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THE NEOTIA UNIVERSITY
ज्ञानम् आत्म प्रदीपाय
Approved Under Sec.2(f) of UGC Act 1956

MATSYA JAGAT

Vol. 1, Issues 2

- Division of Fisheries Science
The Neotia University
Sarisha, Diamond Harbour

Content

Forewords

The second issue of the magazine entitled Matsya Jagat has been created for university students and other fisheries professionals who are eager to learn about Fisheries and Aquaculture. I found that it was challenging for professionals and students to obtain reading material for class and up-to-date information from the literature that was available. The readers' demands will undoubtedly be met by this magazine, especially those who are interested in the most recent advancements in aquaculture and fisheries development. It is a useful compendium of subjects that covers everything from fundamental ideas to cutting-edge concepts, as well as current events and aquaculture and fisheries principles. Here, you'll find some of the most well-known methods, including nutrient requirements, aquasilviculture, fish reproductive behavior, effects of herbicides aquatic animals and fisheries impact assessment as well as few news, subjects of B.F.Sc. Curriculum, students section and activity with advanced techniques have been discussed for betters understanding of the readers.

It offers thorough insights on this area. This journal is a priceless source of information thanks to its coherent flow of recent news, reader-friendly language, and wide use of examples

Dr. Biswajit Ghosh
Vice Chancellor
The Neotia University

The Editor-in-Chief Message

The Division of Fisheries Science publishing 2nd issue of an E-Magazine Matsya Jagat makes me very delighted to hear about it. All of the faculty and students are actively participating and submitting articles, information, news items, etc.

This journal will serve as a venue for teacher and student accomplishments. There will be a new issue of the magazine in every three months. I anticipate that both our students and professors will make better use of this forum, and that, it will develop into a dynamic magazine in the coming months for the sharing of information and knowledge.

The Division of Fisheries Science continues to expand. Recently, faculty members with technical qualifications have been hired. Infrastructure and facilities have been built, including a carp hatchery, wet lab, fish ponds, and laboratories for different Departments. Our first batch of students got really beneficial internships and in-plant training at top universities.

I hope the publication succeeds and all the best.

Prof H Shivananda Murthy
Chair Professor
Division of Fisheries Science
The Neotia University

Editorial

Dr. Vikas Pathak

Editor- Matsya Jagat,
Assistant professor and Head,
The Neotia University, Diamond harbour,
West Bengal- 743368

Dear Readers,

The May 2023 issue of Matsya Jagat is in-front of you and I am happy to inform you that the Division of Fisheries Science has developed collaborations and signed MoUs with several National and International Universities, Institutes, including Bangladesh Agricultural University, Sylhet; ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar; ICAR-Central Inland Fisheries Research Institute, Barrackpore; ICAR-Central Institute of Brackishwater Aquaculture, Chennai; Central Marine Fisheries Research Institute, Cochin, Kerala; West Bengal Animal & Fisheries Sciences, University, Kolkata and several other Private and Corporate Fisheries and Aquaculture Companies, mutual collaborations including students internships and placements. The Division of Fisheries Science has got funds from the Central Government organization, namely, National Fisheries Development Board(NFDB), Hyderabad for a training project. NFDB has approved Rs. 20 lachs to organise series of training programs for the fish farmers. Two training programs on Value addition to fish and fishery products have been organized as off campus trainings and two training programs on High-Tech Aquaculture Production systems including RAS, Biofloc and Aquaponics were organized in the University Campus, for the benefit of fish farmers and entrepreneurs.

In the Article section you may find articles about …

Mangrove conservation: Aquasilviculture Authored by Shyam Kumar, Raju Ram, Jaspreet singh and Vikas Pathak discussed about Aquasilviculture and given an idea to reforesting the disappeared mangrove forests Ecological and economic functions of mangroves, Threats to mangroves and Actions that are needed to be taken for mangrove conservation.

Another article titled **Tracer Techniques in Fish Larval Nutrition Studies** Authored by Munish Kumar et al. discussed Major constrain in larval nutrition and method of study of larval nutrition. A part of it you may find other important articles in article section of this magazine.

In the news section you may find news about ...

Sardine and mackerel back as Kerala's 'big fish: The landings of Indian oil sardine saw an increase of 188.15% in 2022 compared to 2021 and it secured the second position among marine resources in quantity landed in the country

Heat wave affects groundwater: Rise in temperature and heat have a cascading effect on food-producing sectors, including fisheries, as it disrupts groundwater behaviour. "Excessive pressure on groundwater is leading to the presence of more salts on the ground surface.

In a first in Uttarakhand, integrated aqua park to come up in US Nagar under PMMSY: The central government has allocated a budget of Rs 44.50 crore to the Uttarakhand government for the construction of an Integrated Aqua Park in Palasia village in Sitarganj of district Udham Singh Nagar.

India's carbon footprint from marine fisheries is much lower than global level: CMFRI has estimated that the Fisheries sector emits 1.32 tonne of CO2 (carbon dioxide) to produce one tonne of fish. This is much lower than the global figure of more than 2 tonne of carbon emission per tonne of fish.

For future correspondence feel free and you can send articles for publication on the following email: vikas.pathak@tnu.in

Editorial Members

Dr. Neeraj Pathak

Assistant Professor and Faculty Head

Dr. Neeraj Pathak is an Assistant Professor and Faculty Head for the Division of Fisheries Science, as well as in charge-head of Fish Processing Technology and Fisheries Engineering Department at The Neotia University. He is also serving as Academic Coordinator of the Division. He received his doctorate in the subject of Fish Quality Assurance and Management. He has teaching experience of seven years of various organizations throughout India. He has received several national and international Awards. His areas of interest in the research include Fish Processing Technology, Seafood Thermal Processing *(Developed a pasteurization technique for soft shell blue swimming crabmeat in Ph.D. research work),* and Emerging Fish Quality and Safety *(Including value chain analysis for crabmeat, Seafood authentication, Traceability, Exposure of Nanoscience Technology of Scanned Electron microscopy and Transition Electron Microscopy for the crabmeat, Exposed to handle all quality analysis advanced instrument Viz. ICPMS, GCMS, SEM, TEM, LCMS, TPA).* He has published a number of books, manuals, and research articles (with a highest impact factor up to 7.001) in National and International journals.

Dr. Ujjwala Upreti

Assistant Professor and Head

Dr. Ujjwala Upreti is working as Assistant Professor and Head in The Neotia University from July 2022. She has research experience in the areas of nano-toxicity in aquaculture, plankton diversity and supplementary feed in aquaculture. She completed her Post-graduation (M.F.Sc.) from Doon P.G. College, Sri Dev Suma University, Tehri Garhwal (Uttarakhand) and Doctorate Degree (Ph.D.) from Govind Ballabh Pant University of Agriculture and Technology, College of Fisheries, Pantnagar, Uttarakhand in the department of Aquaculture. She has published several Research papers, Book Chapters, and Popular Articles. Also she has presented several oral / poster presentations in national and international conferences / seminars. She has attended several offline / online training / Webinar / Seminar / conference etc.

Editorial Members

Dr. Suman Takar

Assistant Professor and Head

Dr. Takar has more than one year of teaching experience . She has research experience in the areas of Fish Biology, Biodiversity & Conservation, Fish Population Dynamics and plankton diversity. She completed her Post-graduation (M.F.Sc.) from ICAR-Central Institute of Fisheries Education, Mumbai (Maharashtra) and Doctorate Degree (Ph.D.) from Tamil Nadu Dr. J. Jayalalithaa Fisheries University- Fisheries College and Research Institute, Thoothukudi (Tamil Nadu) in the department of Fisheries Resource Management (FRM). She has published several Research papers, Review papers, Book Chapters, and Popular Articles. Also she has presented several oral / poster presentations in national and international conference / seminar. She has attended several offline / online training / Webinar / Seminar / Workshop / conference etc.

Dr. Avishek Bardhan

Assistant Professor and Head (AAHM)

Dr. Bardhan's research focuses on antibiotic resistance, with a particular emphasis on florfenicol. He has made significant contributions to the field, publishing and co-authoring approximately 13 papers, book chapters and popular articles in renowned national and international journals. Notably, he worked as a young professional II for 6 months under the national project 'All India Network Project on Fish Health. He has organized several fish farmers training program.. he actively serves as a reviewer for several esteemed international journals. He is a life member of the Healthcare and Biological Sciences Research Association (HBSRA) and holds recognized memberships with prestigious organizations. He has received research grant project proposal in TNU, reflecting his dedication to innovative research.

Editorial Members

Ms. Camelia Chattopadhyay

Teaching Asst., Fisheries Extension

She holds a master degree (M.F.Sc) in Fisheries Extension from ICAR-CIFE, Mumbai. She has different training experiences regarding fish culture and value-added fish products from several reputed fisheries institutes. She has participated as Event Manager/Media Crew in ICAR NAHEP sponsored Skill Development Programme on Communicating Science. She has completed one month internship in 'Video Editing' from 'Bangla Time', Kolkata. She has participated in All India Agri Uni Fest in the event group dance at Shree Venkateshwara Veterinary University (SVVU), Tirupati. Her directed and edited tribal short film 'Dream Never Lies' has been awarded in International Micro Film Festival, Kolkata in January, 2022. She has published research paper in popular journals.

Dr. Suman Karmakar

Assistant Professor

Dr. Suman Karmakar is an Assistant Professor in the Fishery Science Division at The Neotia University. He has received Masters degree and Doctor of Philosophy award in the subject of Aquatic Environment Management. He was participated different types of National and International Symposium. He is expert in the field of Aquatic Toxicology and Aquatic Ecology and Biodiversity. He was published a number of research article in National and International Journals.

Editorial Members

Dr. Sanjeev Sharma
Assistant Professor

Dr. Sanjeev Sharma is an Assistant Professor in the Department of Fish Processing Technology, The Neotia University, Sarisha, West Bengal, India. He received his Master degree in the discipline of Fish Processing Technology from the College of Fisheries, Central Agricultural University (Imphal), Lembucherra, Agartala, Tripura. In addition, He qualified for the ICAR - National Eligibility Test (ICAR-NET) in the subject of Fish Processing Technology. He has published numbers of research articles, book chapters, books, and popular articles in peer-reviewed national and international journals, magazines, and publishers.

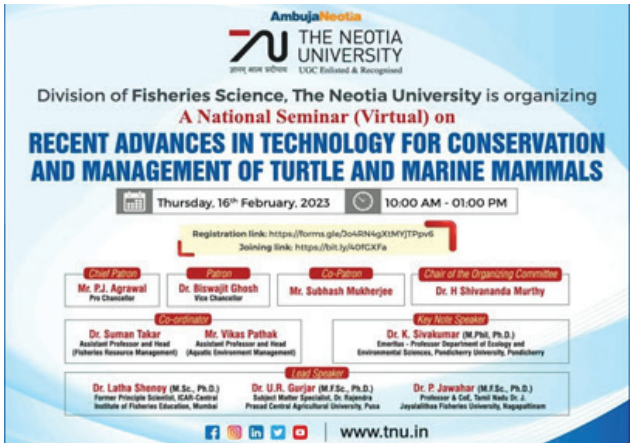
Mr. Khemraj Bunkar
Assistant Professor

Mr. Khemraj Bunkar is an Assistant Professor in the Department of Fisheries Economics. The Neotia University, Sarisha, West Bengal, India. He received his Master's degree in the subject of Fisheries Economics from the ICAR- Central Institute of Fisheries Education, Mumbai. In addition, He qualified for the ICAR - National Eligibility Test (ICAR-NET) in the subject of Agriculture Economics. His areas of interest in the research include fish supply chain analysis, value chain analysis, and economics of reservoir fisheries & fish markets. He has published a number of research articles, book chapters, books, and popular articles in peer-reviewed national and international journals, magazines, and publishers.

Activities
of the Division of Fisheries Science

MoU between The Neotia University and Bangladesh Agricultural University, Sylhet

MoU Signed with CIFA, Bhubaneshwar



National seminar organized by Division of Fisheries Science

Training Program for Fish farmers on High-Tech Aquaculture at The Neotia University

Lifetime Achievement Award to Prof (Dr.) H. S. Murthy, Chair Professor & Dean

Young Scientist Award to Dr. Neeraj Pathak

Activities for Formers

Training programs organised at Sundarbans and Nandigram on fish value addition

Training programs organised in the Univ Campus on Hightech Aquaculture

Studets Activity

Students preparing value added products

Students preparing fish manure

Students and faculties interaction during placement drive

Students interaction with Honorable Pro-Chancellor

Guest lecture and Placement drive at The Neotia University

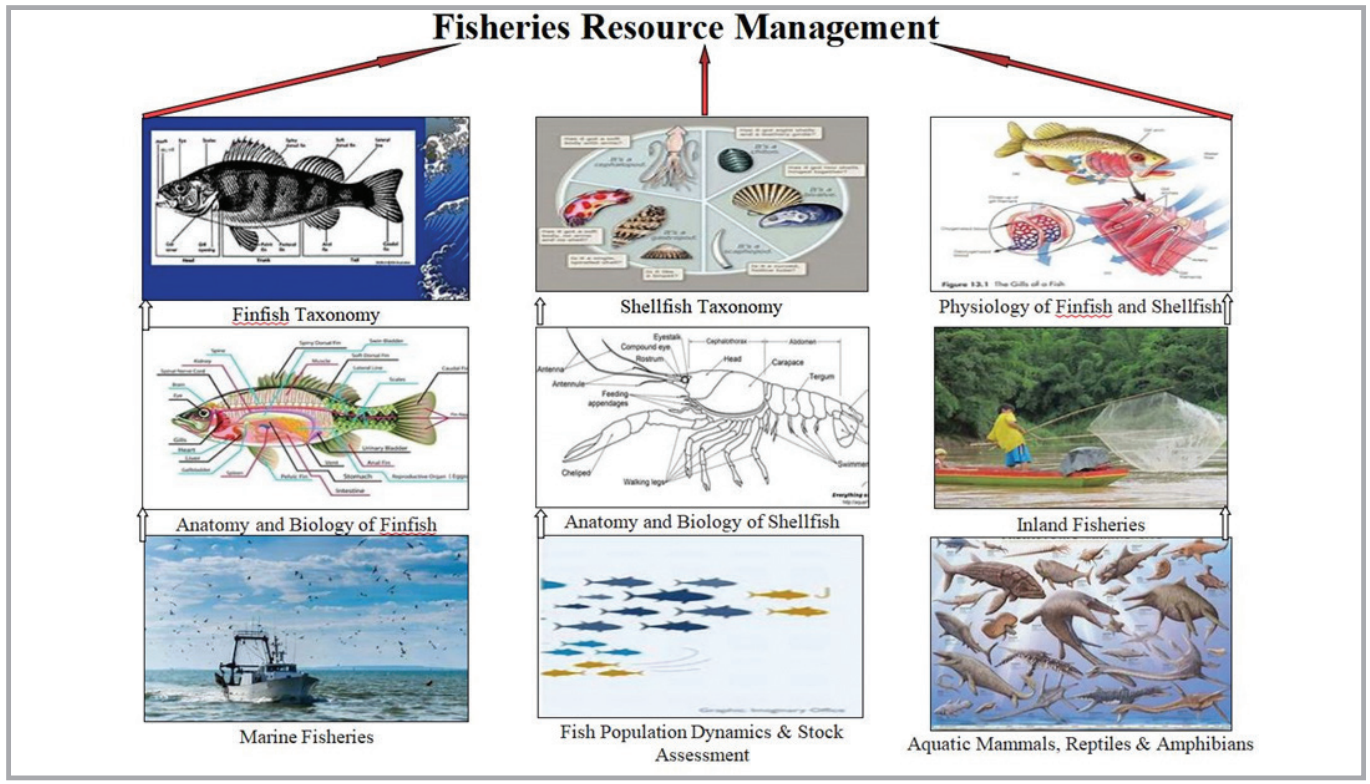
Guest lecture and Placement drive at The Neotia University

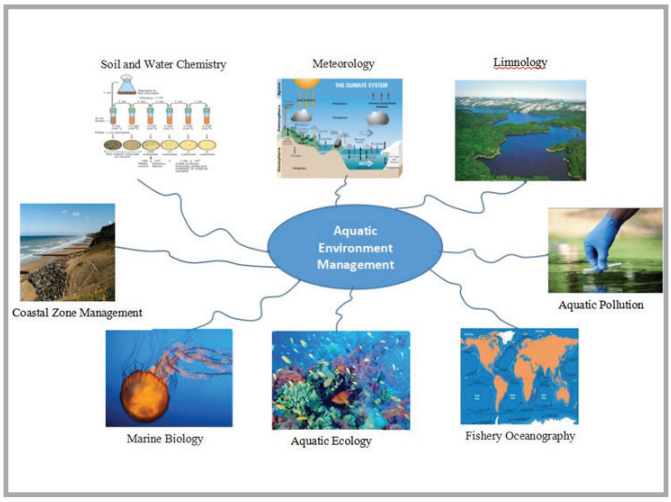
Guest lecture and Placement drive at
The Neotia University

MoU between The Neotia University
and The Krishna Agritech Industries

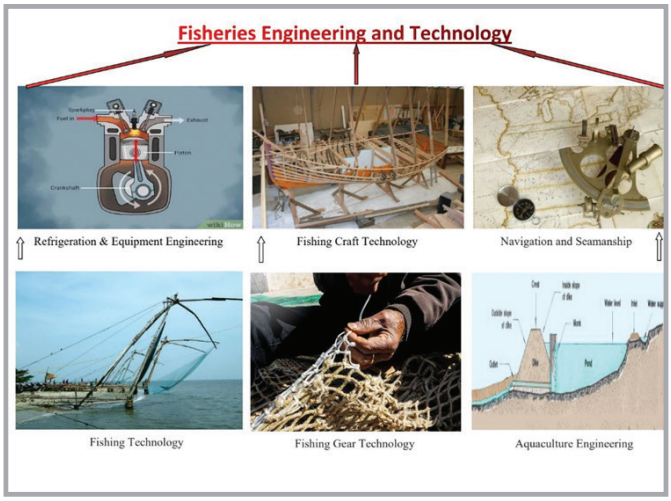
Guest lecture and Placement drive at The Neotia University

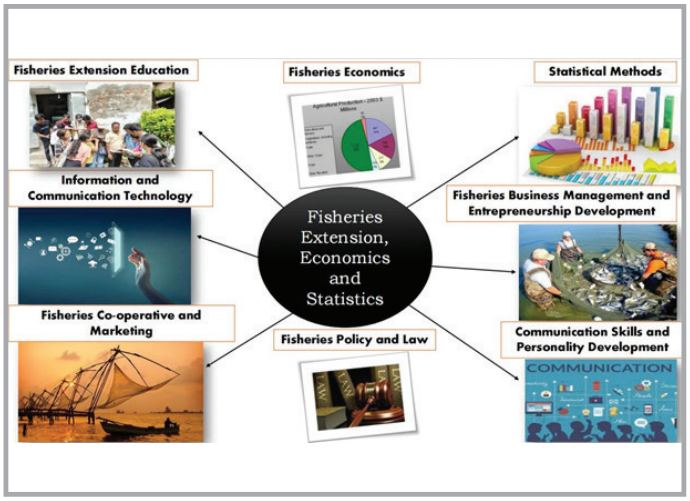
B.F.Sc. Courses

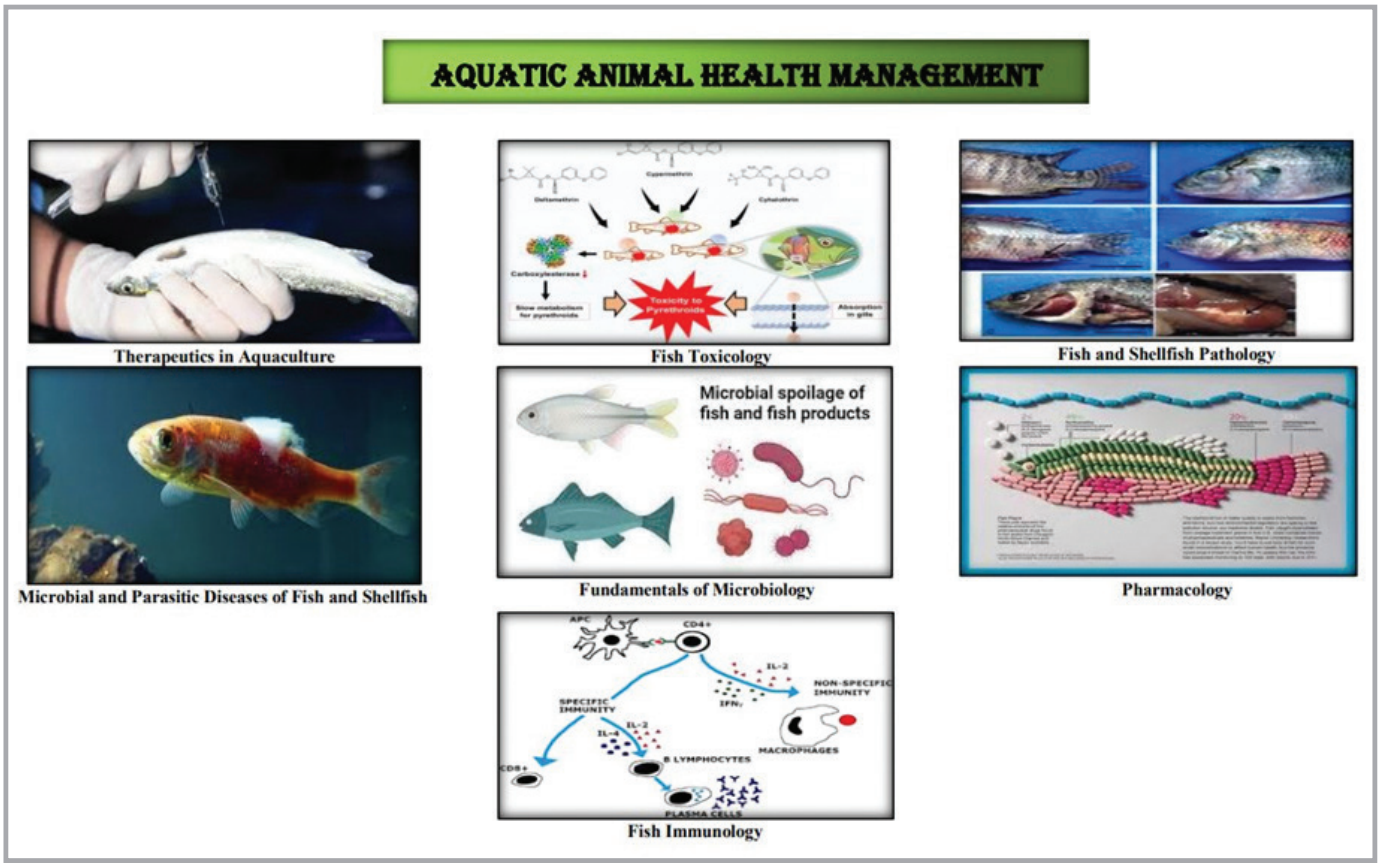



Soil and Water Chemistry
Meteorology
Limnology
Aquatic Environment Management
Coastal Zone Management
Aquatic Pollution
Marine Biology
Aquatic Ecology
Fishery Oceanography


FISH PROCESSING TECHNOLOGY
Fish in Nutrition
Food Chemistry
Freezing Technology
Fish Canning Technology
Fish Packaging Technology
Fish By-products and Waste Utilization
Fish Products and Value Addition
Microbial spoilage of fish and fish products
Microbiology of Fish and Fishery Products
Quality Assurance of Fish and Fishery Products


Fisheries Engineering and Technology
Refrigeration & Equipment Engineering
Fishing Craft Technology
Navigation and Seamanship
Fishing Technology
Fishing Gear Technology
Aquaculture Engineering


Fisheries Extension Education
Fisheries Economics
Statistical Methods
Information and Communication Technology
Fisheries Extension, Economics and Statistics
Fisheries Business Management and Entrepreneurship Development
Fisheries Co-operative and Marketing
Fisheries Policy and Law
Communication Skills and Personality Development
COMMUNICATION


AQUATIC ANIMAL HEALTH MANAGEMENT
Therapeutics in Aquaculture
Fish Toxicology
Fish and Shellfish Pathology
Microbial and Parasitic Diseases of Fish and Shellfish
Microbial spoilage of fish and fish products
Fundamentals of Microbiology
Pharmacology
Fish Immunology

Students Corner

Fisheries General Questions

1. Heart in fishes
   a) Two-chambered b) Four chambered c) Three chambered d) Six chambered
2. In fishes the blood circulation is called
   a) Double circulation b) Arterial circulation c) Venous circulation
   d) Arterial and venous circulation
3. Which fins are paired in fishes?
   a) Adipose fin b) Dorsal fin c) Pelvic fins or ventral d) Anal fin
4. Gills are pouch-like in
   a) Amphibia b) Pisces c) Cyclostomes d) All of these
5. Fishes have taste buds in --------.
   a) Buccopharynx b) Lips c) Barbels d) All of these
6. In fishes respiration takes place by
   a) Gills, lungs and fins b) Gills c) Lungs d) Gills and accessory respiratory organs
7. What is found in the intestine of a shark?
   a) The besian valve b) Scroll valve c) Typhlosole d) Bursa entiana
8. In fishes the axial skeleton is made up of
   a) Cartilage only b) Skeletal bones only c) a & b d) None
9. Fishes have kidney of
   a) Metapheric b) Mesonephric type c) Protonephric type d) None
10. Male Scoliodon is distinguished from female Scoliodon by the presence of
    a) Cloacal aperture b) Claspers c) Pelvic fin d) Dorsal fin
11. Class malacostraca includes:
    a) Prawn b) Lobster c) Crabs d) All of these
12. Macrobrachium malcolmsonii is called prawn of
    a) Fresh water b) Marine water c) brackish water d) None of these
13. Palaemonidae is a family of class:
    a) Insecta b) Crustacean c) Myriaponda d) None of these
14. Edible crustacean are:
    a) Prawn b) Crab c) Lobster d) All of these
15. Carapace is the characteristic features of animals ----------
    a) Mollusca b) Arthropoda c) Porifera d) None of these
16. The cuticle in Arthropod is
    a) Thick b) tough c) chitinous d) All of these
17. The appendages are variously modified as
    a) Jaws b) Legs c) Fins d) All of these
18. Class malacostraca includes:
    a) Prawn b) Lobster c) Crabs d) All of these
19. Macrobrachium malcolmsonii is called
    a) Fresh water b) Marine water c) brackish water d) None of these

Students Corner

20. Palaemonidae is a family of class:
    a) Insecta b) Crustacean c) Myriaponda d) None of these
21. Group of fish born in the same year within a population known as
    a) Cohort b) Stock c) Population d) Density
22. What does relative condition factor indicate
    a) Relationship between length & weight b) Spawning season c) Over all well being of fish
    d) Age at first maturity
23. SSR stand for
    a) Stock Recruitment Relationship b) Species Recruitment Relationship
    c) Species Releasing Relationship d) Stock Species Rate
24. Link between input and output known as
    a) Model b) Stock c) Recruitment d) Mortality
25. Group of populations that share occasional migrants known as
    a) Local population b) Metapopulation c) Absolute population d) Population density
26. Estimate of the total number of organisms in an area known as
    a) Local population b) Metapopulation c) Absolute population d) Population density
27. TAC stand for
    a) Total Access Cost b) Total Available cost c) Target Available catch d) Total Assurance Cost
28. Basic taxonomic unit of stock
    a) Cohort b) Stock c) Population d) Species
29. When parent stock is reduced to the extent that enough young fish are not produced to compensate the stock known as
    a) Recruitment overfishing b) Growth overfishing c) Recruitment d) Growth
30. Self contained and self perpetuating group known as
    a) Mixed stock b) Stock c) Population d) Unit stock
31. Ponderal Index' is another term for
    a) Maturity of Gonads b) Food quotient c) Growth factor d) Condition factor
32. Sub-set of one species having same growth & mortality parameters & inhabiting particular geographical area known as
    a) Cohort b) Stock c) Population d) Species
33. MEY Stand for
    a) Maximum sustainable yield b) Minimum sustainable yield c) Matured species yield
    d) Maximum economic yield
34. Estimate of the number of organisms per unit area known as
    a) Local population b) Metapopulation c) Absolute population d) Population density
35. When fish are caught before they have reached their growth potential known as
    a) Recruitment overfishing b) Growth overfishing c) Recruitment d) Growth
36. The process by which a fish or shrimp of an age group integrates itself for the first time to the exploitable stock known as
    a) Recruitment overfishing b) Growth overfishing c) Recruitment d) Growth

Students Corner

37. MSY Stand for
    a) Maximum sustainable yield b) Minimum sustainable yield c) Maximum economic yield
    d) Mortality species yield
38. What is means of “Lmin” in VBGF equation
    a) Length at first capture b) Length at first maturity c) Maximum length d) Minimum length
39. Intrinsic parameters of fish stock such as
    a) Immigration b) Growth c) Emigration d) Movement
40. What is means of “Lmax” in VBGF equation
    a) Length at first capture b) Length at first maturity c) Maximum length d) Minimum length
41. Pleopods also known as
    a) Peraopod b) Walking leg c) Swimming leg d) Claws
42. Peraopod also known as
    a) Pleopods b) Walking leg c) Swimming leg d) Claws
43. Fenneropenaeus merguiensis common name
    a) Giant tiger b) Indian white shrimp c) Banana shrimp d) Redtail shrimp
44. Total number of pair segments are present in prawn body
    a) 16 b) 17 c) 18 d) 19
45. Hindgut included
    a) Intestine b) Rectum c) Mouth d) Buccal cavity
46. Prawn total number of pair segments in Abdomen region
    a) 5 b) 6 c) 12 d) 13
47. Shrimp are found in
    a) Marine water b) Freshwater c) Marine with Fresh water d) Inland
48. Midgut included
    a) Intestine b) Rectum c) Mouth d) Buccal cavity
49. Body of shrimp divided into
    a) Cephalothorax b) Dorsal c) Ventral d) Posterior
50. Thelycum organ present in
    a) Male penaeids b) Female peaneids c) Male non-penaeids d) Female non-penaeids

Students Corner

Answers:

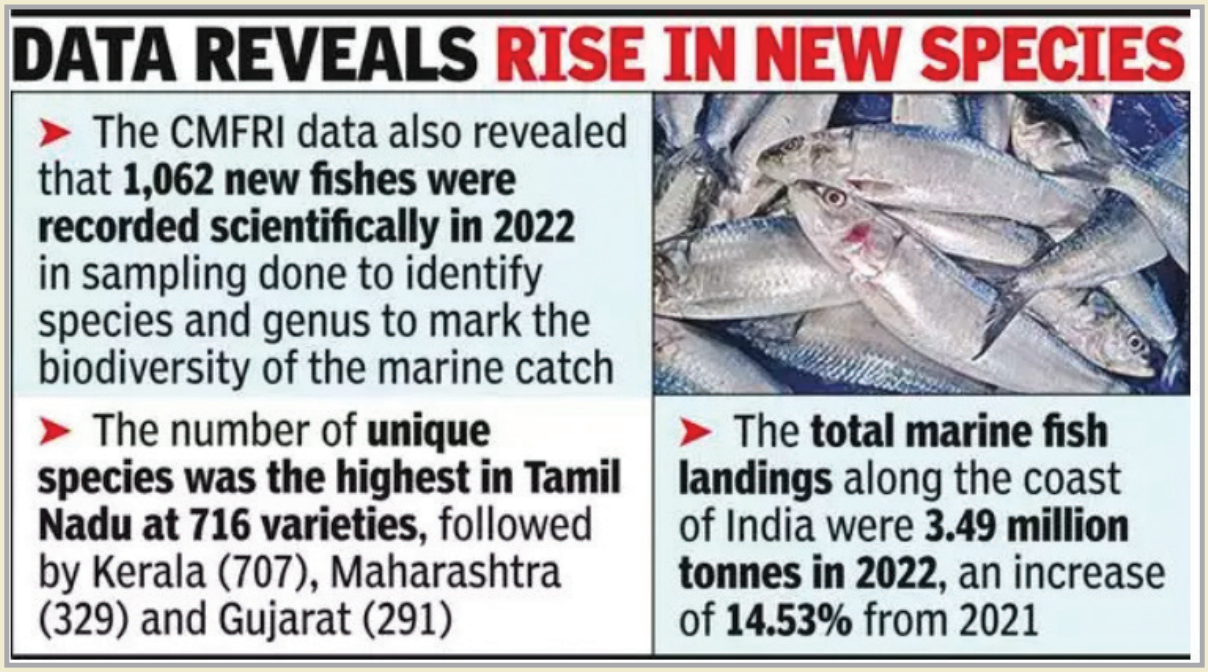
1	2	3	4	5	6	7	8	9	10
a	c	c	c	d	d	d	b	b	b
11	12	13	14	15	16	17	18	19	20
d	a	b	d	b	d	d	d	a	b
21	22	23	24	25	26	27	28	29	30
a	c	a	a	b	c	b	d	a	d
31	32	33	34	35	36	37	38	39	40
d	b	d	d	b	c	a	d	b	c
41	42	43	44	45	46	47	48	49	50
c	b	c	d	b	b	a	a	a	b

Answers:

1	2	3	4	5	6	7	8	9	10
a	c	c	c	d	d	d	b	b	b
11	12	13	14	15	16	17	18	19	20
d	a	b	d	b	d	d	d	a	b
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

Fisheries News

Sardine and mackerel back as Kerala's 'big fish': CMFRI report



(Source: TOI)

The landings of Indian oil sardine saw an increase of 188.15% in 2022 compared to 2021 and it secured the second position among marine resources in quantity landed in the country, according to data collected by Kochi-based Central Marine Fisheries Research Institute (CMFRI). From a meagre 3,297 tonnes in 2021, which triggered a panic among the local fishermen community, the species has returned to the topmost position in the state at 1.10 lakh tonnes. Interestingly, this reappearance of oil sardines began only in the second half of the year, after the annual trawling ban imposed during monsoon.

Heat wave affects groundwater

Dr S K Chaudhari, deputy director general (natural resources management) said that rise in temperature and heat have a cascading effect on food-producing sectors, including fisheries, as it disrupts groundwater behaviour. "Excessive pressure on groundwater is leading to the presence of more salts on the ground surface", and assessing ecological losses should also be considered while studying the impact of climate change on the food sector (The New Indian Express, 12 March 2023).

In a first in Uttarakhand, integrated aqua park to come up in US Nagar under PMMSY (source:TOI)

The central government has allocated a budget of Rs 44.50 crore to the Uttarakhand government for the construction of an Integrated Aqua Park in Palasia village in Sitarganj of district Udham Singh Nagar. The Aqua Park will be built under the Pradhan Mantri Matsya Sampada Yojana (PMMSY), aimed at the development of fisheries and aquaculture infrastructure in the state. The Project Appraisal Committee of the PMMSY recommended the establishment of the Aqua Park in Sitarganj. The Aqua Park, which is the first of its kind in the state, is a unique and innovative concept introduced by the Government of India under the PMMSY. It will facilitate various fisheries activities in one place, serving as an excellent platform for fish farmers and other stakeholders.

Fisheries News

India's carbon footprint from marine fisheries is much lower than global level: Study

For representational purpose (Photo | EPS)

In a landmark research in assessing the carbon footprint in India's marine fisheries, the ICAR-Central Marine Fisheries Research Institute (CMFRI) has estimated that the sector emits 1.32 tonne of CO2 (carbon dioxide) to produce one tonne of fish. This is much lower than the global figure of more than 2 tonne of carbon emission per tonne of fish.

This is the assessment of the greenhouse gas (GHG) emissions from total activities in the sector, from pre-harvesting to marketing, by converting it into CO2 equivalent.

The CMFRI found that the harvest phase (active fishing) in the country used more than 90% of the fuel used in the sector with annual CO2 emissions from this phase being 4,934 million kg.

"The country's carbon emissions from the marine mechanized fisheries sector is 16.3% lower than the global level (The New Indian Express, 12 March 2023).

Climate-Smart Value Chain

In the wake of the disruption of the fish value chain owing to the climate crisis, the CMFRI proposed to develop climate-smart value chain critical points, policy advisory for seafood marketing and a consumer education tool kit for emerging species (The New Indian Express).

Article

Mangrove Conservation: Aquasilviculture

1. Shyam Kumar, 2. Raju Ram, 3. Jaspreet singh, 4. Vikas Pathak

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2. Fisheries Development Officer, Sirohi - 307001, Rajasthan, India
3. ICAR Research Complex For Eastern Region, Patna - 800014, Bihar, India
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Corresponding author- vikas.pathak@tnu.in

Background

In the past hundred years the forest industry has harvested millions of trees to meet the world demand for wood at the same time much valuable timber has been destroyed due to fire insects and disease, if these areas that have been logged or ravaged are left to reforest naturally they may not be ready for re-harvest for a long time. Mangrove forests in the global distribution looking at the ecosystem services than any threats posed to these forests how these can be mitigated through civil cultural systems and whether there's a future for these mangroves.

Mangroves are a economically diverse group of tropical trees and shrubs which grove in the inter tidal zone they thrive in salty conditions 54 species are found in 16 families recognize the true mangroves. Mangrove ecosystem is one the most productive environment popular as nursery, feeding and breeding grounds for many fishes, birds, and other flora and fauna .

The majority of mangroves are occurring between the latitudes of 25 degrees north of 25 degree south. Their ability to naturally re- generate mangrove zonation species distribute them- selves across the inter-tidal zones and create zonation patterns. What really want to show here is the difference is in mangrove species which are typical of each zone and how they insulate and pay a role with the impending sea level rise.

Major Threats for Mangrove Clearing

Mangrove land reclamation for construction activity make room for human settlements, agricultural land and infrastructure (harbors, jetty etc.), apart of this mangrove deforestation also occurs for tourism, shrimp form and salt farms. This clearing of mangrove is act as major threats for mangrove loss around the word.

Over harvesting

Mangrove trees are used for construction wood, firewood, animal fodder, and charcoal production and wood chip threatening the future of the mangrove forests.

River changes

River linking, river diversion and construction of dams and reduce the environmental flow (reduction in amount of water reaching to mangrove area), fluctuation in the water salinity in the forest.

Destruction of coral reefs

Coral reefs act as first obstacle against water currents and strong waves. So coral reef provide favourable condition for mangrove seedling to grow because strong waves can damage seedlings from taking root and wash away nutrients which essential for mangrove ecosystems.

Climate change

Mangroves forests are extremely sensitive to sea water level rising due to climate change and global warming.

Aquasilviculture

Aquasilviculture is an art and science of work to develop and maintain productivity, fertility, production and sustainable use of mangrove forestry. Aquasilviculture guides mangrove forest growth to suit many different needs such as increasing biodiversity and offering a lifeline to different species of trees plants and wild life while aiding the production of valuable timber. civic culture is ensure growth for generations.

It is through civic culture that mangrove forests devastated by man made or natural disasters are revitalized and restored. It promotes growth that maintains the water quality of our water body developed fertile habitats for wildlife species as well as providing the sensational parks and trails that- make nature so beautiful it's a job that begins well be- fore the first mangrove seedling is planted and lasts for the next century or more years.Zero a clear cut or cut over here windblown and damaged timber has been removed and a blank nature is revealed civic culture ascends ever to restore the land to its natural mangrove forest type.

Most countries of Asia don't have any systematic aquasilviculture or management processes in place and it's such countries where mangroves are being continuously harvest at a level that's just not sustain- able with fuel wood construction fetching material and other things however it's not only a confined to a subsistence small-scale also occurs on a commercial scale. Rising sea levels have

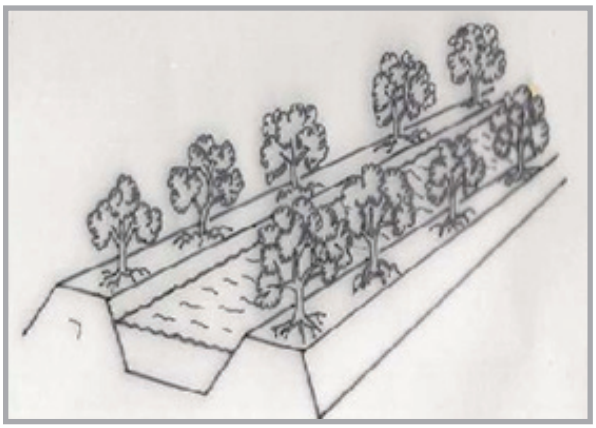

Fig. 1. *Peripheral model of mangrove plantation to pond area*

Trials in India

India has a vast area (Tab. 1) of mangrove so management strategy should be take place. In India, pilot studies are being done for the past few years. In, 2010 National Institute of Ocean Technology (NIOT), Chennai has practiced Aquasilviculture in Andaman & Nico bar Islands for fattening of crabs such as Scylla tranquebarica, S. olivacea and S. serrata in the available mangrove area. 60-80% of the been said to be the greatest threat to mangrove forests there are really likely to be taking place climate models project their rate to accelerate the projections for global sea levels to raise towards the end of the 21st century.

State/UT	Area (area in km*)
Andhra Pradesh	352
Goa	22
Gujarat	1058
Karnataka	3
Kerala	6
Maharashtra	186
Orissa	222
Tamil Nadu	39
West Bengal	2155
Andaman & Nicobar	617
Daman & Diu	1.56
Pondicherry	1

Recommended aquasilviculture models

These models consists of mangroves outside the pond with ratio of 70:30 or 80:20 mangrove plantations to pond area such as peripheral (fig.1) and canal model (fig. 2). This way, the fish farmers save the mangrove stand against illegal mangrove cutting and benefits from the sale of seedling (propagules) produced for contract reforestation of denuded mangrove areas.

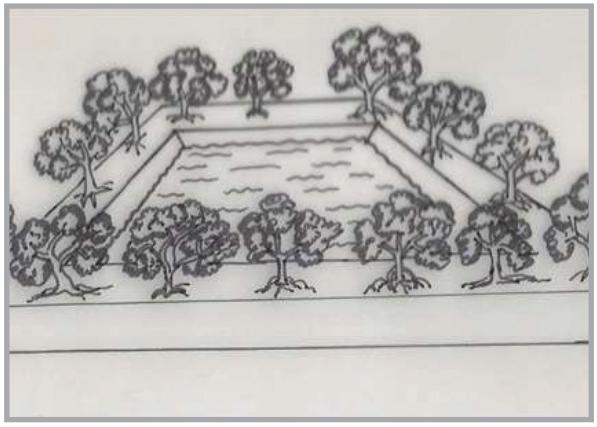

Fig. 2. *Canal model of mangrove plantation to pond area*

total area was allotted for mangroves. Within 30-35 days they achieved 85% survival & 8% increase of the initial stocked weight.

The unique roots system of these trees hold up the land tightly in this way the marine forest protect the terrestrial border from natural calamities, currents, tides, strong winds and waves. At the same movement, they can also provide food and shelter for many fish and other organisms.

Role of Scientist

Scientists are determine whether the cut over needs to be planted with fresh seedlings this process known as stocking analysis involves in examining the biodiversity of plant and animal life within and performing tests to determine what will thrive over the next long period of time.

Role of Policymakers

Policymakers and local stakeholders make adjustments accordingly what is the future of the mangrove forests well. it's not so bleak they will depend upon the technological and ecological advances in multi speciesaquasilviculture, genetics and forestry modelling however the greatest hope for their future is for the reduction in human population growth.

Conclusion

Change is inevitable what we really must focus on and pay attention on the current situation of which man- grove forests are being mismanaged in an unsustainable fashion. We must aim to enforce and implement sustainable strategies for timber production and adapt those successful techniques which are currently taking place and also place importance upon the interdisciplinary approaches and those- which involve government's stakeholders and local communities to secure the future of mangrove forests.

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Highlighted points

- The main focus in this idea is to reforesting the disappeared mangrove forests
- Food security
- Utilization of available coastal resources in proper way without affecting the native living forms
- Providing additional employment to local fisher folks/tribals; and also support fishermen during banned seasons.
- Holds soil & prevents its erosion & pollution of sea
- Input capital is low
- Construction is easy with locally available materials.

Tracer Techniques in Fish Larval Nutrition Studies

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Introduction

The Indian aquaculture production is increasing day by day due to implementation of intensified aquaculture techniques such as re-circulatory aquaculture system, biofloc, integrated multi-trophic aquaculture system, aquaponics, raceway, and cage culture etc. In all these system, fishes are stocked at high intensities as compared with the pond culture system. If we will see the production of these high density culture is 20-50 times higher than the normal pond culture but the operating cost of these system is higher than the normal pond culture system. Therefore to reduce the cost of production in these intensified culture practices need a culture of high values species like murrels, anabas, singhi, magur, pabda, chital rainbow trout, cobia, pearl spot, etc. The supply of good quality fish seed for farming has improved in recent years due to scientific and technical advances. Mass production of good quality juveniles is still hindered by the limited due to very less larval survival and knowledge on nutritional requirements (Takeuchi, 2014). Understanding of larval nutritional physiology is essential for an effective replacement of live food by inert micro diets. The hatchery survival of Indian major carp larvae is very low as around 40-60%. Early mortality of larvae is mainly due to limited idea about nutrients requirements of larvae and failure in first exogenous feeding management. The most critical period of larval nutrition at which maximum death occurs is the first weaning stage (the stage at which yolk became least and starts external feeding by the larvae). The nutritional requirement of fish is vary with species to species. Nutritional requirement study has several constrains larval nutrition.

Constrains in Larval Nutrition

Major constrain in larval nutrition is the small body and mouth size e.g. most marine fish larvae are very small (2–3 mm) at the start of exogenous feeding with small mouth gape, as it requires very small feed-particle sizes (50–150 µm) which causes difficulties in micro-diet production technology, will restrict the size manipulation of larval diet beyond a limit. Larvae are very sensitive, labile and fragile because of that it's not accepting artificial feed by evolution, resulting in low or variable ingestion rates in larval feeding experiments. Preparation of graded level of targeted nutrient for a particular larvae is difficult to produce due to lack of knowledge about requirement of other nutrients in the diet.

Studies of digestion, absorption, and nutrient assimilation in marine fish larvae are limited by these several reasons so, the larval survival is very low at hatchery level. But we need to improved hatchery seed production for super intensive aquaculture or intensified techniques to feed the expanding population. Quantification of feed intake and diet digestibility is a major difficulty in fish nutrition studies to prepare a micro diet for costly fishes. The accurate information on nutrition requirement can be estimated by using tracer techniques (Morais et al., 2004), required for the production of balanced micro diets. Tracer (labelled amino acid) is a substance used to follow the biological transformation of an endogenous substrate, tracee (free amino acid). Difference between tracer and tracee is in the number of neutrons in the isotopic atoms ie, their mass / nuclear spin. There are two types of tracers (A) Radioactive tracer molecules (e.g., molecules with 14C, 35S or 3H and (B) Stable molecules (e.g., molecules containing 13C or 15N) can be used in in vitro and in vivo studies.

Characteristics of Good Tracer

A suitable tracer molecule is one that having following characteristics: (i) the tracer molecule should have chemically identical to the molecule of

interest (the tracee). (ii) the tracer molecule should not be discriminate fish metabolism (iii) tracer should enable its accurate quantification and (iv) the chemical concentration of tracer should be insignificant in comparison to that of the tracee.

Isotopic Tracers

Stable and radioactive isotopes are used in larval nutrition for nutrition requirement study. The tracer are occur naturally in very small amounts e.g., stable isotope (13C) is present about 1.1% of carbon in nature. In vivo studies mostly require quantities above these natural abundances not too high. Abundance of radioactive isotopes in tracer studies is normally expressed as "specific activity" (The number of decays /minute/mol of tracee). Stable isotopes are mainly used in in vivo studies while, stable isotope involve no known physiological risks at the highest levels of enrichment normally used. Inert tracers have also been used to determine feed intake and digestibility in larval studies. However, experimental studies of metabolism and nutrient retention depend on the use of isotopic tracers because of its strong radiation power than stable isotopes.

Tracer Delivery Methods in Larval Fish

Stable and radioactive isotopes are used in larval nutrition for nutrition requirement study. The tracer are occur naturally in very small amounts e.g., stable isotope (13C) is present about 1.1% of carbon in nature. In vivo studies mostly require quantities above these natural abundances not too high. Abundance of radioactive isotopes in tracer studies is normally expressed as "specific activity" (The number of decays /minute/mol of tracee). Stable isotopes are mainly used in in vivo studies while, stable isotope involve no known physiological risks at the highest levels of enrichment normally used. Inert tracers have also been used to determine feed intake and digestibility in larval studies. However, experimental studies of metabolism and nutrient retention depend on the use of isotopic tracers because of its strong radiation power than stable isotopes.

1. Immersion Method

The uptake of tracers from incubation water, in particular amino acids (AAs), has been commonly used to measure rates of oxidation, protein synthesis and turnover in different species of fish larvae and fry. The tracer molecule are dissolved in the incubation water with very less concentration 5-50 micromol/ litre. The nutritional requirement studying fishes are immersed in that water with a suitable incubation time to uptake a tracer molecule. The fish larvae can easily absorb dissolved AAs and some other molecules across the gills, digestive tract and skin. Radiolabelled tracers e.g., Labelled AAs (for protein studies), labelled FAs (for lipid studies), labelled glucose (for carbohydrate studies) use for the study of nutrient metabolism E.g., particularly, AAs are commonly used to measure rates of oxidation, protein synthesis and turnover in different species of fish larvae and fry. The advantage of this technique are better control over tracer dosage and easy to understand that how to conduct the experiment. The disadvantage of this technique is only more suitable for larvae study only and non-uniform distribution of tracer in fish.

2. Microdiet Labelling

In this method, the tracer molecules are homogenously mixed with diet ingredients to ensure uniform distribution of tracer in the prepared feed for larvae. The fish can feed this tracer containing feed to the larvae. The isotope can analyse in body tissues and can detect the role of absorbed nutrients. This method mostly used for the study the effect of dietary PLs on absorption of dietary fatty acids (FAs). Radiolabeled microdiets have also been used to assess how feed intake and lipid absorption are affected by dietary lipid level and its composition or to study the effect of dietary exogenous digestive enzymes on feed intake and diet digestibility. Micro diet method having some advantages like composition of microdiet can control, size of feed maintained as per size of larvae and easy to administer the tracer molecule in diet. However, it's having disadvantages like large amounts of label being lost during the microdiet production process and leaching of tracer may happen during the feeding.

3. Labelling of Live Food

Labeling of live diets has been typically used to quantify larval feed intake and/or to characterize digestion, absorption, metabolism or retention of dietary nutrients such as amino acids and fatty acids. Both radioactive and stable isotopes have been employed to label live prey, either rotifers or Artemia. Rotifers and Artemia can be labelled by feeding them on 14C labelled algae. The algae are labelled by the inclusion of NaH[14C]O3 in the algal growth media. Artemia nauplii labelling can done by: (i) inclusion of radioactive free AAs (FAAs; phenylalanine or [U- 14C] (protein hydrolysate) in either the hatching or enrichment media and (ii) the use of liposomes containing a

radiolabeled triacylglycerol (TAG) or a free FA (FFA), added to the enrichment media.

4. Tube Feeding

Tube feeding method used to determine quantitative data on the digestibility, absorption, and metabolic handling of water soluble and particularly of low molecular weight dietary ingredients in fish larvae (Fig. 1). Tube feeding allows the experimenter to deliver the studied nutrients directly into the larval gut. This method was pioneered by Rust et al. (1993) and Rust (1995) who used tube feeding to deliver 35S-labeled E. coli protein to a variety of species and stages of development. Later, this method was advanced and used for many species. Many of studies used protein, peptides and FAAs, but nutrient like FAs and lipid classes have also been investigated in this method.

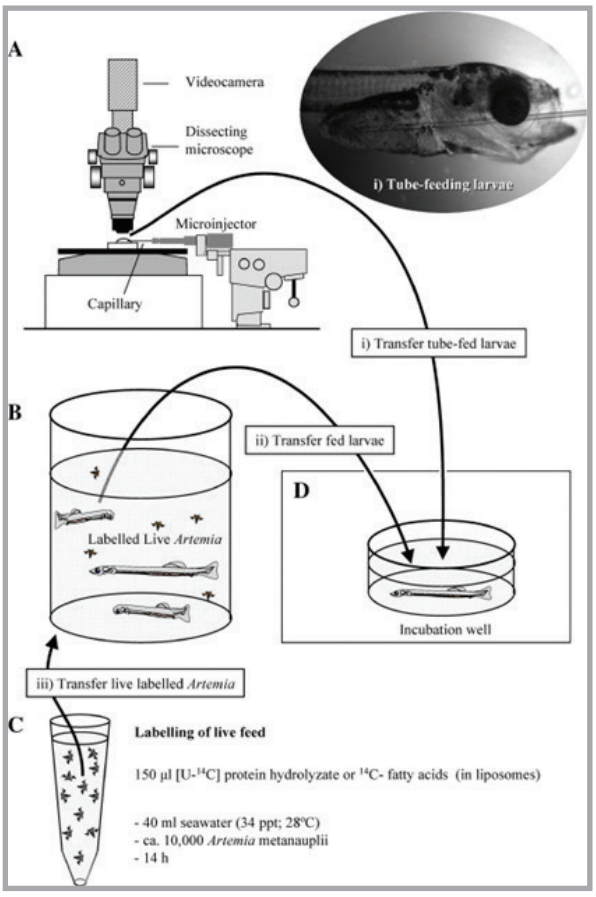

Fig. 1. *Setup for tracer studies using the tube feeding (A) and the Artemia labeling (B and C) methods in fish larvae. In both methods larvae are transferred (i and ii) to an incubation well (D). More details of the incubation well and metabolic budgeting is given in Fig. 2. Photo represents an Atlantic cod (Gadus morhua) larvae (Conceição et al., 2007).*

The set-up comprises of a dissecting microscope with a camera and micromanipulator, to which a nanolitre injector is attached. A plastic or handmade polished glass capillary tube that is adapted to the mouth and oesophagus of larvae. Before tube feeding, the larvae are anaesthetized and gently placed on a microscopic slide in a droplet of clean seawater. The insertion of the capillary tube and the bolus administration into the gut can be controlled visually since most marine fish larvae are transparent or semi-transparent. In this method the total handling time per larva is less than 1 min. The effects of stress imposed by handling and by the tube feeding technique will vary between stage of development and species. The advantage of this method is direct introduction of feed in gut results in 0% leaching loss of tracers from feed and disadvantage is, its very expensive and required skill to conduct the process. It is more suitable for tiny fishes or larvae.

Determination of Digestion and Absorption Efficiencies

Hot Chase

The tracer is fed to a larva as a single meal only where the larvae are allowed to ingest for a period of time but it's shorter than the gut transit time or as a bolus of a radiolabeled nutrient in solution administered directly into the digestive tract by tube feeding. This approach used as a useful framework for measuring the total digestibility and gut absorption rates, but also catabolism and retention (assimilation) of nutrients. In this approach, radioactive tracer was analyse by scintillation counting in the larvae and in the water after the digestive process is finished, i.e. when the gut is empty of visible contents, and based on this assimilation of nutrients was calculated (Rust, 1995; Rust et al., 1993). Radio activity is measured by Geiger Muller counter or Scintillation counter (Fig. 2). Data from tracer studies are normally expressed on a percentage basis of a few body compartments in a few time points. In stable isotope based studies result expressed in percentage excess ie, "enrichment" per mole of tracee". It expressed in relation to a standard sample or the ratio between the quantity of isotope with a less common abundance (e.g., 15N) and the total quantities of isotopes (e.g., 15N+14N) of that atom (expressed in atom %).

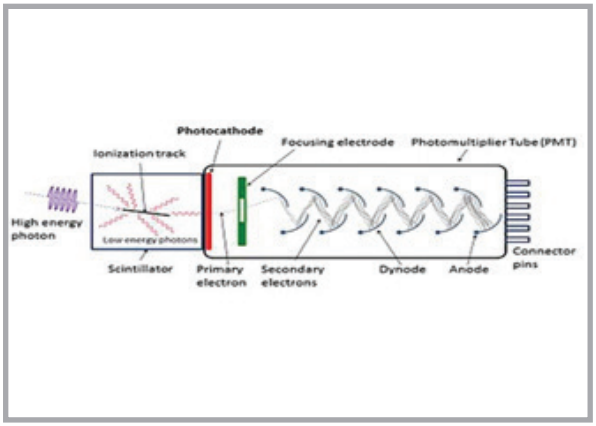

Fig. 2. *Geiger Muller counter or Scintillation counter*

Cold Chase

In this method, the feed is labelled with radio or stable isotopes, until gut fullness (but before start of diet evacuation). After labelled diet feeding, the larval diet replaced with the non-labelled diet (cod diet). The larval sampling was done at the end of the labelled diet feeding period and periodic sampling was done until complete evacuation of the labeled diet. The experimental set-up used to analyze a population of pooled larvae (20–30 larvae in triplicate) in contrast to the incubation set-up often used in hot chase studies, where the study of single individuals is possible.

Absorptive Nutrient Utilization Study

Catabolism of Nutrients

To study nutrient catabolism, the 14C labelled AAs and FAs are used to estimate their respective oxidation rates (Fig. 3). In this method, tracer may be delivered by water, microdiets, live food and by tube feeding, and the catabolised fraction (14CO2) are collected by a chemical trap. Trapping of the metabolically produced 14CO2 is through aeration and manipulation of pH of the incubation water. The utilization quantification of digestion and absorption of labelled protein and AA done by 14CO2-metabolic trap. The larvae have a high catabolism of the absorbed AA labels e.g., about 20% respired within 10 hr after ingestion in larval spot, 11–26% or 20–29% at 24 hr after feeding in Senegalese sole larvae, 17% at 13 hr after tube feeding in Atlantic halibut post-larvae and 39% at 24 h after feeding in Atlantic herring. The absorbed nutrient quantified in fasted Atlantic herring larvae showed high retention of labelled indispensable AAs in the body (>60%), compared to catabolism (<25% respired 14CO2). In contrast, dispensable AAs a higher catabolism (>40%) and a lower body retention (<57%) (Conceição et al., 2007).

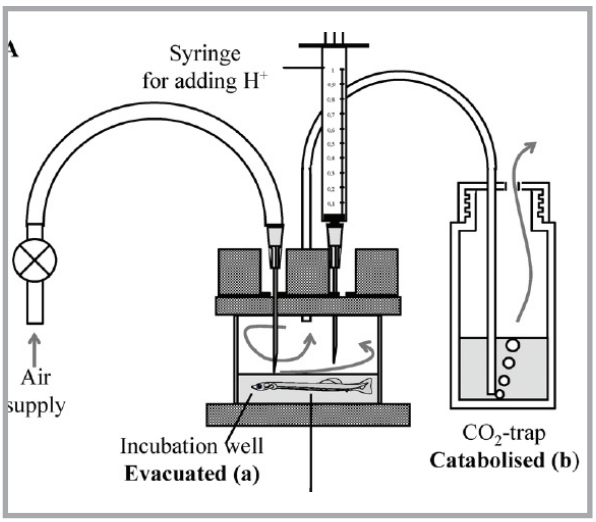

Fig. 3. *Trapping of the metabolically produced 14CO2 is through aeration and manipulation of pH of the incubation water (Conceição et al., 2007).*

Retention of amino acids

The retention of amino acid and quantification of individual amino acid requirement carry out by combining a method of high resolution 13C-NMR spectroscopy and the use of 13C-labeled live food. This combined methods are used to study the qualitative AA requirements of fish larvae through the simultaneous estimation of the relative bioavailability of individual AAs. This method should provide a more robust indicator of the qualitative IAA requirements when compared to the use of the IAA profile of fish carcass (Conceição et al., 2003).

Quantification of feed intake

The quantification of feed intake is essential in any nutritional study. The feed intake is closely associated with the gut transit time, digestive and absorptive efficiency towards dietary nutrients, controlling how much of the dietary constituents

will actually be assimilated. Several methods are used to qualify the feed intake in fish such as 1) direct counting of live food (rotifers or Artemia) in the gut, preceded by colour labelling through the use of microalgae (inducing an intense green colour), black drawing ink or methylene blue. 2) inert markers (non-metabolised by the larvae) have been employed, such as the measurement of ascorbic acid 2-sulfate, yttrium oxide and other metal oxide markers or of auto-fluorescence of pigments associated with an alginate-based microparticulate diet. 3) radioisotopes for the labelling of larval diets due its easiness and high accuracy in quantification by scintillation counting, and that the tracee nutrient can be further traced for digestion/absorption and catabolism determinations.

Protein synthesis and turnover quantification

Due to the impossibility of using the traditional injection of tracers for protein synthesis determinations, commonly employed in larger fish, the “bath immersion” method has been used in larval studies. In immersion method, some dozens of larvae are placed in a small volume of water containing a radioactive AA, most commonly L-[2,6–3H]phenylalanine, after that larval samples are taken at regular time intervals. Separation of the FAA pool from the precipitated protein is performed after samples are homogenized in 0.5 M perchloric acid and centrifuged. Specific radioactivity of protein-bound phenylalanine (Sb) and free pool phenylalanine (Sa), for instance, can be determined by dividing liquid scintillation counts by total phenylalanine contents. The estimation of rate of protein synthesis is based on the change in the different tracer (e.g., L-[2,6–3H] phenylalanine) and tracee (e.g., L-phenylalanine) pools between two time points. Fractional rates of protein synthesis (ks, % protein weight per day) are then normally estimated using the flooding dose equation.

Conclusion

The quality of seed is the primary need for the intensified aquaculture techniques to increase the productivity of available fisheries resources. The larval survival is another concern in high values fishes due to its small body and mouth size, and knowledge gap on nutritional requirement to produce the microdiet at initial culture stage of fish. To solve the nutritional requirement study gap of high value fishes, to increase the survival rate at initial stage and to produce a balance microdiet for different species, tracer technique can be used to study the feed intake, absorption, digestion, catabolism and anabolism of different nutrients.

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The Effects of Climatic Change on Fish reproductive behavior and development

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Abstract

Aquaculture and fishing are two of the most prevalent activities in coastal areas around the world. Furthermore, both correspond to high-risk activities in the context of climate change, as they are vulnerable to environmental changes that threaten the socioeconomic sustainability of fishing communities that rely on fish for food and income. Since the last few decades, the global climate has changed as a result of anthropogenic activities. The subcontinent's climate has also had a negative impact on the country's biological resources. These effects of climate change can be direct, such as changing water temperatures and associated phenologies, hypoxia event lengths and frequency, ongoing ocean acidification trends, or shifts in hydrodynamics and sea level. Climate change's effects on fish populations can be seen at various levels of biological organization: Environmental variables such as temperature, dissolved oxygen, and ocean carbon dioxide levels will cause physiological changes. Temperature influences their metabolic rate and thus their energy balance and behavior, including locomotors and feeding behavior, digestion, reproduction, and other developmental stages. The purpose of this article is to provide an overview of how climate change affects the Fish reproductive behavior and larval development, as well as management actions that help fish populations and habitats adapt to the effects of climate change.

Keywords: Temperature, Physiology, Metabolism

Introduction

A recent summary of the conclusions of Working Group II of the Intergovernmental Panel on Climate Change has predicted that ***"if current warming rates are maintained, Himalayan glaciers could decay at very rapid rates, shrinking from the present 500,000 square kilometers to 100,000 square kilometers by 2030s".*** The race for modernization among the world's countries has resulted in excessive growth in industrialization, urbanization, and transportation, which is destroying the environmental balance through climate change. The major consequences of climate change are the greenhouse effect, global warming, ozone depletion, and epidemics, all of which have a direct or indirect impact on nature's biological resources and life-sustaining systems. There is a lot of uproar about climate change all over the world. Excessive exploitation of nature is causing this problem and altering weather patterns. Global warming is caused by increasing concentrations of greenhouse gases and deforestation, which disrupts weather, wind patterns, and upper atmospheric circulation (Pandey, 2007). Some important examples of climate change listed under Indian prospective are glacier shrinkage, decreasing water flow in perennial rivers, continuous rain failure during monsoon season, heavy and un-occasional rain in coastal areas, decreasing winter and increasing the duration of summer season (Thomas, 2007). The majority of high-altitude environments worldwide consider strong evidence of climate-driven range contraction, declining numbers, and local extinction of Montana fish fauna to be a growing risk (Comte et al., 2013; Troia and Giam, 2019). It is critical to recognize that the observed effects of global warming on fishes at different levels of biological organization (organism, population, and community-ecosystem) are the result of physiological changes at the molecular, cellular, and whole organism levels, and that the ultimate effects of global warming at the ecosystem level will be built on species-specific responses (Portner, 2001, 2002). Climate change will almost certainly continue to have an impact on salmonids throughout their ranges. Increasing air temperatures have warmed stream and lake temperatures (Isaak et al., 2012; Schneider and Hook, 2010), with consequences ranging from increased stress and metabolic rates to the loss of lower-elevation habitats as waters warm (Isaak et al., 2012; Schneider and Hook, 2010). Warmer temperatures will also have an effect on salmonids

through changes in winter precipitation and altered flow regimes (Haak et al., 2010).

Disturbance events such as wildfires, floods, and drought are also expected to increase (Westerling et al., 2006), resulting in increased stream sedimentation (Goode et al., 2012). Climate change is likely to exacerbate many existing stressors for salmonids (Williams et al., 2015). Non native fishes, for example, which now prey on and compete with native salmonids, are likely to increase in number and distribution as the climate changes (Lawrence et al., 2014; Rahel and Olden, 2008).

Impact of climatic change on aquaculture

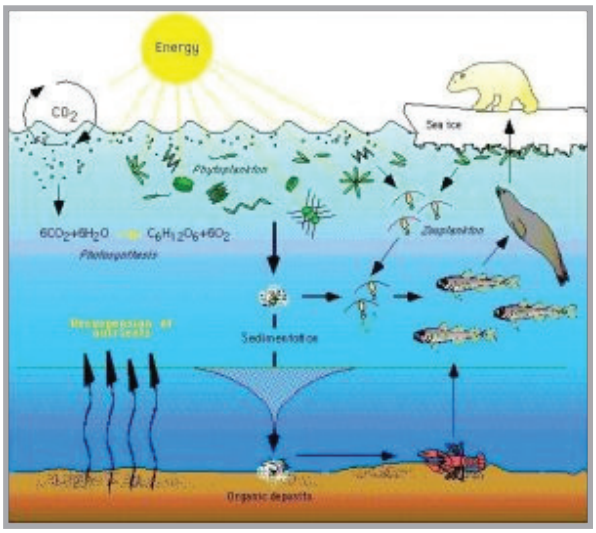

Fig. 1. *Effect of climatic change on aquatic environment.*

Effect of climatic change on fish reproductive behavior

1. Global climate change, environmental disturbance, and endocrine disruption are all likely to introduce new stresses that will have a An increase in water temperature has a direct impact on the physiological processes of ectodermic animals such as fish (Schindler, 1997; Magnuson et al., 2000). Furthermore, the indirect effects of rising temperatures may be reflected in changes in ice conditions. Climate change models predict that winter temperatures in the northern hemisphere will rise (IPCC, 2007). Small temperature increases may cause ice-covered rivers to thaw. Darkness in parr habitat caused by ice cover has been shown to affect RMR, growth, and survival of stream-dwelling fishes in northern environments (Finstad et al., 2004; Hedger et al., 2013). Therefore, changing the environment when a species is in a survival mode might not be good for the species' sustainability. Temperature controls the rates of almost all biochemical reactions and, consequently, the speed of physiological processes in fish. Temperature is referred to as the "abiotic ecological master factor" because it has such a significant impact on fish.

   significant impact on freshwater fish reproductive behavior.
2. Water temperature, hypoxia, and hydrology all have a significant impact on the fish reproductive endocrine (HPG) axis, sex differentiation, gamete maturation, early life histories, spawning pattern and timing, and reproductive success.
3. Climate change effects (variation in water temperature and salinity increases in the duration and frequency of hypoxia events, water acidification) would have an effect on reproduction by influencing the neuroendocrine axis (brain-pituitary-gonad axis).
4. In all fishes studied, the gonads appear to be the organ most easily damaged by heat treatments due to gene expression inhibition and subsequent synthesis of various gonadal steroidogenic enzymes.
5. Considering the feedback role of sex steroids in the synthesis and release of GnRH and GtHs in fish, the inhibition observed at brain and pituitary levels in treated fish could be a result of the sharp decrease in plasma steroids levels.
6. In vitro studies on the inhibition of aromatase expression (Pejerrey gonad) by high temperature

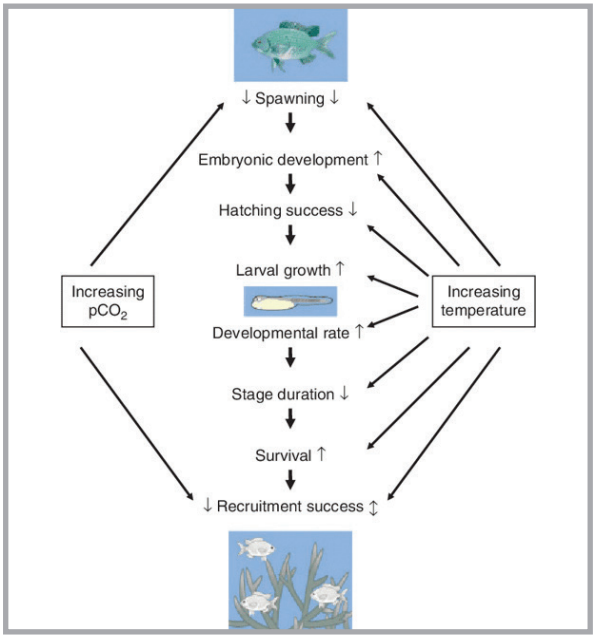

Fig. 2. *Physiological and ecological responses to increased water temperature,Source(Ned W. PankhurstA,C and Philip L. Munday).*

7. Temperature primarily affects gonad function by interfering with steroidogenesis (particularly gonadal aromatase activity) and gametogenesis.
8. Temperature is also a factor in the development of released gametes and embryos. Changes in salinity or water acidification are particularly linked to decreased sperm quality and reproductive output.
9. Hypoxia events can interact with gonad steroidogenesis by influencing the availability of the steroid precursor cholesterol or directly on aromatase activity, affecting gamete quality and reproductive success.

Effect of climatic change on fish larval stage

Eggs are one of the most thermally sensitive life stages in fish, with tolerance limits for many species appearing to be within 68C of spawning temperature (Rombough 1997). Small temperature increases can dramatically increase egg mortality,

confirm that high temperature directly disrupts ovary functions independent of the brain-pituitary axis.

particularly in tropical species (Gagliano et al. 2007). Temperature influences larval fish metabolism, growth, developmental rate, and stage duration (reviewed by Houde 1989; Blaxter 1991; Benot et al. 2000).

Temperature increases will have an impact on the life history and demography of larval fish, potentially affecting recruitment success and population dynamics. Small temperature increases may favour recruitment in some species, particularly at higher latitudes. Larger temperature increases may result in recruitment failures, particularly at low latitudes and when or where food supplies are scarce (Munday et al. 2008a). The effects of temperature on reproduction, which is likely to be one of the first processes impacted by rising water temperatures, will also have a significant impact on larval success and recruitment patterns.

Management practices that mitigate the effects of climate change on fish populations and their habitats:

1. Nonclimate stressors such as hot season livestock grazing, agricultural runoff, or polluted stormwater runoff should be reduced.
2. Enhance watershed function by restoring and expanding wetlands, riparian zones, wet meadows, and floodplains.
3. Improve the resilience of watersheds to disturbances by upgrading culverts, bridges, and other stream/road crossings.
4. Increase the number of cold-water refuge habitats by adding large wood structures, increasing channel complexity, and narrowing and deepening stream channels.
5. Increase riparian habitats and native plant species to increase stream shading and reduce stream siltation.
6. Improve restoration efficiency by focusing on watershed scales and areas that are more likely to withstand climate impacts.
7. Remove instream barriers and replace poorly designed culverts to improve stream connectivity.
8. Rebuild salmon and trout stronghold populations by increasing the availability of high-quality interconnected habitats.

Conclusion

Most fishes' reproductive and early life history events will be or are already being influenced by climate change. This is happening at a variety of levels and through a variety of mechanisms, which are becoming increasingly complex as our understanding grows. These include the interaction of physical variables with habitat, when the thermal challenge occurs in the reproductive cycle, the timing of spawning, whether events are extreme enough to initiate a physiological stress response, the fish's energy status and reproductive age, and the individual's or population's thermal exposure history and adaptive capacity. Except for the relatively few species that have received the majority of research attention, there is also a strong suspicion that we are significantly under-informed to make useful predictions about likely effects beyond broad assumptions. As a result, we are limited in our ability to develop specific options as management strategies. Temperature is one of the most important factors influencing fish survival, but we still know very little about it.

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Effects of herbicides on various aspects of physiology of aquatic animals

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To increase the agricultural productivity, the use of agrochemicals to eliminate weeds has grown in recent decades. The production of agrochemicals in the 50's reached approximately 0.2 million tons and has been increasing at the rate of around 11% per year since then. The largest consumers of agrochemicals are developed countries followed by developing countries. China, USA, Argentina, Thailand, Brazil, Italy, France, Canada, Japan and India top the list of herbicide consumption worldwide. The development of new pesticides formulations and use of herbicides at increasing rate continues at alarming rate due to resistance acquired by the weeds over the years. Herbicides which were developed with the motive to harm/kill plants are also responsible for causing deleterious effects on animals. The intensive use of agrochemicals combined with the lack of treatment of agricultural wastewater is resulting into contamination of the natural biosphere. Water bodies acts as reservoirs of herbicides, which after being applied on crops, show high bioaccumulation of herbicides. Herbicide exposure causes reproductive toxicity and population decline. Further, contaminated fish used for consumption poses a risk to human health. The commonly applied herbicides are known to damage living tissues by lipid, protein and DNA oxidation. Morphological and metabolic changes in fishes by herbicides include impaired cellular function, reduced or increased cell number, altered expression of antioxidant enzymes and tissue damage.

Absorption, metabolism, and excretion of herbicides in fish

Herbicides are mostly absorbed by fishes through their skin, gastrointestinal tracts, and respiratory systems from surrounding water. The lipophilicity of a herbicide often determines how well it is absorbed. The concentration gradient allows these compounds to passively diffuse into tissues.

Herbicide side effects are more likely to affect highly vascularized organs such as the brain, liver, kidneys, spleen, and muscle tissue. Herbicides are bio transformed by certain enzymes found in the cytosol and endoplasmic reticulum of cells in the metabolic organs, such as the liver, kidney, gills, and intestines. These chemicals are oxidised, reduced, and hydrolyzed by cytochrome P450 monooxygenases, nitro reductases, and carboxylesterases. The goal of this reaction is to reduce the toxicity of these substances and increase their water solubility so they may be excreted, although the impact of these enzymes will vary depending on the physicochemical properties of each substance and biotransformation enzyme expression and activity in various fish species. In addition, if we take into account certain herbicides, the expression of these enzymes may change. It is believed that proteins, such as the ABC family membrane transporters, present on the apical and basolateral surfaces of cells in the liver, kidney, and gill tissues transport herbicide metabolites through bile, urine, or faces. The excretion pathways of herbicides in fish are still poorly understood. Herbicides, which are poorly digested and excreted through other channels, can be transferred from the blood to the intestinal lumen through diffusion and, to a lesser extent, by active transport. The toxicity of herbicides and other pesticides in fish tissues is enhanced at higher temperatures as a result of the effects of water temperature on fish absorption, metabolism, and excretion of toxicants.

Effects on Immune system

The immune system of fish has been demonstrated to be impacted by herbicides such glyphosate and atrazine. Efficacy of glyphosate reduced serum bactericidal activity, decreased lymphocyte percentage, and decreased coelomic cell phagocytic capability. decreasing amount of neutrophils and eosinophils in the blood and the bactericidal activity of plasma were

observed with impazapyr and imazapic combined. Inflammation in the liver by exposure to atrazine resulted in leukocyte infiltration and increased incidence of free melanomacrophages in Rhamdia quelen.

Chichlorac at 14 g/L and atrazine at 15 g/L both inhibited the synthesis of Thio Barbituric Acid reactive compounds (TBA017). Since TBARS are a byproduct of lipid peroxidation, their decline in renal cells may be a sign that this tissue's ability to oxidise has been compromised. By lowering total lipids, glyphosate and atrazine were both able to influence energy metabolism and potentially renal hormone production. Additionally, geophagus brasiliensis kidney cells found in a glyphosate- contaminated environment showed DNA damage. The death rates of Rhamdia quelen fingerlings subjected to glyphosate or atrazine after being infected with aeromonas hydrophila bacteria rose, suggesting that both herbicides may have an immunosuppressive impact. When exposed to 0.555 mg/L of atrazine, rainbow trout (Oncorhynchus mykiss), a temperate species, showed elevated plasma cortisol and reduced lymphocytes in peripheral blood, showing a comparable impact.

Effects on Reproductive system

The substance that has been examined the most is glyphosate, followed by atrazine and chlornitrofen. Poecilia species have demonstrated how herbicides can have an impact on both adolescent and adult sexual behaviour. Chlornitrofen was shown to have the ability to dramatically diminish the number of larvae that were hatched in Poecilia reticulata when its concentration was greater than 25 g/L. It was also found to have the ability to disrupt many reproductive cycles in the same exposed individual. In this same species, it was noted that males exposed to atrazine on a long- term basis exhibited changes in their reproductive behaviour, such as less aggressive behaviour when competing for mates and fewer courtship displays. There was also a decrease in orange spots, a sexual secondary characteristic. Glyphosate concentrations exceeding 130 g/L have been shown to impair sperm quality in Poecilia vivipara males after acute exposure. This includes decreased plasmatic membrane integrity, mitochondrial functioning, DNA integrity, motility, and spermatic cell concentration. Sperm death in A. lacustris was only noticed at glyphosate concentrations greater than 300 g/L. Hormonal alterations, including a rise in cortisol levels and a reduction in estradiol levels, were seen in female Rhamdia quelen animals exposed to glyphosate over an extended period of time.

Effects on Respiratory system

Piaractus mesopotamicus, Colossoma macropomum, and Poecilia reticulata experienced histological abnormalities as a result of exposure to glyphosate, including gill epithelial hyperplasia and lamellar hypertrophy. Glyphosate treatment at 5.2 g/L enhanced the glutathione-s-transferase activity of the gills in Astyanax lacustris, and it decreased catalase activity and increased lipid peroxidation in Markiana nigripinnis, showing that it can change the oxidative equilibrium in the gills. By lowering the expression of -actin in P. reticulata's gills at 1.82 mg/L and by lowering the levels of glycogen and total lipids in Rhamdia quelen after exposure to 5.2 g/L, glyphosate was also able to impair respiration.

Effects on Nervous system

Fish have highly developed and structured neural systems that are in charge of vital processes for the preservation and environmental adaption of a species. Herbicides affect fish nervous systems by hampering the motor function which is quantified by measuring Acetyl Cholin Esterase (AChE) in addition to looking at important functions including sensory, behavioural, and reproductive processes. AChE is an enzyme that is found in cholinergic synapses and motor endplates.

Quinclorac and metsulfuron methyl boosted brain AChE activity, but clomazone lowered it, producing swimming abnormalities resulting in respectively tiredness and hyperactivity. Clomazone (0.5-1.0 mg/L) exposure to R. quelen causes a decrease in AChE activity in the brain and muscle as well as an increase in TBARS in the brain that begins 12 hours after exposure.

Effects on Liver

Glyphosate- based herbicide, results into a number of hepatic histopathologies, particularly hepatocytes increase in Poecilia reticulata. Increases in glucose, glycogen, lactate, and ammonia were brought on by exposure to 0.2–0.4 mg/L of glyphosate.

Malondialdehyde (MDA), a significant byproduct of lipid peroxidation, increased in Astyanax altiparanae when exposed to atrazine at concentrations between 0.5 and 10 g/L. Exposure to atrazine increased the histology of the liver and decreased the diameter of the hepatocytes. Hepatic glycogen decreases when clomazone exposure increases from 0.5 to 1 mg/L in the water

Conclusion

Fish have been recognized as effective bio-indicators for evaluating the dangers of environmental pollution and enabling the early identification of possible issues. Although pollutants may not kill fish at acceptable ambient quantities, they may change biochemical, physiological, and behavioral factors, endangering the survival of some species in their natural environments. Increasing concentration of toxic chemicals with increasing trophic levels of food chain poses a serious threat of bio-magnification of herbicides in humans.

Fisheries Impact Assessment

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Background

Social impact assessment (SIA) began as a field in the 1960's as people became more concerned with human impacts on the environment. When designated changes were contemplated, the National Environmental Policy Act (NEPA) of 1969 required an analysis of the impact human actions had on the environment. The Fishery Conservation and Management Act of 1976 led to efforts to gather social data and conduct impact analyses specifically for fisheries. In the 1990s, environmental progress was neither rapid nor successful due in part to a lack of attention to the social and cultural dimensions of resource management. In 1997, SIA became a requirement in many federal programs. In 2003, the Interorganizational Committee on Guidelines and Principles for SIA published revised guidelines and principles. Lack of success in fishery management led to changes in the fishery management process and passage of the Sustainable Fisheries Act (SFA) in 1996. A social scientist was present in every National Marine Fisheries Service (NMFS) region except the Southwest by 2005, signaling a new agency effort to develop its ability to address sociocultural regulatory impacts. The Fisheries Impact Assessment comprises three major parts: establishment of baseline conditions, evaluation, and assessment of fisheries impact following the criteria and guidelines given by the Environmental Impact Assessment Ordinance – Technical Memorandum on the Environmental Impact Assessment Process (EIAO-TM) which describes the general approach and methodology for the assessment of fisheries impacts that may arise from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential impacts. By analyzing the fisheries baseline conditions and the water quality modeling results, FIA helps to determine how the project works may impact existing fisheries resources, fishing operations, and marine culture activities. Stakeholder engagement activities will be organized prior to project implementation in order to obtain their views and foster their understanding of the proposed project works for fisheries-sensitive receivers.

Why it is important?

The economy is almost entirely dependent on the exploitation of its natural resources. For food and developing demands by a growing population, these natural resources should not only be protected, but utilized in a manner that promotes their regeneration. Impact assessment is concerned with making judgements about the effect on beneficiaries of humanitarian interventions. It is a function of the results chain and is an integral part of Monitoring and Evaluation. Freshwater habitats in India have some of the highest biodiversity in the world. While aquaculture has many opportunities and needs, it is essential that it grows in a way that promotes socioeconomic development and food security while conserving natural resources for the immediate needs of other ecosystem users and for future generations. Fisheries Impact Assessment has evolved for a number of reasons, including the growing need for an integrated analysis that incorporates environmental, economic, and social aspects. Multi-national companies must strike a balance between short-term and long-term impacts, different levels, and the consequences of negative or positive interventions.

Which ecosystem will be affected

Some important areas which may be affected by any project are:

- Streams and rivers are flowing waters
- Floodplains are the low land areas, adjacent to water courses that are subject to periodic or near-permanent inundation and sediment deposition.
- Reservoirs are artificial water bodies, primarily used for irrigation, hydroelectric power and domestic water supply.
- Lakes are natural water bodies though artificial lakes can be built. Both are usually freshwater and have high potential for aquaculture and conventional or enhanced capture fisheries.
- Ponds are small freshwater bodies, usually artificial, occasionally natural, in rain fed and

irrigated areas where aquaculture, particularly integrated with agriculture, is possible. conventional or enhanced capture fisheries.

- Estuaries are partially enclosed coastal bodies of water which are either permanently or periodically open to the sea and within which there is a measurable diurnal and seasonal variation of salinity due to the mixture of sea water with fresh water derived from land drainage. They include key habitats, such as coastal lagoons, that support coastal fisheries.
- Lagoons are coastal, lacustrine water bodies that are influenced by both land drainage inputs and marine inputs. They are similar to estuaries in their diurnal and seasonal salinity and tidal patterns.
- Wetlands are defined as a wide variety of habitats such as marshes, peat lands, floodplains, rivers and lakes, and coastal areas such as salt marshes, mangroves and seagrass beds. Also, coral reefs and other marine areas not deeper than 6m at low tide, similarly, constructed wetlands such as waste-water treatment ponds and reservoirs are classified as wetlands.

Identification of Potential Fisheries Impact

Identification and evaluation of the potential short and long-term impacts on both capture and culture fisheries, during the construction and operation phase of any project. It may include the following things

- Potential impacts on fisheries include the temporary loss of fishing grounds and fisheries resources.
- The proposed project works may potentially cause an impact on fishing activities.
- The key potential water quality impacts arising from construction activities of the Project include the suspended solids (SS) release due to dredging activities and the release of contaminants and/or impact on dissolved oxygen due to disturbance of sediment.
- There would be adverse impact to fishing operation in the nursery and spawning ground.

The steps involved in Fisheries Impact Assessment

There are eight steps in the impact assessment which are presented in brief below:

- Screening: it determines whether the proposed project, requires an impact assessment and if it does, then the level of assessment required.
- Scoping: This stage identifies the key issues and impacts that should be further investigated. It also defines the boundary and time limit of the study.
- Impact analysis: This identifies and predicts the likely environmental and social impact of the proposed project and evaluates the significance.
- Mitigation: It recommends actions to reduce and avoid the potential adverse environmental consequences of development activities.
- Reporting: This stage presents the result of an impact assessment in a form of a report to the decision-making body and other interested parties.
- Review: It examines the adequacy and effectiveness of the impact assessment report and provides the information necessary for decision-making.
- Decision-making: It decides whether the project is rejected, approved or needs further change.
- Post monitoring: It checks to ensure that the impacts of the project do not exceed the legal standards and implementation of the mitigation measures are in the manner as described in the impact assessment report.

Forms of impact assessment

In addition to environmental assessments, there are various forms of impact assessment, including Health Impact Assessments (HIA), Social Impact Assessments (SIA) that evaluate the health and social consequences of development and Economic impact Assessments that provides an in-depth look into the impact of business operations and decisions on the economy.

Conclusion

Fisheries is one of the most significant renewable resources that India have for food security, livelihoods and economic growth. The modeling of fisheries impact assessment is followed in a proper way then there would be no significant adverse indirect impact on fisheries caused by the project. Moreover, it ensures that future generations will have access to natural resources, including biodiversity.

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Purview of Integrated Fish-Vegetable farming in the changing scenario

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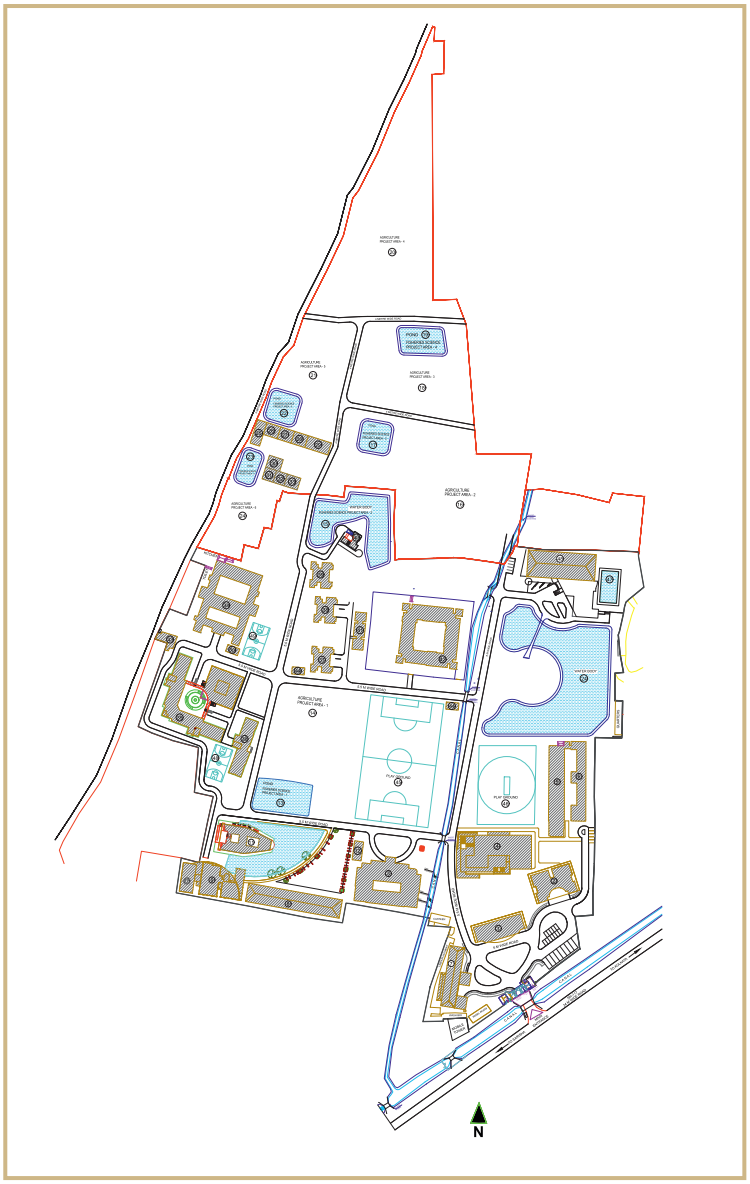
With ever increasing population, limited land resources and competing enterprises for the latter, it is very difficult to provide a sustainable and resilient future. India is the major maritime state and currently ranks 3rd in fisheries and 2nd in aquaculture production in the world, contributing 6.3% to the total global fish production. In spite of this, major shift in the demographic dietary preferences, due to migration towards urbanized coastal areas, is the foundation for increasing gap between demand and supply which is widening every year. The situation calls for more resource-intensive production which has imputation for land and water use, as well as climate change. For higher net returns farmers are dependent on heavy use of chemical fertilizers and pesticides, as a result of which yield increases manifold but a negative impact on environment which eventually affects the whole ecosystem is being noticed. Use of excessive chemical fertilizers not only deteriorates the physicochemical properties of soil but there leaching and runoff into nearby water bodies also affects the aquatic flora and fauna. 30-90% of the N and high fraction of P compounds applied to fish ponds are reported to accumulate in pod sediments. The global damage to the coastal aquatic environment by nitrogen and phosphorus accumulation and consecutively loss of aquatic life associated with hypoxia is estimated to be about USD 170 billion annually. Activity of wetlands, which are considered to be natural scavengers of heavy metals and bio-purifiers of our ecosystems, is being hindered by the excess nutrient loads in the aquatic environment, although there is no estimated data regarding the specific impact. Integrated approach is the way ahead to minimize the use of chemical fertilizers and therefore, integrated aqua agriculture has been into practice to safeguard the environment and to feed the ever growing population with variety of food preferences. Asia now accounts for 88% of world aquaculture production and these trends are expected to continue in the future. Various integrated approaches involving aquaculture are initiated by the government to promote integrated aquaculture with diversified aspects of farming system. Aqua-agriculture not only generates huge returns in small, medium and large farms as a source of sea food but also provides scope to culture the crops with integration of marine system and reduces the adverse impact on environment by landscape modification, loss of bio-diversification and reducing eutrophication. Integrated fish vegetable farming is one such ideal approach which ensures high profitability with limited use of locally available resources and is environment friendly as well. Less adaptation due to less technical knowledge and skill in marginal section of farmers is the major reason why information and farmers' feedback on these farming systems is scarce. Therefore, integrated fish vegetable farming calls for more focus so as to create research target on local challenges and realize demonstrated farming system to farmer context.

Conventionally, aquaculture is known to be integrated with crops like rice but recent researches recommended plethora of olericultural crops with specialized crops likes water spinach (Ipomoea aquatic), water mimosa (Neptunia oleracea), water lettuce (Pistia stratitoes) etc. For human consumption, these crops are also popular for their medicinal values. Aquatic vegetables are well known to cure nervous and general disability, menstrual cramps, uterine bleeding, hemorrhoids etc. and also support marine ecosystem by recycling the nutrients, water purification and maintenance of stream flow etc. Alternanthera philoxeroides (Alligator weeds) used as vegetable in Japanese and Thai cuisine is found to remove lead and mercury from the polluted water. Ipomoea aquatic (Water spinach) has high nitrogen and phosphorus uptake and thereby leads to major N and P removal from aquatic ecosystem thus reducing nitrification, denitrification and volatilization losses. Marine population of Oreochrois niloticus (Nile tilapia) has been reported to increase at faster rate by consumption of Ipomoea aquatic. Cucumber cultivation in the furrows surrounded by canals harbouring Gaint gourami, showed increase in the survival rate (%), specific growth rate, daily weight gain of Gaint gourami by 70.2%, 0.69% day-1 and 1.3 g day-1 respectively and also increased the yield of cucumber. In Tanzania, African sharptooth catfish, Clarias gariepinus and Oreochromis niloticus polyculture were reared in earthen ponds for 270 days integrated with Chinese cabbage (Brassica rapa var. chinese) which resulted into 2.5 times higher net yield than non integrated fish vegetable, respectively. Hence, development of integrated fish vegetable farming system for sustainable agriculture models provide food security, economic liberalization, climate change and many opportunities. Further studies are going on integrated fish vegetable production which involves focus on aquaponics (hydroponics + aquaculture) and hence ensures to double farmer's income, diversify the food production with improved quality and ultimately improving the food security.



LEGEND- BUILDING

A. ADMINISTRATIVE BLOCK

1. ADMINISTRATIVE BUILDING (G + V)

B. ACADEMICS BLOCK

2. SCHOLASTIC BUILDING - 1 (G + III)
3. SCHOLASTIC BUILDING - 2 (G + II)
4. SCHOLASTIC BUILDING - 3 (G + III)
5. SCHOLASTIC BUILDING - 4 (G + III)
6. SCHOLASTIC BUILDING - 5 (G + III)
7. WORKSHOP BUILDING
8. NEW WORKSHOP BUILDING
9. NEW PHARMACY BUILDING (G + III)
10. PHARMACY BUILDING (G + III)
11. SHIP IN CAMPUS (G + III)

C. AGRICULTURE & FISHERY SCIENCE BLOCK

12. POLY HOUSE & NET HOUSE
13. FISHERY SCIENCE PROJECT AREA - 1
14. AGRICULTURE PROJECT AREA - 1
15. FISHERY SCIENCE PROJECT AREA - 2
16. AGRICULTURE PROJECT AREA - 2
17. FISHERY SCIENCE PROJECT AREA - 3
18. AGRICULTURE PROJECT AREA - 3
19. FISHERY SCIENCE PROJECT AREA - 4
20. AGRICULTURE PROJECT AREA - 4
21. AGRICULTURE PROJECT AREA - 5
22. FISHERY SCIENCE PROJECT AREA - 5
23. FISHERY SCIENCE PROJECT AREA - 6
24. AGRICULTURE PROJECT AREA - 6
25. MUSHROOM UNIT
26. FIELD LAB
27. STORE HOUSE
28. SERICULTURE UNIT
29. THRESHING FLOOR
30. BIO GAS PLANT
31. CATTLE SHED
32. VERMI COMPOST PIT
33. BIO FERTILIZER PLANT

D. RESIDENTIAL BLOCK

34. BOY'S HOSTEL - 1 & 2 (G + III)
35. BOY'S HOSTEL - 1 & 2 (G + III)
36. BOY'S HOSTEL - 1 & 2 (G + III)
37. OLD STAFF QUARTERS (G + III)
38. NEW STAFF QUARTERS (G + III)
39. NEW STAFF QUARTERS (G + III)
40. DIRECTOR'S RESIDENCE (G + I)
41. OLD STAFF QUARTERS (G + III)
42. GIRL'S HOSTEL - 3 (G + II)

E. UTILITY & SERVICES BLOCK

43. ELECTRICAL ROOM
44. PUMP ROOM

F. RECREATIONAL BLOCK

45. FOOTBALL GROUND
46. CRICKET GROUND
47. SWIMMING POOL
48. MULTI PURPOSE HALL
49. BASKETBALL COURT (3 NOS.)

G. HEALTH BLOCK

50. MEDICAL UNIT

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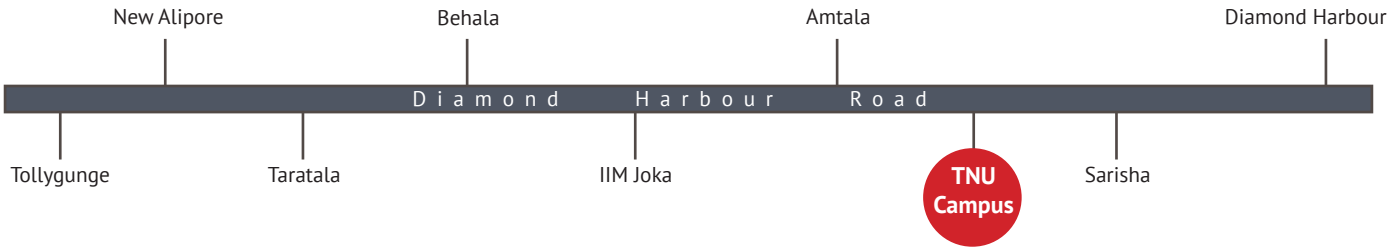

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