fungus does not necessarily mean that fumonisin is also present. Although it is phytotoxic, fumonisin B1 is not required for plant pathogenesis.

Ochratoxin: Ochratoxin A was discovered as a metabolite of Aspergillus ochraceus in 1965 during a large screen of fungal metabolites that was designed specifically to identify new mycotoxins. Shortly thereafter, it was isolated from a commercial corn sample in the United States and recognized as a potent nephrotoxin. Although some early repor ts implicated several Penicillium species, it is now thought that Penicillium verrucosum, a common contaminant of barley, is the only confirmed ochratoxin producer in this genus. In a study of the effects of dietary OA on channel catfish, fish fed 4 ppm (mg/kg of diet) OA in a practical diet gained less weight than control fish and experienced obliteration of the exocrine pancreatic tissue, which is associated with the hepatic portal vein. These catfish had no lesions on the renal tissue of the posterior kidney. Channel catfish that consumed practical diets containing 2 or 4 ppm OA and were subsequently challenged with the pathogenic bacteria Edwardsiella ictaluri had greater mortality than control catfish.

Patulin: Patulin, 4-hydroxy-4H-furo(3,2c)pyran-2(6H)-one, is produced by many different molds but was first isolated as an antimicrobial active principle during the 1940s from Penicillium patulum (later called Penicillium urticae, now Penicillium griseofulvum). The same metabolite was also isolated from other species and given the names clavacin, claviformin, expansin, mycoin-c, and penicidin.

Trichothecenes: The trichothecenes constitute a family of more than sixty sesquiterpenoid metabolites produced by a number of fungal genera, including Fusarium, Myrothecium, Phomopsis, Stachybotrys, Trichoderma,

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Trichothecium, and others. They are commonly found as food and feed contaminants, and consumption of these mycotoxins can result in alimentary hemorrhage; direct contact causes dermatitis.

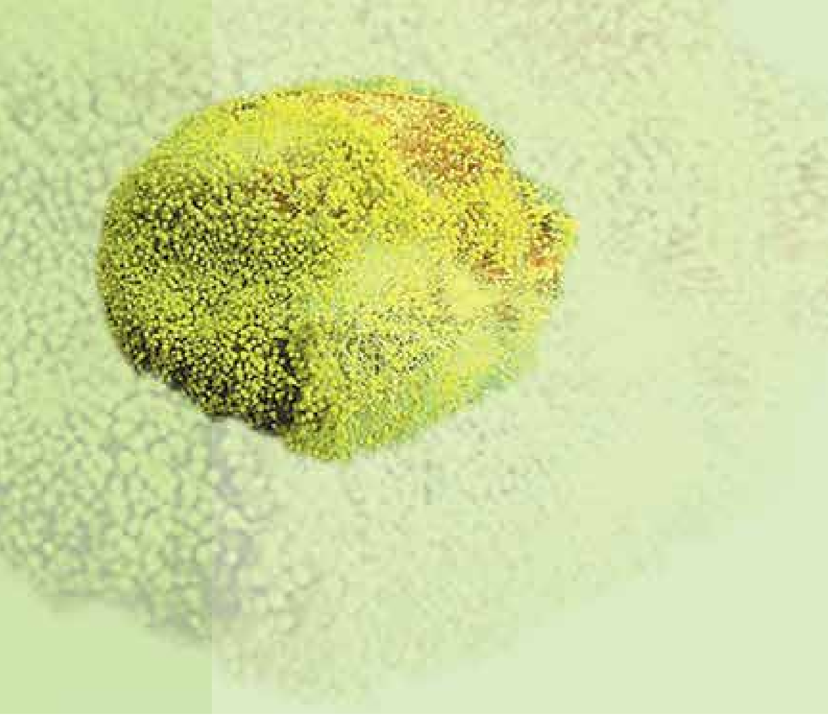
Zearalenone: The zearalenones are biosynthesized through a polyketide pathway by Fusarium graminearum, Fusarium culmorum, Fusarium equiseti, and Fusarium crookwellense. All these species are regular contaminants of cereal crops worldwide. processors and consumers risk. Risk of mycotoxin contamination in food exists from the crop grown in the field until the final product is consumed. One of the approaches for reducing the levels of mycotoxins in food supply can be to encourage the diversion of moulds and contaminated grains to non-food use or processing industries which recover one or more mycotoxin free products.

There are adsorbents that bind feedborne mycotoxins to prevent them from being absorbed by fish after consumption. These binders fall into two main classes: 1) hydrated sodium calcium aluminosilicate (HSCAS) clays and 2) modified fractions of the single-cell yeast organism Sacchromyces cerevisiae, or common bakers' yeast. The clays seem to work well with aflatoxins, but are less effective with other mycotoxins. The yeast preparations appear to be effective on a broader range of mycotoxins. Neither type of binder has been extensively evaluated in fish feeds. Agents that are purported to bind mycotoxins should be tested on the mycotoxin of interest to be certain that effective binding occurs and that the binder is safe for the intended species of fish. The cooker-extrusion process of feed manufacturing, which applies heat, reduces the level of aflatoxins in channel catfish feeds. In catfish pond experiments, preparing floating feeds containing aflatoxin-contaminated corn by cooker-extrusion technology reduced the level of aflatoxin by more than 60 percent.

The effect of moldy feeds, and the mycotoxins and other chemical substances they produce, on the growth and health of cultured fish is not well understood. In fact, the identity of the many chemical substances feed-associated molds produce may not be complete. Because so little is known, it is prudent to prevent fish feeds from becoming moldy and to refuse to purchase feeds and feed ingredients that are moldy, even if they are offered at a discount. If stored fish feed has become moldy, do not use it until it has been evaluated for mycotoxin contamination.

Conclusions

It is difficult to prove that a disease is a mycotoxicosis. Molds may be present without producing any toxin. Thus, the demonstration of mold contamination is not the same thing as the demonstration of mycotoxin contamination. Moreover, even when mycotoxins are detected, it is not easy to show that they are the etiological agents. The incidence of mycotoxicoses may be more common than suspected. It is easy to attribute the symptoms of acute mycotoxin poisoning to other causes; the opposite is true of etiology. In summary, in the absence of appropriate investigative criteria and reliable laboratory tests, the mycotoxicoses will remain diagnostically daunting diseases.



Impact of mola *Amblypharyngodon mola* culture in ponds and pond connected rice fields

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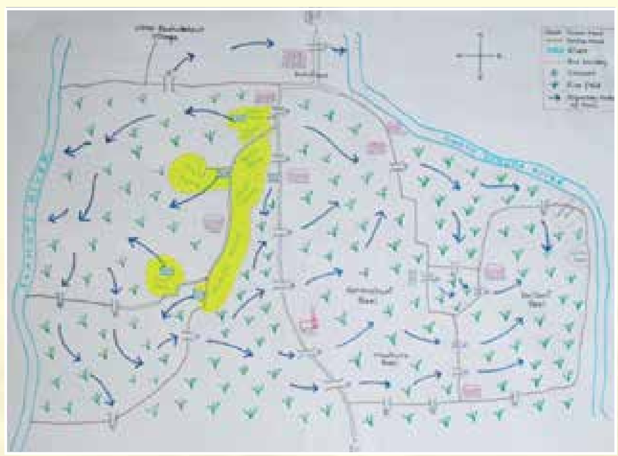
WorldFish, Bangladesh has recently promoted culture technology of micro-nutrient rich small fishes specially mola *Amblypharyngodon mola* with carps in the ponds and pond connected rice fields in some districts of north-west and southern part of Bangladesh under International Fund for Agricultural Development (IFAD), Cereal Systems Initiative for South Asia (CSISA-BD) and Feed the Future (FtF) projects. IFAD funded "small fish and nutrition project" has worked with 80 communities containing 1500 households in the Rangpur and Dinajpur districts. Mostly the poor households having single pond for each or the sharers were the target households who have been involved in the activities of the project to carry out polyculture of mola with prawn and/or carps. Most of the ponds (seasonal or perennial) under project are confined and rest others are connected to rice field.



Resource map with spread path way (showed by arrow symbol) and expanded area of mola around the studied communities in Mominpur union, Parbatipur, Dinajpur (North to South: 5 km; East to West: 10 km). Yellow coloured areas represent the selected communities in the study. Escaped mola from flooded ponds first reached to the closest rice field area, then spread from one rice field zone to another zone through culvert under the roads. Thus, the fish extended to the nearby water bodies like beels, canals, rivers etc.

Currently a survey has been carried out supported by BFRF to assess the impact of mola culture with carps in ponds and pond connected rice fields on production, biodiversity, consumption and income of intervened and non-intervened households in the project area of Dinajpur and Barguna district. Recall data were collected through individual interviews, field observations and other participatory rural appraisal (PRA) tools such as focus group discussion (FGD), case study, trend analysis etc. In addition, cross-check interviews were also conducted with the key informants such as Upazila Fisheries Officers and/or project staffs.

Survey results showed that, production of mola from the ponds of intervened households was higher in several folds after project intervention than before which ultimately increased family consumption of the fish as well as income. The intervened households who have pond connected rice fields reported higher production of mola up to double or more than those having ponds but not connected to rice fields. Such production in the pond connected rice fields occurred due to several advantages of the system. During the wet months, when dry rice fields hold water, the fingerling or brood fish of mola stocked earlier in the connected ponds get access to the rice fields and find suitable environment for breeding, and nursing of small fish, the larvae or fry. In addition, complete drying of rice field during arid season become free from toxic gases is important for fish especially suitable for larvae or small fry. It is notable that, the farmers stopped or reduced to use pesticides in the rice field with their own initiatives when they started to use rice field for mola production after project intervention which obviously has positive effect on the environment.

Cultured mola of the households were not only used for their own consumption but also were given as gift to their neighbors or relatives. Since mola breed in the ponds over the season, households acquired higher production maintaining regular harvest. Encouraging findings were also obtained from the non-intervened households having ponds. Many of them released mola to their ponds getting inspiration from increased production of the neighbouring intervened households. Since the market price of mola is relatively higher, the income of the households from the fish remarkably increased in the subsequent years after starting culture of the fish in their ponds. Another interesting finding was that the culture of mola with carps was found as a useful strategy to save the carp species from harvest in smaller size and gets more time to grow them to large size for getting best price from the market.

Mola is self-recruiting species. It is a prolific breeder and breeds about two or three times a year. Moreover, a very small water area with a water depth of 1 m during dry season is adequate in terms of providing refuge for the fish, for purposes of fish seed. Therefore, production and availability of mola in surrounded wet lands rapidly increased after project intervention. Positive effect of mola culture was also found on the biodiversity of other aquatic animals beside fish. As for example, mola farmers and fishermen reported that the presence of water snakes, herons and kingfishers has been increased around the culture ponds as well as the project area after intervention. Such experience may motivate to find the way of ecosystem restoration for regaining fish diversity and sustainable production of endangered small indigenous fishes in our aquatic environment.

Live feed culture: An essential element for marine fish hatchery production

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The success of any farming practices of fish and shellfish depends upon the availability of seed for grow-out. However, for many marine fish and shellfish species, this has only been possible through the development and use of live feed for the developing larvae. The production and use of the major live feed organisms is currently employed in larviculture practices worldwide. Now this has also been practiced in marine research under Marine Fisheries and Technology Station of Bangladesh Fisheries Research Institute at Cox's Bazar.

The production of live feed organisms as well as their application in larviculture has brought about revolutionary change in mariculture operation. The natural diet of most cultured fish and shellfish species consists of a wide diversity of phytoplankton (diatoms, flagellates, etc.) and zooplankton (copepods, cladocerans, decapods, rotifers, ciliates, etc.). For larval rearing of fish and shellfish live diets should be readily and consistently available.

Phytoplankton comprises the base of the food chain in the marine environment. Therefore, micro-algae are indispensable in the commercial rearing of various species of marine animals as a food source for all growth stages. Algae are furthermore used to produce mass quantities of zooplankton (rotifers, copepods and brine shrimp) which serve in turn as food for larval and early-juvenile of fish and crustaceans. For rearing of marine fish larvae following the "green water technique", algae are used directly in the larval tanks where they are believed to play a role in stabilizing the water quality, nutrition of the larvae, and microbial control.

Class	Genus	Application
Bacillariophyceae	*Skeletonema* (2-20μm)	PL, BL, BP
	Thalassiosira (2-20μm)	PL, BL, BP
	Chaetoceros (2-20μm)	PL, BL, BP
	Nannochloropsis (2-20μm)	MR
Rotifer	*Brachionus sp* (50-200μm)	CL, ML

Note: PL, Penaeid shrimp larvae; BL, Bivalve mollusc larvae; BP, Bivalve postlarvae; MR, Marine rotifers *(Brachionus)*; CL, Crustacean larvae; ML, Marine fish larvae.

All algal species are not equally successful in supporting the growth and survival of a particular filter-feeding animal. Suitable algal species have been selected on the basis of mass-culture potential, cell size, digestibility, and overall food value for the feeding animal. Today, more than 40 different species of micro-algae, isolated in different parts of the world, are cultured as pure strains in intensive systems. The eight major classes and 32 genera of cultured algae currently used to feed different groups of commercially important aquatic organisms. The list includes species of diatoms, flagellated and chlorococcalean green algae, and filamentous blue-green algae, ranging in size from a few mm to more than 100 um. The most frequently used species in commercial mariculture are the diatoms *Skeletonema costatum, Thalassiosira* sp., *Chaetoceros gracilis, Tetraselmis* sp., *Nannochloropsis oculata* and rotifer *Brachionus plicatilis.*

Live feed culture needs correct routine program as well as regularity with full concentration. Clean and hygienic laboratory are mandatory in live feed culture because 70% on the success depends on sanitation followed by 20% of correct routine program and rest 10% on technology.

The live feed culture in mariculture research is first initiated by MFTS in recent times. This initiation supports the crab breeding success for the first time in Bangladesh. A few years ago, induced breeding of marine fish and crustacean was impossible due to lack of live feed culture lab, but at present it is possible by the blessing of live feed culture. This will provide great opportunities in marine fisheries research of the country in coming days.

Success on mud crab (*Scylla seratta*) breeding in Bangladesh

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This is first time in Bangladesh to produce crablet from artificial propagation of mud crab (*Scylla seratta*). The study was conducted in Marine Fisheries & Technology Station, Cox's Bazar of BFRI during December 2014. Here we present a pictorial pathway of success story of induced breeding of mud crab in Bangladesh.

Rearing of mature crabs in hatchery cistern

Graved mud crab

Graved mud crab with orange color eggs

Orange color egg turn to brown color indicates that crab ready for hatch

Eye ablation of graved crab

Indoor and outdoor live feed culture for crab breeding operation

Hatched eggs to crablet stages

Crablet of 15 days age

Analysis of two red seaweed polysaccharides by Matrix-assisted laser desorption/ionization time-of-flight (MALDI-TOF) mass spectrometry

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Marine macroscopic algae known as seaweed plays an important role in the ecosystem of the coastal areas in the world, serving as nursery grounds for fish and many invertebrates, and contributes to the maintenance of both biodiversity and natural environments. So an understanding of seaweed sensitivity is important for understanding the wider ocean acidification impacts on coastal ecosystems.

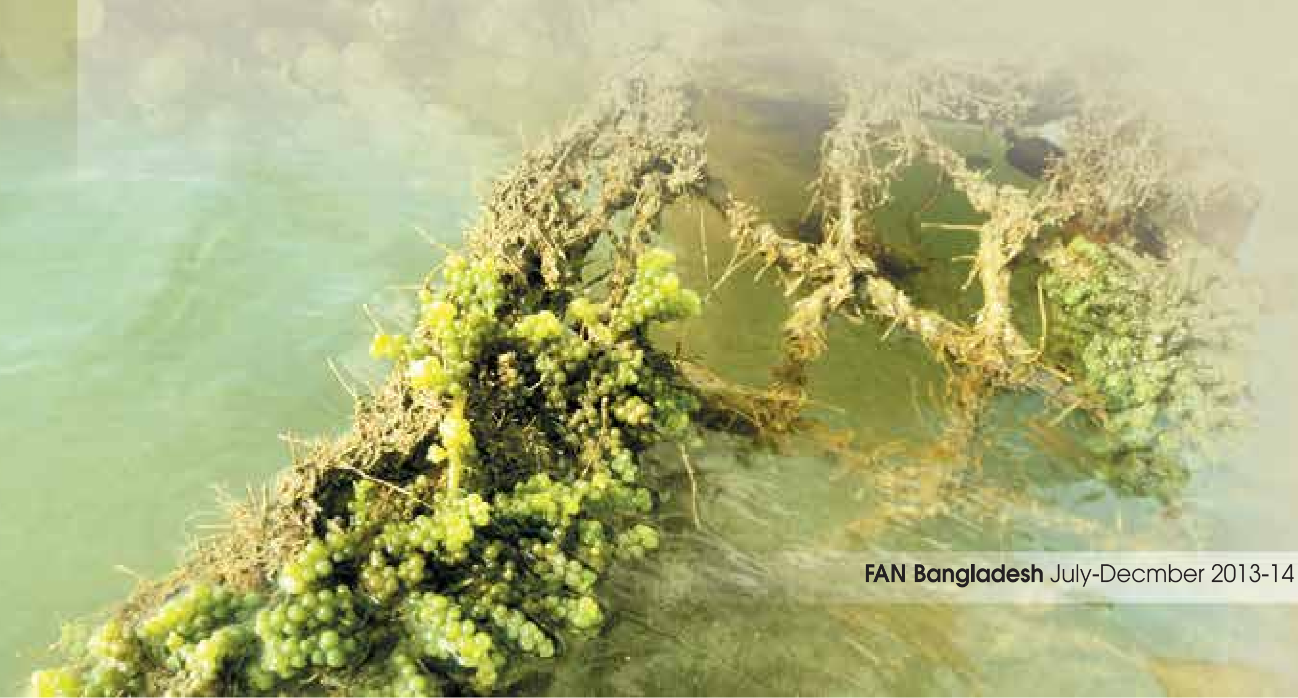
It is well known that seaweed can keep small organic metabolites, salts and metal cations in its cell wall structure present as contaminants in water. Also it is known that seaweed polysaccharides can play a very important role in keeping metals as polysaccharide-metal complex in the intact cell walls and in the solutions obtained after isolation of cell wall polysaccharides for their analysis. Polysaccharides present in seaweed can provide important applications as hydrocolloids of use in food industry, medicinal chemistry and pharmacology. Some of them have been shown very interesting antiviral activity. In general, their properties depend on their chemical structure. Some of them can be neutral agarans, mannans and xylans as well as sulfated oligosaccharides. The biosynthesis of them can be modified by environmental factors such as temperature, solar radiation and environmental pollution. As a result, seaweed is becoming important day by day, and has been widely investigated due to its virtual benefits. Till recently the exact structure and composition of these mixture of natural polymers of seaweed was almost impossible to know. Since UV-MALDI MS has been introduced as analytical technique the chance to get information about chemical structure and composition of natural polysaccharides has increased dramatically. Although its potentiality, UV-MALDI MS analysis of polysaccharides is quite difficult because of the shortage of efficient matrices and lack of data bank for data comparison. We developed new efficient matrices for polysaccharides analysis in algae *Nemalion helminthoides* (Nemaliales) and *Nothogenia fastigiata*, and analyzed the effect of frequent contaminant metal cations and salts on the UV-MALDI MS analysis of polysaccharides extracted from red seaweed.

We isolated polysaccharides from the red seaweed collected from its natural populations and developed suitable experimental conditions for the optimum analysis of polysaccharides of seaweed as well as we developed some new ionic liquid matrices such as DHB-n-butylamine (DHB-Bu) and FA-Bu for analysis of seaweed oligosaccharide alditols. As part of our research project related with the study of MALDI MS analysis of carbohydrates of red seaweed, we reported the behavior of selected model compounds, oligosaccharides (aldoses) and oligosaccharide alditols of two important red seaweed, using different matrices (2,5-dihydroxybenzoic acid (DHB), nor-harmane, ferulic acid (FA), and the ionic liquid matrices DHB-n-butylamine (DHB-Bu) and FA-Bu.

(A) Threadweed or Sea noodles Nemalion helminthoides

(B) Nothogenia fastigiata

These compounds, obtained from agaroses, kappa- and iota-carrageenans, were chosen to study the MALDI and the fragmentation processes (prompt fragmentation and PSD) of both families of carbohydrates. The experiments conducted by using several compounds as MALDI matrices allowed finding suitable conditions for effective analysis of the alditols and oligosaccharides studied. The results obtained can be summarized as follows: (a) Alditols with more than one sulfate group suffered desulfation. Glycosidic cleavages were also observed, (b) Sulfated oligosaccharides with more than one sulfate group gave, as it was expected, desulfation, but glycosidic fragmentation was more important. (c) Non-sulfated oligosaccharides and non-sulfated alditols did not show any prompt fragmentation. (d) Non-sulfated oligosaccharides yielded cross-ring fragmentation in the PSD mode. It is important to note that this behavior is completely different to that observed in the MALDI-TOF linear and reflectron spectra of sulfated neocarrabiose oligosaccharides using DHB and nor-harmane as matrices where desulfation but no glycosidic C-cleavages was detected as prompt fragmentation. Finally, red seaweed contains great amounts of carrageenan as well as used in the manufacture of the all-important agar, widely used as a growth medium for microorganisms, and for gelling and thickening purposes for food, pharmaceutical and biotechnological applications. Red seaweed are also increasingly appreciated as sources of compounds that evolved as defensive responses to microbial or herbivore attack that also have potential uses in human medicine. The wide distribution makes the seaweed a prospective subject for industrial obtaining of polysaccharides.



Dried fish industry: Livelihoods and food security in Bangladesh

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Dried (*shutki*) and fermented (*chapa or shidol*) fish are among most frequently consumed fish products in Chittagong, Sylhet and Mymensingh regions of Bangladesh. Dried and fermented fish are also among the most important types of fish consumed in these areas in terms of quantity, when water loss during the drying process is taken into account, because, on average approximately 4 kg of fresh fish are used to produce 1 kg of dried fish. Dried fish products are particularly important for poorer consumers because, unlike large fresh fish, they can be purchased in very small quantities (eg. 25-100 g), with a low cost per individual portion. *Shutki* or *shidol* is usually mixed with vegetables and spices and served as a nutritious side dish. Just Tk. 10-20 worth is usually sufficient for a family meal, because its strong flavour means that a little goes a long way when cooked.

Despite the importance of dried fish as a source of food, relatively little is known about the conditions under which it is produced and marketed. In order to try to understand this situation better, WorldFish began an investigation into dried fish value chains in Bangladesh, in association with Bangladesh Agricultural University. The first phase of this research was a rapid appraisal of inland and marine drying sites and wholesale and retail markets in Sunamganj, Netrakona, Krisoreganj, Cox's Bazar, Chittagong, Sylhet, Mymensingh and Dhaka. This represented the first ever attempt to document all stages of dried marine and freshwater production, distribution and consumption in Bangladesh.

Composition of the sector

Dried marine fish accounts for an estimated 85% of total dried fish production. The most important dried marine fish are loitya (*Harpadon nehereus*), churri (*Eupleurogrammus muticus*) and phaisa (*Setipinna spp.*). Other commonly dried marine species include poa (*Panna microdon*), clupiforms such as ichhiri, shrimps, and small sharks, rays and flat fish. Large high value fish such as bhetki (*Lates calcarifer*), kamila (*Congresox spp.*) and surma (*Rastrelliger spp.*) are also dried in smaller quantities. There is no limit to which species may be dried however, and virtually all the species caught are dried. We estimate that as much as 45% all marine landings in Bangladesh may be dried, or even more if the hilsa (*Tenualosa ilisha*) fishery is excluded. A very wide variety of freshwater fish are also dried, but puti (*Puntius spp.*) is dominant, possibly accounting for as much as 75% of total production, and is used primarily for the production of fermented fish. Phaisa is also used to make fermented product. Puti shidol is most popular with consumers in Mymensingh and Dhaka, while phaisa shidol is more commonly eaten in the haor region. Shidol is not traditionally eaten in Chittagong division. Fermented products may account for as much as 20% of all dried fish consumed. Most marine fish drying occurs from mid-August to mid-April, while the peak season for production of dried fish from inland sources is shorter, running from October to March.

Drying sites and markets

Marine drying sites are found all along the coast of the Bay of Bengal. Some of the largest concentrations are found in Dublarchar (Khulna) and Nazirartek (Cox's Bazar). Large freshwater drying operations are found in Lalpur (Bhramanbaria) and Kuliarchar (Krishoreganj). Smaller scattered operations are found throughout Sunamganj and the haor basin, as well as in Faridpur and around Chalan Beel and Kaptai Lake. There are four major assembly markets for dried fish in Bangladesh. Asadgonj in Chittagong is the largest of these, and the vast majority of marine fish sold in Bangladesh passes through this market. Large wholesale markets also exist in Karwan Bazar (Dhaka), Massimpur (Sylhet), and Syedpur (Rangpur).

Labour: In contrast to most other sectors of the labour market in Bangladesh, fish processing work is overwhelmingly performed by women, who account for approximately 80% of the workforce. Women are paid Tk. 150 for approximately 12 hours of work, which consists mainly of sorting, bunching and turning fish. Despite extremely harsh conditions under which this work is conducted, marine fish drying represents a livelihood opportunity of last resort for many who have been displaced by climatic events such as cyclones, or are completely or assetless for other reasons. A large proportion of female fish processing workers in Cox's Bazar are Rohinga refugees who have migrated Myanmar. Most female workers involved in processing freshwater fish do not receive cash payment. Instead, they are allowed to retain puti guts, which they boil in order to produce oil. Puti oil is used in the production of fermented fish. Several hours work usually yields around a liter of oil, worth Tk. 80-100. Numbers of people employed throughout the dried fish value chain are cumulatively high, totaling in the tens of thousands.

Trade: A substantial but largely undocumented trans-continental trade in dried fish exists. India is the main source of imports of both freshwater and marine fish. Myanmar is the second largest supplier, providing mainly small marine fish, but some dried marine fish is imported from as far away as Pakistan and the Persian Gulf. It is probable that at least 20% of all the dried fish consumed in Bangladesh is imported. Bangladesh also exports dried puti to India for the production of shidol, as well as puti shidol itself. Some good quality marine fish is exported to the Middle East for Bangladeshi migrant workers, and high value freshwater fish and shidol are shipped from Sylhet to the UK for consumption by non-resident Bangladeshis. Large high value dried marine fish, sharks fins and the swim bladders of some large marine and freshwater species are shipped to Hong Kong and Southeast Asia.

Food safety: The use of pesticides appears to be widespread, during both drying and storage. Pesticide application during drying is commonest with large fish when high levels of atmospheric moisture slow down the drying process. Pesticides are also applied to dried fish while stored by traders. Pesticides used during drying prevent fly eggs from hatching, while chemicals are applied during storage to control infestation by weevils and other insect. The effects of exposure to these substances on fish workers and regular consumers of dried fish are unknown.

Fish feeds: Small crabs and other marine invertebrates, fish which are considered unfit for human consumption and food fish which has become spoiled, are dried and used as ingredients in fish and poultry feeds. This represents a significant portion of marine landings. Utilization of these organisms in animal feeds does not compete directly with their utilization as human food at present, but the fishing practices used to capture them (mainly estuarine set bag nets with very small mesh sizes) appear unsustainable. Dried and fermented fish is particularly important food for poor consumers, and its production provides a livelihood or source of income for very large numbers of women and men with few alternative options. The characteristics and significance of the sector remain very poorly understood to date however, and evidence suggests that real prices of dried food fish are increasing, resulting in declining consumption among the poor. Bangladesh's food and nutrition security may be negatively impacted as a result. Further research is needed to better understand the production and consumption dried fish and to support policies and interventions which can help to sustain the sector's important role.

Crab fattening – an effective livelihood option for poors in coastal Bangladesh*

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Bangladesh has been exporting mud crab-*Scylla serrata* since 1977-78, and from 1982 as an exportable commodity, which now stands about 5,000 MT annually. Crab is now only second to shrimp in terms of earnings in country's fisheries products export line-up. Production from crab fattening is quite healthy (nearly half of the total harvest) and scaling up rapidly in the coastal areas. The farming is rapidly extending among coastal poor including women of low-caste Hindu *Jaladas* (fishers), and ethnic tribal communities. From the socio-cultural point of view, low caste Hindu community and a number of indigenous tribes- Rakhaing, Mog, Marma have been catching and consuming crab from the time immemorial as a tasty dish.

The practice is a low techno-centric activity with low inputs and little management. The severe outbreak of shrimp diseases over the last few years resulting production loss from *gher* farming systems led many poor and marginal farmers with very small *ghers* to opt for crab fattening. Crab fattening turnover is quicker with higher profit margin and small investment compared to shrimp farming. Among others a BFRF led and DFID funded project (under the Asian Innovation Challenge Fund-Research into Use RIU Programme) entitling "Promoting sustainable coastal aquaculture in Bangladesh (ProSCAB) during July 2008 to June 2011" played the key role in technology generation of crab fattening in cages and disseminating among farmers in the coastal region through community mobilization and capacity building approach. With two partner NGOs assistance - Sushilan and COAST, the project developed easy-to-use technology manuals, arranged numerous trainings and workshops involving crab farmers, traders and others in the value chain and successfully improved and promoted low-cost production and marketing of the mud crab. Bangladesh Fisheries Research Institute through its Brackishwater Station, Paikgacha also arranged training programs for the farmers through establishing model farms for disseminating crab fattening technologies in the coast.

During the ProSCAB initiative, more than 5,000 community partners from four agro-ecological zones along the coast were addressed. An initial core of 1000 households were trained and equipped with technical, and business skills. Community partners of 11 Upazilas under 5 coastal districts validated the technology in their own circumstances and enabled horizontal scaling-up to more households. Through the efforts of the ProSCAB research team, crab culture was introduced into target villages and expanded there rapidly. Crab cages with large multi compartments gave better results compared to small compartments. Therefore, designs of cage have been modified from small compartment to big multi compartments. The constraints were identified and possible remedies discussed by all partners in the innovation network, including community-to-community discussions facilitated by the NGO partners. Thus the production and marketing practices were extended to an additional more than 4,000 households by the initial community partners through exposure visits and training facilitated by NGOs, DOF and technical back-stoppers.

The primary partners came from the 1,000 HHs of the coastal low-caste Hindu *Jaladas*, poor Muslim Fishers and Adivasi (Rakhaing) communities. The secondary partners were another cohort of >4000 coastal poor fisher HHs of same community groups. The stakeholders involved in the value chain of the crabs, whose livelihood opportunities were monitored using focus group discussions formed the tertiary partners. About 1000 community partners formed groups of 15-20 people (1 from each of 1,000 HHs), wherever applicable separately for men and women occupational groups (OGs) covering three targeted communities: Hindu Jaladas, poor Muslim fishers and Adivashi Rakhaings from 34 fisher villages under 18 unions of 11 Upazilas in 5 coastal districts- Cox's Bazar, Chittagong, Bagerhat, Khulna and Satkhira. Exclusive poor and disadvantaged coastal fishing villages were selected on the basis of set criteria. Due to the lucrative nature of the commodities, with a high market demand, easy operation technology, environment-friendly nature and good profit margin, it was estimated that an additional 15,000-18,000 households adopted these new technologies.

Socio-cultural context

The Bangladesh coastal people have long been involved with the gher farming of shrimp. Historically they are well-acquainted with the mangrove species and ecosystems of Sundarbans. Crab fattening being a low techno-centric and low input venture being practiced in the homesteads, most women and young children of the community take part in stocking, feeding, harvesting and marketing of crab. Farmers generally feed the crab with low-value fresh eel (*Monopterus* sp. and *Ophisternen* sp.) fish, small tilapia grown in ghers and mollusk meats which are abundant in the coastal waters including ghers.

In south-western coastal Bangladesh, 74% of the crab fatteners are women. Women crab farmers were found to be carrying out several farming activities. The recurring loss in the shrimp farming and ban on wild shrimp seed collection, principally prompted people on the coast to adopt crab fattening. The lucrative overseas market price - East and Far East also encouraged many poor and middle class Muslim and Hindu HHs to involve in crab fattening. Lack of crab hatchery and the full dependence on wild mangrove for crab seeds limit the expansion of crab fattening only among the poor and marginal community in the coast. The crab fattening activities can give enough earning for a poor family to sustain, the venture, however, is yet to be feasible for wealthy farmers with large land (gher) area.

Women found to involve in different activities in crab fattening

Constraints to development

Wild caught crabs have low profit margin because of size variation and injury during catching. In addition, harvesters report overexploitation as major problem for gradual reduction of wild catch from the Sundarbans mangrove. The farmers and harvesters also reported illegal export of underweight crab which results the over-fishing of juvenile crab from the natural source and reducing the abundance alarmingly. In most of the cases, the juveniles and adults for crab fattening are obtained from the by-catches of fishermen and fisherwomen's catch. However, seed collection is becoming risky for environment and the natural stock has already been suffering overexploitation. Now it is the time of the need to establish crab hatchery in the coast especially in the vicinity of Sundarbans. If crab seed production systems are not established in near future, the whole fattening industry as well as the natural crab population will be in jeopardy. Previously, the livelihoods of coastal low-caste Hindu *Jaladas*, poor Muslim fishers and ethnic tribal communities consisted of fishing, shrimp/prawn PL collection (banned now), working in the *ghers* as labour or earth cutting and were threatened by serious depletion of fish stocks and abundance of wild shrimp/prawn PL. Due to their involvement in crab fattening, the HH income increased substantially and their livelihoods improved significantly.

Mainly due to the initiative of ProSCAB and later on a number of GOs and NGOs, now more than 50,000 coastal families have become involved in crab fattening in small earthen ponds and bamboo cages. The fattening is either for 2 weeks for gravid females or for two months for both sexes, with the work done mainly by the women and children either in mini ponds or in cages set up in ponds or canals. Most of the activities like collecting the crab juveniles, feeding, taking other cares, selling and maintaining the account are done by women.

Crab fattening ponds

Crab fattening cages

 

Fattened crab ready to sell

About 228,111 hectares of land situated near the riverbanks in the tidal zone in the southwest Bangladesh are suitable for brackish water crab farming/fattening. Expansion of crab fattening in a sustainable way in the suitable areas of the coast could have huge impact on the livelihoods of coastal poor mainly through the improvement of income generation, poverty alleviation, nutritional security, confidence and esteem. The high demand for the wider dissemination of the crab fattening technologies along the coast had been vocalized by the coastal poor fishers and landless, NGOs working in the coast, policy makers and Govt. agency like Ministry of Commerce. Poor people in the bottom of the chain are earning for their livelihood, improving nutrition, and contributing in the national economy by earning valuable foreign currency from the export.

Story of Sujata

Sujata (32), a woman of low caste Hindu *jaladas* community, lives in Horinagar Village of Shayamnagar Upazila under Satkhira of the south-west coast of Bangladesh. Shujata does not know how to read or write and got married at the age of 14. Sujata has husband, two sons, a daughter, father in law and mother in law - all living in a thatched house closed to the Sundarbans. It was gradually becoming impossible for Sujata's husband to maintain seven member-family only with his income. In January 2009, Sujata received training on crab fattening under ProSCAB project. She also received 80 ft net, bamboo cages and fifty crabs- rejected by the depot because of the undersize. She set the cages in the river and stocked the crabs. Not her husband, but her boys and girl helped her with day-to-day taking care of the crabs. That was the beginning of the new days for the family. After fattening the 50 crabs just for 15 days, Sujata sold the crab in a neighboring depot and earned Tk. 3,000. Since then she continued crab fattening in bamboo cages also in earthen ponds in her homestead. She bought several milking cows and other livelihood assets, sent her dropout children back to school and rebuilt the house (now half-building). Her acceptability increased day by day not only in her family but also in the neighborhood. She established good contact with local union council leaders and upazila fisheries officer. Other members of the community seek suggestion and technical advice from Sujata. Now Sujata is a self employed woman.

*** The case study is prepared under AFSPAN wp.**

From fresh fish to dried fish-how much weight is lost?

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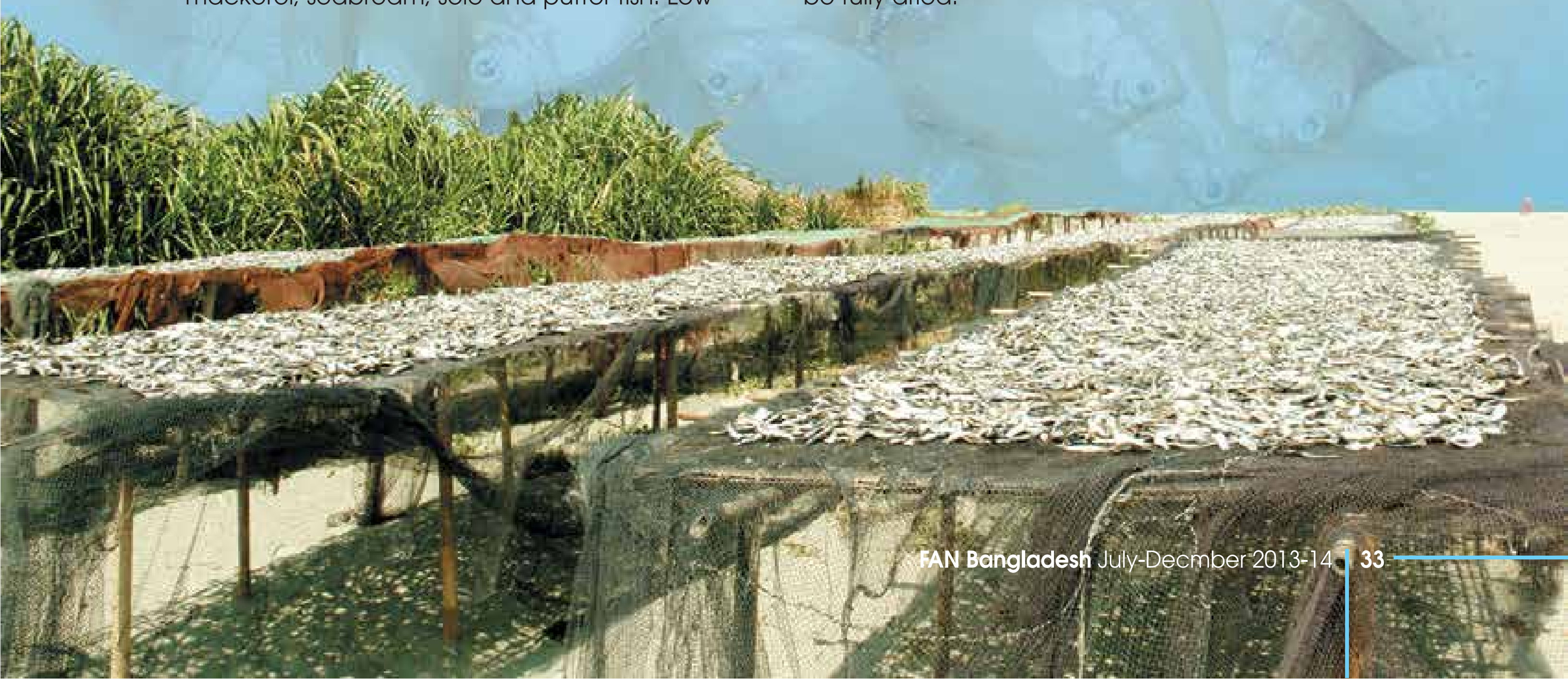
Nearly all of the marine and a number of freshwater fishes, shellfishes and molluscs are sundried in Bangladesh. The major species or species groups used to produce dried fish (considering volume and abundance) are: loitya (Bombay duck), chhuri (ribbon fish), poa (croaker), ichiri (white sardine), phaisa (anchovy), icha (small and medium shrimp), tak chanda (ponyfish), chapila (river shad), ilish (hilsa shad - mainly salted), and pata and shapla pata (flatfish and rays). Somewhat less important, but still commonly used, species/species groups used for drying include kachki (river sprat), kamila (conger eel), bhetki (giant perch), surma (queenfish), hangor (shark), chewa (goby), olua/amadi (anchovy), tailya/lakhua (threadfin), rupchanda (pomfret) and perki/nuila (squid). A number of other fishes are dried in smaller quantities. These include numbfish, trippletail, mullet, scat, mackerel, seabream, sole and puffer fish. Low quality fish (i.e. fish which has begun to rot or deteriorate in quality) is dried separately, along with crab, mollusks, chewa, puffer fish, and a number of non-conventional fish, and sold for use in fish and poultry feeds, either whole or ground into fish meal.

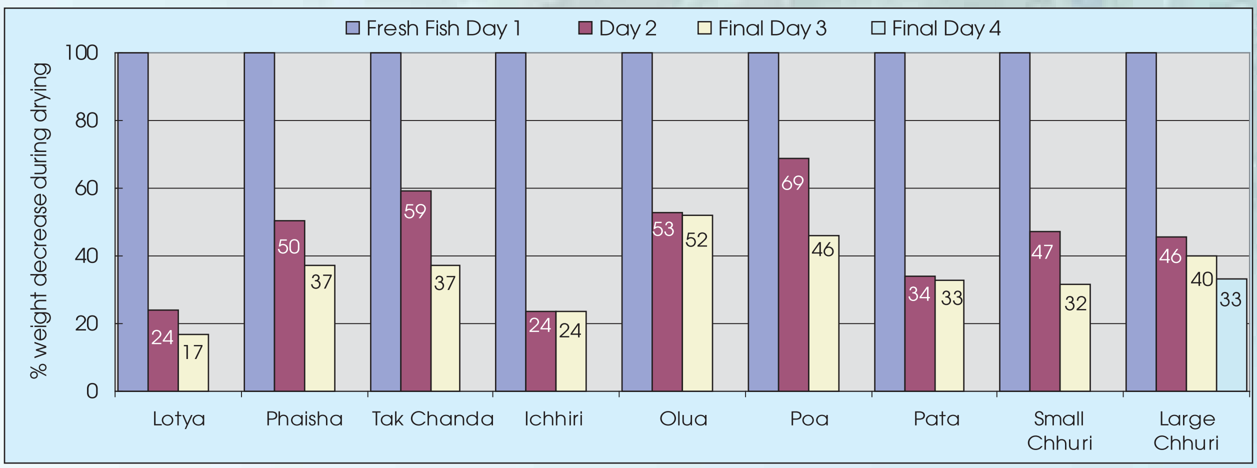
Puti (barb) is main type of fish dried, accounting for an estimated 75% of volume of all dried freshwater fish. Most dried puti are used to produce fermented fish. Other commonly dried SIS include chanda (glas fish), tengra (riverine catfish), and small prawnetc. Large high value fishes, especially boal (river shark) and gazor (giant snakehead) account for less than 10% of total production. The main drying season lasts from mid-August to April. The duration and start time vary from location to location. Depending on species, and size (thickness), fish takes 2-4 days to be fully dried.



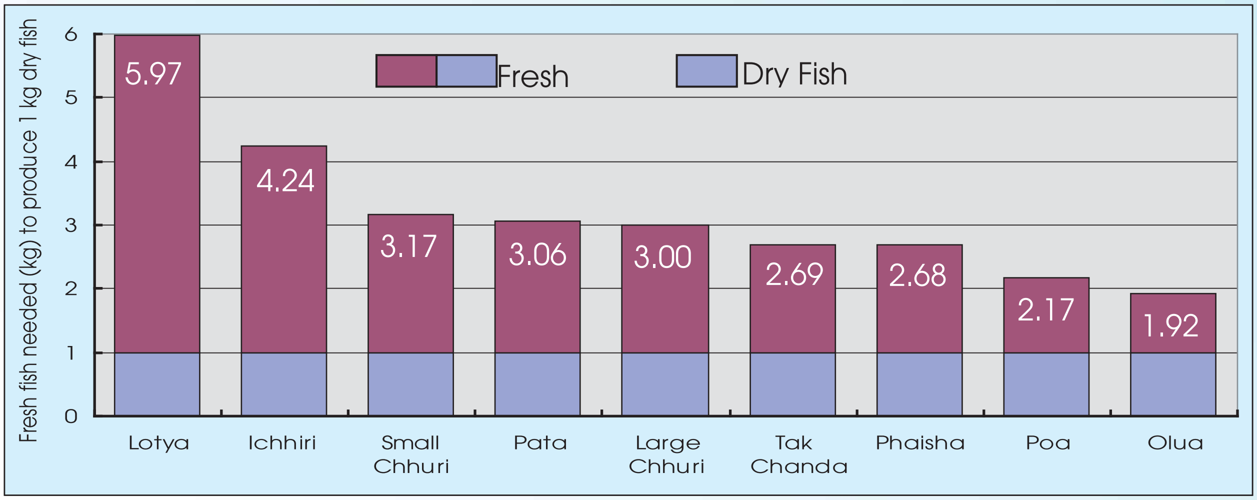
From fresh fish to dried fish-how much weight is lost?

Day to day weight loss (g) during drying of the common marine dried fishes

	Fresh Fish Day 1 wt. (g)	Day 2 wt. (g)	Final Day 3 wt. (g)	Final Day 4 wt. (g)
Loitya	1045	252	175	
Phaisha	1009	509	376	
Tak chanda	1008	598	375	
Ichhiri	1005	239	237	
Olua	1010	532	527	
Poa	1005	691	464	
Pata	1008	345	329	
Chhuri (small)	1082	510	341	
Chuhri (large)	1000	455	400	334



% weight losses during marine fish drying.



Fresh and dry weight of different marine fishes (kg) needed to prepare 1 kg dry product

Pictoral presentation of weight losses in fish drying process...

Day 1 **Day 2** **Day 3**

Lotya, Bombay duck, *Harpadon nehereus*


1045 g fresh fish


266 g semi-dried fish


184 g dried fish

Ichhiri, White Sardine, *Esculosa thoracata*


1005 g fresh fish


239 g semi-dried fish


237 g dried fish

Small Chhuri, Hairtail, *Eupleurogrammus* sp.

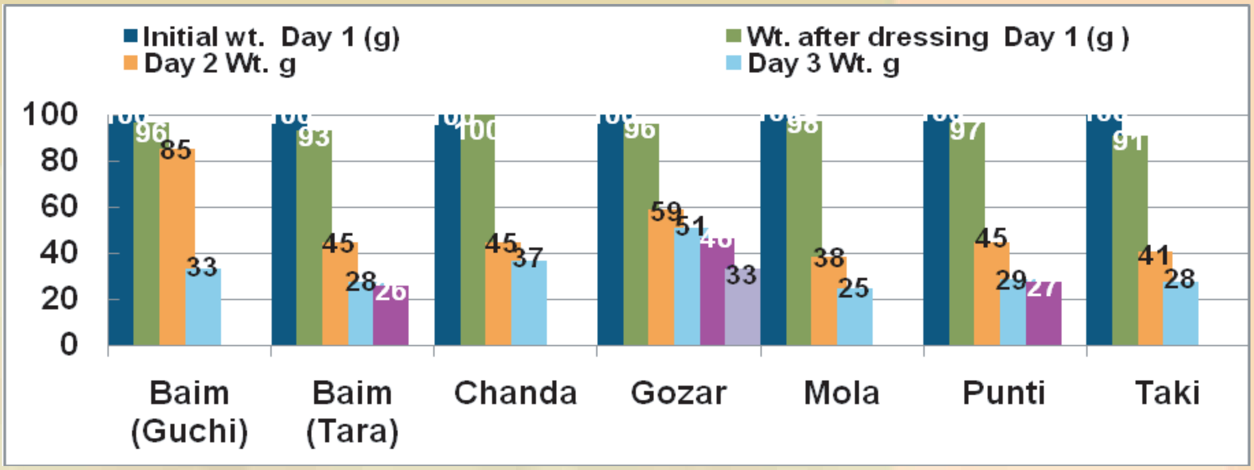

1082 g fresh fish


510 g semi-dried fish

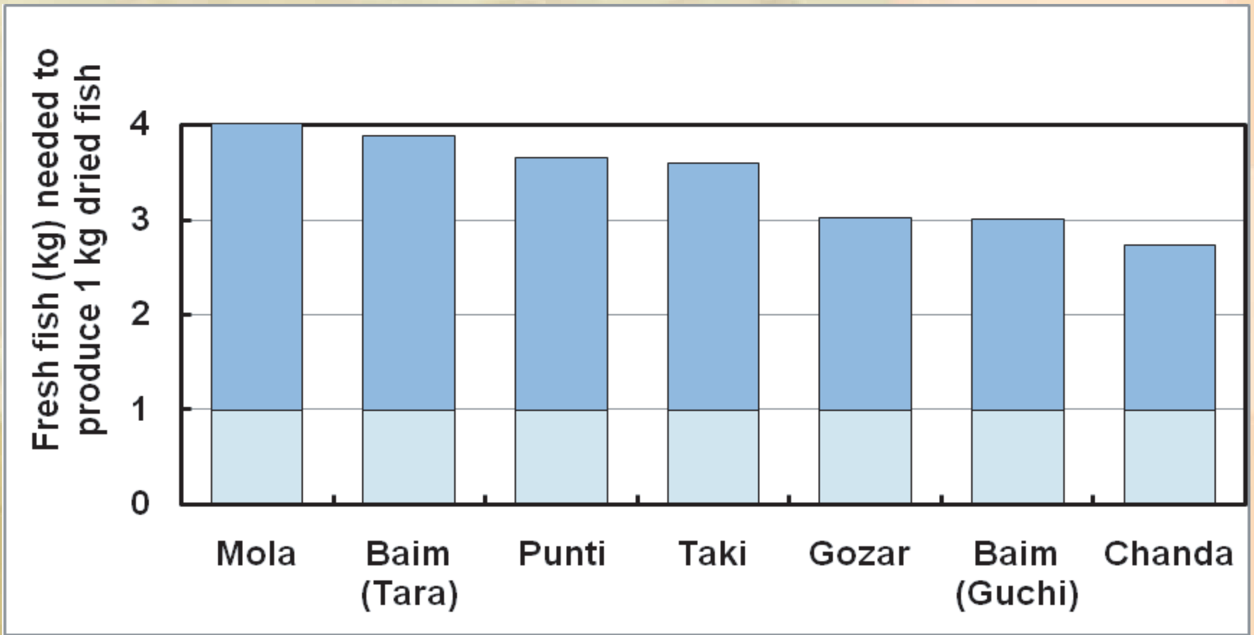

341 g dried fish

Day to day weight decrease (g) during drying of common freshwater dried fishes

Fish	Initial wt. Day 1 (g)	Wt. after dressing Day 1 (g)	Day 2 Wt. (g)	Day 3 Wt. (g)	Day 4 Wt. (g)	Day 5Wt. (g)
Mola	482	470	185	120		
Baim-Guchi	256	247	218	85		
Chanda	492	492	220	180		
Taki	540	490	220	150		
Punti	518	502	233	150	142	
Baim -Tara	486	454	218	134	125	
Gozar	920	885	545	468	425	305



% weight losses during freshwater fish drying.



Comparison between fresh and dry weight of freshwater fishes (kg) needed to prepare 1 kg dry product

Pictural presentation of weight losses in fish drying process…

Day 1 | **Day 2** | **Day 3** | **Day 4**

Mola, mola carplet, *Amblypharyngodon mola*


482 g fresh


470 g dressed


185 g semi-dried


120 g dried

Punti, barb, *Puntius* sp.


518 g fresh


502 g dressed


233 g semi-dried


142 g dried

Chanda (gol), glassy perchlet, *Parambassis ranga*


492 g fresh


492 g dressed


220 g semi-dried


180 g dried

Water Quality of River Tista at Kaunia in Rangpur and Its Impact on Aquatic Environment

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The River Tista is the most important river in the northwest Bangladesh that originates from the Sikkim valley of the Himalayan range. The original name of the river was Trisrota means tri- channel. According to the District Gazetteer of Rangpur (1977), the historic flood of 1787 changed the Trisrota river main flow towards the Dharla river course then join with the Ghagot river course and finally with a new course in downstream via Gangachhara, Kaunia and Ulipur upazila, developed to fall into the Brahmaputra river near Chilmari of Kurigram district, and this is the new Tista river. The river is flashy and eroding during monsoon with 315 km out of which 129 km is inside Bangladesh. At Kaunia railway cum Road Bridge in Rangpur, there is a water level discharge measuring station for the Tista River.

Due to the importance of Tista River in the northwestern part of Bangladesh, a study was conducted to investigate the water quality of the River at Kaunia of Rangpur and its impact on aquatic environment for a period of six months from September 2013 to February 2014. The water samples were collected for laboratory analysis from five different stations during wet season (September to November) and dry season (December to February). The physicochemical parameters as transparency, temperature, electrical conductivity (EC), pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), total dissolved solid (TDS), alkalinity and total hardness were determined with the help of secchi disc, thermometer, EC meter, pH meter, DO meter, titration method, TDS meter, titration and EDTA titration methods, respectively in the Laboratory of the Department of Environmental Science and Resource Management, Mawlana Bhashani Science and Technology University, Tangail-1902, Bangladesh.

The results of the study showed that the transparency, temperature, EC, pH, DO, BOD, TDS, alkalinity and hardness level were within the standard limit set for fisheries by DoE (1997) which presents the favourable condition for fish culture. Moreover, pH, TDS, EC and Alkalinity increased in both post and pre-monsoon season and the water was more transparent in pre-monsoon season. However, the nutrients from fertilizers, human activities and other animal wastes could be the main causes of degradation of water quality and may be responsible for occasional fish mass mortality.

Water quality parameters of the Tista River at Kaunia upazila

Parameter	Season (mean ±SD)		Standard
	Wet season (Sep. to Nov.)	**Dry season (Dec. to Feb.)**	
Temperature (^{0}C)	21.95 ± 0.707	20.9 ± 0.405	20-30 (EQS, 1997)
Transparency (cm)	21.96 ± 1.86	14.06 ± 8.78	40 or less (Rahman, 1992)
EC (µs/cm)	111.73 ± 10.40	117.93 ± 15.36	700 (EQS, 1997)
TDS (mg/l)	65 ± 3.34	62.07 ± 7.37	165 (Huq and Alam, 2005)
pH	7.9 ± 0.18	7.85 ± 0.56	6.5-8.5 (Das, 1997)
DO (mg/l)	5.4 ± 0.31	5.31 ± 0.24	5.0 (EQS, 1997)
BOD (mg/l)	1.74 ± 0.35	1.8 ± 0.23	<5 (Meade, 1998)
Alkalinity (mg/l)	43.27 ± 6.31	41.11 ± 9.01	100 (Rahman, 1992)
Hardness (mg/l)	102.21 ± 27.23	98.73 ± 32.15	123 (Huq and Alam, 2005)

Now a day, over exploitation of fisheries resources, river bank erosion and human activities affected the aquatic environment. Over use of fertilizers and pesticides in the surrounding farm land which is washed out through surface runoff causes degradation of the quality of the water of Titas River.

Aquaculture for Food Security Poverty Alleviation and Nutrition (AFSPAN)

Final Project Report

SEVENTH FRAMEWORK PROGRAMME

Fish and other farmed aquatic foods are potentially of importance in two key respects with regard to poverty and hunger. First, fish is a nutrient dense food, rich in highly bioavailable quality (in terms of essential amino acids) protein, essential fatty acids and micronutrients, recommended as an essential part of a balanced diet. The capture, culture and trading of fish also creates jobs, thereby generating incomes. Recent estimates by the FAO are that between 27 and 57 million full-time equivalent aquaculture related jobs, almost three-quarters of which are in production. The value of global fish trade exceeds that of all other animal proteins combined, contributing an estimated 0.5-2.5% of global GDP. In some countries, such as Mauritania and VietNam, however, contributions may be as high as 10%, while in the smaller island states of the Pacific contributions can exceed 25% of GDP. Developing countries account for approximately 80% of world aquaculture production.

It is for the above reasons that aquaculture has been widely seen as worthy of investment for development purposes, enhancing food security, alleviating poverty and improving nutrition. However, as is increasingly acknowledged, the knowledge base around the direct and indirect impacts of aquaculture on food and nutrition security and poverty alleviation in developing countries is poor and the little detailed analysis that has been done remains inconclusive. There are marked geographical discrepancies in farmed fish supplies. There is little information on the extent or effectiveness of investment in aquaculture development. Some have questioned whether the focus by governments and international development agencies on smallholders has been entirely apposite: is the adoption of aquaculture an appropriate strategy for poorer, more vulnerable households to escape from poverty? However, others have countered that aquaculture can increase resilience to calamities such as drought, cyclones or HIV-AIDS. While the focus on smallholders has been held responsible for the sluggish growth of aquaculture in Africa in particular others point to a lack of policy coherence for development as the root cause underlying the sector's mixed record in the continent.

The objectives of the AFSPAN project were to strengthen the knowledge base and develop new and more rigorous methodologies of quantifying the contribution of aquaculture to combat hunger and poverty, thus providing the evidence upon which sound strategies, policies and research programs can be developed to support the sustainable expansion of aquaculture to maximize its impact on food and nutrition security and poverty alleviation. The three-year project was implemented by eighteen partners in eleven

Asian, African and South American developing and Low Income, Food Deficit Countries (LIFDCs), encompassing the spectrum of development conditions and role of aquaculture in national economies. The partnership also included EU partners and international organizations. BFRF represent Bangladesh in AFSPAN project.

A theory of change was elaborated and range of analytical frameworks, economic models and indicators, complemented by surveys and case studies developed. The contribution of aquaculture to national GDP, excluding multiplier effects, was found to vary from negligible in countries with emergent aquaculture sectors up to 5% or more of national GDP in countries where the sector is very dynamic. Aquaculture was shown to have helped lower global fish prices, increasing economic access for all but the very poorest consumers. Although households engaging in aquaculture were found less likely to be poor than those that did not, poor households too benefitted from engaging in fish farming, irrespective of scale of operation. Fish consumption rates of households engaged in fish farming were typically higher than national averages.

Contribution of aquaculture to national GDP in the 11 partner countries

(Million (US$)	Bangladesh	Brazil	Chile	China	India	Kenya
National GDP [(a)]	100,360	2,143,068	217,502	5,930,502	1,708,459	32,440
Aquaculture GDP [(b)]	5,879	1,201	4,983	83,591	12,677	57
% National GDP [(b)]	5.86	0.06	2.29	1.41	0.74	0.17
Agriculture GDP [(a)(c)]	18.59	5.30	3.46	10.10	18.21	25.11
% Agriculture GDP	31.51	1.06	66.10	13.96	4.08	0.70

(Million (US$)	Nicaragua	Philippines	Uganda	Viet Nam	Zambia
National GDP [(a)]	8,938	199,589	16,031	115,932	16,190
Aquaculture GDP [(b)]	126	7,062	369	6,687	74
% National GDP [(b)]	1.40	3.54	2.30	5.77	0.46
Agriculture GDP [(a)(c)]	18.56	12.31	25.68	18.89	20.45
% Agriculture GDP	7.57	28.73	8.97	30.53	2.25

Both immanent (e.g. economic growth) and interventionist (the implementation of policies promoting aquaculture development, improving governance and capacity) factors, as well as institutional arrangements, public-private partnerships and pioneering companies and individuals, were found to be capable of creating enabling conditions for aquaculture growth. Socio-cultural factors, especially gender and ethnicity, were also important: interventions tailored to match given specific socio-cultural contexts were most likely to lead to successful adoption and retention and delivery of equitable development outcomes, thereby producing lasting impact on livelihoods.

The volumes of seafood exported from developing to developed countries were found to approximate those of seafood imported by developing from developed countries. While expensive seafood may be being exchanged for cheaper but not necessarily less nutritious seafood, thereby minimizing threats to food security, there remains a lack of supporting evidence that this is the case. *With the exception of Bangladesh no policies or interventions linking fish, aquaculture and nutrition were found in study countries and little is included in nutrition education on aquatic animal foods.*

Project outputs are being disseminated among the development community to help improve efficiency and coordination of development initiatives focused on aquaculture that promotes food and nutrition security and alleviates poverty and helps focus research on addressing researchable gaps. The development of science outputs has also begun.

(BFRF represented in AFSPAN project by *Mostafa A R Hossain, Md. Saifuddin Shah, M. Enamul Hoq and Md. Akhtar Hossain*)

PROFILE

Journal of Fisheries

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Profile: Journal of Fisheries

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Decisions on the submitted manuscript will be made as rapidly as possible, and the journal strives to return reviewers' comments to authors promptly. If the manuscript is accepted with minor/major correction, it would be returned to corresponding author to perform necessary correction according to the reviewer's comment. Author will get 7 days to resubmit the manuscript. The Editorial board will re-review manuscripts that are accepted pending revision. Finally the manuscript will be reviewed by the Chief Editor at the last stage of publishing. It is the goal of the Journal of Fisheries to publish manuscripts within the shortest possible time after submission.

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PARASITE CORNER
Sessile peritrichs

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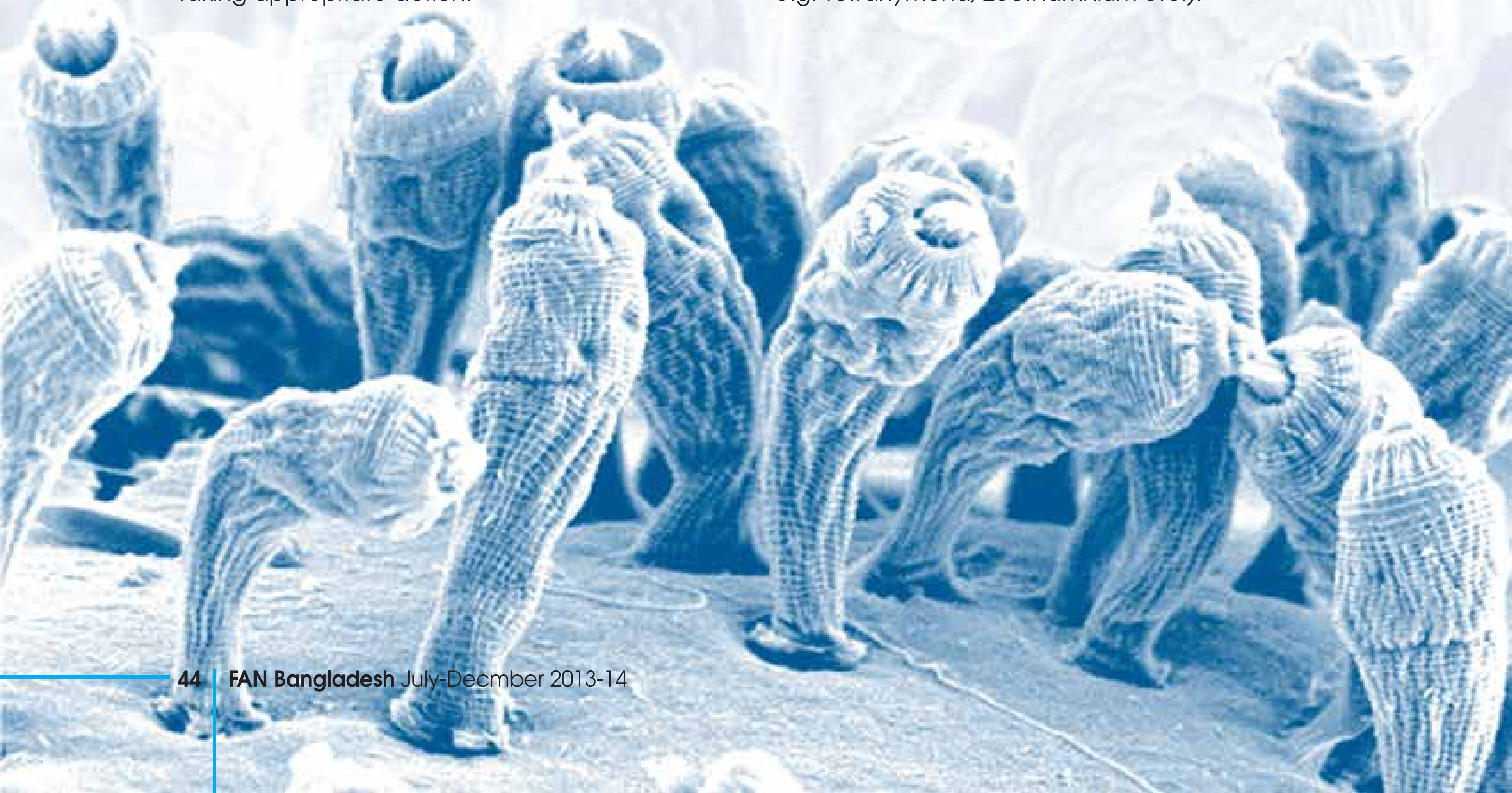
The mere thought of a parasite infection makes many people feel uncomfortable and is certainly not a topic for discussion over the dinner table. And yet, most people are blissfully unaware that they play host to their own community of parasites. For example, around a third of people under 20, half of all adults, and two thirds of elderly people carry parasitic *Demodex* mites, commonly referred to as eye lash mites, which inhabit our hair follicles and associated sebaceous glands. Parasites are more common than many think. In fact, a free-living organism that does not harbour several parasitic individuals or a number of species is a considered something of a rarity. One should not be surprised, therefore, to encounter parasites during a routine health assessment of a sample of fish and it is important to bear in mind that their presence does not infer the presence of disease or that a treatment must be administered. Having encountered a parasite, it is imperative to have a proper identification and a clear understanding of its life-cycle before taking appropriate action.

Here we take a closer look at some particular microscopic, ciliate protozoans of fish, which although common are frequently overlooked - the sessile peritrichs or non-mobile ciliated protozoans. Peritrichs typically possess a prominent ring of cilia that arises from a centrally positioned, oral cavity and extends in an anti-clockwise direction around the circular or bell-shaped anterior end of the parasite. These cilia function to catch and transfer organic matter towards the oral cavity, at the centre of which, is a contractile vacuole. There is, however, great diversity within this sub-class of parasites and they can be highly mobile, obligate parasites of aquatic organisms (i.e. those that need a host to complete their life-cycle, e.g. *Trichodina*), sessile, obligate ectocommensals (e.g. *Apiosoma, Epistylis* - which use a stalk to attach themselves to an appropriate substrate and can be either solitary or produce branched colonies), or facultative (i.e. those that can demonstrate parasitic activity but are not dependent on a host to complete their life-cycle, e.g. *Tetrahymena, Zoothamnium* etc.).



Parasite corner
Sessile peritrichs

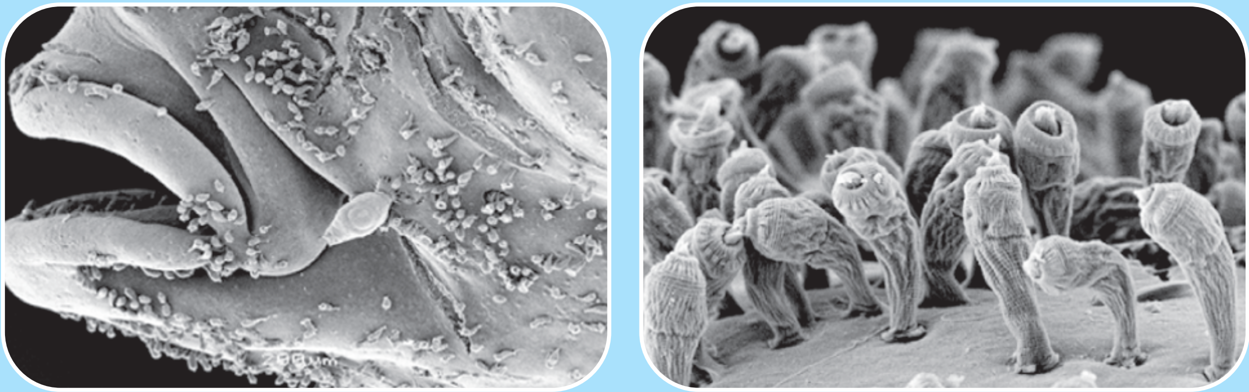


Fig. 1 a, b. Scanning electron micrographs of *Apiosoma* sp. on the head a freshwater fish. **a.** A moderate infection of *Apiosoma* on the head of the fish. A single specimen of *Gyrodactylus* (Monogenea) is also visible in the centre of the image. **b.** A higher magnification of the *Apiosoma*. Each organism is about 110 microns long.

The sessile peritrichs *Apiosoma* (formerly *Glossatella*) and *Ambiphyra* attach themselves to the skin and gills of their fish and amphibian hosts. *Apiosoma* typically has a barrel-shaped body (30×50 µm) with cilia at the distal end (Fig. 1b), a large rounded macronucleus and are solitary organisms rather than colony formers. *Ambiphyra* spp. are also barrel-shaped but possess an equatorial, ciliary fringe. Both parasites reproduce by binary fission with new ciliated, motile individuals budding off that can then colonise new hosts. They do not feed off the fish but on suspended organic debris borne in the water current. Both are generally considered as harmless ectocommensals, however, high numbers can cause inflammation, increased mucus production, hyperplasia, necrosis and ultimately ulceration of the skin and degeneration of gill tissues. Poor water quality, e.g. high organic loading, can allow parasite numbers to rapidly proliferate and cause problems.

By comparison, *Epistylis* and *Zoothamnium* are colonial ciliates. *Epistylis* is an obligate parasite whilst *Zoothamnium* is primarily free-living on a range of other aquatic substrates and are opportunist settlers. Once attached, one parasite will divide and spread to form large colonies. When present in large colonies, the attachment sites can cause a lesion that can become inflamed and necrotic and eventually ulcerated - commonly referred to as "red sore disease". The lesion is then vulnerable to invasion by secondary pathogens.

Finding a large number of sessile peritrichs on your fish, however, does not automatically infer the presence of disease and that they must be treated. Instead, the first course of action would be to improve water quality, to reduce the level of organic loading and then, following an evaluation of the host, decide upon whether a concurrent treatment should be applied or whether a period of monitoring, to see if parasite numbers decrease, is appropriate.

Fish Vet Group touch down in Asia...

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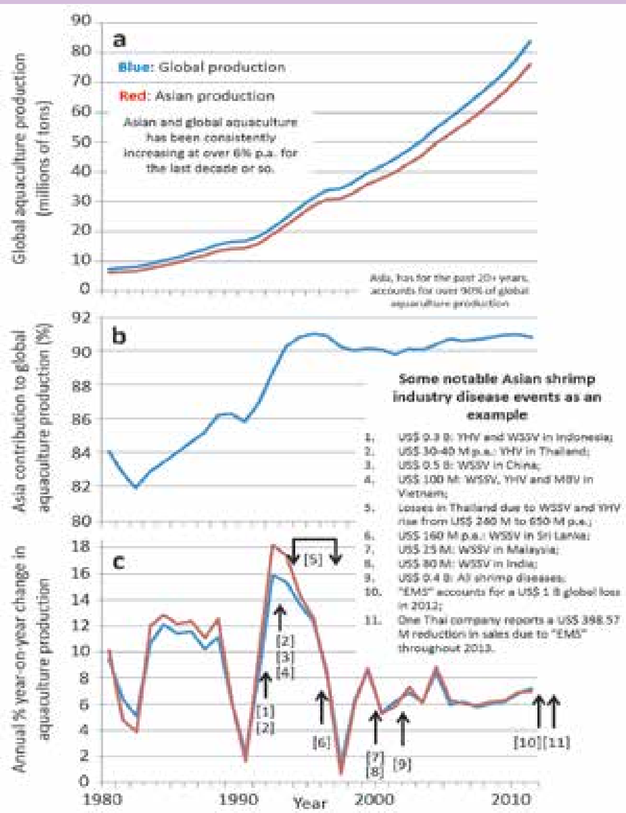
Asia's collective contribution of 90.8% to global aquaculture production is impressive, i.e. 38 countries producing 76,017,966 tons of aquatic products in 2011 (see Figures 1a, b, 2). It is not surprising, therefore, that Asia's production shapes global production, which is currently increasing at about 6.5% year-on-year (Figure 1c). Continental production elsewhere, however, is quite different. Europe produced 2,752,447 tons in 2011 and although total tonnage has increased over the past 5-10 years, it has been erratic. In 2011, Africa produced 1,539,837 tons of aquatic products, with a near 10% annual increase (except for 2009) over the last 7 years. Interestingly aquaculture production in North and Central America fell over the period 2006-2011 from 999,843 tons to 840,547 tons. This is a stark contrast to production in South America where year-on-year production rose by 27% between 2010-2011 from 1,660,211 tons to 2,112,315 tons. Year-on-year growth has, however, been erratic over the preceding 5 years. Aquaculture production in the Middle East and North Asia (which includes the Russian States), as a collective, has had mixed fortunes over the past 25 years. Total aquaculture production at the start of the 1990s was close to 350,000 tons but production fell dramatically through a large part of the following decade to about 121,000 tons in 1996. Since then, there has been good growth and production in 2011 was 462,342 tons with about a 9% increase in production over that in 2010.

Asia is currently doubling its aquatic output approximately every 10 years and expansion of the various aquaculture industries are not without their various challenges. Arguably one of the most notable being the impacts of disease on the direct loss of stock and on economic return. In Asia, losses are probably in the magnitude of 20% or more. Fig. 1c, for example, highlights just a few of the notable disease events in the Asian shrimp industry over the last 30+ years, with Acute Hepatopancreatic Necrosis Disease (AHPND) commonly referred to as "EMS" or Early Mortality Syndrome having a major impact on current operations. It is against this backdrop of stable aquaculture production growth and an associated need for a veterinary diagnostic service capable of providing total aquaculture care that the **Fish Vet Group** has set-up a new facility in Bangkok to provide modern, evidence-based fish health services across the Asian Pacific region.

It is now almost a quarter of a century ago, that three vets working in the Scottish salmonid industry got together to form the Fish Vet Group to provide an independent total aquatic animal health care service. From humble beginnings, the company has expanded its outreach



Figs. 1a-c. Asia's contribution (red line) to global (blue line) aquaculture production over the period of 1980 to 2011 (for which the last figures are available) by tonnage (a) and as a percentage (b). Global (blue line) and Asia's (red line) year-on-year growth presented as a percentage. To demonstrate the impact of certain disease events, we show some of those that have impacted on the Asian shrimp industry, as an example of one industry, with estimates of the resultant losses (c).

to several continents and today has branches within the UK, Norway, the United States of America, Ireland, Chile and launched in June 2014, Thailand. Establishing a branch in Bangkok to help service the extensive and varied aquaculture industries throughout South East Asia was logical.

Fish Vet Group Asia Limited (FVGAL), a subsidiary of Benchmark Holdings, has new premises in Bangkok - a four-storey building complete with offices and state-of-the-art laboratories including a histology slide digital scanning facility.

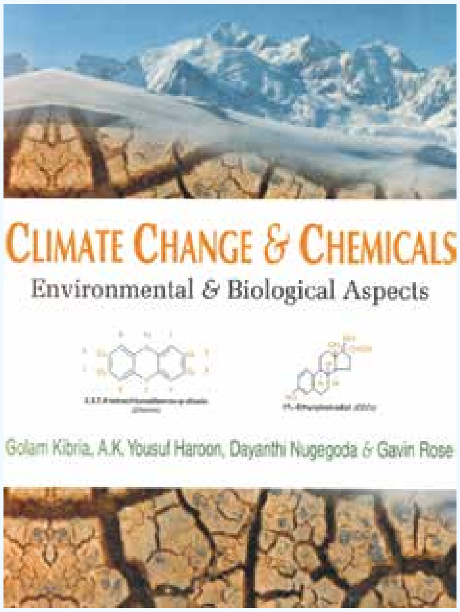
Fish Vet Group is the world's largest specialist aquatic veterinary practice dedicated to providing modern, evidence-based veterinary services to the aquaculture, fisheries and aquaria sectors. Our specialist-led veterinary team works alongside a global network of diagnosticians who lead in the use of digital histopathology and other tools to provide experienced, actionable advice for aquaculture producers. The Fish Vet Group Asia Limited offers the following services:

- Rapid, aquatic disease diagnostics including:
  - Histology, histopathology and slide image scanning;
  - Bacteriology, virology and parasitology;
  - PCR and molecular-based determination of pathogens;
- Epidemiology evaluation and risk assessments;
- Disease management and production unit risk analysis;
- Consultancy on shrimp/fish hatcheries and farm management, domestication and genetic selection programs;
- Product development, testing, patenting and sales of parasiticides, immunostimulants, probiotics and, disease testing kits;
- On-the-job and bespoke training courses, and online training programmes;
- Advising governments on legislation and procedures required for the safe trans-boundary movement of aquatic species.

Fish Vet Group touch down in Asia...

New Books

Climate Change & Chemicals: Environmental & Biological Aspects



Golam Kibria, A.K. Yousuf Haroon
Dayanthi Nugegoda & Gavin Rose

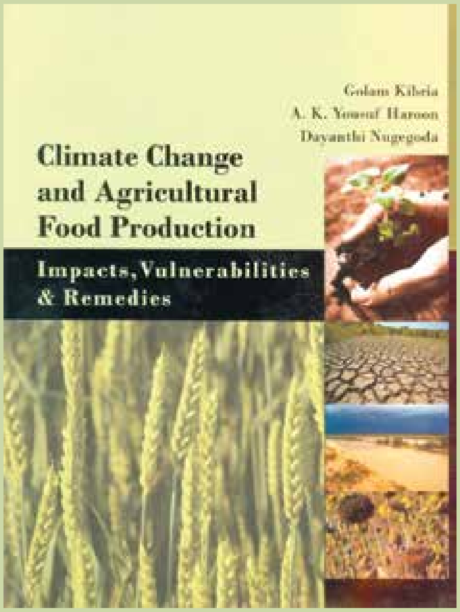
Publisher: New India Publishing Agency (NIPA), New Delhi, India
Publication Year: 2010, Pages: 470 p.
ISBN-10: 9380235305 ISBN-13: 978-9380235301

The book has addressed two key environmental issues: climate change and chemical impacts on human health, environment and agricultural production with reference to chemistry, ecotoxicolgy, toxicology, and biology. It reviewed and summarized research results and information from both developed and developing countries including Asia-Pacific, Australasia and other parts of the world.

Part 1 of the book 'Climate Change Impacts' provides an account of greenhouse gases (carbon dioxide, methane and nitrous oxide) and its relationships with climate change and likely impacts on water resources, agriculture, livestock, fisheries (freshwater and marine), aquatic ecosystems and human health. Part 2 of the book 'Chemical Impacts' highlights the impact of arsenic, heavy metals, pesticides, dioxins, endocrine disrupting chemicals, pharmaceuticals (human and veterinary drugs) and freshwater and marine biotoxins.

New Books

Climate Change and Food Production: Impact, Vulnerabilities & Remedies

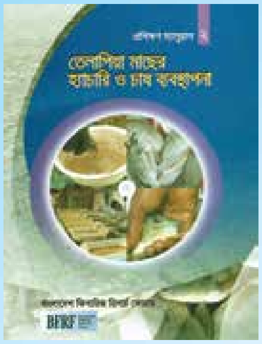


Golam Kibria, A. K. Yousuf Haroon and
Dayanthi Nugegoda

Publisher: New India Publishing Agency (NIPA), New Delhi, India
Publication Year: 2013, Pages: 298 p.
ISBN-10: 938145051X ISBN-13: 978-93-81450-51-2

This book provides an overview of climate change impacts on all agricultural food producing sectors (agriculture, livestock and fisheries), food contamination, and food safety (microbial pathogens, toxic biological and toxic chemical contaminants), food security and climate change adaptation and mitigation measures to counteract or minimize or reduce the effects of climate change on agriculture, livestock and fisheries.

Chapter 1: Climate change and green house gas emissions (GHG) from agriculture, livestock and fisheries; Chapter 2: Climate change impacts on agriculture, livestock and fisheries; Chapter 3: Climate change impacts on food contamination and food safety; Chapter 4: Climate change impacts on food security; and Chapter 5: Climate change adaptation and mitigation measures in agriculture, livestock and fisheries.

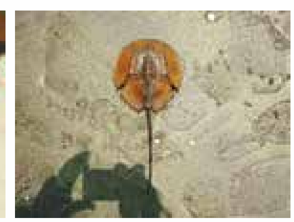


BFRF-Katalyst collaboration

Under the BFRF-Katalyst collaboration training need of the pangas, koi and tilapia hatcheries allover Bangladesh were assessed. Then the hatcheries were clustered in to two different tiers - basic and advanced. Training modules were developed as per needs of the hatcheries. Then in Comilla, Mymensingh, Bogra, Satkhira and Rajshahi, over 160 hatchery owners were trained. Through the training, the concept of the BMPs were introduced at all levels for sustainable hatchery and grow out systems for the three species. The training also helped tilpia, pangas and koi hatchery owners to be linked with countries of the origin of the species and international organizations, for periodical replacement of the brood stocks. Also to be noted that for the first time in Bangladesh, all the trainees paid 2000 taka registration fee to BFRF.

Under the collaboration LightCastle Partners developed a comprehensive business plan for BFRF. The course-curricula followed by the Universities in Bangladesh that teach fisheries are thoroughly reviewed by two consultant Professor and a comprehensive report is produced with detail recommendations blending the changing need of the country regarding production, technologies, obstacles and mitigations measures and what presently are taught by the famous universities overseas. BFRF would like to thank Katalyst for assisting the endeavor not only financially but also with timely suggestions all way through.

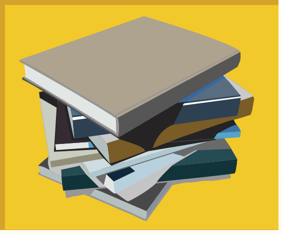
Updating Species Red List Bangladesh by IUCN-BD



Updating Red List of Bangladesh is ongoing by IUCN-BD funded by World Bank and led by the Department of Forest, MoEF, GoB. Under the initiative, seven Red List Assessor Groups (RAG) were formed namely Fish, Crustacean, Butterfly, Amphibian, Reptile, Bird and Mammal led by seven Species Specialist. Field data collection is almost complete now reviewing is going on and as is hoped by early 2016, updated Species Red List would be published.

Enhanced Coastal Fisheries in Bangladesh (ECOFISH-BD)

WorldFish, USAID and the Government of Bangladesh (GoB) have come together to support the country's coastal fishing communities and improve food security through research-led fisheries management initiatives. The project seeks to strengthen the ability of local communities, especially women, to extract maximum benefit from coastal environments using sustainable best practices and to mitigate the adverse affects of climate change. It will work closely with small-scale artisanal catch fisheries that target hilsa shad, the national fish of Bangladesh. Hilsa stocks have been hit hard by habitat degradation and have suffered from overfishing. This project aims to boost the resilience of those communities who rely on hilsa for their livelihoods.



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Upcoming Conferences/Seminars

Upcoming Conferences/Seminars

12th International Conference on Food and Agricultural Engineering
http://www.icfae.org/
12th to13thMay 2015
Warsaw, Poland
Contact: icfae@cbees.net

7th World Fisheries Congress: Challenge to Sustainable Fisheries and Safe Seafoods
http://www.wfc2016.or.kr/english/main/index_en.asp#
23-27 May 2016
Busan, Korea
Contact: info@wfc2016.or.kr

Aquaponics Technology and Design workshop
https://www.was.org/meetings/default.aspx code=WA2015
26th May 2015
Jeju, Korea
Contact: carolm@was.org

10thInternational Conference on Ecosystems and Sustainable Development
http://www.wessex.ac.uk/ecosud2015
3rd to 5th June 2015
Valencia, Spain
Contact: enquiries@wessex.ac.uk

The 5th International Conference on Algal Biomass, Biofuels and Bioproducts
http://www.algalbbb.com/
7th to 10th June 2015
San Diego, USA
Contact: conferenceCS@elsevier.com

6th Offshore Mariculture Conference 2015
http://aquaculturedirectory.co.uk/event/6th-offshore-mariculture-conference-2015/#sthash.WTBLWZi3.dpbs
9th to 12th June 2015
Baja California, Mexico
Contact: conferences@offshoremariculture.com

EIFAAC International Symposium on Recreational Fisheries
http://www.miljodirektoratet.no/no/Nyheter/Arrangementer/EIFAAC-Symposium-on-Recreational-fisheries/
15th to17th June 2015
Lillehammer, Norway
Contact: oystein.aas@nina.no

8th International Conference on Sustainable Water Resources Management
http://www.wessex.ac.uk/
15th to 17th June 2015
A Coruna, Spain
Contact: enquiries@wessex.ac.uk

8th International Conference on River Basin Management including all aspects of Hydrology, Ecology, Environmental Management, Flood Plains and Wetlands
http://www.wessex.ac.uk/
17th to 19th June 2015
A Coruña, Spain
Contact: enquiries@wessex.ac.uk

International conference on river connectivity best practices and innovations
http://fishpassage.umass.edu/
22nd to 24th June 2015
Groningen, Netherlands
Contact: Olle.calles@kau.se

3rd International Conference on Oceanography
http://www.oceanographyconference.com/
22nd to 24th June 2015
Philadelphia, United States of America
Contact: oceanography@conferenceseries.net

International Conference on Water Technology
http://www.icwt.org/
25th to 26th June 2015
Bangkok, Thailand
Contact: icwt@cbees.net

REFORM Final Conference "Novel Approaches to Assess and Rehabilitate Modified Rivers"
http://reformrivers.eu/
30th June to 2nd July 2015
Wageningen, The Netherlands
Contact: reform2015@deltares.nl

39th Annual Larval Fish Conference
http://www.larvalfishcon.org/Conf_home.asp?ConferenceCode=39th

12th to 17th July 2015
Vienna, Austria
Contact: hubert.keckeis@univie.ac.at

International Conference on Biotechnology and Bioengineering
http://bbseries.org/
15th to 17th July 2015
Barcelona, Spain
Contact: info@bbseries.org

3rd International Conference on Water and Society
http://www.wessex.ac.uk/
15th to 17th July 2015
A Coruna, Spain
Contact: enquiries@wessex.ac.uk

Annual Symposium of the Fisheries Society of the British Isles
www.fsbi.org.uk/events/symposia
27th to 31st July 2015
Plymouth, UK
Contact: secretary@fsbi.org.uk

International Conference on Aquaculture, Fishery and Hidrobiology
http://icafh2015.weebly.com/
31stJuly to 1stAugust 2015
Jakarta, Indonesia
Contact:infoipnindon@gmail.com

4th European Large Lakes Symposium, "Ecosystem Services and Management in a Changing World"
http://www.uef.fi/en/ells2015
24th 28th August 2015
Joensuu, Finland
Contact: arja.hukkanen(at)kareliaexpert.fi

2nd Annual International Conference on Fisheries and Aquaculture
http://aquaconference.com/2015/
26th to 28th August 2015
Colombo, Sri Lanka
Contact: isanka@tiikm.com

Aquaculture
http://www.aquaculture-conference.com/
23rd to 26th August 2015
Le Corum, Montpellier, France
Contact: conferenceCS@elsevier.com

2nd International Conference on Fisheries and Aquaculture
http://aquaconference.com/2015/
26th to 28th August 2015
Colombo, Sri Lanka
Contact: isanka@tiikm.com

2nd International Conference on Substantial Environmental Engineering
http://www.icsee.org/
27th to 28th August 2015
Hong Kong, China
Contact: icsee@cbees.net

2nd International Conference on Aquaculture, Agro Business Industry and Agritourism
http://icaaa2015.weebly.com/
4th 5th September 2015
Krabi, Thailand
Contact: infoipnenquiry@gmail.com

Aquatic Biodiversity International Conference
http://stiinte.ulbsibiu.ro/aquatic_biodiversity_conference/
7th to 10th October 2015
Sibiu, Transylvania, Romania, European Union
Contact:ad.banaduc@yahoo.com, angela.banaduc@ulbsibiu.ro

2nd International Conference on Global Food Security
http://www.globalfoodsecurityconference.com/
11th to 14th October 2015
New York, United States of America
Contact: conferenceCS@elsevier.com

The 5th International Conference of Aquaculture
http://icai.aquaculture-mai.org/
6th to 8th October 2015
Grand Sahid Jaya Hotel, Indonesia
Contact: Icai.aquaculture@gmail.com

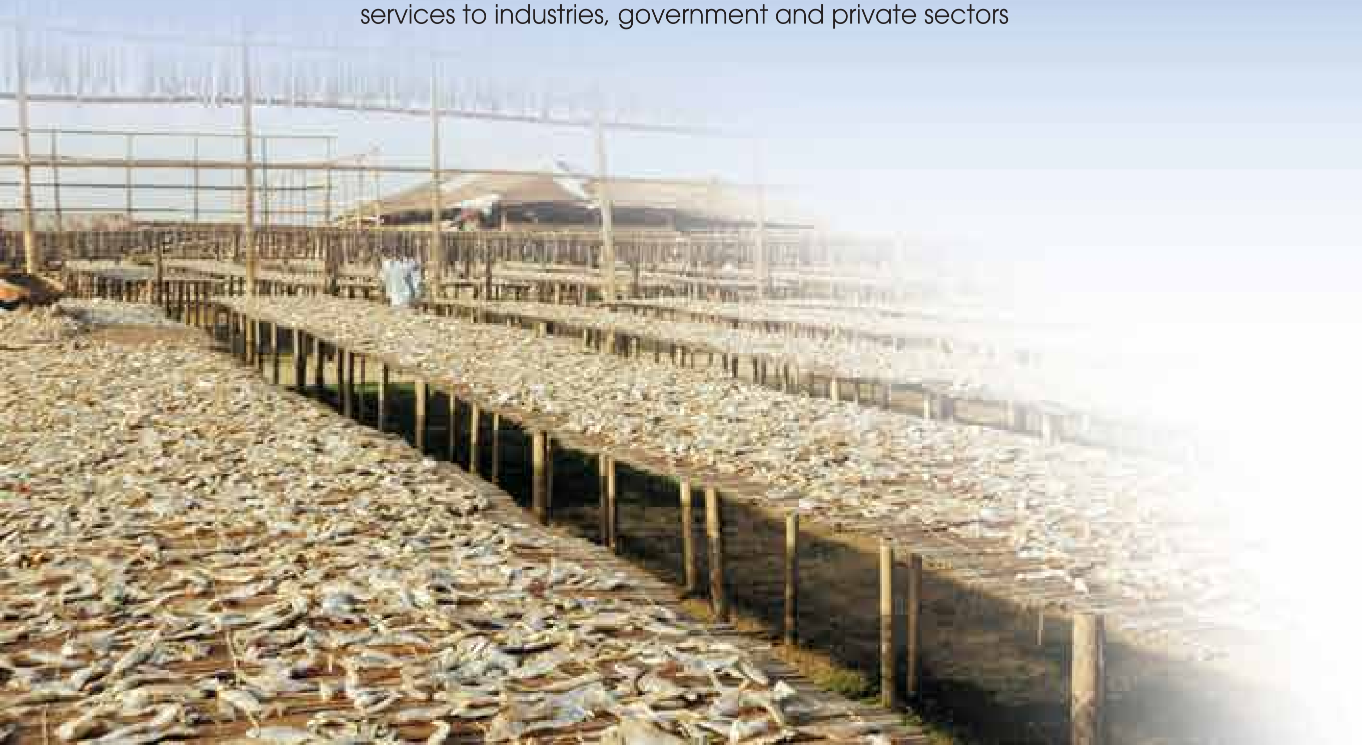
Canadian International Conference on Agriculture & Fisheries
http://agriconference.info/canada/
12th to 13th October 2015
Toronto, Canada
Contact: info@uniqueca.com

Inernational Conference on Agriculture, Aquaculture, Fisheries and Animal Science
http://icaafas2015.weebly.com/
30th to 31st October 2015
Cebu, Philippines
Contact:ipnphilippine@gmail.com

AgriAqua 2015-Second International Conference on Agriculture, Animal Sciences and Aquaculture
http://www.agriconference.info/
28th to 30th December 2015
Colombo, Sri Lanka
Contact: infoicrd@gmail.com

www.bfrf.org

Bangladesh Fisheries Research Forum (BFRF) foresees ahead to be flourished as an organization to provide a platform for scientific collaboration, team work and future horizon of research and development activities in fisheries sector. Major objectives of BFRF are to develop networking among fisheries professionals and institutions; to share knowledge and experience to promote growth of the sector; to initiate discussion and dialogue among different stakeholders; to assist public and private sector, donors and development partners; to secure funding from donors and offer research awards to scientist/s to address demand-led research; to organize workshop, seminar, conference, dialogue and training; and to offer support services to industries, government and private sectors



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