FAO Reference Centre

Annual report - January - December 2025

Title of FAO Reference Centre: FAO Reference Centre for Antimicrobial Resistance (AMR) & Aquaculture Biosecurity (AB)

Name of the institution: Nitte University (NU)

Country: India

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Activities supporting raising awareness on AMR

1. **Distinguished Lecture under One Health**

The centre organized a lecture by Dr. M Suresh, Associate Dean for Research and Graduate Education, John Butler Professor of Comparative and Mucosal Immunology from the University of Wisconsin School of Veterinary Medicine, USA. Dr. Suresh spoke on “Tenets of T Cell Immunity to Respiratory Viral Pathogens”. The distinguished lecture was held on 27 February 2025. This event was organized as part of the ‘One-Health Lecture series. The speaker provided insights into vaccine-induced multifaceted mucosal T-cell immunity with implications for the development of vaccines against respiratory pathogens, including the influenza virus and SARS-CoV-2, using a combination adjuvant strategy to elicit CD8 and CD4 T-cell responses. The relation between immune response and protection against infection and disease was also explained. Most often, immune response is measured in terms of antibody titers, but the need to understand T-cell response, which is important in overcoming intracellular pathogens like viruses, was highlighted. The lecture focused on providing fundamental insights into T-cell-based vaccine-induced protective immunity against respiratory viruses.

2. **National Conference on “Antimicrobial resistance: Strategies for prevention and alternatives”**

The National Conference on “Antimicrobial Resistance: Strategies for Prevention and Alternatives” at KSTA Auditorium, Bangalore, on 14-16 May, 2025, was inaugurated by Dr. Iddya Karunasagar, Shri N.S. Bosaraju, the Hon’ble Minister for Science and Technology,

Government of Karnataka, and Dr. Raghavendra Bhatta, Deputy Director General, Indian Council of Agricultural Research. The conference was organized by Karnataka Science and Technology Academy (KSTA) and was addressed by delegates from the WHO and leaders from various national organizations. Dr. Indrani Karunasagar delivered a keynote lecture on "Phage therapy for the mitigation of antimicrobial resistance", emphasizing the potential of bacteriophages as highly specific and effective agents against multidrug-resistant bacteria. It discussed the mechanisms by which phages infect and lyse bacterial cells, offering a targeted approach that does not disrupt beneficial microbiota. The talk also addressed current challenges, including regulatory frameworks, phage characterization, and large-scale production.

3. **Organizer of Scientific Sessions – 12th Symposium on Diseases in Asian Aquaculture**

12th Symposium on Diseases in Asian Aquaculture on "Transformative Innovations Shaping the Future of Aquatic Animal Health Management" organized by the Indian Council of Agricultural Research-Central Brackish Water Aquaculture, was held in Chennai on 23-26 September 2025. Dr. Iddya Karunasagar delivered a keynote lecture on "Antimicrobial Resistance and Aquatic Animal Health" and chaired the session on "One Health and Aquatic Biosecurity". Dr. Indrani Karunasagar chaired the session on "Finfish Health" and served as a Jury Member for the Best Oral Presentation and Best Poster awards.

4. **World Antimicrobial Awareness Week (WAAW): "Advancing Aquatic Health – Addressing AMR in Global Aquaculture"**

The 2025 World AMR Awareness Week event was hosted by the Mississippi State University through the FAO Reference Centre on AMR and Aquaculture Biosecurity, in collaboration with global partners on 17 November 2025. The Centre played a significant role as one of the FAO

Reference Centers on AMR and Aquaculture Biosecurity, contributing actively to the global dialogue on antimicrobial resistance in aquaculture.

5. Workshop on One Health: Together for a Safer Future

The centre organized the workshop titled “One Health: Together for a Safer Future,” held on 24 November 2025, emphasized the interconnectedness of human, animal, and environmental health. The programme highlighted collaborative strategies to prevent zoonotic diseases, strengthen antimicrobial resistance surveillance, and promote interdisciplinary research. Experts and participants engaged in discussions to foster integrated approaches that ensure a safer, healthier future for all.

6. International Conference on “Blue Horizon 2025: Rethinking Fisheries for a Sustainable Future”

The International Conference on “Blue Horizon 2025: Rethinking Fisheries for a Sustainable Future”, held on 17–18 December 2025, brought together leading scientists, researchers, and industry experts to deliberate on emerging challenges and innovations in fisheries, aquaculture, aquatic animal health, and sustainable resource management. The conference featured plenary sessions, keynote addresses, technical presentations, and panel discussions structured across four thematic areas: Aquaculture & Animal Health, Aquatic Environment & Conservation of Fishery Resources, Fish Harvest Technology & Engineering, and Fisheries Extension & Economics. The inaugural plenary address by Dr. Indrani Karunasagar set the tone for the conference, stressing the need to realign fisheries and aquaculture with sustainability, biosecurity, and global health priorities in the face of emerging aquatic animal diseases. She highlighted the growing challenges posed by climate change, globalization, and intensive farming, emphasizing a One-Health approach, cautioning against antimicrobial misuse, and advocating science-based alternatives and advanced molecular surveillance tools. Her address concluded with a strong call for capacity building, interdisciplinary

collaboration, and responsible innovation to ensure a resilient and sustainable future for fisheries and aquaculture.

7. **Virocon-2025: Annual international conference organized by the Indian Virological Society (IVS)**

   "VIROCON 2025" with the theme "Changing Landscapes in Human, Animal and Plant Viruses: Bridging Basic Science, Innovation and Public Health". The conference was jointly organized by the Indian Virological Society (IVS) and ICMR-National Institute of Virology (ICMR-NIV), Pune, Maharashtra along with NIV Research Foundation, from 8-10 December 2025. Dr. Indrani Karunasagar was invited to chair the scientific session on "Development of countermeasures". The session emphasized the development of effective countermeasures against emerging and re-emerging viral diseases, highlighting the importance of integrated surveillance, translational research, and strong laboratory networks in strengthening public health preparedness.

Support for developing capacity of surveillance of AMR, AMU and residues

1. **International Symposium on Aquaculture Medicine and Aquatic Animal Health Management (AQUAMAP)**

Dr. Iddya Karunasagar and Dr. Indrani Karunasagar delivered keynote lectures at the International Symposium on “Aquaculture Medicine and Aquatic Animal Health Management” (AQUAMAP), organized by Cochin University of Science and Technology, Kochi, 16-18 January 2025. Dr. Iddya Karunasagar enlightened the audience on the recent developments in disease diagnosis and field-level application of diagnostics. He also served as moderator for the Panel discussion on “Cell line development”. Dr. Indrani Karunasagar moderated the session on “Sustainable aquaculture production systems in practice” and delivered a lead lecture on the topic “Vaccination and immune stimulation as two facets of preventive healthcare and drug delivery systems in the aquaculture industry”.

2. **Training on Bacterial Whole Genome Sequencing and Metagenomic Analysis**

The center organized a two-day hands-on training workshop on bacterial whole-genome sequencing and metagenomic analysis from 26- 27 March 2025. The training was organized for scientists from the Central Marine Fisheries Research Institute (CMFRI) in Cochin to strengthen their bioinformatics capabilities. Participants were introduced to advanced tools and pipelines for genome assembly, annotation, and comparative genomic analysis. The workshop also covered metagenomic data processing, microbial diversity analysis, and interpretation of high-throughput sequencing results. The programme enhanced the participants’ practical skills in applying bioinformatics approaches to aquatic and marine microbial research.

3. Development of Farm-Level Early Warning System for Aquatic Animal Disease

The programme on “Development of Farm-Level Early Warning System for Aquatic Animal Disease” focused on formulating guidelines and developing a roadmap to strengthen aquatic animal health surveillance. Organized from 3–5 November 2025 by Yellow Sea Fisheries Research Institute (YSFRI) and 7-9 November 2025 by Pearl River Fisheries Research Institute (PRFRI), and the Food and Agriculture Organization (FAO) in collaboration with the Chinese Academy of Fishery Sciences (CAFS), the initiative aimed to enhance preparedness at the farm level. Experts deliberated on risk assessment models, disease reporting frameworks, and rapid response strategies for emerging aquatic diseases. The roadmap emphasized the integration of field diagnostics, data-sharing platforms, and the capacity building of farmers and extension personnel. The programme laid a strategic foundation for improving biosecurity, minimizing disease outbreaks, and safeguarding aquaculture productivity.

4. Validation Workshop on the “Technical Roadmap for the Early Warning System (EWS) for Aquatic Diseases”

The Aquatic Disease Early Warning System (EWS) Validation Workshop was held from 9–11 December 2025 in Rome, Italy. Organized by the Food and Agriculture Organization (FAO), the workshop focused on validating the effectiveness and reliability of the EWS framework for aquatic diseases. Experts reviewed data models, surveillance mechanisms, and implementation strategies to strengthen early detection and rapid response systems in aquatic animal health management.

5. Advisory support to Student Research Projects

A. Decoding drug resistance in *Streptococcus agalactiae* isolated from aquatic environments: This study isolated and identified *S. agalactiae* from hospital environments and aquatic environments using standard microbiological and molecular methods. Antibiotic susceptibility testing revealed resistance to streptomycin, amikacin, and methicillin, aligning with known resistance patterns in *S. agalactiae*. The findings highlight the genetic basis of antimicrobial resistance and emphasize the public health risks linked to resistant strains in aquaculture settings. The study stresses the need for continuous surveillance and tailored antimicrobial stewardship programmes to mitigate the emergence of resistant strains.

B. CRISPR typing of *Streptococcus agalactiae* isolated from aquatic environments: Using bioinformatic resources such as CRISPR Cas Finder and CRISPR Cas Typer, we identified and characterized the CRISPR-Cas systems of *Streptococcus agalactiae* isolates. All strains possessed a type II-A CRISPR-Cas system, with short spacer arrays and three principal types of direct repeats. RNA structure prediction revealed that the repeats adopted stable hairpin structures, suggesting they are functionally relevant. The study observed high spacer sharing among aquatic isolates, indicating restricted phage exposure. This project produced India's first curated CRISPR dataset for aquatic GBS and identified several novel spacer sequences. Our study helps close the knowledge gap in Indian GBS data and lays the foundation for enhanced disease surveillance, outbreak management, and prevention.

C. **Genomic characterization of *Streptococcus agalactiae* isolated from Indian aquatic systems:** This study conducted whole-genome sequencing and comparative genomic analysis of *Streptococcus agalactiae* isolates from Indian aquatic and human clinical sources to understand genetic diversity, antimicrobial resistance (AMR), virulence, and zoonotic potential. Molecular typing revealed distinct host-associated lineages and evolutionary links, such as the CC7 clonal complex found across environments, suggesting potential cross-species transmission. Clinical isolates showed AMR for tetracycline, aminoglycosides, and macrolides, whereas aquatic isolates generally lacked these resistance genes. This emphasizes the need for integrated "One Health" surveillance to monitor and control the health and economic impacts of GBS across humans, animals, and the environment.

6. **Support to student internship**: Supported internship for a student at College of Fisheries, Kishanganj, Bihar to get training in vaccination of gold fish via different routes, under the guidance of Dr. Abhiman, Assistant Professor, Department of Aquaculture.

Support strengthening governance related to AMU, AMR, and aquaculture biosecurity

1. **International Scientific Advisory Board Meeting of the Saudi Food and Drug Authority**

Dr Iddya Karunasagar, as a Member of the International Scientific Advisory Board of the Saudi Food and Drug Authority attended the second meeting of the Board at Riyadh on 19-20 February 2025. Dr Karunasagar provided advice on issues related to microbiological risk assessment for various food commodities and the measures that need to be adopted following any food safety emergencies Dr Karunasagar had several one to one meetings with SFDA officers to address the queries they had on microbiological issues.

2. **Microbiome Conclave and Ideathon 2025**

Dr Iddya Karunasagar delivered an invited lecture on “Regulations related to Microbiomes and Probiotics” at Microbiome Conclave and Ideathon 2025 organized by the Center for Excellence in Microbiome and Kerala Startup Mission in Cochin on 5 March 2025. The conclave was attended by several Startups and Academic Institutions from Kerala and other States. The Startups evinced keen interest in understanding the regulatory landscape for the application of microbiomes in various sectors.

3. **Participation in the World Society for Virology Conference 2025**

Dr. Indrani Karunasagar and Dr. Iddya Karunasagar were invited to participate in the 3rd International Conference of the World Society for Virology (WSV 2025) held from 6–8 May 2025 in Kuala Lumpur, Malaysia. The international conference brought together virologists and researchers from several countries to discuss advances in virology covering human, animal, plant, and environmental viruses within a One Health framework. The conference provided an important platform for exchange of knowledge on emerging viral diseases and interdisciplinary approaches relevant to aquaculture and public health.

4. The 3rd Global Food Regulators Summit 2025

Dr. Iddya Karunasagar, Dr. Sanu Jacob, Director, National Food Laboratory, Chennai and Dr. Indrani Karunasagar attended the GFRS 2025, organized by the Food Safety and Standards Authority of India **(**FSSAI) under the Ministry of Health & Family Welfare, held on 26-27 September 2025 at the Bharat Mandapam, New Delhi, focusing on "Evolving Food Systems, Yatha Annam Tatha Manah". More than 70 country representatives and various international organizations participated in the summit to discuss updating and harmonizing global food safety standards, risk assessment, technological innovations, integrating traditional food practices, and balancing food safety with traceability, nutrition, and health goals. The summit reinforced India's role as a hub for global food safety regulations and innovation.

5. WOAH Ad Hoc Group on the Revision of Chapter of Aquatic Animal Health Code

The World Organization for Animal Health invited Dr. Iddya Karunasagar to participate in the first WOAH Ad hoc Group meeting for the revision of Chapter of the Aquatic Animal Health Code. The Ad hoc Group was constituted to review and update international standards to ensure scientific

accuracy and global relevance. This engagement further strengthened collaborative efforts aimed at improving aquatic animal health management worldwide.

6. International Conference Participation – World Aquaculture Society India 2025

Dr. Indrani Karunasagar and Prof. Iddya Karunasagar were invited to participate in World Aquaculture India 2025, held from 10–13 November 2025 in Hyderabad, India. The international conference brought together scientists, industry experts, and policymakers from across the Asia-Pacific region and other parts of the world to discuss recent developments and challenges in sustainable aquaculture, including aquatic animal health and antimicrobial resistance.

Promote good aquaculture practices and prudent use of antimicrobials

1. **Aquatic Animal Diseases: Emerging Challenges and Preparedness**

   Dr. Iddya Karunasagar delivered a Lead Lecture on “Biosecurity and Aquaculture” at the Symposium on “Aquatic Animal Diseases: Emerging Challenges and Preparedness” on 13 February 2025. This Symposium was part of the 14th Aquaculture and Fisheries Forum organized by the Asian Fisheries Society and the Indian Council of Agricultural Research at the National Agricultural Science Complex, Delhi, held on 12-15 February 2025.

2. **One-day workshop on Food Safety: Science in Action**

The Centre organized a one-day workshop on the occasion of celebrating World Safety Day 2025 on 10 June 2025. The theme for the Food safety day 2025 was “Food Safety: Science in Action”. Dr Iddya Karunasagar, delivered a talk on the scientific basis for international food safety standards. He explained the scientific risk assessment reports produced by the Joint FAO/WHO Expert Committees, the Joint Expert Committee on Food Additives (JECFA), the Joint Expert Meeting on Microbiological Risk Assessment (JEMRA), and the Joint Meeting on Pesticide Residues (JMPR). These risk assessments form the basis of science-based food safety standards set by the Codex Alimentarius Commission. He also explained about microbiological sampling plans and compliance testing. Dr. S B Barbuddhe, Director, ICAR- National Meat Research Institute, Hyderabad, enlightened the gathering on the present contours and future scope for advancement in food safety. He highlighted the importance of *Listeria monocytogenes* as a foodborne pathogen and the repository and culture collection of foodborne pathogens being maintained at ICAR-NMRI. He also explained the problems with food authenticity and the technology used to detect mislabeled food. Dr. Indrani Karunasagar addressed the attendees about the safety of water in food production and processing. She explained the need for fit-for-purpose water to be made available to primary producers, such as agricultural fields, fishing boats, and fish landing centers. She explained harmful algal blooms and the toxins they

produce, which may impact food safety. Her presentation included concepts of food adulteration and food contamination, and ways to minimize or mitigate them.

3. **Managing Emerging Environmental Contaminants in Aquaculture and Fisheries**

   The National Academy of Agricultural Sciences organized a scientific programme on 18 July 2025 titled “Managing Emerging Environmental Contaminants in Aquaculture and Fisheries”. The session focused on understanding how environmental contaminants contribute to the emergence and spread of new pathogens in aquaculture systems, the role of pollutants such as heavy metals, antimicrobial residues, and industrial effluents in altering aquatic ecosystems and weakening host immunity. The deliberations emphasized the link between environmental stressors and increased disease outbreaks in fish and shellfish populations. The programme highlighted the need for integrated monitoring, sustainable management practices, and policy interventions to safeguard aquatic animal health and food security.

4. **Marine Nutraceuticals for Boosting the Bio-Economy of India**

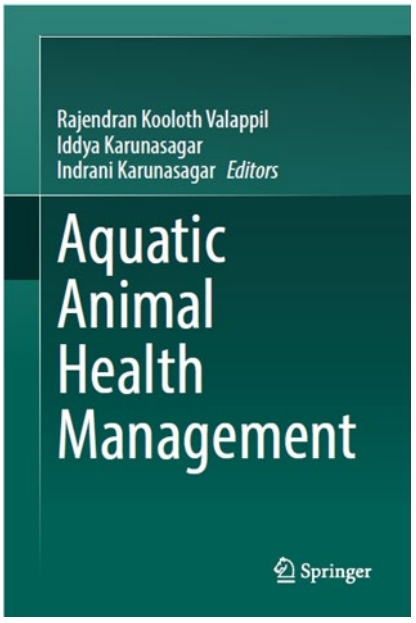
   The programme titled “Marine Nutraceuticals for Boosting Bio-Economy of India” focused on exploring the immense nutraceutical potential of carotenoid pigments derived from marine algae as an emerging frontier in dietary supplements. Organized by the National Academy of Agricultural Sciences on 18 July 2025, the event highlighted the growing significance of marine bioresources in strengthening bio-economy of India. The programme me emphasized the health-promoting properties of marine carotenoids, including their antioxidant and therapeutic benefits. Experts deliberated on sustainable harvesting, value addition, and commercialization strategies to translate research into market-ready products. The programme me underscored the need for interdisciplinary collaboration to harness marine nutraceuticals for economic growth and public health advancement in India.

5. **Workshop on One Health: Together for a Safer Future**

   The Centre organized a workshop titled “One Health: Together for a Safer Future” on 24 November 2025, as part of World Antibiotic Awareness Week 2025. The workshop was conducted in collaboration with K S Hegde Medical Academy (KSHEMA), Nitte University Centre for Science Education and Research (NUCSER), and Nitte Institute of Allied Health Sciences (NIAHS), and brought together experts to discuss interdisciplinary approaches to health under the One Health framework. Eminent speakers addressed topics including vector-borne diseases, zoonotic viral diseases, antimicrobial resistance in tertiary care hospitals, food safety, and water safety. Dr. Iddya Karunasagar delivered a lecture on “One Health and Food Safety,” while Dr. Indrani Karunasagar spoke on “Water Safety and One Health,” highlighting the importance of integrated approaches to combat antimicrobial resistance and emerging health challenges.

List of Publications

1. The book *Aquatic Animal Health Management*, edited by Rajendran Kooloth Valappil, Iddya Karunasagar, and Indrani Karunasagar, is a comprehensive reference published by Springer that addresses key aspects of aquatic animal health. The editors are distinguished experts in aquaculture and aquatic animal diseases, bringing together contributions from leading researchers and practitioners in the field. The volume covers a wide range of topics including bacterial, viral, and parasitic diseases of finfish and shellfish, environmental influences on health, and advances in disease diagnosis and management. It also discusses emerging technologies in aquaculture, including genomics, nanotechnology, vaccines, probiotics, and cell line development. Additionally, the book highlights policy frameworks, surveillance programmes, and international trade issues, making it a valuable resource for researchers, policymakers, and aquaculture professionals. The book was released at the International Conference on Diseases in Asian Aquaculture, organized by the Indian Council of Agricultural Research-Central Brackish Water Aquaculture, which was held in Chennai on 23-26 September 2025.



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List of Patents

1. Unique primer pairs for the rapid detection of Hepatitis B Virus (HBV) by polymerase spiral reaction (PSR) assay. (Indian Patent No. 202541068643)

2. Species specific oligonucleotide primers for molecules of *Streptococcus agalactiae*. (Indian Patent No. 202541067390)

3. Fluorescence-based nanoprobes for selective detection and quantification of methicillin-resistant *Staphylococcus aureus*. (Indian Patent No. 20254100024

Success Story (January – December 2025):

During 2025, the FAO Reference Center at Nitte University collaborated with a number of national and international organizations to create awareness about antimicrobial use, antimicrobial resistance, aquaculture biosecurity and disease prevention in aquaculture. This includes collaboration with Indian Council of Agricultural Research and Asian Fisheries Society Fish Health Section in organizing the 12th Diseases in Asian Aquaculture Symposium (DAA12) at Chennai, September 23-26, 2025 and presenting the efforts of FAO in minimizing AMU and AMR in aquaculture. The Nitte FAO Reference Center participated actively and contributed to the workshop on Technical Roadmap for development of Early Warning system (EWS) for Diseases in Aquaculture in Qingdao and Guangzhou and also in the validation of EWS held at FAO, Rome. The FAO Reference Center scientist was part of the Expert Committee constituted by WOAH for the revision of chapter on antimicrobials in the Aquatic Code. FAO Reference Center Scientists edited the book “Aquatic Animal Health Management” published by Springer Nature.