



Sher-e-Bangla Agricultural University

SDG Activity Report on

SDG 14: Life Below Water

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EXPLORING WATER QUALITY AS A DETERMINANT OF THE EXISTENCE OF SOFT SHELL CRAB (SCYLLA OLIVACEA) IN DIFFERENT HABITATS OF THE LARGE MARINE ECOSYSTEM IN THE BAY OF BENGAL.....	15
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Faculty Research and Publications

Retraction notice to “Managing the invisible threat of microplastics in marine ecosystems: Lessons from coast of the Bay of Bengal” [Sci. Total Environ. 889 (2023) 164224] (Science of the Total Environment (2023) 889, (S0048969723028450), 10.1016/j.scitotenv.2023.164224))

Author: Mir Mohammad Ali

Year: 2024

Abstract: Invisible microplastics (MP) have become a significant problem worldwide in recent years. Although many studies have highlighted the sources, effects, and fate of MPs pollution on various ecosystems in developed countries, there is limited information on MPs in the marine eco system along the north eastern coast of the Bay of Bengal (BoB). Coastal ecosystems along the BoB coasts are critical to a biodiverse ecology that supports human survival and resource extraction. However, the multi-environmental hotspots, ecotoxicity effects, transport mechanisms, fates, and intervention measures to control MP pollution initiatives along the BoB coasts have received little attention. Therefore, this review aims to highlight the multi-environmental hotspots, ecotoxicity effects, sources, fates, and intervention measures of MP in the north eastern BoB to understand how MP spreads in the nearshore marine ecosystem. This study critically evaluates the hotspots and ecotoxic effects of pollution from MP on the coastal multi-environment, e.g., soil, sediment, salt, water, and fish, as well as current intervention measures and additional mitigation recommendations. This study identified the north eastern part of the BoB as a hot spot for MP. In addition, the transport mechanisms and fate of MP in different environmental compartments are highlighted, as are research gaps and potential future research areas. Research on the ecotoxic effects of MP on BoB marine eco systems must be at top priority, given the increasing use of plastics and the presence of significant marine products worldwide. The knowledge gained from this study would inform decision-makers and stake holders in a way that could reduce the impact of the legacy of micro-and nano plastics in the area. This study also proposes structural and non-structural measures to mitigate the effects of MPs and promote sustainable management.

Microplastics contamination through a mighty estuarine island: Distribution, influencing factors, and risk assessment

Author: Mir Mohammad Ali

Year: 2024

Abstract: The global concern over microplastic (MP) contamination in diverse ecosystems is well-established, yet Nijhum Dwip Island (NDI), known for its ecological diversity, has not undergone a comprehensive study addressing the extent of MP pollution. This research aims to evaluate the spatial distribution, influencing factors, and ecological risks of MPs in both sediment and surface water surrounding NDI, situated in the Northern Bay of Bengal. A meticulous collection of 40 sediment

and 40 tidal water samples from various sites facilitated a detailed analysis. The mean abundance of MPs in sediment was 138.39 ± 34.15 pieces/kg, while in water, it was 72.83 ± 30.76 pieces/m³. Various shapes observed on NDI included films, fragments, fibers, and foams, with fragments dominating in sediment (64.05 %) and water (61.51 %). Analysis of FTIR spectra identified two primary polymer types, namely polyethylene (PE) at 57 % and polypropylene (PP) at 40 %. The results indicated elevated pollution levels on NDI, with sediment and water pollution load index measuring 1.32 and 2.01, respectively, signifying significant MP contamination in both compartments. Given the island's rare biodiversity, the vicinity of wastewater sewages, anthropogenic activities, and atmospheric deposition, could be behind MP contamination in water and sediments. No strong correlation between MP and physiochemical properties in water and PCA biplots showed their similar distribution, whereas MP abundances in sediment were significantly correlated with pH and organic matter ($p < 0.05$), signifying a pivotal role in transporting MPs in the aquatic environment. Two canonical variables were identified as important by canonical correlation analysis, demonstrating the interdependence of MP contamination at the sample sites. This research contributes to better insights into the occurrence of MP in the rare islands, which are ecosystems that have been hardly examined for this type of pollution, and it can report sustainable interventions to lessen MP inputs to the Bay of Bengal.

[Edibility of cultivated green seaweed *Ulva intestinalis* from Monkhali Beach, Cox's Bazar coast of Bangladesh: bio-toxicity and heavy metal contents](#)

Authors: Md. Mohibbullah, Md. Afzal Hossain, Mahfuzul Alam Mithu

Year: 2024

Abstract: *Ulva intestinalis* (UI) is widely available edible seaweed and has potential to be introduced as functional food items in Bangladesh. However, potential health hazards of this seaweed with biotoxicity assays and its relation to heavy metal contents were not evaluated previously. With these objectives, toxic effects of UI collected from floating raft culture in Monkhali Beach was evaluated using various organisms such as *Chlorella vulgaris*, *Artemia salina*, *Daphnia magna*, and *Lactuca sativa*. In relation to this effects, heavy metal concentrations (Fe, Cr, Ni, Cu, Zn, Pb, Cd, and As) and its potential health hazards were subsequently analyzed. The results showed that UI water extract had positive effects on the survivability and growth of the all-test organisms over different time periods, with minimal LC₅₀ values, indicating no toxic to tested organisms. However, increased levels of total dissolved solids and electrical conductivity were observed as extract concentrations increased but considered to be safe below 5 mg kg⁻¹, as compared to control. Moreover, Fe, Cr, Ni, Cu and Zn (43.60, 0.10, 0.44, 0.07, 0.27 and 0.13 mg kg⁻¹ of dry weight, respectively) in UI were found to be low levels compared to previous studies, in addition, Cd and As remained not detected. No significant health risk ($HQ < 1$) and target carcinogenic risk were found. Therefore, UI could be utilized as functional foods or nutraceuticals for health-conscious consumers of Bangladesh without having potential risks.

[Detailed characterization of the complete mitochondrial genome of the oceanic whitetip shark *Carcharhinus longimanus* \(Poey, 1861\)](#)

Author: Sadia A. Kamal

Year: 2024

Abstract:

Background

The oceanic whitetip shark *Carcharhinus longimanus* (family Carcharhinidae) is one of the largest sharks inhabiting all tropical and subtropical oceanic regions. Due to their life history traits and mortality attributed to pelagic longline fishing practices, this species is experiencing substantial population decline. Currently, *C. longimanus* is considered by the IUCN Red List of Threatened Species as “vulnerable” throughout its range and “critically endangered” in the western north Atlantic. This study sequences and describes the complete mitochondrial genome of *C. longimanus* in detail.

Methods and results

The mitochondrial genome of *C. longimanus* was assembled through next-generation sequencing and then analyzed using specialized bioinformatics tools. The circular, double-stranded AT-rich mitogenome of *C. longimanus* is 16,704 bp long and contains 22 tRNA genes, 2 rRNA genes, 13 protein coding genes and a 1,065 bp long control region (CR). Out of the 22 tRNA genes, only one (tRNA-Ser1) lacked a typical ‘cloverleaf’ secondary structure. The prevalence of TTA (Leu), ATT (Ile) and CTA (Leu) codons in the PCGs likely contributes to the AT-rich nature of this mitogenome. In the CR, ten microsatellites were detected but no tandem repeats were found. Stem-and-loop secondary structures were common along the entire length of the CR. Ka/Ks values estimated for all PCGs were < 1, indicating that all the PCGs experience purifying selection. A phylomitogenomic analysis based on translated PCGs confirms the sister relationship between *C. longimanus* and *C. obscurus*. The analysis did not support the monophyly of the genus *Carcharhinus*.

Conclusions

The assembled mitochondrial genome of this pelagic shark can provide insight into the phylogenetic relationships in the genus *Carcharhinus* and aid conservation and management efforts in the Central Pacific Ocean.

Climate-smart agriculture and food security in climate-vulnerable coastal areas of Bangladesh

Author: Monoj Kumar Majumder, MdSadique Rahman, Ripon Kumar Mondal, MstShopna Akter

Year: 2024

Abstract:

The issue of global climate change is increasingly worrisome, particularly for countries heavily reliant on agriculture. To reduce the negative impact of climate change on agriculture, farmers of Bangladesh started adopting different climate smart agriculture (CSA) practices. The CSA sustainably increases productivity, resilience, and food security, which can contribute to the achievement of a number of sustainable development goals (SDGs). However, the adoption of CSA is low especially in the climate-

vulnerable coastal areas of Bangladesh. Therefore, this study was conducted to identify the factors affecting the adoption of CSA and its influence on coastal household's food security. A total of 327 sample farmers from three coastal districts of Bangladesh were interviewed. The collected data were then analyzed by using the binary probit and ordered probit model. The findings indicated that highest 65 % of farmers adopted early planting of rice as one of CSA practices. The adoption of CSA practices positively affected by the household annual income, extension services and awareness regarding CSA practices. Moreover, the adopters of CSA were more food secure than non-adopters. For instance, adoption of one additional CSA practice leads to an increase in the likelihood of being food secure by 4.3 %. In terms of policy perspective, the adoption of CSA in the coastal areas can be increased through creation of employment opportunities, increasing access to extension services, and broadcasting of CSA-related programs on mass media.

Molecular Identification, Histopathology and Antibiotic Susceptibility Profiling of *Aeromonas veronii* Isolated from *Oreochromis niloticus* in Bangladesh

Authors: Sayed Mashequl Bari, Mohammad Muttakinul Islam, Aktia Amina, Marufa Khatun, A. M. Shahabuddin

Year: 2024

Abstract

Background: Tilapia (*Oreochromis niloticus*) is the most widely cultured freshwater fish species in Bangladesh and worldwide. However, commercial tilapia culture systems face increasing challenges from bacterial infections.

Objectives: The objective of this study was to identify the bacterial isolates from infected tilapia in an intensive cage culture farm located along the Shitalakshya River in Bangladesh.

Methods: Infected fish samples were collected and underwent comprehensive clinical and post-mortem investigations, followed by phenotypic, biochemical and molecular identification of the bacterial isolates, as well as histopathological and antibiotic susceptibility examinations.

Results: Phenotypic and biochemical characterization showed similarities of the -collected isolates with *Aeromonas veronii*. Moreover, molecular analysis of the bacterial conserved region 16S rRNA also confirmed these isolates as *A. veronii*. The analysed 16S rRNA sequence (GenBank accession no. PP832815) showed a close relationship (100% identity) with *A. veronii* from China (GenBank accession no. MT071624) in the NCBI BLAST search, and in the phylogenetic tree, they grouped in a single clade. This close genetic relationship is also supported by the low genetic distance between the isolates. Histopathological analysis revealed gross pathological changes like necrosis, hypertrophy and inflammation in muscle tissues. The isolates were found to be sensitive to multiple antibiotics but resistant to trimethoprim and sulphamethoxazole.

Conclusion: This study investigated the presence of *A. veronii* infection in tilapia (*O. niloticus*) in an intensive cage culture farm in Bangladesh.

Impact of contemporary management practices in pond fish farming on the socio-economic condition of fish farmers in north-central Bangladesh

Authors: Md. F. Hossain, Afsana A. Asha, Koushik Chakroborty, Hoomayra Yasmin, Jahid Hasan

Year: 2024

Abstract: Abstract. Aquaculture in Bangladesh has greatly improved diet structure, ensured food safety, and facilitated the transformation of fisheries growth mode. The study aimed to investigate the existing management techniques of fish farming in ponds and assess its impact on the socioeconomic status of fish farmers in the Trishal upazila (sub-district), Mymensingh, a region in north-central Bangladesh, from January to June 2023. Data were collected using a well-structured questionnaire. The majority of farmers (62.50%) had ponds that were 0.5-1.0 ha in size. Over half of the farmers (52.50%) practiced monoculture, with catfish comprising 37.13%. The average stocking density was 50,000-65,000 fry ha⁻¹. With conventional post-stocking management, the majority of farmers (90%) utilized probiotics, and 87.50% used vitamins and minerals. Around 90% had formal education, and most individuals resided in standard housing. All participants had access to electricity and potable water, 96% had adequate sanitary facilities, and 95% of the farmers had proper healthcare facilities. Half of the farmers (50%) were involved in fish farming as their primary occupation. Most farmers (75%) earned an annual income ranging from 700 to 1,300 USD, and a significant 90% invested their own funds into fish farming. More than half of the farmers (55%) received technical assistance from their neighbors. Fish farming in the region has intensified, and the existing management practices have led to enhanced production, thus benefiting the livelihoods of the fish farmers. However, achieving long-term sustainability necessitates a supply of high-quality fry, cost-effective and high-quality feed, comprehensive training, and effective marketing strategies.

Assessment of heavy metals and proximate composition in jellyfish (*Lobonemoides robustus* Stiasny, 1920) collected from Cox's Bazar coast: Human health risk assessment

Author: Mir Mohammad Ali,

Year: 2024

Abstract

Jellyfish are known for experiencing periodic blooms in population, which occur when their density increases suddenly. The present study assessed the level of heavy metals and proximate composition in the jellyfish *Lobonemoides robustus* collected from Cox's Bazar coast of Bangladesh. This is the first study conducted in Bangladesh. Most of the studied metals were not possible to detect in *L. robustus* samples because concentrations were below the detection limit. Ca, Na, Se, and Mg were found to have safe levels in the *L. robustus* while the amount of Pb was recorded 0.39 ppm. The findings of Target Hazard Quotient, and Carcinogenic Risk indicate that the *L. robustus* is safe for human consumption (both for children and adults). Hence, it is suitable for consumption and can be exported. This study emphasizes the need for regular marine environment monitoring to ensure that the seafood harvested from these waters is safe for consumption.

Seasonal Changes of Nutrient Stoichiometry in the Tidal Mangroves Estuary, Bangladesh

Author: Jahid Hasan

Year: 2024

Abstract:

In the current study, the stoichiometry of dissolved nutrients was addressed in the Pasur River estuary (PRE) mangrove ecosystems of Bangladesh to characterize the ecological and nutrient state of the inter-tidal mangroves in light of rising human disturbances from January to December 2019. The findings suggest excess phosphorus (P) relative to nitrogen (N) in these systems, indicating that mangrove coastal habitats along the PRE are severely N-constrained. Since the silica(Si): N ratio in the PRE mangrove estuary was greater than 1, it was concluded that the estuarine mangrove waters receive a significant amount of silica from terrestrial weathering. P can limit primary production in some systems; therefore, managing both N and P is recommended for an optimal management of coastal eutrophication, even though N is likely the main source of eutrophication in most coastal systems in the tropical zone. Excess P in estuaries can also combine with nitrogen (N) and silica (Si) availability to destabilize ecosystems. Through mechanisms such as enhanced Si fluxes, decreasing P in upstream freshwater habitats can also benefit coastal marine ecosystems. These intricate relationships are important while devising strategies to reduce nutrient pollution in coastal areas.

Keywords: Mangrove Estuary Dissolved nutrients Stoichiometry Redfield ratio

Corrigendum to “Quantification of heavy metals in wild gravid female mud crab (*Scylla olivacea*) collected from different rivers of Sundarbans mangrove region” [Desalin Water Treat 319 (2024) 100521]

Author: Md. Abdul Hannan

Year: 2024

Abstract: Heavy metals pollution is one of our major problems in Sundarbans mangrove zone as we all their surrounding rivers. The presence of industrial development in the nearby areas of coastal and marine aquacultures sites are the cause of heavy metals pollution. The aim of the research was to quantify heavy metals in gravid female mud crabs (*Scylla olivacea*) in three different rivers of Sundarbans region. Mud crabs and their surrounding water and soil sediments were collected from Mongla, Kholpetua, and Kopotakkho rivers. Analysis of river water was conducted in the laboratory of Shiva Analyticals (India) Private Limited, India, whereas live mud crabs and sediment samples were analyzed from Quality Control Laboratory (QCL), Khulna, Bangladesh for the quantification of heavy metals. The results showed that the heavy metals As, Cr, Cd, Hg and Pb were detected in mud crabs and their surrounding river water and sediments, but the concentration of heavy metals in mud crabs was remains below the limit of human's consumptions except the heavy metal Chromium (Cr). Maximum concentration of heavy metals was detected Kopotakkho river followed by Mongla and Kholpetua river. The concentration of heavy metals was highest in soil sediments followed by mud crabs and river waters. Mud crabs were contaminated by heavy metals that bioaccumulated from their surrounding sediments and water sources. The hierarchy of mean concentrations (mg/kg) of the heavy metals were $Pb > As > Cr > Pb > Hg$. Heavy metals are carcinogenic for human consumption when exceeded their permissible levels. It is urgent to stop pollution in Sundarbans mangrove zone and led to serve healthy foods for the nations.

Quantification of heavy metals in wild gravid female mud crab (*Scylla olivacea*) collected from different rivers of Sundarbans mangrove region

Author: Md. Abdul Hannan

Year: 2024

Abstract

Heavy metals pollution is one of our major problems in Sundarbans mangrove zone as we all their surrounding rivers. The presence of industrial development in the nearby areas of coastal and marine aquacultures sites are the cause of heavy metals pollution. The aim of the research was to quantify heavy metals in gravid female mud crabs (*Scylla olivacea*) in three different rivers of Sundarbans region. Mud crabs and their surrounding water and soil sediments were collected from Mongla, Kholpetua, and Kopotakkho rivers. Analysis of river water was conducted in the laboratory of Shiva Analyticals (India) Private Limited, India, whereas live mud crabs and sediment samples were analyzed from Quality Control Laboratory (QCL), Khulna, Bangladesh for the quantification of heavy metals. The results showed that the heavy metals As, Cr, Cd, Hg and Pb were detected in mud crabs and their surrounding river water and sediments, but the concentration of heavy metals in mud crabs was remains below the limit of human's consumptions except the heavy metal Chromium (Cr). Maximum concentration of heavy metals was detected Kopotakkho river followed by Mongla and Kholpetua river. The concentration of heavy metals was highest in soil sediments followed by mud crabs and river waters. Mud crabs were contaminated by heavy metals that bioaccumulated from their surrounding sediments and water sources. The hierarchy of mean concentrations (mg/kg) of the heavy metals were $Pb > As > Cr > Pb > Hg$. Heavy metals are carcinogenic for human consumption when exceeded their permissible levels. It is urgent to stop pollution in Sundarbans mangrove zone and led to serve healthy foods for the nations.

Unveiling microplastics pollution in a subtropical rural recreational lake: A novel insight

Author: Mir Mohammad Ali

Year: 2024

Abstract:

While global attention has been primarily focused on the occurrence and persistence of microplastics (MP) in urban lakes, relatively little attention has been paid to the problem of MP pollution in rural recreational lakes. This pioneering study aims to shed light on MP size, composition, abundance, spatial distribution, and contributing factors in a rural recreational lake, 'Nikli Lake' in Kishoreganj, Bangladesh. Using density separation, MPs were extracted from 30 water and 30 sediment samples taken from ten different locations in the lake. Subsequent characterization was carried out using a combination of techniques, including a stereomicroscope, Fourier transform infrared spectroscopy (FTIR) and field emission scanning electron microscopy (FE-SEM). The results showed a significant prevalence of MPs in all samples, with an average amount of 109.667 ± 10.892 pieces/kg³ (dw) in the sediment and 98.167 ± 12.849 pieces/m³ in the water. Small MPs (<0.5 mm), fragments and transparent colored particles formed the majority, accounting for 80.2%, 64.5% and 55.3% in water and 78.9%, 66.4% and

64.3% in sediment, respectively. In line with global trends, polypropylene (PP) (53%) and polyethylene (PE) (43%) emerged as the predominant polymers within the MPs. MP contents in water and sediment showed positive correlations with outflow, while they correlated negatively with inflow and lake depth ($p > 0.05$). Local activities such as the discharge of domestic sewage, fishing waste and agricultural runoff significantly influence the distribution of polypropylene. Assessment of pollution factor, pollution risk index and pollution load index values at the sampling sites confirmed the presence of MPs, with values above 1. This study is a baseline database that provides a comprehensive understanding of MP pollution in the freshwater ecosystem of Bangladesh, particularly in a rural recreational lake. A crucial next step is to explore ecotoxicological mechanisms, legislative measures and future research challenges triggered by MP pollution.

Oxygen declination in the coastal ocean over the twenty-first century: Driving forces, trends, and impacts

Author: Mir Mohammad Ali

Year: 2024

Abstract:

Oxygen declination in coastal oceans has accelerated drastically in recent decades, both in terms of severity and spatial extent, and such disappearance of oxygen leads to dead zones where life can't survive. This phenomenon is mainly attributed to nutrient pollution and climate change due to intensified anthropogenic activities. The annual statistical oxygen mean concentrations showed the current deoxygenation trends based on (WOA_2001–2018) data comparison of 200 m below the surface water from the first two decades of the 21st century. A relatively similar significant oxygen loss of 0.5–3 ml/L was indicated in the first decade (2001–2009) over the water of continental shelves (200 m) in the tropical oceans and the areas of subtropical Pacific, Atlantic, and southern Indian oceans gradually started to fall from their moderate oxygen concentrations 4–5 ml/L between 2005 and 2009. Consequently, in the next decade (2013–2018), the negative oxygen trend persisted at a similar depth in the global oceans, and its expansion to more regions suggested that this trend of oxygen loss will continue in the future. This is a serious threat that has to be made more widely known since declines in oxygen levels in coastal oceans could have a wide range of negative impact on marine life, biogeochemical cycles, coastal habitats, economies that run on the sea, and ultimately humans. Therefore, it is crucial to investigate and put into practice management alternatives in order to lessen the effects of continuous deoxygenation on marine life and the supply of services by marine ecosystems.

Molecular diagnosis appended by histopathological signature delineates the white spot syndrome virus (WSSV) infection in penaeid shrimps

Author: Md. Juwel Hasan, Mohammad Nazrul Islam

Year: 2024

Abstract:

White spot disease (WSD) occurred by the highly devastating white spot syndrome virus (WSSV) poses a serious impediment toward global shrimp production. We investigated molecular diagnosis and natural

infection with WSSV in cultured tiger shrimp (*Penaeus monodon*) and inspected histopathology of WSD. The incidence of WSSV infection was recorded in six small-scale shrimp farms situated in two districts of Bangladesh, namely Bagerhat and Satkhira. One- and two-step nested polymerase chain reaction models were applied to check the presence of WSSV DNA in shrimp samples. By one-step PCR, 25 of the 36 shrimp samples were WSSV-positive, while the remaining 11 samples were found to be WSSV-negative. After the negative samples underwent a two-step PCR process, only three samples were detected WSSV negative. In Satkhira and Bagerhat districts, the prevalence rates of WSSV infection were 83.33% and 55.56%, respectively, as confirmed by one-step PCR; following two-step nested PCR, the prevalence rates remained unchanged for Satkhira but increased to 100% for Bagerhat sourced samples. One-step PCR was less effective than two-step nested PCR in diagnosing viral infection; instantly evident that the overall prevalence rate rose from 69.44% to 91.67% when switching to two-step nested PCR. In a different experiment, histological analyses of PCR-confirmed WSSV-positive shrimp specimens revealed degenerated tubule lumen and degenerated hepatopancreas with necrosis, while the infected muscle tissues showed muscle fiber fragmentation and separation. Based on effective PCR technique and histopathological evidence of WSSV infection, the study demonstrated the occurrence of WSSV infection in small-scale shrimp farms. The combined practices of the diagnostic tools and information will be useful in understanding the white spot disease and managing its prevention in shrimp production systems.

Site suitability mapping for different seaweed cultivation systems along the coastal and marine waters of Bangladesh: A Generalized Additive Modelling approach for prediction

Author: Afshana Ferdous

Year: 2024

Abstract

While seaweed cultivation has reached an advanced stage in many Asian countries, this industry remains nascent in Bangladesh, hindered by a lack of comprehensive site suitability mapping. To address this gap, we employed the Generalized Additive Model (GAM) approach to develop habitat suitability maps for different seaweed cultivation systems encompassing the entire coastal and marine territorial areas of Bangladesh. Our study leveraged an *in-situ* dataset comprising production and environmental factors from 180 cultivation plots of four species (*Gracilaria* sp., *Enteromorpha intestinalis*, *Ulva lactuca*, and *Hypnea musciformis*) across five cultivation sites, supplementing this data with other ecological variables derived from satellite observations and model simulations. The GAM analysis identified seven key explanatory variables that collectively accounted for 78 %, 76 %, and 79 % of the observed variability in seaweed data for off-bottom long-line, off-bottom net, and floating long-line cultivation systems, respectively. The model predicted that total suspended solids (TSS) predominantly influenced the habitat suitability for off-bottom net and floating long-line cultivation systems, while salinity was a crucial determinant for off-bottom long-line cultivation systems. The study further demonstrated that the predicted suitable areas (50–100 %) for floating long-line cultivation systems (1850 km²) substantially outnumbered those for off-bottom long-line (372 km²) and off-bottom net (380 km²) cultivation systems. The model showed that the southeast coast, specifically the sandy bottom areas of the Moheshkhali channel and its surroundings, exhibited high suitability (>75 % probability) for off-bottom long-line and

off-bottom net cultivation systems. In contrast, the floating long-line cultivation system appeared most suitable for seaweed farming along almost the entire coastline of Bangladesh, excluding the Meghna and adjacent estuaries in the central region. Notably, the most suitable areas were specifically concentrated in the coastal areas of Moheshkhali Island, Cox's Bazar, Teknaf, and Saint Martin's Island in the southeast coastal zone, extending potentially to far offshore waters. The predictions of our model aligned well with *in-situ* observations, as evidenced by an area under the curve (AUC) of 0.83 and an R^2 value of 0.85. The insights gleaned from this research offer invaluable guidance to seaweed farmers, entrepreneurs, and policymakers, thereby contributing to the sustainable development of the emerging seaweed-based blue economy in Bangladesh.

River pattern influences the composition of small indigenous species (SIS) of fish in deltaic Rajbari district, Bangladesh

Authors: Zubayda Mushtari Nadia, Md. Abdul Baten, Kazi Ahsan Habib, Mohammad Rashed

Year: 2024

Abstract

Bangladesh is endowed with diverse rivers providing huge ecosystem services, but the diversity status and the abundance of the small indigenous species (SIS) are not identical in all rivers due to the natural water flow regime and anthropogenic challenges. Therefore, the present study endeavors to elucidate the composition and conservation status of SIS fish from four rivers namely, the Padma, the Gorai, the Chandana and the Horai rivers of Rajbari District, Bangladesh. Data were meticulously collected through fish sampling in each season, field observations, focus group discussions, and individual interviews by using a semi-structured questionnaire spanning from May 2021 and April 2022. The number of SIS in the Padma, the Gorai, the Chandana and the Horai rivers of Rajbari were 60, 36, 33 and 26, respectively, whereas a predominant concentration of fishes was notably observed in the benthopelagic zone of these rivers. Among the 60 riverine SIS, 23 fish were common in the four rivers. Additionally, Cyprinidae (>30%) was observed to be the most abundant SIS in the studied rivers. The fishermen in the research area used seven major fishing equipment of which cast nets are the most common for catching fish species. The abundance of SIS during the rainy season was the highest for all the studied rivers than the other seasons and 12 SIS were available throughout the year. Notably, the least concerned SIS outnumbered the other categories whereas, more than 10% was under the vulnerable category in the four rivers. The leading threats to the fish diversity were pollution followed by illegal and overfishing, siltation, reduced depth, degeneration of rivers and others. Consequently, to safeguard the existing SIS, reducing human pressure, implementing fishing regulations strictly, establishing and administering fish sanctuaries, and raising public awareness can be helpful for the sustainability of aquatic resources in deltaic areas.

Influences of Feed Additives for Sustainable Aquaculture Production in Asia: A Review

Author: Jahid Hasan

Year: 2024

Abstract: Aquaculture is considered as the primary source to increase fish supply in order to ensure food security and effectively address the nutritional needs of the growing population specially in Asian countries. The utilisation of antibiotics in aquafeeds has been extensively employed in aquaculture of Asian region in order to prevent disease and promote growth. But due to various unfavourable consequences and growing acceptance of the benefits of restricted use of antibiotic administration in aquaculture, the necessity to consider alternate options is urgent. In light of this, the development of eco-friendly feed additives, particularly immunostimulants, for disease control and improved health of aquatic animals is gaining popularity in Asia. The utilisation of natural feed additives has the potential to enhance the efficiency of aquaculture production, reduce the need for medicated treatments, minimise waste discharges, and promote sustainability and long-term profitability. Various high-quality feeds, customised for specific needs, are now supplemented with essential feed additives in the Asian aquaculture industry. The recent focus on functional feed additives has led to the incorporation of probiotics, prebiotics, mycotoxin binders, organic acids, phytogenic compounds, and other medicinal herbs. These feed additives not only boost and support the general health of aquatic animals but also increase consumer confidence in farmed fish. The main objective of the present review is to emphasize the significance of functional feed additives in Asian aquaculture, as they play a vital role in regulating growth, optimising feed utilisation, and enhancing the overall health status of aquatic animals.

Climate-smart practice: level of effectiveness and determinants of Sorjan farming adoption in coastal Bangladesh

Author: Md. Hayder Khan Sujan, Monira Sultana

Year: 2024

Abstract

Climate-smart agriculture stands as a promising solution to elevate cropping intensity and enhance food security in climate-vulnerable communities. Despite the evident potential, there is an existing gap in understanding the effects of climate change adaptation measures, with limited research explicitly focusing on adopting sorjan cultivation. This study seeks to address this gap by delving into the effectiveness and determinants of sorjan farming in the coastal regions of Bangladesh. Data was collected in three south-central districts, namely Patuakhali, Jhalakathi, and Pirojpur in 2022. A total of 222 farmers participated in the study, with 120 practicing plain land cultivation, while the remaining 102 were engaged in sorjan farming. Results show that the cropping intensity of farm households increased from 100–200% to 300–500% in sorjan farming. Farmers earned the highest net return by following the crop combinations of ‘Bottle gourd-Potato-Sweet gourd-Indian spinach’, ‘Banana-Okra-Snake gourd-Bottle gourd’, and ‘Jujube-Stem amaranth-Indian spinach’ under the sorjan method in Patuakhali, Jhalakathi, and Pirojpur districts, respectively. On average, farmers realized an additional net benefit of Tk. 55 for every Tk. 100 invested upon transitioning from plain land farming (benefit cost ratio, BCR = 1.25) to sorjan cultivation (BCR = 1.80). The results of the logit model found that household size, farming experience, and extension contact positively influenced the adoption of the sorjan method, while farmers' age and farm size had a negative influence. Further analysis of challenges in both types of farming revealed the advantages of sorjan over plain land cultivation, categorizing them into four distinct areas: environmental, management,

input-related, and market issues. Government policies should prioritize holistic support systems and foster collaborative knowledge-sharing among stakeholders to enhance the adoption and diffusion of sorjan farming in coastal communities.

EXPLORING WATER QUALITY AS A DETERMINANT OF THE EXISTENCE OF SOFT SHELL CRAB (SCYLLA OLIVACEA) IN DIFFERENT HABITATS OF THE LARGE MARINE ECOSYSTEM IN THE BAY OF BENGAL

Author: Md. Abdul Hannan

Year: 2024

Abstract: The present study determined the concentration of semicarbazide (SEM) in water and soil samples from diverse habitats of mud crabs encompassing natural breeding grounds, mangrove-associated rivers, different commercial farms and the tissue samples in soft-shell crabs. Semicarbazide is a residue of banned veterinary drug nitrofurazone that can be found in some natural crustaceans that have never been exposed to nitrofurazone. Analysis of water and soil sediment confirmed the presence of SEM in natural habitat, however the concentrations was very low as <0.1 ng/g throughout the study. The extraction and analysis of nitrofuran metabolites was conducted by using liquid chromatography-tandem mass spectrometry (LC-MS/MS) methods. The commercial farms of mud crabs were also exhibited the lowest levels of SEM in both water (0.0003 ng/g) and soil sediment (0.0005 ng/g). Tissue-specific SEM analyses encompassing muscle, shell-muscle composite, and shell revealed a distinct spatial gradient in which shell tissues exhibiting the highest concentration of SEM (3.51 ± 0.03 ng/g) in commercial farms, surpassing those observed in muscle tissues (0.33 ± 0.01 ng/g). Remarkably, crabs from commercial farms exhibited higher SEM concentrations across all tissue types compared to those from natural breeding grounds. However, no SEM was detected in crab feed snail and tilapia fish in commercial farms, suggesting feed composition may not be a major contributor. The lowest concentrations of SEM in water and soil sediments towards physiological processes rather than environmental contamination as the source. This study highlights limitations of SEM as a sole nitrofuran abuse marker, advocating for broader regulatory frameworks and calls for reevaluating regulations to ensure public health and responsible aquaculture.

Sources and impacts of microplastic on the world's longest sea beach of the Bay of Bengal coasts: a review on microplastic management

Author: Mir Mohammad Alif

Year: 2024

ABSTRACT

The toxic impact of microplastics (MPs) in the terrestrial and aquatic environment has recently become a global problem. The Bay of Bengal coasts is an important bio-diverse ecosystem, which help the people for their sound living and gather natural resources. However, the distribution, impact, source and transport mechanism, and policy to take initiatives for MPs pollution control at the Bay of Bengal coasts'

have received less attention. Therefore, this review summarizes MPs' distribution and their source in the Bay of Bengal coasts' ecosystems. Current knowledge extends the impacts of MP on this vital ecosystem, existing policy, and further recommendations to mitigate MPs contamination are critically assessed in this study. Furthermore, mechanisms of MP on human health are also highlighted with the identification of current research gaps and future study suggestions. Given the escalating plastic usage and the prevalence of important sea products globally, there is a pressing need to prioritize research efforts on the impacts of MPs on the Bay of Bengal coasts from a long-term perspective. Knowledge obtained in this way would inform the scientists, stakeholders, and policy makers in such a way as to help them mitigate impacts of the micro- and nano-plastic legacy at this region.

Genome-wide identification and characterization of interleukin-18 gene family in rainbow trout (*Oncorhynchus mykiss*)

Author: Sayed Mashequl Bari, Md Rafiqul Islam

Year: 2024

Abstract: Abstract

Rainbow trout (*Oncorhynchus mykiss*) are cold freshwater fish species belonging to the Salmonidae family, and they hold significant economic importance in the global aquaculture industry. The interleukin-18 (IL-18) gene family plays a crucial role in the immune response of rainbow trout when combating viral infections. A wide range of computational approaches were conducted to investigate the functions, phylogeny, and expressions of IL-18 family genes. The study found that there were nine IL-18 genes present on eight chromosomes of rainbow trout, and their encoded proteins were predicted to be distributed in the cytoplasm and nucleus. Genetic structures, motif and conserved domains analysis revealed that IL-18 genes in the same group have similar exons, motifs, and conserved domains. The phylogenetic study demonstrates the divergence of 38 IL-18 genes from three fish species into three distinct subgroups across time. The synteny analysis revealed the evolutionary mechanisms, such as gene duplications and mutations. In addition, the research investigated the expression of IL-18 genes in the liver tissues of rainbow trout following infection with infectious hematopoietic necrosis virus. These findings provide a comprehensive understanding of the role of IL-18 genes in *O. mykiss* in response to pathogenic infection.

Factors influencing fish farmers' decision in selecting the right market outlet: empirical evidence from Bangladesh

Author: Md. Sadique Rahman

Year: 2024

ABSTRACT

Aquaculture contributes significantly to the sustainable livelihood improvement of a considerable portion of Bangladesh's population. However, fish farmers often encounter the challenge of receiving lower market prices, necessitating the exploration of market choice options to mitigate economic losses. Using cross-sectional data collected from 200 fish farmers, this study applied the multinomial logit (MNL) model to identify the factors influencing fish farmers' decision to select a fish market. Results indicate that the bargaining power of the fish farmers can increase the probability of selling their fish at the upazila and district markets by 44% and 36%, respectively. Conversely, education, age and distance from the market display a negative association with market choices. The findings suggest several interventions to facilitate fish sales through alternative marketing outlets, including financial assistance for fish production, promoting collective marketing, strengthening extension services, and investing in logistics services, particularly improving the dissemination of market information.

Microplastics in sediment and surface water from an island ecosystem in Bay of Bengal

Author: Mir Mohammad Ali

Year: 2024

Abstract:

Microplastics (MPs) have garnered global attention as emerging pollutants in aquatic and terrestrial ecosystems. Despite their significance, studies on MP pollution have overlooked a biodiverse island ecosystem in the northeast Bay of Bengal. Hence, the current study is a pioneering effort to delve into this issue with the island. This research embodies the first comprehensive report exploring the presence of MP pollution in sediment and surface water and their influencing factors along Sandwip island in the northeast Bay of Bengal. The average MP concentration was 305 ± 37.16 (items/kg) in sediment and 106.14 ± 22.57 (items/m³) in surface water. Fragments emerged as the predominant type in sediment (78.77%) and surface water (54.64%) samples. Fourier Transform Infrared Spectroscopy identified three plastic polymers, the most abundant being polyethylene (56%) and polypropylene (41%). Anthropogenic activities, particularly fishing practices, improper waste disposal, and inadequate waste management strategies, were pinpointed as potential sources of MP contamination on the island. MP concentrations in water and sediment correlated positively with pH and organic matter ($p < 0.000$), indicating important factors influencing MP distribution. The spatial distribution and hotspots of MPs followed significant human routes. By shedding light on the extent of MPs' presence and their potential sources, this study contributes essential insights that can inform effective environmental management strategies for the island's future well-being.

Catastrophic risk perceptions and attitudes in aquaculture: Evidence from flood prone areas of Bangladesh

Author: Airin Rahman

Year: 2024

Abstract

Aquaculture is still an emerging industry that is highly dependent on the environment and more unstable than other conventional agricultural operations. Diverse environmental and production hazards must be managed by aquaculture farmers for sustainability. Farmers' decisions on farm operations and risk management are significantly influenced by their risk attitudes and perceptions of risk. However, few empirical studies on risk management have been done, but literature on aquaculture is scarce. In light of this knowledge vacuum, the current study investigated how farmers perceive catastrophic risk and their attitudes toward various sources. The information was gathered using a stratified random sample method, with 300 aquaculture farmers interviewed from two major flood-prone regions in Bangladesh. A cubic utility function and the Equally Likely Certainty Equivalent (ELCE) approach were used to quantify farmers' risk aversion. The risk matrix technique was used to assess farmers' perceptions of risk. The effects of socioeconomic factors on farmers' risk attitudes were examined using a Logit model. Floods, strong rains, and pest and diseases all posed potential productivity hazards and most farmers were risk averse in nature. Age, educational position, income, and land proprietorship were the most important predictors of risk attitude, while social and agricultural characteristics had little influence on farmers' risk perceptions. The study's findings will eventually allow policymakers to forecast the suitable risk management measures for the aquaculture farmers in Bangladesh.

The path of microplastics through the rare biodiversity estuary region of the northern Bay of Bengal

Author: Mir Mohammad Ali

Year: 2024

Abstract

Due to its harmful effects on ecosystems and human health, microplastic (MP) pollution has become a significant environmental problem on a global scale. Although MPs' pollution path and toxic effects on marine habitats have been examined worldwide, the studies are limited to the rare biodiversity estuary region of Hatiya Island from the northern Bay of Bengal. This study aimed to investigate the MP pollution path and its influencing factors in estuarine sediments and water in rare biodiversity Hatiya Island in the northern Bay of Bengal. Sixty water and sediment samples were collected from 10 sampling sites on the Island and analyzed for MPs. The abundance of MPs in sediment ranged from 67 to 143 pieces/kg, while the abundance in water ranged from 24.34 to 59 pieces/m³. The average concentrations of MPs in sediment and water were 110.90 ± 20.62 pieces/kg and 38.77 ± 10.09 pieces/m³, respectively. Most identified MPs from sediment samples were transparent (51%), while about 54.1% of the identified MPs from water samples were colored. The fragment was the most common form of MP in both compartments, with a value of 64.6% in sediment samples and 60.6% in water samples. In sediment and water samples, almost 74% and 80% of MP were <0.5 mm, respectively. Polypropylene (PP) was the most abundant polymer type, accounting for 51% of all identified polymers. The contamination factor, pollution load index, polymer risk score, and pollution risk score values indicated that the study area was moderately polluted with MPs. The spatial distribution patterns and hotspots of MPs echoed profound

human pathways. Based on the results, sustainable management strategies and intervention measures were proposed to reduce the pollution level in the ecologically diverse area. This study provides important insights into evaluating estuary ecosystem susceptibility and mitigation policies against persistent MP issues.

Farmers perspectives on options for and barriers to implementing climate resilient agriculture and implications for climate adaptation policy

Author: Shilpi Kundu

Year: 2024

Abstract

The impacts of climate change in low lying coastal areas, such as Bangladesh, are adversely affecting food and livelihood security, requiring adaptation to build resilience. However, effective implementation is limited by a lack of local-level knowledge regarding the barriers that prevent adoption and up-scaling of climate resilient agriculture (CRA). Case studies in coastal Bangladesh provide novel insights regarding barriers to planned and autonomous adaptation from the perspective of farmers facing multiple climate change impacts across seven key dimensions of CRA (agrometeorology services, water management practices, nutrient management activities, technologies and knowledge management activities, infrastructure development, socio-economic resilience, and institutions and good governance). Farmers generally perceive that adaptation actions increase resilience in crop production systems and their surrounding social systems, but also identify the important barriers that inhibit or constrain planned and autonomous adaptation opportunities. Planned adaptation actions are perceived to be limited by institutional arrangements and lack of implementation capacity. Autonomous adaptation was found to be dependent on income level, farm-holding size, access to input resources and services and peer/social influences. Planned and autonomous adaptation actions were both affected by specific social and geographic contexts and cultural factors. Recommendations are suggested to address key constraints and thereby promote CRA in coastal agricultural landscapes in Bangladesh and in other developing countries confronting similar challenges.

Chapter Eleven - Microplastics in fishes: Occurrence, impacts and future perspectives

Author: Mir Mohammad Ali

Year: 2024

Abstract

Microplastics (MPs) have become an issue of global concern. Due longevity of its nature, these contaminants are potentially harmful, especially to the aquatic organism. MPs act as vectors as these are synthetic solid particles or polymeric matrices insoluble in water with a regular or asymmetrical shape. There are different types of MPs like films, fibers, microbeds, etc. The accumulation of MPs in different organisms is widespread. Most of the MPs attribute to the aquatic environment from secondary sources.

The excess accumulation MPs in fish digestive tracts can cause biological and physical injury that enhances mortality. Moreover, adverse effects such as growth retardation, hormonal imbalance, metabolic disruption, oxidative stress, immunological and neurotoxicity issues, as well as behavioral changes, were observed due to MPs toxicity. Most of the fishes ingest MPs seeming as food items and bioavailability occurs. MPs can reach a higher trophic level through the food chain. Some adverse effect of MPs in higher trophic level also occurs. In humans, MPs accelerate autoimmune disorders. Moreover, long-term exposure to MPs can induce neurotoxicity, including oxidative stress and immune cell activation in the brain. As MPs exhibit a different level of toxicity with other contaminants, proper investigation is required in various stages of fish.

Chapter One - Plastic pollution in the aquatic ecosystem: An emerging threat and its mechanisms

Author: Mir Mohammad Ali

Year: 2024

Abstract

The smaller fragments of plastics including microplastics and nanoplastics are of particular concern since their existence throughout the food web is more persistent than larger particles. Microplastics enter in the food chain and its very bottom, when aquatic organisms eat or ingest contaminated food materials, and keep being transferred in the next food web predator, including humans. These are detected in Asia, Europe and North America and the studies show that aquatic organisms frequently ingest microplastics across a variety of feeding guilds. Marine organisms may cause shock, inner or outer injuries, ulcerating sores, blocking digestive tracts, fake feelings, degraded feeding capabilities, fatigue, weakness, limited predator prevention, or death in the ingestion of large plastic material and/or particles. However, effects of ingestion of microplastic particles on marine organisms and the toxicity mechanisms are largely unknown. There is much more limited evidence of the impacts of microplastic intake on freshwater species, both in the limited number of studies performed and the number of species examined. However, the few recent studies of freshwater suggest that physical effects are analogous to those carried out in the sea. Therefore, we reviewed the state of the science for briefly identifying knowledge gaps and investigating research needs. To date, a small number of studies have been conducted to investigate biological effects of plastics on aquatic species, and the significant transport pathways of plastics from freshwater ecosystems to marine ecosystems and vice-versa have received little attention. So potential sources and the fate of the environment continue to be investigated. Likewise, there is limited research to explain how plastics and its fragments could transfer from the freshwater to terrestrial and to marine ecosystems, and to know if they can affect human health.

Assessing risk to human health for potentially toxic elements in farmed and wild giant tiger prawn (*Paeneas monodon*) in the coastal area of Bangladesh

Author: Mir Mohammad Ali

Year: 2024

ABSTRACT

Giant tiger prawn (*Penaeus monodon*) is an important marine crustacean widely reared for food all over the world but poses a health risk if it is contaminated by toxic elements. Potentially toxic elements (PTEs), i.e. copper (Cu), chromium (Cr), nickel (Ni), arsenic (As), cadmium (Cd), lead (Pb), manganese (Mn) and zinc (Zn) in wild- and farm-cultured prawns were measured for the first time to assess the levels of PTEs, their sources and health risks. Average concentrations (mg/kg) of Cr, Ni, Cu, As, Cd, Pb, Mn and Zn in farm prawn were 3.13, 3.06, 14.21, 1.28, 0.50, 1.32, 5.89 and 7.68, respectively, and in wild prawn, they were 0.98, 2.43, 8.48, 0.45, 0.19, 0.46, 2.77 and 3.88, respectively. Except Ni and Zn, the concentrations of PTEs in prawn samples were higher than the maximum allowable concentration (MAC), indicating their contamination by PTEs which might pose risks to human health. Multivariate principal component analysis (PCA) revealed that anthropogenic activities including industrial wastes and agricultural chemicals are substantial sources of PTEs in the samples. Estimated daily intake (EDI), target hazard quotient (THQ) and target carcinogenic risk (CR) assessed for potential human health risk implications suggest that the values were slightly higher than the acceptable threshold for both adults and children.