

8<sup>th</sup> Global Conference on  
GENDER IN AQUACULTURE & FISHERIES (GAF8)  
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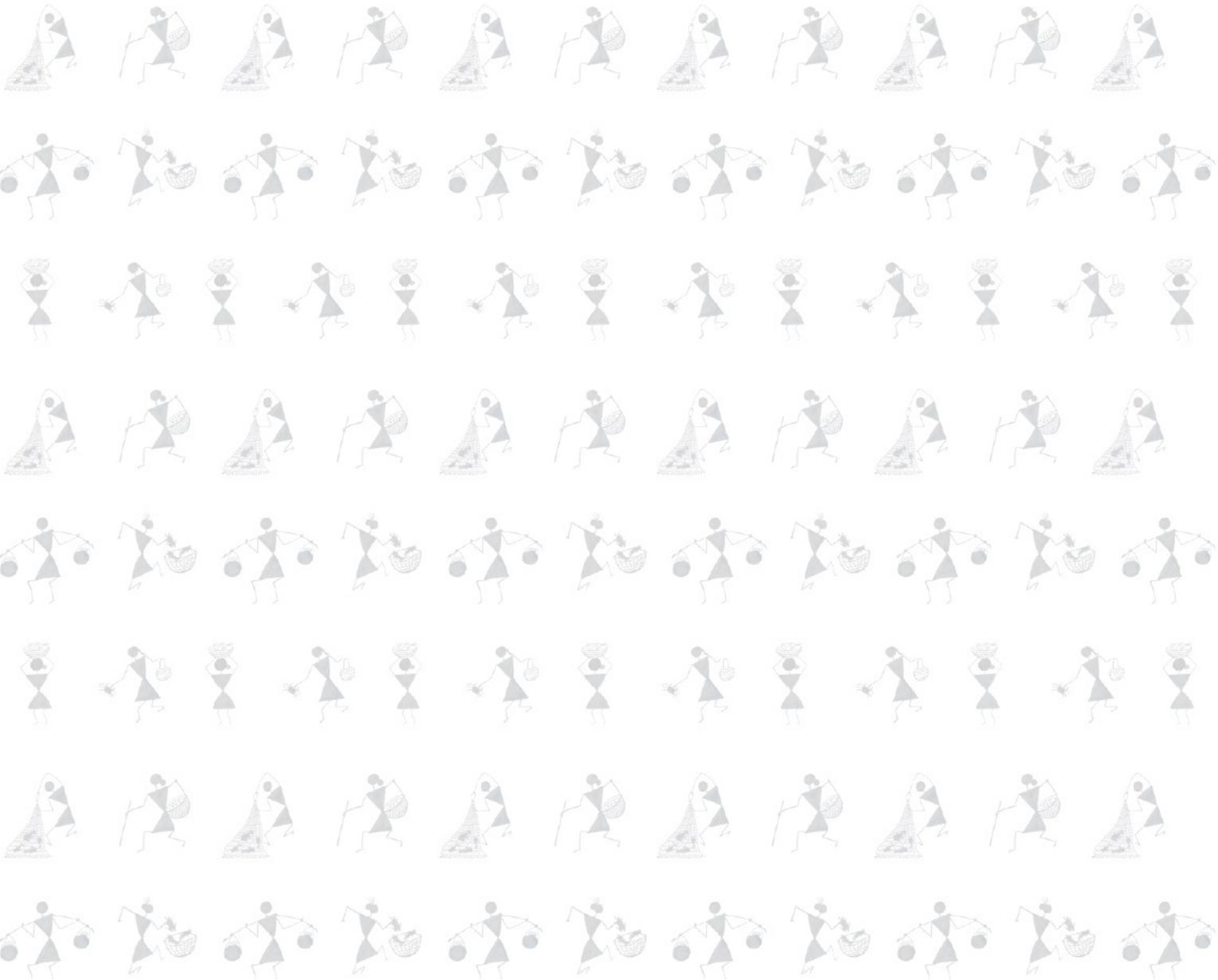


SHAPING THE FUTURE : Gender Justice for Sustainable  
Aquaculture and Fisheries

# GAF8

# Book of Abstracts

21-23 November 2022



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# **Book of Abstracts**

## **8<sup>th</sup> Global Conference on Gender in Aquaculture & Fisheries**

**21-23 November 2022**



**GAF8 - The 8<sup>th</sup> Global Conference on Gender in Aquaculture & Fisheries**  
**Shaping the Future: Gender Justice for Sustainable Aquaculture and Fisheries**

**Book of Abstracts**

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**Editors**

Nikita Gopal

Arlene Nietes Satapornvanit

Surendran Rajaratnam

Kyoko Kusakabe

Luceni Hellebrandt

Carmen Pedroza

Mohammad Nuruzzaman

Toms C Joseph

B Madhusudana Rao

V Murugadas

Minimol V A

Madhu V R

Renjith R K

Sandhya K M

**Assistance in Compilation**

Rejula K

Shyma P K

Sijitha Mary C X

**Design & Graphics**

Razia Mohamed A

Sijitha Mary C X

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# MESSAGES





*It is a matter of great pride that we are hosting the 8th Global Conference on Gender in Aquaculture and Fisheries (GAF8) in Kochi, India. This Conference of the Gender in Aquaculture and Fisheries Section (GAFS) of the Asian Fisheries Society (AFS) has been an important global platform for discussing and debating on emerging work and building evidence on the importance of gender in the sector.*

*I have followed with great interest the growth of the Conference, having hosted the 5th edition at NBFGR, Lucknow and also having witnessed past events as a past-Chair of the AFS. What began as a parallel event at the Asian Fisheries Forum has now grown into a full-fledged event on its own and this is in itself recognition of the importance that gender has in the sector.*



*India has been a leader in this area of work. ICAR is probably the only organisation in the world that has an Institute dedicated to Women in Agriculture, highlighting the importance the organisation gives to gender. Women are integral to food production systems and their role and contribution cannot be ignored. Studies have to focus on building evidence systematically so that the crucial role that women play in the sector can be brought to the centre-stage so that policies can be built around this evidence.*

*I am happy to see the overwhelming response to the Conference Call and the final programme that has emerged with very relevant and diverse themes and sessions incorporating experiences of different countries across the globe. I am also proud of my colleagues from ICAR-Central Institute of Fisheries Technology (ICAR-CIFT) have put in their best efforts to organise the event. I also offer my appreciation to the Society of Fisheries Technologists (India) (SOFTI) for having come forward to co-host GAF8.*

*The Parallel events on AMR and SSF are also very timely as we observe the World Antimicrobial Awareness Week and the FAOs International Year of Artisanal Fishereis & Aquaculture (IYAFA).*

*I wish the GAF8, and the future endeavours of GAFS, all success.*

A handwritten signature in blue ink, appearing to read 'Joykrushna Jena', written over a light blue horizontal line.

**Dr. Joykrushna Jena**  
Deputy Director General (Fisheries Science)  
ICAR, New Delhi  
&  
Patron, GAF8

*Congratulations to the GAF8 Organizing Committees and Secretariat for producing this historic Book of Abstracts.*

*The 8<sup>th</sup> Global Conference on Gender in Aquaculture and Fisheries can trace its pedigree back to Mangalore (Karnataka, India) in 1990 when the Asian Fisheries Society Indian Branch held the Women in Indian Fisheries Workshop. That Workshop was initiated by the then Secretary of the Branch, the late Dr M. C. Nandeeshha. Dr Nandeeshha went on to convene, in*



*partnership with the Asian Fisheries Society, women in fisheries workshops in Cambodia and Indo-China. In the mid to late 1990s, he captured the attention of others in the Society and together we went on to organise symposia (on women in Asian fisheries and in fisheries, globally) and other events to build knowledge about women in fisheries and aquaculture. Each of these events was hosted in a different city or country. As attendance at the events grew and their products became better known, collaborations also grew, and knowledge deepened. We welcomed a gradually widening circle of experts and a steady stream of new participants. The events were transformed into regular global symposia on gender in aquaculture and fisheries (GAF) at the triennial Asian Fisheries and Aquaculture Forums. Our first GAF symposium was held in 2004. In 2007, GAF2 was held in Kochi, to which we are delighted to return 15 years later for GAF8.*

*Using advancing means of electronic communication, we were able to stay in better contact between regular events, share news about advancements in research and policy and hear from more like-minded people all around the world. Our virtual networks grew.*

*Then, in 2017, our informal and open network of interested people took the next big step and established the formal Gender in Aquaculture and Fisheries Section of the Asian Fisheries Society (GAFS). This was the first such group within a mainstream fisheries society. With firmer organizational arrangements, we took an even bigger leap and held our first standalone conference in 2018 at the Asian Institute of Technology in Bangkok, Thailand (GAF7).*

*Our best-laid plans to hold GAF8 in Kochi in 2021 were derailed by the COVID-19 pandemic. The pandemic still disrupts lives and work, but we are learning to navigate it as best possible.*

*During the pandemic lock-downs, our social media outreach was augmented by more intense scheduling of online meetings and events, including our November 2021 GAF8 webinar “Women Work in Fisheries, Too!” This helped us, professionally, to get through.*

*But the online methods and a gradual return to face-to-face work and events also showed us that we needed the more holistic experiences offered only by in-person conferences. Therefore, we are delighted to finally hold in our hands the impressive Book of Abstracts for GAF8, revealing our biggest every line up of presentations, oral and poster, special sessions and parallel events. Most importantly, our growing community has open walls and welcomes many newcomers and like-minded groups each time. GAF8 continues this trend.*



**Meryl J Williams**

Co-Chair, GAF8 Overall Organizing Committee

&

Past Chair GAFS

See the milestones of the Gender in Aquaculture and Fisheries Section of the Asian Fisheries Society on our website: <https://www.genderaquafish.org/gaf-section/milestones/>



*Welcome to all participants and presenters at the 8th Global Conference on Gender in Aquaculture and Fisheries (GAF8). GAF8 and its predecessor conferences and symposia are the latest in a long-running stream of women/gender events of the Asian Fisheries Society (AFS), led by the Gender in Aquaculture and Fisheries section (GAFS) of the AFS. GAFS is also hosting two parallel events during GAF8: one on 'Interventions for control of Anti-Microbial Resistance: Harnessing one health knowledge'; and the other on 'Small-scale fisheries: its global and regional significance', both important topics for achieving sustainable fisheries and aquaculture yields.*

*Aquaculture and fisheries in Asia and the Pacific make a massive contribution to the total fish protein produced in the world and aquaculture continues to grow at a very fast rate so that it is now about 50% of the total fish production. Women play a vital role in this production and gender is an important topic in the set of overall areas of interest that AFS covers. This highlights the importance of the Gender in Aquaculture and Fisheries Section of AFS and of GAF8 and also the contribution that GAFS is making towards the Sustainable Development Goals (SDG) of the United Nations, particularly SDG14: Life below water, and SDG5: Gender Equality.*

*The AFS is a non-profit society, established in 1984, that has a vision of "A vibrant Asia-Pacific society of researchers and other stakeholders that is valued by members for its ability to provide opportunities for communication, collaboration and capacity development in fisheries and aquaculture science." The GAF conferences are an important mechanism for building the knowledge base and for information exchange on the latest results and new initiatives, such as women's work and agency, small-scale fisheries, community-based management, the dried fish economy, gender justice, women's rights, and institutions. The conferences are also important for engaging students and young researchers in fisheries and aquaculture and extending the networks and collaborations of all people.*

*The GAF8 Conference is being organized and hosted by the Society of Fisheries Technologists (India) (SOFTI), Kochi, and the ICAR-Central Institute of Fisheries Technology, Kochi, India and advised by a set of expert committees. On behalf of the AFS, I thank the organisers and sponsors of GAF8 for their commitment to developing the program for GAF8 and wish everyone well for a successful Conference.*

A handwritten signature in black ink, appearing to read "N. Loneragan". The signature is fluid and cursive.

**Neil Loneragan, PhD**  
President of AFS (14<sup>th</sup> Council)  
Professor Emeritus Murdoch University, Western Australia  
&  
Adjunct Professor IPB University, Indonesia

## KEYNOTES



**Dr. Suvarna Chandrappagari** is the Chief Executive of National Fisheries Development Board, which is an autonomous organization under the administrative control of the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India. Dr. Suvarna is an Indian Forest Service (IFS) officer with experience in working in different capacities at various levels (field, middle and policy levels) in natural resource management (NRM); Forestry, watershed management, and Fisheries sectors with Government of Andhra Pradesh and Government of Telangana, India. She worked extensively with communities, international and national level organizations, Government of India, and civil society organizations on participatory natural resource development and watershed management programs, common property resources (CPR), equity, self help groups, poverty issues, and capacity building. At GAF8, she will speak on ***Gender inclusive models for fisheries development.***



**Dr.V. Kripa** is the Member Secretary, Coastal Aquaculture Authority (CAA), Ministry of Fisheries, Animal Husbandry and Dairying, Government of India from April 2020. The CAA was established as an Act of the Indian Parliament for regulating the activities connected with coastal aquaculture in the coastal areas and for matters connected therewith or incidental thereto. Prior to joining CAA, Dr. Kripa was Principal Scientist and Head & Head of Division, Fishery Environment Management Division at ICAR-Central Marine Fisheries Research Institute, Kochi. She has extensively worked on climate change and its impacts on marine fisheries, quantification and mapping the spread of marine litter and blue carbon stock estimation. She was also associated with IPCC for review and preparation of IPCC reports. At GAF8, she will speak on ***A gendered perspective of aquaculture development in India.***



**Ms. Jennifer Gee** leads the Gender Team lead of the Fisheries and Aquaculture Division of FAO. Her role is to coordinate the Fisheries and Aquaculture Department's gender-related work by raising awareness, providing technical advice, knowledge, and tools both internally and for FAO member states. At the start of her career, nearly 20 years ago, Jennifer worked as an on-board observer for the west coast Canadian fishing fleet and then on the development of aquaculture performance indicators out of the University of Victoria. More recently she was the fishery officer responsible for global fleet and employment statistics and socio-economic data collection while working extensively on survey methodology. At GAF8, she will speak on ***Global overview of artisanal fisheries: contribution and challenges*** as part of the Parallel Event ***Small-scale Fisheries: Its Global and Regional Significance***.



**Dr. P. Krishnan** is the Director of Bay of Bengal Programme- Inter-Governmental Organisation (BOBP-IGO), Chennai, which is a Regional Fisheries Advisory Body of the countries bordering the Bay of Bengal region and serve as a think tank on transboundary and contemporary national issues of member countries concerning fisheries management. Dr. Krishnan has over 20 years of Research/Extension/Capacity Building/Policy Advocacy experience in the areas of Coastal Zone Management, Evidence-based Conservation and Management, Agricultural Research, Education & Policy, Fisheries Resource Management, Aquatic Animal Health and Environment Management, Biodiversity and Ecosystem Conservation, Environmental Law, Policy and Governance. At GAF8, he will speak on ***BOBP initiatives for fisherwomen***.



# THEMATIC SESSIONS







**Session 1:**  
**Women's voice and agency: Individual collectives,  
associations, platforms, institutions**





## **WOMEN'S CONTRIBUTIONS TO GOVERNING SMALL-SCALE FISHERIES: A GLOBAL LITERATURE REVIEW**

**Madu Galappaththi \*, Derek Armitage, Andrea Collins**

University of Waterloo, Canada

*\*Madu.Galappaththi@uwaterloo.ca*

This presentation will focus on the findings of a synthesis of current empirical evidence on how women experience, shape, and influence small-scale fisheries (SSF) governance. Globally, women make up about half of the fisheries workforce and critically depend on coastal resources for livelihoods and wellbeing. Yet, women are rarely involved in any decision-making and institutions concerning the issues of access to, control over, and the management of coastal resources. Their unique experiences, issues, and priorities are therefore left out of deliberations while perpetuating gender inequity. These issues also have gained attention in recent global policy frameworks (e.g., Food and Agriculture Organization's Voluntary Guidelines for securing sustainable small-scale fisheries, United Nation's Sustainable Development Goals), where explicit commitments have been made to foster gender equality as a guiding principle in efforts at all levels.

Despite the growing attention, a comprehensive synthesis on the state of empirical evidence on women's engagement in governing SSF remains a critical gap in scholarship. To address this gap, we employed the systematic scoping review method to assess peer-reviewed literature. We identified, characterized, and synthesized 54 empirical cases at the intersection of gender and SSF governance. Our review findings showed that women in SSF engage with a broad spectrum of institutions, including formal rules, participatory arrangements such as co-management, and informal institutions. We also synthesized a typology of governance tasks performed by women. These tasks included leadership roles and active participation in decision-making; relational networking and collective action; exercising agency and legitimacy; resource monitoring; knowledge sharing; meeting attendance (with no or less participation in decision-making); and activism and mass mobilization. The review also highlighted broader implications towards improving women's voice and agency.

Our findings will be of interest to the scholarly community, practitioners, and policymakers alike as they have the potential to inform future research agendas, policy dialogues, and targeted interventions. From an applied perspective in particular, the findings can guide the entry points to meaningfully engage women in SSF governance; address the issues of gendered power relations; and improve governance outcomes for women themselves, their families, and communities. Such insights are also relevant in the context of blue justice narratives, as women have historically been marginalized, overlooked, and under-represented in fisheries and other ocean sectors.

## WOMEN LEADER IN FISHERIES AND AQUACULTURE GROUP IN THAILAND

Jariya Sornkliang<sup>1\*</sup>, Malasri Khumsri<sup>2</sup>, Wanna Thawinwan<sup>2</sup>, Tamolwan Raweng<sup>2</sup>, Suphalak Ruaylap<sup>2</sup>, Narakorn Somwanthana<sup>2</sup>, Ratana Tiaye<sup>1</sup> and Krit Phusirimongko<sup>1</sup>

<sup>1</sup>Southeast Asian Fisheries Development Center

<sup>2</sup>Department of Fisheries, Thailand

\*[jariya@seafdec.org](mailto:jariya@seafdec.org)

Women's roles in the fisheries value chain include gear maintenance, sorting, processing, gleaning, and marketing. However, because it is rare for women to go fishing in the sea that made women fail to recognize themselves as fishers; therefore, there is a lack of participation of women in fisheries management, especially in the decision-making process. Looking through the gender lens, women and men have the same ability to do everything, and women can be leaders for all kinds of institutions. In Thailand, fisheries management groups are composed of women who are group leaders. The study on women leaders in fisheries and aquaculture aimed at understanding the roles and background of women leaders in successful in fisheries management groups in the country. The study was conducted in 2020–2021 through the focus group discussion with the officers and members of the fisheries management groups, namely: Sub Somboon Aquatic Animal Food Bank for inland fisheries and Kayoed Small scale Fisher's Group for coastal fishing.

Sub Somboon Aquatic Animal Food Bank in Buri Ram Province was initiated in 2017 with support from the Department of Fisheries, Thailand (DOF). The group committee is composed of 14 people (6 women and 8 men) and 65 members. The leader of the group is a woman who is also the head of the village, and she has a bachelor's degree. The Aquatic Animal Food Bank is the big pond in the village; therefore, group activities are fishing and fish hatchery for the food security of the community. The income is from fishing by villagers who want to fish must pay the fee, and it is spent on hatcheries and shared with members at the end of every year.

Kaoyod small-scale fisher group in Rayong Province was established in 2014 for resource enhancement through crab bank. The group committee is composed of 15 people (4 women and 11 men) and 62 members. The group leader is the daughter of the previous group leader. When her father was the leader of the group, she assisted him in many activities especially when the group members started saving money. Since then, the group members had known her ability and requested her to be the group leader even though she is not a fisher. Under her leadership, Kaoyod small-scale fisher group has become a popular tourist spot, and the marketplace where women sell their fish and fishery products has improved.

This study showed that women could be good leaders of the fishers group. Both fishers' groups are continuing the activities under the leadership of women. The key to the success of both group management was high-level participation of women and having a strong group leader. However, women were accepted to be the leaders in the fishers' groups in Thailand because of their high education and family background. Both women

leaders intend to develop and support their respective groups in the long-term for sustainable utilization of fishery resources as well as inspire and empower other women to be involved in the fisheries management groups. The dissemination of information on the capabilities of women based on their knowledge and experiences is crucial to encourage more women to participate in the decision-making process.



**A JOURNEY TO GET A SEAT IN THE BLUE SWIMMING CRAB FISHERY  
MANAGEMENT: A CASE STUDY IN LAMPUNG, INDONESIA**

**Ria Fitriana<sup>1\*</sup>, Onesya Damayanti<sup>2</sup>, Rizani Ahmad<sup>3</sup>**

<sup>1</sup>Independent Consultant based in Jakarta-Indonesia & Research Fellow at CSTFA, James Cook University

<sup>2</sup>Environmental Defence Fund, Lampung-Indonesia

<sup>3</sup>Mitra Bentala, Lampung-Indonesia

*\*rfitriana@gmail.com*

Despite an emerging recognition of fisherwomen in fishery sector, the participation of fisher women at the management level in fishery governance is still a concern. Based on the gender study conducted in the early 2021, women involve in all activities along the value chain of blue swimming crab (BSC) except at the capturing stage. This situation brought women less considered in the blue swimming crab fishery management. Attention is often given to production stage where women are invisible. The nature of female's work as an extension of domestic task makes it problematic to highlight the roles of women in the production and governance stage. There needs initial initiatives to boost the fisherwomen contribution to better participate in the BSC fishery discussion, supporting sustainable fisheries management and improving community's resilience. This case study illustrates not only to enhance the capacity of fisherwomen but also the enabling condition and improving wider key stakeholder's capacity in terms of gender equality to enable fisherwomen to be able to participate in the management.

## **ENVIRONMENTAL RACISM AND STRUGGLE OF THE FISHING COOPERATIVE "MUJERES PECADORAS DEL MANGLAR" FOR COMMUNITY DEFENSE**

**Nuria Jiménez García**

Universidad Autonoma Metropolitana-UAM, Mexico

*nuriajgarcía79@gmail.com*

This presentation is based on my postdoctoral research (2018-20), on rural women, fishing activities, tourism, and coastal resources in Oaxaca, Mexico. I intend to analyze the strategies carried out by women fishermen and gatherers in the struggle to visualize the importance of their work in the fishing activity, and in the rescue and care of the coastal-maritime ecosystem in which they live and on which their subsistence and survival depend of their families. I am interested in identifying the difficulties, barriers and violence (family, community and institutional) that these women have suffered by transgressing a space and a productive activity, considered socially as a "monopoly" of men.

Many of the women I worked with have been involved in fishing since childhood, in activities related to fishing and shellfish harvesting. These women usually have to alternate between various economic activities and diversify their work areas since, in recent years, the situation of coastal spaces has changed on multiple levels (social, economic and family). These transformations have been the result of various factors, including tourism development, the dispossession of many of the natural resources by the State and by national and international companies, and the contamination of the lagoon's waters. There have also been changes and consequences that have occurred through natural processes within the coastal lagoon and mangrove systems (hurricanes, earthquakes, droughts).

I start from feminist political ecology to analyze the access, use and management of coastal and fishing resources by women. This theoretical perspective sees gender as a critical variable that shapes resource access and control by interacting with class, caste, race, culture, and ethnicity to shape processes of ecological change, to the struggle of men and women to sustain ecologically viable forms of subsistence and to the expectations that any community has of "sustainable development".

In this presentation I present the route, obstacles, difficulties, joys and satisfactions that the fisherwomen who make up the Mangrove Women Fishermen's Cooperative have been experiencing. The cooperative was not formed with the explicit objective of fighting and conserving the environment, but rather, out of an economic need to formalize its productive fishing activity. However, they have been adopting and developing practices with a sustainable approach to protecting and defending the environmental resources of their community, which has also materialized in an environmentalist discourse.

**FACTORS THAT CONTRIBUTE TO SUSTAINABLE COMMUNITY  
ORGANIZATIONS: GENDER ANALYSIS IN RAYONG PROVINCE, THAILAND**

**Malasri Khumsri\* and Kyoko Kusakabe<sup>1</sup>**

Department of Fisheries, Thailand

<sup>1</sup>Asian Institute of Technology, Thailand

*\*malasrikhumsri@gmail.com*

In order to manage fisheries resources sustainably, the Thai government is encouraging fishers to form groups and register. With registration, the groups are able to receive support from the government. There have been differences in performance of these local fisheries groups. Some have developed strong cohesion and governance, while others have stopped functioning when the external support stopped. This presentation explores the factors that contribute to strong groups by comparing three communities in Rayong Province, Thailand. These are artisanal fisheries communities, and all are small-scale fishers. Literature point out that factors that ensure strong community groups are leadership and committee, as well as external support. We argue that although these are important, how much the groups are inclusive to women and their roles in fisheries also make a difference. Women's activities allow consistent activities on shore that creates cohesion for the group and visibility in the group activities. The continued presence of women in the group's office makes it difficult to ignore women's voices even when women are not officially a leader. The rules of no-drinking creates a secure space for women fishers to participate in the group activities.

## **WOMEN AS AGENTS OF CHANGE IN TURNING DISASTER INTO A BLESSING WITH A CASE STUDY OF THE STRATEGIC PROJECT OF THE STEAM POWER PLANT IN BATANG REGENCY**

**Arisanti Ayu Wardhani\* and Indah Susilowati<sup>1</sup>**

Student, Master of Economics, Faculty of Economics and Business, Diponegoro University,  
Semarang, Indonesia

<sup>1</sup>Faculty of Economics and Business, Diponegoro University, Semarang, Indonesia

*\*arisantiayu98@gmail.com*

To meet the ever-increasing demand for electricity supply, the Indonesian government launched a national strategic program for constructing steam power plants in Batang Regency. However, in implementing strategic programs, the community has many issues. The women generally can quickly adapt and see opportunities from existing problems so that they can provide new perspectives on social disasters that exist in society.

This research was conducted in Batang Regency, Central Java Province, Indonesia. This study aims to see the role of women in changing the negative perception of the establishment power plant development into a blessing for the community. The approach used in this research is the Photo voice and mix method with quantitative analysis using descriptive statistics and qualitative descriptive analysis assisted by Atlas Ti. Data were obtained through in-depth interviews with respondents. Namely, women were selected using snowballing sampling. The study results show that women have a significant role in providing a positive perspective on constructing steam power plants. Although women only work in the informal sector, women can provide a new picture of the current power plant development program has many benefits for the surrounding community. Women can create new economic activities that can revive their family's economy by opening various businesses such as making shrimp paste business units, restaurants, laundry services, catering, and many more.

## **NETWORK, EXPLOITATION, AND RESISTANCE: THE EXPERIENCE OF CAMBODIAN MIGRANTS IN FISHERIES IN THAILAND**

**Sokha Eng\***

Asian Institute of Technology, Pathum Thani, 12120 Thailand

*Sokha.Eng001@umb.edu*

Over the past two decades, more than 1 million Cambodians have migrated to Thailand for employment opportunities. The scholarship on migrants working in Thailand suggests that Cambodian migrants (both documented and undocumented) are not protected from labour exploitation and other forms of abuse. These forms of exploitation may include low pay with long working hours, illegal deduction of earnings, control of mobility, and withholding of passports (in the case of documented migrants). However, we know little about how Cambodian migrants themselves understand and resist exploitation. By using ethnographic methods, my research aims to examine how Cambodian migrants experience, understand and resist labour exploitation, and how migrant networks may shape migrant's understanding and facilitate or impede resistance; I also plan to investigate how these experiences and resistance strategies vary by gender. The study site is Rayong Province, Thailand, where many Cambodian migrants are employed in the fishery industry. I conduct fieldwork for 5-7 months, using participant observation and in-depth, semi-structured interviews. The findings from this study will contribute to the larger field of South-to-South migration studies and inform policies that can assist Cambodian migrants in improving their wellbeing in Thailand.

**OUTCOMES FROM COMMUNITY-BASED TRAINING AND MOTIVATION PROGRAM FOR FISHER'S FAMILY UNDER KISHOREGONJ HAOR AREA IN BANGLADESH**

**Mohammad Nuruzzaman<sup>1\*</sup>, Mahfuza Begum<sup>2</sup>, Fanindranath Sarker<sup>2</sup> and A K M Nowsad Alam<sup>3</sup>**

<sup>1\*</sup>Program Specialist (Fisheries), Krishi Gobeshona Foundation (KGF)

<sup>2</sup>Department of Fisheries (DOF)

<sup>3</sup>Bangladesh Agricultural University

\**nuruzzaman07@gmail.com*

Direct involvement of women in fishing is not commonly visible among the fisher's society in Bangladesh. Women and girls are often found helping post-harvest handling, sorting, processing, and participate in ancillary works including net making, net mending and repair and maintenance of fishing traps and gears. These types of petty works usually not counted for income earning for the fisher households except catching fish for sale. This is the tragedy of fisher's community across the *haor* areas where fishing is only possible for about 3-5 months in a year when there is water. Much of the *haor* land recedes water from October to May until next rainy season to inundate the low land and start fishing again.

Aiming to create some additional employment and income for the fisher's family, community-based and participatory research on post-harvest loss reduction has been done over the last four years in different villages close to fish landing centers at Kishoregonj *haor* areas. Out of a total 39 Fishers and Fish Traders groups formed, four Fishers Family Groups were organized comprising 93 members including wives and girls to train them on alternative income generation from fish.

This paper presents the outcomes of community-based training and motivation activities of two fishers' villages under Karimgonj, Kishoregonj district where the group members were trained and facilitated to develop value-added ready-to-eat fish items saleable as street food. Research on fish processing, maintaining nutrient quality and shelf-life, use of spice and condiments for test has been provided by Fish Processing Lab under Fisheries Technology department, Bangladesh Agricultural University (BAU) while filed support for group formation, training and motivation activities were provided by a local NGO. Krishi Gobeshona Foundation (KGF) funded the research project on post-harvest fish loss reduction under BAU supervision and taking support from local NGO.

## **STRENGTHENING AGENCIES AND VOICE OF WOMEN WITH DISABILITIES FOR PROMOTING INCLUSION AND DIVERSITY**

**Rakhi Barua\***

\*Expert, IRD, CIRDAP and Senior Coordinator, Centre for Disability in Development (CDD), Bangladesh, A, 18/6, Genda, Savar, Dhaka, Bangladesh.  
*rakhibarua2022@gmail.com*

Women and girls with disabilities in Bangladesh are discriminated against due to gender and disability status. They have a limited capacity to address persistent attitudinal, institutional, and environmental barriers than males with disabilities. Negative impacts on Women with disabilities aggravate further due to the consequences of inequality and discrimination because of intersectionality in its varied forms. Globally, with a few exceptions, every gender and development indicator for which data is available shows that rural women fare worse than rural men and urban women & disproportionately experience poverty, exclusion, and the effects of climate change. The recent COVID-19 pandemic exponentially intensified all these barriers and challenges for women with disabilities.

Overcoming the impact of the COVID-19 pandemic depends on the health, well-being and resilience of rural women and girls, who have been disproportionately affected by the pandemic poverty, exclusion, and the effects of climate change. According to SDG Progress report 2021 by ESCAP- the Asia –Pacific Region may achieve less than 10% of the SDG targets by 2023. That's why it is important to strengthen collectives or agencies for Women with disabilities.

To strengthen agencies of Women with Disabilities, it is essential to facilitate the formation of Self-Help Group, an Organization of women with disabilities and strengthen their organizational capacity to amplify their voices in the local development process. We need to build the capacity of Women with Disabilities in financial literacy, business skills, entrepreneurship & other tailored made programmes. Education on Nutrition and Foods to cultivate and information on good food and source of easily available nutrition in rural areas are needed for women with disabilities.

Men Care approach for shared Care: We need to create awareness of shared care and educate the community on more shared responsibilities between male and female members for Care Work so that women can participate more in activities outside the home. Representation of Rural Women with disabilities is required in local Government Institutes at Sub-Urban level as local leaders. Their political participation needs to be enhanced by connecting them to the broader women's movement and local governance mechanisms.

Administering Social Accountability Tools: Introducing social accountability tools to create linkages and citizen engagement to improve responsiveness and service delivery. Strengthening agencies and voices of women with disabilities to increase their advocacy and lobbying capacity for empowerment is required to improve health, well-being, and resilience. As a result, more gender equality, dignity, and human rights would promote diversity and inclusion in line with Sustainable Development Agenda 2020.

## FISHERWOMEN IN KERALA STATE OF INDIA: AN EXTENSION PERSPECTIVE

**Sajesh.V.K\*, Pe.Jeyya Jeyanthi and Rejula.K**

ICAR-Central Institute of Fisheries Technology, Kochi, Kerala, India

*\*sajeshvk@gmail.com*

Globally, women participation in fisheries ranged between 5 to 73% of the total capture fisheries labour force. Role of women in fisheries is increasingly being recognised by policymakers and various strategies have been formulated to enhance their well-being. Extension has important role in supporting fishers and other rural producers to improve their livelihoods and well-being by enhancing their technical, organisational, and management skills. Need for gender inclusive extension strategies were widely debated in recent years to optimise the contribution of women in agriculture and allied sectors.

Women and children constitute around 60 % of fisher folk population in Kerala. Women contribute to the major workforce in post-harvest fisheries sector. Access to extension by fisherwomen in Kerala is facilitated by public and civil society segments in pluralistic fisheries extension system. The State Department of Fisheries and associated agencies like MATSYAFED (Kerala state cooperative federation for fisheries development Ltd), Society for Assistance to Fisherwomen (SAF) and Kerala Coastal Area Development Corporation (KSCADC) are the major actors in the fisheries extension system of Kerala. These agencies are supporting women fisher folk through microfinance, provision of interest free loans and entrepreneurship development. Involvement of private sector with respect to development of fisherwomen was found to be very limited. Non-Governmental Organizations in fisheries sector of Kerala are mainly dealing with livelihood development activities, participatory development, policy advocacy, conservation, and sustainability. Extension system, to be inclusive, should assume newer roles in addition to the traditional extension and advisory roles. An assessment of the role performance of extension personnel pointed out that, their performance with respect to new extension roles was yet to be improved.

The paper focuses on the institutional mechanism for provision of extension service to women fisher folk of Kerala and further strategies required to enhance the livelihood security of fisherwomen.

## SEAWEED HARVESTERS IN THE GULF OF MANNAR AND PALK BAY: A TALE OF WOE

**M.S Ahila\*, Neha W. Qureshi, Ananthan P.S, Jhonson B<sup>1</sup> and Shivaji Argade**

ICAR-Central Institute of Fisheries Education, Mumbai, Maharashtra, India

<sup>1</sup> ICAR-Central Marine Fisheries Research Institute, Mandapam Regional Centre, Mandapam Camp, Tamil Nadu, India

*\*msahila81@gmail.com*

Coastal communities in the Gulf of Mannar and Palk Bay depend on fishing and related activities for their livelihood. These regions have flourishing seaweed growth and produce a massive chunk of India's seaweed, both wild and cultured. Wild harvested seaweed contributes 78% of the total seaweed production. The inhabitants, primarily women, collect these natural stocks for sustenance, and their work participation in three villages of Gulf of Mannar (Seeniappa Dharga, Vedalai, Chinnapalam) and three villages of Palk Bay (Soliyakudi, Sambai, Mangadu) was documented. The photo essay depicts the everyday narratives of lives, experiences and challenges in wild seaweed harvesting. It also carves out stories on the social and cultural interactions among people, different sources of income, and their living standards. The harvesters use minimal protective equipment and are prone to occupational hazards such as injuries and threats from sea creatures. These underpaid and marginalised women harvesters put their lives in peril for a pittance even though seaweed-derived products command high prices on the market. They contribute substantially, as primary producers, to the seaweed-phycolloid (agar and alginate) value chain yet go unseen and unsung.

## **MUD CRAB FISHERY IN PAPUA NEW GUINEA**

**Rita Daka Goiye**

Marine Officer, Conservation Environment Protection Authority, Papua New Guinea  
*rgoiye@gmail.com*

The Biotou Mud Crab project was the first to be implemented in Papua New Guinea. The project is focusing mainly on women in the coastal communities including the leprosy affected individuals. The Leprosy Mission PNG through the Old Dart Foundation has seen the need and funded this project as a way forward to improve the livelihood of the leprosy affected individuals and the communities as a whole.

In the past mud crabs were regarded as a subsistence fishery for household consumption only. The mud crab trading commenced around 2002 when the commercial value of the mud crab picked up globally which result in the over harvesting of mud crabs in the coastal communities of Papua New Guinea. Due to the over harvesting of this fishery, the National Fisheries Authority realised the declined of mud crab's population in the wild and conducted a scientific research study around the country to support their hypothesis.

Having considered all the resource management options, there were two options chosen; seasonal or yearly closure and farming (mariculture). The Leprosy Mission PNG took the initiative to assist the local coastal communities by funding this project. This project is located in the Central Province in the National Capital District, Papua New Guinea.

A week long training workshop was conducted targeting 50 plus individuals from the nearby coastal communities. The trainings include; pen constructions, stocking and fattening facilities, feeding, weighing and measuring, general management of pens and fattening baskets, processing, storage and quality control, packaging and transportation to marketing and distribution.

The pen stocks are constructed with the available resources mostly mangrove sticks, bamboos and bush ropes. The pens are constructed next to the mangrove habitat to maintain the same salinity levels. Each woman in the community has to construct a grow out pen with the assistance from their husband and families to supply the main basket which is the fattening facility. Apart from the grow out pens and fattening facility, 15% of the mud crab babies in the hatcheries are release to the wild for restocking to maintain the sustainability of this fishery.

The mud crab species farmed in the grow out pens are *scylla serrata*, *scylla tranquebarica*, *scylla olivacea* and *scylla paramamosain*. The Mud crab fishery is seen as another lucrative market to generate income for the coastal communities to ease the fishing pressure and over harvesting of marine resources. The project is planning to replicate to neighbouring coastal communities but could not do so due to lack of funding.

## COMMUNITY AQUACULTURE FOR ORNAMENTAL SHRIMPS: AN ALTERNATE LIVELIHOOD OPTION FOR THE WOMEN AT LAKSHADWEEP

Rekha, M. U., T. T. Ajith Kumar\* and Kuldeep K. Lal

ICAR - National Bureau of Fish Genetic Resources

Lucknow - 226 002, Uttar Pradesh

\*ttajith87@gmail.com

The livelihood activity of Lakshadweep islanders is mainly live-bait-based tuna fishing and men are involved in this activity. Women in this region are engaged in small-scale activities like tuna pickling, making of coconut oil, snacks preparation and cowry collection; getting marginal income. In order to uplift women's income with the utilization of native resources, ICAR-NBFGR introduced a concept, community aquaculture of marine ornamental shrimps. The ICAR-NBFGR has standardized the breeding and seed production technology for two high value ornamental shrimps, *Thor hainanensis* and *Ancyllocaris brevicarpalis*, which are having good demand in domestic and international markets. Local women islanders were given hands-on learning about ornamental shrimp rearing, followed, juvenile shrimps were supplied for further rearing in community aquaculture units. Such units were built in a cost-effective way, using local indigenous materials available in the island. A total of 62 women beneficiaries were trained and currently, 54 women are involved in this activity in five community aquaculture units. An agreement was signed with the trader for the sale of ornamental shrimps reared by the women beneficiaries. The income of women is raised with Rs. 3000 - 4000/- for one to one and half months. Scope for the innovative model developed for the women islander's welfare along with associated issues is addressed.

## ROLE OF FISHERIES COOPERATIVES IN FISHERWOMEN EMPOWERMENT

**Neethu Mol Jacob\*, Vijaykiran V and A. Suresh**

ICAR-Central Institute of Fisheries Technology, Cochin, Kerala, India

*\*neethumoljacob@hotmail.com*

Capture fisheries and aquaculture employ 54.8 million people worldwide, 48 million of whom are located in Asian nations. In the world's fisheries, women make up nearly half of the workforce. Despite the fact that they are frequently centered on upstream and downstream activities, they play a wide range of roles in the industry. Aquaculture sector expansion, particularly in Asia, and significant changes with significant gender implications merit special attention. In recent years, women's significant contributions to the fisheries sector and the variety of roles played by them have become increasingly well-known throughout the world. The fisheries sector requires collaborative action to protect shared interests in the marketplace, protect rights, or even just catch fish. However, this stands in stark contrast to the low representation of women in fisherfolk groups around the world, as well as their lack of access to leadership positions in many professional fishing-related organizations. The indigenous women in rural areas should be given the same access to ownership, possession, and control over land, water, forests, fisheries, and other resources as indigenous males, including by defending them against discrimination and dispossession. In this context, the study was conducted to evaluate the potential of women's fishing cooperatives to empower women fishers. Secondary sources of information were utilized for the study. The study revealed that in Kerala, Matsyafed (Kerala State Co-operative Federation for Fisheries Development Ltd.) and SAF (Society for Assistance to Fisherwomen) had taken various initiatives such as microcredit, SHG (Self Help Groups), entrepreneurship and management development programmes; training in advanced technologies for skill up gradation; workshops; seminars; theeramythri programme; theeramythri sea food restaurant; JLG (Joint Liability Group) project; Ashtamudi Project Phase II; refrigerator mobile fish vending kiosks; and the 3-R pilot project for ensuring women empowerment, livelihood and social security among the fisher folk of Kerala. Although fisheries cooperatives offer numerous prospects for the empowerment of fisher women, the majority of them are not taking advantage of them despite their proportion in the sector. While recognizing the distinctions between women and men and adopting particular steps to hasten equality when appropriate, gender equality ensures that both men and women have the same right to enjoy all human rights. The state should ensure that men and women have equal access to land, fisheries, and forests, regardless of marital or civil status.

## WOMEN, YOUTH AND RURAL DEVELOPMENT PROGRAMME OF CIRDAP

**Usharani Boruah\***

Librarian & Gender Coordinator

The Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP)

Chameli House, 17, Topkhana Road, Dhaka 1000

*\*usharani@cirdap.org;*

Gender equality and youth empowerment is essential to rural development in the Asia-Pacific region, and it contributes to the achievements of the Sustainable Development Goals 1, 2, 5 and 8. The region is home to 55% of the world's young people. Studies show that youth continue to face challenges, from the inequitable provisions of services and employment opportunities to social and political exclusion, and persistent gaps in gender equality.

Youth employment is a complex socioeconomic challenge which is affected by economic, social, and cultural dimensions and their interconnected dynamics. Understanding the complexities can help shift the emphasis of the policies, programs, and investments that are needed. Fostering job opportunities for rural youth becomes as important as increasing employability. Due to the consistent rural-urban migration of young people, rural areas are losing their young, productive workforce. There is a critical need to provide appropriate education, training, and job opportunities for rural youth so that they can stay, work, and prosper in rural areas.

Agriculture is a key sector associated with rural youth employment in many developing countries, particularly in the Asia-Pacific region. Agriculture supports national economies by providing employment, food security, and social stability, particularly for small-scale farmers, women, and vulnerable groups who do not have access to formal occupational employment or social benefits. In many countries, the current situation of rural youth is characterized by illiteracy, a lack of educational and training opportunities, and unemployment, which leads to mass migration.

Women account for nearly half of agricultural employment in the developing world. Despite significant progress toward gender equality, there are still significant gaps and challenges that must be addressed. Youth development and gender equality have been identified as key strategies for achieving sustainable integrated rural development in the region by the Center on Integrated Rural Development for Asia and the Pacific (CIRDAP). Empowering women clearly empowers and benefits men, and gender equality has been identified as a key to agricultural productivity, food and nutrition security, and long-term rural development in the region.

Rural areas are losing the young productive workforce, due to consistent rural urban migration of young people. There is an urgent need to provide appropriate education, training, and job opportunities that give rural youth the choice of staying, working, and prospering in rural areas.

The mission of CIRDAP is to provide technical assistance and promote innovative best practices in sustainable integrated rural development (IRD) among Asia-Pacific member countries to improve the lives of rural people. CIRDAP recognizes that persistent gender disparities are a major impediment to rural development. Gender integration among relevant agencies, stakeholders, and governments in the region must be strengthened so that gender equality and youth employment are reflected in national and regional development programs.







**Session 2:  
Women's work in aquaculture and fisheries: Human rights,  
labour rights, occupational safety and health, exploitation,  
conflict**





## **GENDER ROLES IN SECONDARY MARINE FISHERIES SECTOR OF MALPE HARBOR, UDUPI DISTRICT, KARNATAKA, INDIA**

**Amrutha Prakash\* and Swathi Lekshmi P.S.**

ICAR, Central Marine Fisheries Research Institute, Vizhinjam Regional Centre,  
Thiruvananthapuram, India

*\*amruthajayasree1995@gmail.com*

Gender concerns in the fishery sector can only be identified and documented by looking at the various gender stereotypes and identifying various gender roles in the fishery sector. The importance and contribution of women in the fishery sector and their dual role in production and reproduction offers a huge demand to document and analyse gender roles in the fishery sector. In the fisheries sector, women constitute almost half of the work force and have active roles especially in the post-harvest operations. Both men and women contribute significantly to overall growth and development of fisheries sector where they perform different activities or roles especially at various stages of capture fisheries. The secondary sector stakeholders form a major work force in marine fisheries which involves all gamut of activities once the fish has landed. These stakeholders are mainly women and are exclusively involved in post-harvest activities or fishery allied activities like fish marketing, net making/repairing, processing, peeling, labour and other related activities.

The present study was conducted at Malpe Fisheries harbor which is one of the major fishing harbors situated in Udupi district of Coastal Karnataka where fishing is a major occupation and has the second largest fisher population after Dakshina Kannada. This study was undertaken to document the socioeconomic profile, gender roles and participation of fisher folks engaged exclusively in secondary marine fisheries sector of Malpe. The study assessed the level of gender participation in the secondary marine fisheries sector of Malpe harbor. Specifically, it determined the roles of men and women in the different post-harvest activities and described the fisher folk's socioeconomic profile. Primary data was collected by a field survey covering 60 respondents using simple random sampling. Personal interviews were conducted with the aid of a well-structured pre-tested interview schedule related to their socio-personal, psychological and socio-economic characteristics. Socio-economic profiling was carried out to assess their living conditions, specific roles, responsibilities, access to control over resources and various constraints faced by both men and women. The results indicate that women are able to augment their income leading to economic empowerment. The role and participation of women in the secondary fisheries sector of Malpe has proven their contribution to the economy of the State by their myriad activities, once the fish has landed in the harbour to the various nodes in the demand supply and value chain. The socio-economic participation of women labourers has evinced to improve the basic educational requirements of their children to a great extent. Women have specific and significant roles in the post-harvest operative sector than the males but are facing various constraints in the workplace based on gender discrimination, resource use, marketing, infrastructure, access to resources as well as information. While gender approaches go beyond the study of women, there is an overall lack of data on the role of women in the secondary sector due to insufficient baseline data.

## WOMEN IN SMALL-SCALE MARINE FISHERIES IN CAMBODIA

Leakhena Chin<sup>\*</sup>, Tsutom Miyata<sup>1</sup>, Hiroshi Saito<sup>2</sup>, Satoshi Ishikawa<sup>2</sup>

Department of Administrative Affairs and Litigation, Fisheries Administration, Ministry of Agriculture, Forestry and Fisheries, Cambodia

<sup>1</sup> Japan International Research Center for Agricultural Science, 1-1-1 Oiwake, Tsukuba, Ibaraki, Japan

<sup>2</sup> Graduate School of Earth and Environmental Science, Tokai University, 3-20-1 Orido, Shimizu-ku, Shizuoka, Shizuoka 424-8610, Japan

*\*leakhenachin85@gmail.com*

Marine fisheries of Cambodia are significant sources of employments in the country, contributing to the livelihoods of the coastal people, as well as contributing to Cambodia's food security for many years. Traditionally, women in the coastal fishing village play a crucial role in fishing and fishing related activities. However, women's involvement in fishery sector is neglected in the research, report, and record, making it impossible to develop policies that address their needs. The collection of accurate and rational data on current fishing practices of women in the marine small-scale fisheries of Cambodia is essential for the establishment of a reliable management system and for setting rational regulations. Our presentation will focus on small-scale fishing and fishing-related activities performed by women, in term of fishing, distributing, trading, and processing fishery products according to the results of latest survey.

Household interview, focus group discussion and key informant interview were used to collect data and information from 290 out of 880 household fishers in the six coastal villages of the three provinces, Trapeang Ropov and Trapeang Sangkae of Kampot, Angkaol and Ou Krasar of Kep, and Preaek Pras and Chrolong villages of Preah Sihanouk. Data collection was conducted from 2019 to 2021. The sample size selection was followed the formula of Miyata, 2018. The SPSS, R software program, and Microsoft Excel were used to analyse the collected data.

A total of 12 of 22 types of fishing gears and methods are used by fisherwomen in the six villages operated within four fishing areas to target 32 marine species. The fishing is conducted by one women operator in the mangroves and on the tidal areas. In contrast, women work together with their husbands to fish along the channel and on the ground up to 10 km from the coast. Women in Chrolong village harvest swimming crabs with their husbands at grounds beyond 10 km from the village. Whether or not they fish, women in both groups are responsible for selling the catch at village markets and along the road, to intermediaries, retailers, processors, and end consumers. Women are usually the intermediaries and retailers play a key role to distribute and transport fishery products to other destinations inside the country and cross-borders. Those women who do not fish, either independently or with their husbands, work at the fishery processing plants in addition to taking care of family members, especially children and the elderly. Products processed include dried shrimp, pilled crab meat, and steamed short mackerel. Even though

women have a limited participation in fishing in far offshore waters, their multiple roles on land contribute significantly to increasing not only the economic aspect of fishing, but also maintaining the welfare of household members, which is invaluable to the development of the fishing community and the country as a whole.



## DECENT WORK AND THRIVING BUSINESSES FOR WOMEN WORKING IN FISHERIES: A COOPERATIVE ACTION PLAN

**Arlene Nietes Satapornvanit\*<sup>1,2</sup>, Meryl J. Williams<sup>1,3</sup> and Nikita Gopal<sup>1,4</sup>**

<sup>1</sup>Gender in Aquaculture and Fisheries Section of the Asian Fisheries Society; <sup>2</sup>Bangkok, Thailand; <sup>3</sup>Penang, Malaysia; <sup>4</sup>ICAR--Central Institute of Fisheries Technology, Cochin, India.

*\*arlenens@gmail.com*

Although women's labor in fisheries is economically and socially important, it receives little attention in fisheries policies and support programs. As fisheries undergo rapid changes over the years, women's labor issues remain under-prioritized and under-investigated. Most studies on women's labor in fisheries describe the gender-based divisions of labor that exist for women and men across different value chains, with a few in-depth studies look at the status of women working in seafood processing industries, and even fewer on women as traders and business entrepreneurs. This leads to excluding women in formal fisheries statistics, from being considered in key topics and decision-making, such as forced labor at sea, illegal, unreported, and unregulated fishing, sustainable fisheries management, and, most troublingly, relief efforts such as during disasters or pandemic, i.e., COVID-19. Women's total labor contributions include not only their productive labor in the workforce and as business entrepreneurs, but also their reproductive and care labor in households, communities, society, and for the environment. Much of women's labor is still to be revealed and quantified, and the means found for empowering women to secure decent work and thriving businesses.

Thus, in 2021-2022, a number of organizations and experts led by USAID Sustainable Fish Asia Local Capacity Development Activity in collaboration with Gender in Aquaculture and Fisheries Section of the Asian Fisheries Society, came together to develop a Cooperative Action Plan to provide a roadmap to the fisheries sector. This roadmap is necessary if the sector is to advance towards meeting key gender-related Sustainable Development Goals by 2030 in the Asia-Pacific region, to aid recovery from the COVID-19 pandemic, and to comply with global instruments on gender equality, decent work, and fair labor. The goal of the roadmap is to contribute to greater regional understanding across stakeholder groups of key labor challenges for women in fisheries and to support regional advancements for gender and just, equitable, and inclusive labor conditions in Asia-Pacific.

Acknowledging that women are not a homogeneous group, the Plan has taken an intersectional approach because the types of labor women do are varied, as are the women and their needs. The Plan recognizes this by differentiating broad groups of people with different needs for action (Clusters A and B) and more generic needs relevant to all groups (Cluster C). For Domains of Labor (Cluster A), we divide the women's domains of fisheries labor according to where the work is done, based on the types of fisheries value chains (small-scale, industrial) or work environments (professional office or company or home and community). Groups Frequently Overlooked: Youth, Elderly, and Indigenous (Cluster B) receive special attention as groups whose needs may not be fully met by the actions for the majority in each main group. For other categories of women such as self-employed,

entrepreneurs, and migrants, their needs are woven into actions under the various labor domains.

This Plan is intended for various audiences working across the fisheries sector. We have identified partner agencies and groups that have the potential to adopt and further develop the recommended actions. Many of the actions being recommended will require detailed design and practical application to be implemented effectively in different places and context.



## **GENDER SEGREGATED INVOLVEMENT, SOCIO-DEMOGRAPHIC PROFILE AND FOOD SAFETY RELATED GENDER NORMS IN FISH DRYING IN BANGLADESH**

**A. K. M. Nowsad Alam\* and Al Shahriar**

Department of Fisheries Technology, Bangladesh Agricultural University, Mymensingh 2202.

*\*nowsad12@yahoo.com*

A study was conducted to explore gender segregated involvement of stakeholders in fish drying throughout Bangladesh. Food safety related gender norms along with some other gender parameters were also studied in Cox's Bazar district where highest number of women were involved in fish drying. Data for gender segregated participations of actors in 20 fish drying districts were collected through government extension personnel by check-list interview and then cross-checked by sampled field visits and key informant interviews. General gender parameters and food safety related gender norms were explored in the drying yards of Cox's Bazar district by sample survey with face-to-face interview and focus group discussion. Out of 2258 fish drying yards in 20 districts, 273 (12.1%) were owned by women. Total workers involved in the drying yards were 73435, of which 23,425 (31.9%) were women. Women workers were highest in Cox's Bazar district (8017), followed by Netrokona (5260), Chattagram (4000), Bagerhat (1914) and Sunamganj (1406).

In Cox's Bazar, 200 women workers were interviewed face-to-face by a pre-tested questionnaire and found that about 91% of them were married and 62% were aged below 40 years. About 73% have gone upto elementary school and 17% were illiterate. Fish drying was for 5-6 months in year, and more than 97% women worked 9 hours per day during drying period. About 53% women had less than 5 years of experience in fish drying, while 41.2% had 6-10 years and the rest had above 10 years' experience. A 65% women did not receive any training on fish drying and 81% respondents said that women were excluded in fish drying and food safety and hygiene related training. Women were 30% less paid compared to man workers for similar type and duration of works. A 92% women workers informed that they hand over the daily wage to husbands or parents every day. About 38 % women could purchase small personal things from own income, but for that they need to take permission from parents and husbands. 58.5% married women workers never took decision on household expenditure, but 38.2% women took decision very often. About 85% women did not hear issues like 'dried fish quality and safety', and 'personal hygiene and occupational safety' before. A 53% respondents raised the low quality issue of raw material fish and illegal practice in fish drying to their supervisors, but the supervisors stopped them and advised to concentrate on own works only.

## **GAVIOTERAS, THE HIDDEN LINK IN THE FISHERIES VALUE CHAIN, YUCATAN, MEXICO**

**Carmen Pedroza-Gutiérrez**

Asian Institute of Technology (AIT), Visiting Faculty,  
Universidad Nacional Autónoma de México (UNAM), Senior Researcher  
*pedrozacarmen@yahoo.com*

Women play substantial role in fish economies around the world, particularly in the small-scale fisheries sector. However, most small-scale fisheries are immersed in an informal economic sector, and women are often at the lowest level of the value chain. The informal sector is the primary source of employment for women in most developing countries. But, because of the informal economic setting much of women's paid work is not counted in official statistics making women's paid work invisible for national economies.

In the fishing industry women play many roles all along the value chain of this economic sector such as fish processors, traders, fishers, and all of them contribute to food security and local economies. Despite their socioeconomic contributions, some of these activities are completely ignored and unaccounted in local economic data, and not even considered as a job, but rather as an extension of domestic work, and thus they are not assigned any economic value.

Considering this the aim of this work is to find out the working dynamics of *Gavioter*s (women seagulls) in the fishing sector and the importance of their activities for household survival. *Gavioter*s is the name given to women in Yucatan whose work is paid with fish. At the moment of landing, in exchange of some work or sometimes sex, the fishers paid them with one piece of his daily catch. Therefore, to achieve the objective of this research results were obtained through in-depth semi-structured interviews in two fishing communities in Yucatan, Celestun and Dzilam de Bravo.

Results indicate that these women pool a certain number of fish, then they try to sell it for the best possible price and use it in their household needs. However, *Gavioter*s activities have been changing according to fisheries dynamics, from the sea cucumber fishery, the number of women performing this activity increased, therefore, competitiveness among them started a race to get into the boat and have access to fish. Ever since, new ways to perform this activity, such as sex for fish, have been appearing. The importance of this source of income can be crucial to household survival. For some women it might be the main or only source of income, especially for those who are single mothers or widows, for some others it might be a way to complement their husband income. Moreover, *Gavioter*s can also be an alternative source of supply to some fish traders in times of scarcity.

## **INCLUSION, EQUITY AND WOMEN'S EMPOWERMENT TO TRANSFORM THE SEAWEED FARMING SECTOR IN ZANZIBAR AND BEYOND**

**Cecile Brugere<sup>1,2\*</sup>, Flower E. Msuya<sup>3,2</sup>, Narriman Jiddawi<sup>4,2</sup>, Tulika Bansal<sup>5</sup>**

<sup>1</sup> Soulfish Research & Consultancy, Stillingfleet, York, YO19 6SH, United Kingdom

<sup>2</sup> Sea PoWer, Zanzibar, United Republic of Tanzania

<sup>3</sup> Zanzibar Seaweed Cluster Initiative, Malindi Area, United Republic of Tanzania

<sup>4</sup> Zanzi marine and coastal solutions, Zanzibar, United Republic of Tanzania

<sup>5</sup> Danish Institute for Human Rights (DIHR), 1403 Copenhagen K, Denmark

\**cecilebrugere@gmail.com*

This paper uses the framework and concepts for humanizing aquaculture development presented at the FAO Global Conference on Aquaculture 2020 in Shanghai, China, to analyse the situation of women in the seaweed farming sector in Zanzibar, Tanzania, and identify strategies that could drive it to being more gender equitable. To ground our analysis and draw lessons for scaling out actions and support to women farming seaweed in the region and beyond, we use the experience of Sea PoWer, a project/organization promoting a small-scale seaweed farming innovation for women's empowerment.

Despite the very large participation of women (80% of seaweed producers in Zanzibar are women), and being economically important for the government and coastal communities living in Zanzibar, seaweed farming in the archipelago is unequitable: the sector is plagued by several sources of inequity and insufficient compliance with decent work standards. The sector's dependence on global value chains and market structures challenges further the governance of the sector and the conditions under which women producers could fully benefit and become empowered from seaweed farming.

Humanizing aquaculture development rests drivers of social change and strategies for shaping a new human relationship with aquaculture. We examine the extent to which these apply to, and could support, the transformation of the seaweed farming sector in Zanzibar towards a more just, inclusive, equitable and empowering industry. We find that a combination of some types of inclusive business models, tailored innovative governance procedures, social provisioning considerations and targeted capacity building could provide suitable entry points to move the sector in this direction. Embedding these actions within the principles of substantive equality and agency, intersectionality and integrated knowledge systems would further their reach and impact given the important gender dimension of the sector, and we suggest how.

With an increasing light being shone globally on the potential benefits of seaweeds to address challenges of plastic pollution, carbon sequestration, nutrition, and the calls for investments in technological innovations to farm seaweed at greater scales and national blue economy developments, it is critical that the voices, agency and interests of the women upon which the entire seaweed industry depends in Zanzibar are enhanced and adequately accounted for, and that their knowledge and practices are fully integrated in new developments. This analysis provides important lessons and pointers on how this could be achieved not only in the archipelago but in the Western Indian Ocean and beyond.

## GENDERED ANALYSIS OF TRAPA VALUE CHAIN IN WULAR LAKE, J&K, INDIA

Atufa Regu\*, Ananthan P.S, Shivaji D. Argade, Qureshi N.W

ICAR-Central Institute of Fisheries Education, Mumbai - 400 061, Maharashtra, India

\*atufaaliregu@gmail.com

All over the world, women contribute in multiple ways to the production, processing, marketing, and management of fish and other living aquatic resources. In recent years, the involvement of women in fisheries, especially pre-harvest and post-harvest activities, is being acknowledged. In Indian context, women's role is primarily recognized in the post-harvest handling and marketing sector. However, recent studies indicate women's involvement in harvesting including gleaning work, both in inland and marine fisheries. Also, it is not uncommon to find fisher women directly in fishing either independently or as equal partners in inland fisheries. Wular is the largest freshwater lake in India with an area of 13000 ha and a notified Ramsar site since 1990. Fed by Jhelum, a major tributary of the Indus basin, Wular Lake contributes about 54% to the total Lake fisheries production of Jammu and Kashmir and is crucial in maintaining the valley's water ecology. The present study was undertaken to quantify the contribution of both women and men fishers involved in various functions that takes place across the value chain of Wular Lake fisheries. The preliminary results indicate dependence of nearly 35000 families from 62 fishing villages in Bandipora and Baramulla districts including 3245 fishers and 900 *Trapa* (water chest nut) harvesting households living on the Wular shore. Women are involved in both fishing and *Trapa* (water chest nut) as 1200 out of 1500 *Trapa* harvesting licences (80%) were obtained by fisherwomen. Women collect, process and market *Trapa* using traditional methods that involves hard manual labour. It encompasses activities of collecting/harvesting, steaming, peeling, baking, crushing, winnowing and then marketing. The study also identified a potential for value addition through training, capacity development and collectivization of women, especially in *Trapa* value chain and fish marketing.

## FISHING GROUNDS OF HEALING AND LIVELIHOOD: A CASE STUDY OF SOUTH KOREAN WOMEN DIVERS

Sun Ae li\*

Miyazaki Munciple University, Miyazaki Prefecture, Japan.

*iisune@miyazaki-mu.ac.jp*

Women divers are the probably the only women in the wrold to make a living by collecting shellfishes and seaweeds by diving hundreds of times for about one minute while holding their breath in a fishing ground at a depth of about 10 meters. In addition, they are skilled specialists and naturalists who have the ecological knowledge of the sea and climate.

According to the South Korean Ministry of Oceans and Fisheries, in 2021 there were more than 10,000 Korean women divers on islands such as Jeju and along the coast. The South Korean women divers' origin is due to the influence of Jeju women divers who started fishing at the end of the 19<sup>th</sup> century. Their culture, which maintains a symbiotic society through the coexistence of nature and humans, and the sustainable use and distribution of resources, was registered as a UNESCO Intangible Cultural Heritage in 2016. They are symbols of local culture and history.

However, women divers outside of Jeju Island have been treated unfairly in the use of resources and fishing grounds. For this reason, local women divers are actively lobbying the central and local governments to acquire rights as fishermen. In 2017, all of Korea's women divers were designated as national intangible cultural asset, which has increased the support of local governments and social interest, and is also attracting attention as the tourism resource. They are socially recognized and have come to take pride in their work as women divers.

On the other hand, Korean women divers are suffering from poaching and overfishing by opening their exclusive fishing grounds to tourists and marine laser in order to revitalize the region. Poaching of marine animals and plants by marine lasers has become a major new problem for women divers who are facing aging populations, lack of successors, and declining resources.

In South Korea's coastal fishing villages, the number of camping cars and tourists is increasing more than the number of fishermen, and the number of accommodation facilities and coffee shops is also increasing. During the COVID-19 pandemic, fishing village beaches and coffee shops were crowded with underwater lasers and tourists. The fishing grounds of women divers make their living are becoming places of healing for urban residents. Therefore, the purpose of this research is to explore the coexistence of women divers and urban people through the process of changes in fishing grounds and resource use in South Korean fishing villages.

## **WORK RELATED HEALTH ISSUES AMONG WOMEN WORKERS IN SEAFOOD PROCESSING UNITS IN CENTRAL KERALA, INDIA**

**Krishna A.S and Nikita Gopal\***

Research Scholar, Kerala University of Fisheries and Ocean Studies, Panangad Road, Cochin, Kerala, India, [krishnaarun2014@gmail.com](mailto:krishnaarun2014@gmail.com)

\*Principal Scientist, ICAR – Central Institute of Fisheries Technology, CIFT Junction, Willingdon Island, Matsyapuri, Cochin, Kerala, India

*\*krishnaarun2014@gmail.com*

Women represent the dominant proportion of labour force in seafood processing. Despite significant contribution to productivity and having high work efficiency, a major percent of women workers face occupational health issues. This can result from physical exposure at work place as well as the social work environment. This paper examines the work related health problems among the women workers in seafood processing export units in the central Kerala in India. A questionnaire based survey was conducted among randomly selected women workers for collecting the information.

The study revealed that women workers in seafood processing sector are exposed to cold, chemicals and organic matter of the seafood at work place. They are also exposed to repetitive job tasks for long periods of time. This exposure creates health risks including musculoskeletal disorders like cervical, dorsal, lumbar issues, disc slips etc. Work place injuries, occupational allergic reactions including respiratory and dermatologic issues are also noted.

Though regular health checkups are part of the organized industry requirements, there still needs special focus on the health of women workers taking into consideration special work related issues.

## **GENDER IMPACTS IN FISH VENDING IN THE CONTEXT OF CHANGING PRODUCTION AND MARKET RELATIONS: A CASE STUDY IN KERALA, INDIA**

**A.Suresh\*, S. Ashaletha and K. Rejula**

ICAR- Central Institute of Fisheries Technology, Cochin, Kerala, India

\* *sureshcswri@gmail.com*

Fish vending as a profession has evolved over the years with the infusion of capital in fishing, credit facilities for fish marketing, development of transportation facilities, technology for marketing, changes in the business ecosystem, and development of direct purchase and export. The impacts of this change is gendered. This was examined by using a field-level survey from fish vendors in Kerala. The survey was conducted from 237 fish vendors in Kerala. The sample size consisted of 77% men and 23% women, and they varied in access to inputs and services, and for the space for fish vending, all skewed in favour of men. With the entrance of the capital, fish vending is gradually transforming, and is shedding its regional, caste and gender hues. The unsustainability issues in fishing in the form of increased effort per catch and cost of production transcended to fish marketing as well. Those with better economic power and social capital stood to gain over the traditional persons and women engaged in fish vending. Still, 58% continued in the profession as it was their traditional occupation. The issues and constraints faced by these layers differed with capital base, traditional orientation, gender and mode of vending. The vendors faced constraints in access to fish, storage of fish, access to ice, infrastructure, transportation facilities and capital. About 41% of fish vendors had capital invested less than Rs 5000; 15% about Rs 5000-10000; 10% about Rs 10000-25000. At a higher level, about 14% invested between Rs 1-5 lakhs and 3% between Rs 5-10 lakhs. The Average quantity of fish purchased was 137 kg by men and 27 kg by women fish vendors. The modernization in fish vending has affected women's access to fish, ice, credit and their ability to acquire and sell fish of the desired quality, relatively badly. Also, those with a low capital base are being displaced. Deliberate policy initiatives are needed to mainstream women's fish vendors, particularly of low capital base, in view of their instrumental value in fisher households and equity in access to livelihood.

**GENDER ANALYSIS OF MARINE FISHERIES BASED LIVELIHOOD IN RAMANATHAPURAM,  
TAMIL NADU, INDIA**

**Ganeshkumar, K. Shivaji Argade\*, Neha Qureshi and Johnson, B.<sup>1</sup>**

ICAR- Central Institute of Fisheries Education, Mumbai, Maharashtra, India

<sup>1</sup>ICAR-Central Marine Fisheries Research Institute, Mandapam, Tamil Nadu, India

*\*shivaji@cife.edu.in*

Globally, women play key roles in harvest and post-harvest activities in marine fisheries. But their participation and contribution in marine fisheries remain invisible due to a lack of gender disaggregated data along the value chain and largely affected by gender based constraints. The study was conducted in Ramanathapuram district of Tamil Nadu to analyse gender dimensions of marine fisheries based livelihood with a randomly selected sample of 40 fishermen and 40 fisherwomen from different households. The study reported men dominance in terms of family headship, house ownership, boat ownership and decision making. The significant difference between fishermen and fisherwomen status was found in terms of social participation, drudgery, decision making, participation in fishing activities and gender empowerment. Net repairing, paddling, and harvesting were the highest drudgery-prone activities for fisherwomen whereas paddling, net repairing, and net setting in fishing areas were the highest drudgery-prone activities for fishermen. The mean values of gender empowerment for fisherwomen (37.53) and fishermen (44.28) demonstrated the significant difference in empowerment levels of men and women. The gender role analysis highlights that fisherwomen work 3.5 hours/day more than fishermen. Majority of fisherwomen preferred fishing, seaweed farming and value addition as their livelihood options but fishermen mostly preferred fishing and cage culture as their livelihood options. The major needs perceived by fisherwomen were training on seaweed farming, requirements of fishing nets and information fisheries schemes and programmes. The major needs perceived by fishermen were training on new fishing techniques, requirement of well-equipped boats & fishing nets and information on schemes and subsidies for fishers. The identified major gender issues were poor education and capability, men's dominance in ownership of resources and assets, limited use of information sources, limited access to fisheries resources and services, less participation in decision making, overburden of works, high drudgery, poor marketing and sanitation facilities, limited extension participation and poor technological adoption. The strategies suggested for promoting gender mainstreaming in marine fisheries based livelihood were gender specific skill development, gender sensitive time, place and personnel for organizing extension activities, promotion of joint ownership of resources and assets, develop women friendly business models, gender sensitization, gender equitable access to resources and services and promotion of gender friendly technology interventions. Study recommends conducting large-scale investigation in the major marine States of India to confirm gender gaps with more empirical evidence in order to formulate comprehensive gender mainstreaming strategies for addressing gender gaps in marine fisheries based livelihood.

**SEASONAL WATER BODIES AS AN ADDITIONAL SOURCE OF LIVELIHOOD FOR WOMEN SELF HELP GROUP (SHG): A CASE FROM GADCHIROLI DISTRICT OF MAHARASHTRA, INDIA**

**Prashant A. Telvekar<sup>1\*</sup>, Rajiv H. Rathod<sup>1</sup>, Sandip B. Gore<sup>1</sup>, Supriya Meshare<sup>2</sup>, Sandesh V. Patil<sup>2</sup> and Bhalchandra V. Naik<sup>2</sup>**

<sup>1</sup>College of Fishery Science (Maharashtra Animal and Fisheries Science University), Nagpur,

<sup>2</sup>College of Fisheries (Dr. B. S. Konkan Agricultural University), Ratnagiri-415629, M.S.

\*prashanttelvekar@mafsu.in

Gadchiroli district of Vidarbha is classified as tribal and undeveloped, with much of the land covered by forests and hills. The total tribal population of the region is about 38.17% (according to the 2011 census). Around 98 % of the tribal population is engaged in primary industry, i.e., related activities such as agriculture, horticulture and fishing and few of them are also involved in other sectors, such as goats and poultry. The main source of fish production is capture fisheries, as there are 4,873 lakes and ponds in the area with a total water dispersal area of 8,657 ha, suitable for fishing activities. It has been demonstrated that the impact of fish production on household food security and income is generally higher for the productive farmers, and that women play an active part in pond management. Present investigation was carried out in Gadchiroli district, Maharashtra to assess the importance of seasonal water bodies as a source of livelihood for SHGs. In this study, Women Self Help Groups were involved and took a water bodies (village ponds, farm ponds or percolation ponds commonly known as “*Bodis*”) on lease basis from Gram Sabha. It was observed that, even a low level of investment in seasonal water bodies can generate substantial income in a short period of time. Rearing of spawn to fingerling in seasonal water bodies can be additional livelihood source for farmers which also reducing the risk of economic loss. The use of seasonal water bodies can to a certain extent solve the problem of scarcity of aquaculture seeds in the rural areas in this district. It is suggested to use seasonal water bodies as an additional source of livelihood for SHGs, farmers and youths.

## ASSESSMENT OF WASTE GENERATED IN THE FISH MARKETS OF MUMBAI

**Shubham Soni\***, Arpita Sharma, Martin Xavier, Nidhi Katre, Gitashree Thengal,  
**Mehul Patel, Anurag Singh and Swadesh Prakash**

ICAR-Central Institute of Fisheries Education, Mumbai, India

*\*shubhamsoni29@gmail.com*

As per a report by the United Nations nearly 50 million tonnes of fish are wasted every year and more than 27% of all captured fish is either thrown away or rots on decks before it's sold. There is a rising concern about fish waste management and utilisation in India. In India, the city of Mumbai generates the most solid waste among metro cities. There are research gaps on the quantity of fish waste generated in this city, how is this waste managed, whether waste is being recycled, converted to make useful products or simply dumped. An effort has been initiated to address these research gaps. Preliminary studies were done in four fresh fish markets (Dadar, Worli, Versova and Khar Danda) of Mumbai city and information was collected by market visits and interviews with fish vendors, market and fisheries society representatives. It was found that Koli women from the fishing communities are involved in purchasing fresh fish from wholesale markets or landing centers. The fish species sold are Tuna, Mackerel, Sardine, Pomfret, Bombay Duck, Seer Fish, Perches, Prawns, Shrimps, Ribbon fish, Hilsa and Tilapia They sell fishes as whole or dressed or filleted or steaked; whole or peeled or deveined shrimps as per the customers' demand. These activities performed in the market generate huge quantities of fish waste nearing 5-10 kg per vendor per day. It was reported that about 100 kg of fish waste is generated in Dadar and Worli Fish Markets while 30-50 kg of fish waste is generated in the Khar Danda and Versova fish markets. This contains approximately 60% fish waste (20% viscera, 10% bones, 30% scales, head and fins), 30% shrimp waste (20% shell and 10% head waste) and 10% is plastics, paper and other waste. The waste generated every day is mostly disposed of without any segregation in Dadar, Khar Danda and Versova fish markets. However, it is segregated into dry and wet waste in Worli fish market and is sent for bio-degradation in landfills. Under the Swachh Worli Koliwada project a NGO was involved in making manure from fish waste but due to hygiene issues it was not successful. Marketing activities are a major source of livelihood for Koli women. Mumbai is home to the Koli community which is known for performing fishing and other fisheries related activities since time immemorial. The waste generated in the markets has potential for developing fish by-products like chitin and chitosan from shell wastes, foliar spray for plant nutrition, silage, fish meal and as feed for other culture animals. In addition, based on some successful art projects, it is suggested that urban art combining the street art and graffiti can be initiated to give a colourful makeover to fish markets with a vision of bringing forward the cultural heritage of fishing communities to the forefront.

## **ROLE OF WOMEN IN INLAND FISHING: STUDY FROM AN ISLAND FISHING VILLAGE OF A TROPICAL ESTUARY ON THE SOUTH-WEST COAST OF INDIA**

**Sandhya K.M\*, Prajith K. K., Remesan M. P.**

ICAR-Central Institute of Fisheries Technology, Kochi, Kerala

\*sandhyafrm@gmail.com

Women play a major role in fisheries particularly in the inland sector. The role of women in fish harvesting is much more visible in inland waters, though their participation in marine fishing is negligible. The present study attempts to document the role of women in inland fishing in Valanthakad, an island fishing village spreading over 200 acres lying in the Northern end of Vembanad estuary in south west coast of India. Valanthakad, is a small island surrounded by mangroves. In local parlance, "Valantha" denotes surrounded and "Kadu" stands for forest. There are 45 families residing in the island and all of them belongs to Scheduled Caste. Fishing and allied activities are the main occupation of the villagers. Using an unstructured questionnaire, individual and group interviews with women of the island was carried out. Direct observation of different types of gears and their operations were also made. The collected information was validated by cross-checking with the existing information. Forty-two percentage of the total population is represented by women. Fishing is usually a collective family activity of the island community and all the women are directly or indirectly involved. Whereas 20% of the women population performs fishing by themselves using traditional wooden canoes without any assistance from the male family members Nylon monofilament gillnets with different mesh sizes (25-75mm) are the major fishing gear operated, targeting native species like *Etroplus suratensis*, *Mugil cephalus*, *Macrobrachium rosenbergii* and estuarine shrimps. Catch varied from 0.5-8kg per day per person. Women are also involved in clam (*Villorita cyprinoides*) harvesting either by hand picking or using hand held scoop nets. Respondents of the group interview opined that fish catch is declining over the year. Influx of polluted water from the nearby industrial sites, increment in the amount of plastic debris is the main reasons cited by them. Absence of road access to the mainland is the main issue faced by them and all the 45 families depend on their canoes for transportation. The picturesque island provides ample scope for the promotion of ecotourism involving all the residents to improve their socio- economic status.

## **WOMENS' LABOUR IN FISH VENDING IN KERALA, INDIA**

**Jeyya Jeyanthi.Pe., Sajesh V K\* and Nikita Gopal**

\* ICAR-Central Institute of Fisheries Technology, Cochin 682 029, Kerala, India

*\*sajeshvk@gmail.com*

Fish vendors are one of the viable market functionaries of the fish supply chain and an important link between producers and final consumers in distributing fish to many urban and remote areas. Fish is a highly perishable commodity, which requires quick disposal at a convenient time to consumers, in an unorganized way which is mainly done through fish vendors, especially women fish vendors. Even though they are considered critical from the food security point of view, they are still invisible, unsupported and unrecognized. Like other market functionaries, they are facing various problems viz., lack of storage facilities, poor transport facilities, non-availability of credit, exploitation through the imposition of informal taxes during fish vending, but with higher magnitude. The study focused on the status of women fish vendors in different districts of Kerala, India across the period of 2014 to 2018 using secondary data. Field-level data were used to assess the issues faced.

## HEALTH PROFILING OF WOMEN POPULATION AMONG WAYAND TRIBES WITH RESPECT TO THEIR FISH CONSUMPTION

**Akshay. P<sup>\*</sup>, Suseela Mathew, Mohanty A. K., Gopika. R, Joshy C. G. and Sajeev M. V.**

ICAR- Central Institute of Fisheries Technology, Kochi, Kerala, India

*\*akshay.cift@gmail.com*

Tribals form more than 1% of the Kerala's total population and they belong to 35 communities. About 22% of tribal population are still living in the forest areas. The health and nutrition problems of the vast tribal population of India are as varied as the tribal groups themselves who have a diverse socio-cultural and ecological setting. Nutritional anaemia was a major problem for women in tribal belt of Kerala. Data collection of 150 women respondents were done through a structured questionnaire from various parts of Wayand district. The study reveals that around 87.66% of women facing headache and 56.93% affected with tiredness rarely or frequently. Among them tiredness is prevalent in the age group 15-30yrs and headache is more prominent in 42-70yrs. Their average per capita fish consumption estimated as 1kg/month. The health profile is showing an improved trend in those individuals whose per capita fish consumption is higher. It has been also shown that those who consume more fish with reduced symptoms of anaemia like pale skin, dizziness, loss in appetite etc.

## THE DOMINANCE OF WOMEN IN FISH RETAIL MARKETS: EVIDENCE FROM MAHARASHTRA, INDIA

Rehana Raj\*, Greeshma S.S., Priyanka Nakhawa, Nikita Gopal<sup>1</sup> and Asha K.K.

Mumbai Research Centre of ICAR-Central Institute of Fisheries Technology, Sector 1, Vashi, Navi Mumbai, Maharashtra, 400703

<sup>1</sup>ICAR-Central Institute of Fisheries Technology, Kochi, Kerala, India

\* *rehanaraj9@gmail.com*

In India, it has been observed that fisherwomen handle the pre-harvest activities, retail marketing and export marketing sectors. In Maharashtra, generally, fisherwomen participate in activities such as fish vending, fish drying, prawn peeling, sorting, grading and packaging. The study was focused on the status of fisherwomen across the occupational group viz., fish retailing and fish vending. The major objectives were to estimate the social, political and economic empowerment of fisherwomen involved in marketing of fish in Maharashtra. The study was based on the data collected from primary and secondary sources of selected markets. Various empowerment parameters related to work, income and gender were analysed. The study revealed a dominance of fisherwomen in seafood retail marketing. Fisherwomen offer jobs to men for assisting them in their routine activities. They have the power of decision-making in the family. In some cases, they are the sole working members of their families constituting 4-5 members. The major concerns of the fisherwomen with respect to their market premises is that they lack toilet facilities, proper drinking water and have no access to hygienic food. In spite of their low levels of literacy and educational status, the women are quite knowledgeable in all aspects of financial transactions. This study recommends interventions for improving the livelihood status of the fisherwomen involved in the drying and marketing of fish in Maharashtra by providing awareness about modern accessories and facilities in the sector to facilitate successes in their marketing ventures.

## FROM CREEK TO EXPORT: THE STORY OF A WOMAN FISHER IN MUD CRAB VALUE CHAIN, MAHARASHTRA, INDIA

**Manju Lekshmi N., Greeshma S.S., and Leela Edwin**

ICAR-Central Institute of Fisheries Technology, Fishing Technology Division, Cochin, India

The crab value chain is predominantly a male-dominated industry, particularly where culture, fattening, and trading are concerned. This story describes how a rural illiterate woman become a renowned entrepreneur through her active participation in crab culture, fattening, and export from Maharashtra, India. Gunabai Sudhar, a woman crab farmer in Navi Mumbai, Vashi, Maharashtra, had been rearing and fattening crabs in the tidal fed ponds of 0.5 ha for the past 20 years. Juvenile mud crabs (*Scylla serrata*), fish (pearl spot, seabass, groupers, etc.), and shrimp seeds are collected during the high tide hours (multitrophic capture-based culture) by setting traditional bag nets in the sluice gates (between the ponds and estuaries). The juvenile crabs are stocked in the plastic containers for 40–50 days of fattening while being fed with poultry waste. Meanwhile crab seeds (500–1500 numbers) are also procured from local suppliers of Ratnagiri and stocked into the earthen ponds. Large crabs of size 1– 2.5 kg are harvested either by handpicking or using traditional bamboo traps or modified scoop nets. Gunabai is an expert in handpicking of large crabs from the mud during low tide. Premium quality crabs are exported to the foreign markets (China, Malaysia, Singapore) via Chennai and Calcutta in thermocole boxes and the rest were transported alive to Mumbai markets in bamboo pots of various dimensions. 1000–2000 kg of crabs is exported each month at a rate of Rs. 600–1000/kg. She provides employment for eight people, one of whom is a skilled worker for laboratory analysis. Gunabai started fishing as a family occupation, but she overcame many obstacles to reach her current level of success. Nevertheless, today she has the support of her entire family and the community. The goal of the study is to examine a rural woman's involvement in aquaculture improves the living standards not only for the family but for a community even at the age of 70.

## **PORTRAIT AND CHALLENGES OF GENDER MAINSTREAM IN FISHERIES BUSINESS IN INDONESIA**

**Nurlaili<sup>1\*</sup>, Tikkyrino Kurniawan<sup>1</sup>, Retno Widiastuti<sup>1</sup>, Widya Safitri<sup>1</sup>, Riesti Triyanti<sup>2</sup>  
Hikmah<sup>3</sup>, Christina Yuliaty<sup>3</sup>, Nensyana Shafitri<sup>3</sup>, and Bayu Vita Indah Yanti<sup>3</sup>**

<sup>1\*</sup> Researcher of the Center for Community and Cultural Research, National Research and Innovation Agency, Jalan Gatot Subroto, South Jakarta

<sup>2</sup> Researcher at the Center for Circular Behavior Economics Research, National Research and Innovation Agency, Jalan Gatot Subroto, South Jakarta

<sup>3</sup> Policy Analyst of the Ministry of Maritime Affairs and Fisheries, Jalan Pasir Putih 1 Ancol Timur, Jakarta

\* *nurl016@brin.go.id*

This paper is based on a study conducted by the Center for Maritime Affairs and Fisheries Socio-Economic Research, Ministry of Maritime Affairs and Fisheries in 2018-2021. The research uses a mixed method by combining quantitative and qualitative approaches. Field work was carried out using survey methods, in-depth interviews and FGDs with respondents according to predetermined criteria, with an average number of respondents of 30 people in each location, including Tangerang Regency, Banten Province, East Lombok Regency, West Nusa Tenggara Province, North Jakarta Municipality, DKI Jakarta Province, Bogor Regency, West Java Province, Kendal Regency, Central Java Province, Rote Ndao Regency, East Nusa Tenggara Province. Secondary data was obtained from the Ministry of Maritime Affairs and Fisheries in 2014-2020, as well as literature from related studies. Qualitative descriptive analysis was carried out.

The results of the study show that in the fishing business, men have greater access than women. In capture fisheries and aquaculture, based on statistical data, the percentages of male and female business actors are 98:2 and 88:12. The opposite condition is shown in the fishery product processing business, where business actors are dominated by women with the percentage of men and women being 37:63. However, empirically, women have become important supporting actors and partners of men who determine the success of fishing businesses. In production, men have a bigger role than women because cultural values position men as breadwinners. In society, working women are seen as only helping men to increase household income. However, women still have control over the fishing business when deciding matters related to the business together with men.

The challenges of gender mainstreaming include access, social, economic factors as well as cultural values regarding gender in fishery businesses. Efforts are needed by all stakeholders to increase access and control, especially for women in fishing businesses. Understanding in the community that men and women have the opportunity to participate in production activities, as well as domestic activities is not only a burden on women. Minimize the limiting factor of the value and perception of gender in society for women to contribute to the fisheries business. The results of gender-based studies can be used to support gender mainstreaming in fisheries businesses in Indonesia.

## STATUS OF FISH PRODUCTION IN SUNSARI DISTRICT OF NEPAL

Dreesti Wasti<sup>1</sup> \* and Sijan Bajgain<sup>2</sup>

<sup>1</sup> G.P. Koirala College of Agriculture and Research Center, Purbanchal University, Gothgaun, Morang, <sup>2</sup> G.P. Koirala College of Agriculture and Research Center, Purbanchal, University, Gothgaun, Morang  
*\*dreestiwasti@gmail.com*

Despite of the high production potential, large number of fish has been imported from India. Thus the present research was conducted to know the marketing and production problems in aquaculture sector at Sunsari district of Nepal. A total of 50 samples were collected, randomly sampled homestead fish farmers within the study area. Similarly, 5 local traders were selected purposively. The B:C ratio was found to be 1.98. The study revealed that the farmers faced lack of availability of technical manpower, flood, and disease and predator prevalence in production of the fish. Similarly dependence on input materials from India and pollution were also other major factor in the hindrance of production of fish in Nepal. The study revealed that the farmers were not getting reasonable price of reared fish. The polynomial average cost function was used to estimate economies of scale. It was estimated that the economies of scale for fish production was 10.2 metric ton. This is the optimal amount of production at which lowest long-term cost is achieved. This study also found that overall variable cost contribution ratio is higher than that of the total fixed cost contribution, which means that variable costs make up the bulk of fish farming costs. Seminars and field day for fish breeders to guide them on modern fish breeding methods as well as optimal methods to raise the economic efficiency of fish farming can be done to uplift the fish farmers in the study area.

## **WOMEN ENTREPRENEURS IN COASTAL VILLAGES: HOW VULNERABLE THEY ARE TO DISASTERS**

**Ashaletha.S\*, Amulya Kumar Mohanty and Rejula.S**

ICAR-Central institute of Fisheries Technology, Cochin, Kerala, India

*\*ashalethasuresh@gmail.com*

India is unique owing to its diverse geography, population and culture. In the coastal villages of India, women are engaged in traditional fish related occupations like fish sorting in landing sites, fish drying, selling fresh catch etc. All these livelihood options provide them the status of just an additional income earner only in male headed households. On the other hand, they have to play the role of breadwinners in women headed households with whatever meagre income they earn. These circumstances force women to venture into small scale businesses in groups or with husband and sometimes alone. This process cannot clearly be termed as entrepreneurship. However, a woman entrepreneur in fisheries faces many exceptional challenges, like unpredictability of resource availability & resulting fluctuations in market demand & thus the price, highly perishable nature, male dominated fish landing centres & markets and the gender stereotypes prevalent in most of the societies.

While situation is already bad, the onset of the COVID pandemic had distinct and substantial implications on women engaged in fishery based occupations. While the incidence of man originated and natural disasters are predicted to occur more frequently in the coming future, this paper is making a humble effort to see how vulnerable this sector of women are in such disaster situations, what factors contribute to the vulnerability of women in coastal villages and what impacts a pandemic can make on the livelihood of women engaged in fishery related occupations. The study made for the purpose found that majority belonged to medium or low income group and had no health insurance. The investment on capital was ranging from Rs. 25,000 to 3 lakh only and due to the low investment capacity more than 80% tried starting a business as joint venture only indicated the 83 percent had initiated the units as joint ventures. Almost 40% belonged to minority community. The paper also brings light to few peculiar aspects of fishery based occupations which needs urgent attention of policy makers and technocrats, so as to make it possible for following restrictions on mass gatherings and to keep social distancing, which is to be practiced generally for maintaining hygiene and preventing spread of any pandemic.

## UNSUNG QUEENS OF THE COAST: A PHOTO ESSAY ON WOMEN IN HARVEST IN SMALL-SCALE FISHERIES OF MAHARASHTRA

Priyanka Nakhawa<sup>1\*</sup>, Ananthan, P.S.<sup>2</sup>, Ajay Nakhawa<sup>3</sup>, L. N. Murthy<sup>1</sup>,  
Asha K.K.<sup>1</sup> and Shivaji Argade<sup>2</sup>

<sup>1</sup>Mumbai Research Centre of ICAR-Central Institute of Fisheries Technology, Navi Mumbai, Maharashtra, India, <sup>2</sup>ICAR- Central Institute of Fisheries Education, Mumbai, Maharashtra, India, <sup>3</sup>Mumbai Regional Station of ICAR-Central Marine Fisheries Research Institute, Versova, Mumbai, Maharashtra, India

\*[priyankavichare666@gmail.com](mailto:priyankavichare666@gmail.com)

Participation of the work of women in fish harvest is underreported, unrecognised and thus unaccounted. This deprives and excludes them from availing any of welfare benefits from the State. We document, through a photo essay, the involvement of women in fish harvest activities, in the shore and creeks along the Raigarh & Thane coastal districts of Maharashtra, India. The photo essay captures three case studies of women fishers engaged in small-scale harvest activities such as gleaning and gill netting. Pictures depict stories of their everyday struggles and locate them within the specific socio-cultural and ecological environment in which they work and live. Interactions and focus group discussion with the women fish harvesters also brought out their expectations for bettering the livelihoods.



## PROSPECTIVE ASSESSMENT OF SMALL-SCALE CLAM FISHERY: A CASE OF KORAPUZHA RIVER BASIN IN KERALA, INDIA

Rejula, K.<sup>1\*</sup>, Sajesh, V.K<sup>1</sup>, and Sandhya, K.M.<sup>2</sup>

<sup>1</sup>Scientist, Extension Information and Statistics Division, <sup>2</sup>Scientist, Fishing Technology Division  
ICAR-Central Institute of Fisheries Technology, Cochin

\*rejula.iari09@gmail.com

Korapuzha, also known as Elathur River, is a short river of 40 km (25 mi), flowing through the Kozhikode district of Kerala state in India. The present study was conducted to assess the prospect of small-scale clam fishery in a village Atholi, located along Korapuzha river basin. Purposive sample of 43 respondents were interviewed with a semi structured interview schedule during January 2022. Respondents had average 17 years of experience in clam-fishery, mostly middle aged with high school level education. Majority of the families were below poverty line and had small size. Significant gender difference was observed with respect to occupational class. Women were mainly engaged in clam processing in the nearby makeshift sheds on a daily wage basis. Poor market prize of the clam was reported as the major constraint in clam fishery while at the household level major constraint was scarcity of fresh water. Privately owned clam sheds operate in a traditional way and there exist immense scope for improvement in terms of working conditions and infrastructure facility. The concept of responsible fishing needs to be promoted among fisherfolks as there is an alarming trend of increasing juvenile catch in this river basin. Processing of clam and value addition were found to have potential in these area in order to address the challenge of lower income from clam fishery. Therefore, scientific clam fish processing and value addition can be introduced for the livelihood improvement of the fishers through awareness programmes, exposure visits, capacity building trainings by concerned stakeholders in this sector.

**GENDER PROFILE OF PERSONNEL IN SHRIMP PROCESSING UNITS:  
A RANDOM SURVEY IN ANDHRA PRADESH, INDIA**

**Madhusudana Rao. B<sup>\*</sup>, Viji, Pankyamma, Ahamed Basha, K. and Jesmi Debbarma**  
Visakhapatnam Research Centre of ICAR-Central Institute of Fisheries Technology (ICAR-  
CIFT), Visakhapatnam, 530003, Andhra Pradesh, India  
*\* bmrift@gmail.com, bm.rao@icar.gov.in*

Frozen shrimp was the major item of Indian fishery exports in 2021-22, both in terms of quantity (53%, 728,123 MT) and value (75%, USD 5,828 million). Andhra is the leading state in India in terms production, processing and exports of shrimps. A random survey of 20 shrimp processing units located in Andhra Pradesh, covering 10,051 personnel was undertaken to understand the gender profile within shrimp processing units. Female formed 63% of the total personnel in shrimp processing units. Further analysis, based on four categories of personnel in the shrimp processing units viz., processing personnel (involved in raw material receiving, pre-processing, processing, packaging, cold storage), auxiliary personnel (involved in water treatment, effluent treatment, transport, security, pest control, etc.) quality control personnel (quality assurance managers, technologists, laboratory assistants) and managerial personnel (CEOs/MDs and plant managers) indicated that majority of the personnel were employed in the processing areas (81.3%) and nearly two-thirds of the processing personnel were females (73%). However, the proportion of females in the managerial posts (5.5%) and auxiliary areas (10.5%) was low but the proportion of females (47%) in the quality control area was almost equal to that of the males. The female predominant workplaces in the processing areas were de-heading / peeling of shrimp, freezing areas, value addition and grading of shrimp. Male personnel were predominant in cold stores and machinery room. Though, the number of female technologists (51%) in the quality control area was nearly equal to males in the quality control section, the proportion of females as quality managers was relatively low (33%). The proportion of females at the top managerial position i.e. CEO or MD, was only 6.5% and none of the plant managers were female. The gender profile analysis indicates that females are the major work force in the shrimp processing units serving prominent roles in shrimp processing and export quality assurance but are conspicuously missing in the upper echelons of management that needs to be addressed.

## **WOMEN'S RIGHTS AND GENDER EQUITY IN FISHERIES AND AQUACULTURE: EXPERIENCES AND LESSONS FROM CHILE, BANGLADESH AND GHANA**

**Tulika Bansal**

Danish Institute for Human Rights, Wildersplads 8K, 1401 K, Copenhagen, Denmark,  
*tuba@humanrights.dk*

This study looks into the women's rights and gender dimensions in fisheries and aquaculture through looking at three case studies. Through a sectoral human rights study of the human rights situation in the Chilean salmon industry by the Chilean National Institute for Human Rights (INDH) and the Danish Institute for Human Rights (DIHR), evidence has been found of the human rights impacts on women working in salmon processing plants, ranging from discrimination, including towards pregnant workers, lack of family friendly policies, gender-based violence (including harassment, verbal and physical violence and rape); and unequal access to middle management and wage gaps.

A study on the shrimp sector by the Bangladesh Institute for Labour Studies (BILS) and DIHR found that the majority of workers in the shrimp sector in Bangladesh reported a gender wage-gap, with more than half of workers claiming that women workers are not paid an equal wage. The treatment of pregnant workers was also highlighted, noting there are no special facilities for pregnant workers. While female workers generally did not face indecent behavior, the study did note incidents where women workers faced discrimination or harassment. The study also noted concerns related to women workers with children, finding that day care facilities were absent at more than one third of the workplaces.

A study conducted in Ghana showed that many women are involved in processing, distributing and marketing of fish throughout Ghana and emphasized the positive impacts that small-scale fishing can have on the rights of women, such as increasing access for rural women to income generating opportunities. However, the report found that women reported lower levels of access in a number of areas: (i) participation in social security schemes; (ii) availability of government support in the form of subsidies; (iii) provision of skills upgrading or training to assist in the transition to additional income generating activities; (iv) support to form or join cooperatives to improve income/marketing of produce; (v) completion rates for primary and secondary education; (vi) access to sufficient food; and (vii) access to improved toilet facilities.

The three studies demonstrate that women working in the fisheries and aquaculture sectors, whether in fish processing or in small-scale fisheries, are at risk of being disproportionately affected, and similar trends exist across the globe. This paper recommends a number of ways forward by industry actors, governments and other stakeholders, to make the fisheries and aquaculture sectors more gender equitable, such as through the implementation of international human rights law instruments including the Convention on the Elimination of Discrimination Against Women (CEDAW), and soft law instruments such as the UN Guiding Principles on Business and Human Rights and Sustainable Development Goal 5.

**ADDITIONAL LIVELIHOOD ACTIVITY FOR THE COASTAL FISHERWOMEN THROUGH NURSERY REARING ASIAN SEABASS (*LATES CALCARIFER*) IN BACKWATERS**

**Bhuvanewari. T\*, Jayakumar. R, Subburaj. R, Geetha. R, Vinay.T.N, Kailasam. M, Jithendran.K.P.**

ICAR-Central Institute of Brackishwater Aquaculture,  
75, Santhome High Road, Chennai – 600 028, Tamil Nadu, India  
*T.Bhuvanewari@icar.gov.in*

The Scheduled Caste fisherwomen in Kottaikadu village, Chengalpattu district of Tamil Nadu, India are involved in collection of meat from the oyster beds in the backwaters of their village and neighboring areas. They have to dive up to 1.5 meter depth under the water for about four to five hours, to collect one or two kilograms of oyster meat per day from the rough beds with bare hands and foot. The occupational health risk and hazards like skin cuts and abrasions in hands and feet, eye irritation, cold, skin burn, musculoskeletal weakness and accidental death were also encountered while collecting oyster meat. In this background, 36 resource poor fisherwomen were grouped under three Self-Help Groups with 12 members in each group. Skill oriented training were provided in scientific nursery rearing method of Asian seabass fingerlings developed by the Fish Culture Division of ICAR-CIBA. Hapas of 2 meter length x1.5 meter height x 1 meter width were installed inside the crab fencing and 12,000 numbers of seabass fingerlings of 3.0 – 4.0 cm length and 1.20–1.50 g weight were stocked @ 300 /hapa in the backwaters of their village. The fish fingerlings were grown by feeding with formulated pellet feed and periodic grading to avoid cannibalism to attain a marketable size of average of 10.52 cm length (13.50 grams weight) in 48 days with the survival rate of 93.30%. This technology has been promoted under the Scheduled Caste Sub Plan (SCSP) programme of ICAR-CIBA, to create additional livelihood avenues for the rural coastal fisherwomen and supported with all required implements to start the rearing activities. Fisherwoman was earning about Rs. 4,000–5,000/person/month through oyster meat collection. Now, on adoption of nursery rearing of Asian seabass has generated a gross income of Rs. 4.20 lakhs per cycle, as a livelihood enhancement model for doubling their income to Rs. 12,000/person/cycle. This success story could be up-scaled in suitable areas through State Departments of Fisheries and related development agencies.

## **SUPPORTIVE ROLE OF WOMEN IN INLAND FISH FARMING AND TECHNOLOGY INITIATIVES FOR DOUBLING INCOME**

**V. Geethalakshmi\*, V. Chandrasekar, Nikita Gopal and A.A. Zynudheen**

ICAR-Central Institute of Fisheries Technology, Cochin 29

*\*geethasankar@gmail.com*

Aquaculture is the fastest-growing food sector in the world, and contributing to more than 50 percent of total fish consumption. Although shrimp production is the main focus of this sector, the development potential of other aquaculture species is large which varies from region to region. In Kerala coast, catfish, tilapia, seabass, crab, pearlspot production systems contributes to the inland fish production considerably. The vast inland water bodies are conducive for farming of certain commercially important fish species due to favourable environment and weather conditions. Owing to investment and nature of physical labour work involved, aquaculture sector is often considered a male domain. There have been many relevant development projects and programs operational in Ernakulam district, Kerala which have led to gainful employment of fisherwomen, among which cage culture is promising. However, the role and participation of women is largely supportive in this domain. A study from selected fish farming groups in Pizhala and Chendamangalam in the district has proven that women participation is crucial in the chain ranging from sorting of fingerlings, stocking, feeding, and fish harvest. It was more of a family enterprise with all members contributing and the earnings were around Rs.2.5 to 3 lakhs per annum. Feed constitutes to more than 50% of operational cost and adoption of “conversion of fish waste to aquafeed” technology can bring down the costs considerably. Mainstreaming marginalized fishers to technologies in fish waste utilisation through capacity building has created self-employment in the coastal communities.

Around 1250 fishers were trained in preparation of aquafeed from fish waste and the technology was demonstrated covering fish markets and landing centres where management of waste is a growing concern. The defined role and potential of women in fish farming has been discussed in this paper and the challenges faced by women which can be addressed through capacity building and R & D initiatives are outlined.

## UNVEILING THE ROLE OF WOMEN IN DRY FISH VALUE CHAIN OF THE ALIBAUG REGION, MAHARASHTRA, INDIA

**Greeshma S. S<sup>\*</sup>, Rehana Raj, Priyanka Nakhawa, Nikita Gopal and Asha K. K**

Mumbai Research Centre of ICAR-CIFT, Mumbai

*\*greeshma.ambadi@gmail.com*

Dry fish is an important component of Indian fisheries sector in terms of its use in the diet and economy. Over years, the Alibaug region remains a predominant dry fish trade zone in Maharashtra. In this region, women constitute a major labour force of the dry fish sector and play a vital role in fish drying and related activities. Even though, women single-handedly carry out various dry fish value chain processes *viz.*, fish procurement, sorting, cleaning, drying, packaging, retail and wholesale selling *etc.*, their role is barely visible in this sector. Therefore, the present study was conducted based on the semi-structured questionnaire and focus group discussion to reveal the role of women in dry fish value chain of the Alibaug region of Maharashtra. According to this study, women of this region have been engaged in dry fish trade for generations and fishes, according to fish species were dried under the sun on bamboo poles, cemented floors and roped cots. This study explored the responsible role of women in productive, reproductive and caregiving areas related to the dry fish sector. This study also highlights the challenges faced by women in this sector such as lack of hygiene and drinking water facilities, the burden of caring for uneducated and unemployed men in the family, health issues *etc.* Poor level of literacy remains a major hurdle in adopting modern banking facilities, upcoming modern technologies, and next-level business opportunities through online marketing platforms. The study group identified were aware of the gender-based rights in the sector. This study provides the baseline data to design and implement possible strategies and interventions through SHG /NGO for the empowerment of women's groups in the dry fish sector of the Alibaug region of Maharashtra.

## **INTRODUCING SUSTAINABLE BIOMASS BRIQUETTES AND MODERNIZED DRUM KILN FOR IMPROVED LIVELIHOODS AND WELL-BEING OF SMALL-SCALE FISH SMOKERS IN LAGOS, NIGERIA.**

**Kafayat A. Fakoya<sup>\*1</sup>, Kafayat O.Ajelara<sup>2</sup>, Ayojesutomi Abiodun-Solanke<sup>3</sup>, Shehu L.Akintola<sup>1</sup>.**

<sup>1</sup>Department of Fisheries, Lagos State University, Ojo, Lagos State, Nigeria

<sup>2</sup>Department of Zoology, Lagos State University, Ojo, Lagos State, Nigeria

<sup>3</sup>Federal College of Fisheries and Marine Technology, Victoria Island, Lagos State, Nigeria

*\*kafayat.fakoya@lasu.edu.ng, adikafayat@gmail.com*

Fish smoking is a major traditional livelihood activity of women in coastal small scale fisheries of West Africa. The fish smoking equipment are mainly traditional or local and rudimentary while production methods lack standardization. For ages, fuel woods have been principal biomass energy sources in fish smoking and also for domestic use in most fishing households. Domestic and regional markets in the region show strong preference for fish traditionally smoked with fuel woods, affecting demand and supply. This factor influences fish smokers who have posited as resistant to adoption of modern fish smoking kiln and charcoal, also a wood-product. Against this backdrop, a team of 5 Nigerian researchers under the umbrella of Gendered Design in Science, Technology, Engineering, Arts and Mathematics (STEAM) program funded by the International Development Research Centre and facilitated by Carleton University, Canada conducted a participatory action research and training workshop with 14 participants composed of 12 female fish smokers and two fishermen. Sensory evaluation of fish smoked with biomass briquettes indicated that it was best preferred to either charcoal and fuel woods, and instantaneously taken up for try-out. Sequel to the workshop, volunteer fish smokers conducted further try-out with the briquettes and also participated in trials of smoking fish with briquettes in a prototype drum kiln. Through peer-peer learning and social networking, they facilitated community outreach on biomass briquettes and the prototype drum kiln. Overall, the gender-responsive approach adopted has created demand for biomass briquettes and the drum kiln. Anticipated outcomes are development of value-chains for different biomass briquettes and a modernized drum kiln with potentials for up-scaling to higher production capacities.

**WOMEN AS AN AGENT OF CHANGE: THE CASE OF WOMENFOLK IN KERALA****Vijaykiran V\*, Neethu Mol Jacob and A. Suresh**

ICAR-Central Institute of Fisheries Technology, Kochi, Kerala, India

*\*vijaykiranx093@gmail.com*

Women are often dynamic leaders of change, encouraging women and men to get involved, claim their rights, strengthen their community, and protect their planet. Women around the world play a dual role—as producers of goods and services as well as their reproductive role, and wives and mothers—yet their contribution to economic development has been neglected. Fishery is not exempt from this. Fishing remains a traditionally male-dominated sector where women's contributions are highly devalued. However, women fishers contribute significantly to household income and food security, and their economic contributions are often the mainstay of family and community livelihoods. Fishing sector is the main source of livelihood for women. In India, approximately 27% of women work in pre-harvest and post-harvest activities. Women also play an important role in the fisheries sector in Kerala with 79% participation in fishery-related activities such as marketing, fish drying, peeling, processing, sorting, grading, fish packing, net making and repairing. In this context, the study sought to examine and value the contribution of womenfolk in the fishing sector, in the fishing community, and in their family as an agent of change. The study was conducted on the basis of data collected from primary and secondary sources information. The study revealed that women are predominant in the post-harvest sector in both small-scale and industrial processing units in Kerala. Marketing (84%), curing/processing (96%), and peeling (99%) appear to be their dominant sectors. In addition to their direct involvement in fishing and related activities, they also make a significant yet unrecognised indirect contribution to the marine fishing industry. Economic freedom improves their ability to participate equally in existing markets; their access to and control over productive resources, access to decent work; increased voice, and meaningful participation in decision-making at all levels, from the family to the public domain. Yet, despite these well-known gains, women still face many barriers to contributing to and benefiting from development. Barriers begin with limited access to opportunities, relatively low wages, and social and cultural norms. There is no formal recognition of women's work in fisheries and aquaculture, and women are underrepresented in policy and decision-making. Many gender inequalities persist even as countries develop, calling for sustained and focused public action. Women's economic empowerment is particularly necessary as it is central to the realization of women's rights and gender equity.

## **WHY ARE WOMEN LABOUR MOVING AWAY FROM THE FISHERIES SECTOR? A CASE STUDY FROM A FISHING VILLAGE IN KERALA, INDIA**

**Sajna V.H.\*, Sethulakshmi C.S., Sreejith S. Kumar, Madhu V.R., Sandhya K.M., Rejula K., Bethan O'Leary, Deepayan Bhowmik, Paul Kemp, Bindi Shah and Nikita Gopal**  
ICAR-Central Institute of Fisheries Technology, Kochi, Kerala, India  
\*sajnavhussain@gmail.com

The fishery sector contributes significantly to the livelihood of more than one lakh fisher families in Kerala. A gender-based analysis reveals that a notable proportion of women are employed in the secondary sector of marine fisheries for both subsistence and additional income. Women contribute to small-scale and artisanal fisheries through post-harvesting activities such as fish processing, peeling and marketing. Over the decades, there has been a gradual decline of women labourers in the sector. The specific objective of the present study is to identify the factors that contribute to this progressive decline of women labour as well as to explore the future opportunities of gender mainstreaming. Data was collected through qualitative age-structured gender-sensitive interviews with 33 randomly selected women from the fishing village of Chellanam. In addition, district-wise gender-segregated secondary data on employment in fishing allied activities was obtained from the Marine Fisheries Census for the period 2005-2020. R software was used for data analysis. A SWOT analysis was also conducted to identify socio-economic factors affecting women's representation and employment prospects in the sector. The results indicate that the proportion of young women (now under 40) working in small-scale and artisanal fisheries has declined significantly. In contrast, although the resources were limited in the earlier periods, the old age group (now above 50) made maximum use of the available resources and provided financial support to the family. The major socio-economic factors that significantly contributed to the gradual decline of young women workforce in this sector were identified as the educational and economic progress of the fishing community, changes in the perspective of social status, lack of interest, lower wages, drudgery, lack of financial assistance and inadequate technical assistance. Marketing issues, changes in food safety regimes, personal health issues, lower access to landing centres and climate-related changes were identified as secondary factors. The study also highlights the strengths, opportunities and future benefits of gender mainstreaming for youth into the sector.





**Session 3:**  
**Pandemics, disasters and shocks: Impacts on livelihood, occupations, habitat, resources, lifeoitation, conflict**





## ROLE OF WOMEN IN THE MITIGATION OF IMPACT OF CLIMATE CHANGE IN AQUACULTURE IN CHITWAN DISTRICT

**Pratikshya Neupane and Sunila Rai\***

Fisheries Program, Agriculture and Forestry University, Rampur, Chitwan, Nepal

\*sunilarai10@gmail.com

Aquaculture is one of the fastest growing sectors of food production in Nepal. However, aquaculture in the country is highly vulnerable to flood and drought. In order to assess the role of women fish farmers in mitigating the impact of climate change in aquaculture, a study was done from March to July, 2021 in Chitwan district. Altogether, 40 women fish farmers were selected randomly for questionnaire interview. Half of farmers were interviewed in person while remaining half by telephone conversation due to Covid 19 pandemic in the country.

Small scale women farmers have been found actively involved in mitigation practices compared to commercial women farmers. Their involvement has been more on mitigating impacts of drought (40.3%) compared to flood (27.2%). Farmers have adopted different mitigation practices for flood and drought which are shown in the Figure 1 and 2.

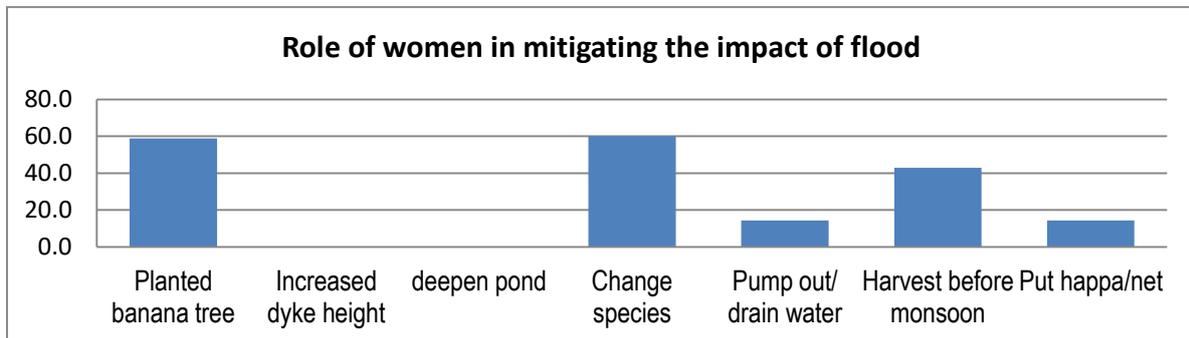


Fig 1. Role of women farmers on mitigating impacts of flood on fish farming.

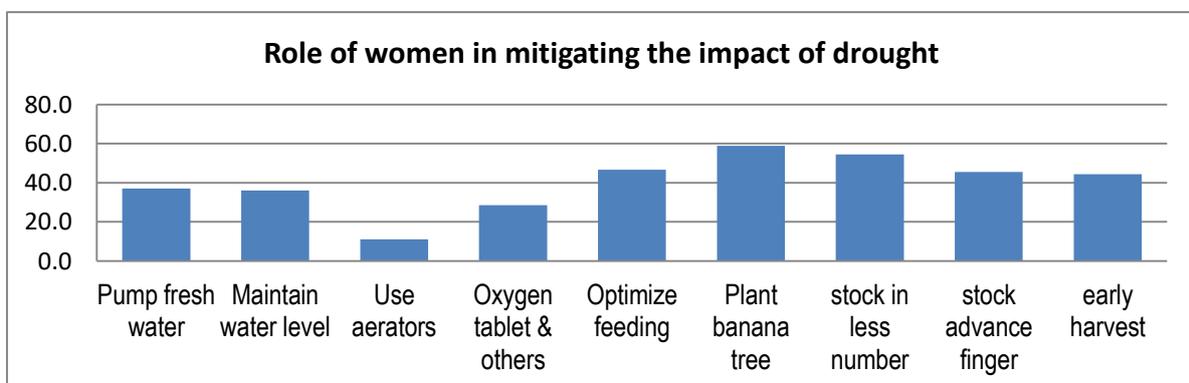


Fig. 2. Role of women farmers on mitigating impacts of drought on fish farming

## IMPACT OF THE PANDEMIC ON LIVELIHOOD: LESSON LEARNED FOR FUTURE PANDEMIC PREPAREDNESS

**Mohammad Monjurul Karim**

Student of M.Sc. in One Health, The University of Edinburgh, United Kingdom  
*s1784961@sms.ed.ac.uk*

Several endemics and epidemics strike the planet over the last two decades worldwide namely H1N1 outbreak in 2009, Ebola outbreak in West Africa in 2014, and subsequent outbreak in Congo in 2019, Zika outbreak in 2016 etc. COVID-19 pandemic is the severe most in the list as it affect the world at multi-dimensional level starting from the health, economy, education etc. It is alarming that close proximity of human-animal-environment interface which is now the closest than ever threatening the humankind for more pandemics in coming future. So it become important to find coping strategies from the lesson learned from the pandemic experience.

COVID-19 pandemic has created a severe impact on the livelihood. The impact on the work related to the manual labour was enormous, most devastatingly on the developing countries where many people depends on the manual labour for production. This study has conducted a realist review of the available literature on the impact of the livelihood to suggest possible future strategies to cope as pandemic preparedness. The review was done using a realist method of relevant published studies to understand the impact and to suggest a possible pandemic preparedness strategies.

A nationwide survey on livelihoods, nutrition, education and health in Bangladesh revealed that around 11% people turned as an agricultural worker which was the only productive work among many other coping strategies. This also supported by Islam, Khan and Barman, 2021 where they discovered an increase of fish stock despite of many negative impact on fishery sector. By contrast, an Indian study revealed the manpower shortage during this period as a negative impact of the COVID1-19 pandemic (Daniel *et al.*, 2021). This is an indication of potential coping strategy, possibly the most convenient one during any a pandemic. Where lockdown minimised the opportunity of manual labour in the cities for the resource challenged people, immediate decision of farming and fishing could be an intermediate solution for the wage based earners to survive. Where many studied reported reverse migration to village as a challenge during pandemic, this challenge could be turned in to a possibilities if supply- chain issues could be mitigated (Daniel *et al.*, 2021; Islam, Khan and Barman, 2021). Appropriate policy framework is required to develop as an intermediate coping strategies for the wage based labours, especially the developing countries like Bangladesh.

We are yet to face more devastating pandemic due to climate change and more human-animal interaction. We need to find appropriate coping and mitigation strategies for future pandemic from now on. More related research is required to be initiated to find more coping strategies to cope with the uncertainties.

**GENDERED IMPACT OF THE ALL YEAR FISHING BAN AS A DOUBLE-EDGED SWORD OF CONSERVATION ON PROFESSIONAL FISHERS AROUND THE ERHAI LAKE IN YUNNAN, CHINA**

**Sai Tang**

Asian Institute of Technology, Dong Xing Xiao Qu, Qujing City, Yunnan Province, China  
*1127571136@qq.com*

Conservation on resource and environment have social and economic impact on individuals dependent on the resource and environment. Fishing bans in China as double-edged sword help realize sustainable goals but the exclusionary effect on disadvantaged groups is also evident. However, research on the gender effect of fishing bans and conservation measures are still rare. This study aims to explore how women and men from the fishing community around the Erhai Lake have been affected by the fishing ban implemented in 2017. The study adopted both quantitative and qualitative research methods. It is found that livelihood impact of the fishing ban and related measures on professional fishers is gendered. Both women and men have been impacted, but women are faced with more vulnerabilities due to patriarchal gender norms. With household fishing days decreased dramatically, women's participation in illegal fishing trips decreased and women becomes more dependent on men's fishing activities. The convention of women in charge of household money becomes the reason of vulnerability. Women showed more responsibility to keep family life as normal as possible, while men go for Mahjong playing as a way to deal with the stress of not being able to fish. This study adds to the literature on gender and conservation with implications for more inclusive policy making to achieve the balance between conservation benefit and economic interest of impacted population.

## **THE COVID-19 PANDEMIC AND WOMEN FOLK HEALERS IN FISHING COMMUNITIES: THE CASE OF PANDAN, ANTIQUE, PHILIPPINES**

**Sashah B. Dioso and Darlene Joy D. Calsado**

Center for West Visayan Studies, University of the Philippines Visayas, Iloilo City, Philippines,  
*sbdioso@up.edu.ph, ddcalsado@up.edu.ph*

Pandan was the first municipality in mainland Antique Province, Philippines, to register a case of COVID-19 infection in April 2020. As infected cases continued to rise, mobility restrictions and lockdowns that were implemented caused hardships, anxieties, and fears to the people of Pandan specifically in fishing communities that mainly rely on the sea for their daily subsistence. Utilizing key-informant interviews, this paper looks into the lived experiences of five women folk healers in fishing communities in Pandan during the height of the COVID-19 pandemic, their personal struggles, how the pandemic affected their craft, and their methods of coping. Study results revealed that the pandemic had compounded the struggles of these women folk healers as they carried out their domestic and social responsibilities. The pandemic had also disrupted conventional methods of carrying out folk healing procedures and even forced some folk healers to stop receiving patients momentarily. However, imposed mobility restrictions, inadequate knowledge of the virus, and the fear of getting infected, among others, discouraged people to go to hospitals or consult medical practitioners for their illnesses, and instead, relied on the knowledge and skills of these women folk healers. As they could not turn away from their destined calling as folk healers, these women modified the forms but retained the essence of diagnoses and treatments that they performed to comply with preventive measures implemented by government authorities.

## ADAPTATION AND MITIGATION FOR COASTAL COMMUNITY IN PEKALONGAN FROM HIGH TIDE: USING DISSAGREGRATED GENDER ANALYSIS

Aini Nur Furoida<sup>1\*</sup>, Waridin<sup>1</sup> and Rudhi Pribadi<sup>2</sup>

<sup>1</sup>Faculty of Economics and Business, Diponegoro University-Indonesia

<sup>2</sup>Faculty of Fisheries and Marine Science, Diponegoro University-Indonesia

\*ainifuroida@gmail.com

Pekalongan is one of the important landing place for fish auction in Java. It lies in the northern coast of Java sea towards direction in wastern part of Semarang city. For the last ten years Pekalongan facing a severed problem of high tide flood (locally called as '*rob*'). *Rob* also hits several coastal areas in Java, such as Pekalongan, Semarang, Demak, Jakarta, etc. *Rob* in Pekalongan have been occurring since 2005 and lately becoming worsen.

This study aims to analyse community how is adaptation and mitigation efforts by gender wise given high tide floods. There are two sub-locations areas with permanen Siwalan District and Pekalongan Utara District. There were 50 sample had been interviewed. The informants consisted of 4 components, representing elements of academics, government, and community. Mixed method approach has been used to combine between descriptive statistics with triangulation analysis. Data collection techniques are using instruments of questionnaires, in-depth interviews, and photo voice. Further, NVIVO has been invoked to process the data.

The results showed that women's role is often limited to household chores such as sweeping, mopping, cleaning, washing clothes or dishes and kitchenware and looking after their children. A unique role of women in disasters management such as high tide are mostly in securing their property, children and/ or dependent family members (senior citizen and/ disable persons). While, men are often working outside their house and they likely prefer to avoid working nearby to the high tide flooding area and its adjunction. The ability of inhabitants (either men or women) will respond differently given such certain natural resource disaster such as high tide flooding. Similarly to their adaptation and mitigation from this natural disaster are different by disaggregated gender analysis.

## GENDER IMPACT OF MARINE PLASTICS ON FISHING COMMUNITIES IN SOUTHEAST ASIA

**Veena N\* and Kyoko Kusakabe<sup>1</sup>**

Independent Researcher, Bangalore, India

<sup>1</sup>Gender and Development Studies, Department of Development and Sustainability, SERD,  
Asian Institute of Technology, Thailand

*\*vienie@gmail.com*

Coastal communities across Southeast Asia have two main sources of livelihood, fisheries and tourism. In this paper, we will explore the impact of marine plastic on communities which are dependent on fisheries for livelihood. Most communities practice gender-based division of labor with respect to fisheries. Men go fishing in the ocean/sea while women tend to be involved in gleaning, part-time fishing and post-harvest activities. Such gender-based division of labor is also noted at the household and community level with women being responsible for the bulk of carework and hence being responsible for feeding the family, irrespective of the status of men's income from fisheries. Further, there is a gender difference in terms of access to and control over resources such as membership of fisher organizations, access to insurance, loans and grants due to loss of fisheries resources since such facilities are aimed at men and women are considered as not-fishers despite being affected by the loss in fisheries.

Due to the gender division of labor in fisheries and in the household and community, the impact of marine plastic debris is different on women and men in fishing communities. The impact on women is exacerbated due to their greater responsibility for reproductive labor and responsibility for health and food within the household, which increases women's workload for productive and reproductive work. Further, loss of men's income tends to increase violence against women within the household and in the community. Thus, marine plastic has a greater impact on women in fishing communities by increasing their productive and reproductive workload as well as increasing their responsibility for livelihood as well as family well-being. There is an urgent need to conduct field research on the specific impacts of marine plastic on every demographic within fishing communities across Southeast Asia. Although there is considerable research on plastic pollution, significant gaps remain that limit evidence-based decision making.

## **SAILING TOWARDS ECONOMIC AUTONOMY: MEXICAN FISHERWOMEN BEFORE AND DURING THE PANDMEIC**

**D. Pinedo\*, Lopez-Ercilla, I., N. Solano, J. Torre, F.J. Fernández Rivera Melo**

Comunidad y Biodiversidad A.C. Isla Del Peruano, Lomas de Miramar, Guaymas Sonora

*\*dpinedo@cobi.org.mx*

Women in fisheries have traditionally been invisible, ignored and unrecognized. In 2020, amidst the COVID-19 pandemic, despite of multi-sectoral efforts to recognize the role of women in fisheries continued worldwide, the paralysis of the fisheries sector severely affected women's opportunities to access, control and benefit from resources. This increased inequalities towards women and hindered their participation in sustainable fisheries management actions. The following proposal is situated at the intersection of three Sustainable Development Goals (SDGs). SDG 5 calls for action to achieve gender equality and empower all women and girls; SDG 8 promotes sustainable economic growth and decent work, and SDG 14 seeks to conserve and sustainably use the oceans, seas, and marine resources for sustainable development, which supports small-scale fisheries (SSF) as a key driver of sustainability.

In this work, we present four years of efforts (2017-2021) to promote gender equality in SSF sustainability initiatives in Mexico and explore the conditions necessary for fisherwomen to achieve and endure in leadership positions. We analyze the empowerment process of 14 women from nine Mexican coastal communities in the temperate Pacific, Gulf of California, and Caribbean before, during and after the pandemic. In addition, we complement the results obtained from the individual cases with information collected through 370 interviews applied between April-November 2020 to 96 women from 42 coastal communities to have a national scope of the impacts of COVID-19 on Mexican SSF.

Before the pandemic, empowered women began to be recognized as leaders in their communities and fishing cooperatives. During the pandemic, women played a key role as the main caregivers, in addition to leading tasks that contributed to their household economy and engaging in biological and fisheries surveillance towards ocean sustainability. However, in the face of a changing scenario full of uncertainties, one of the main underlying structural factors that stand out in this analysis and that must be transformed to avoid deepening gender inequalities is the lack of financing alternatives that contribute to women's economic autonomy and sustainability. In response to the socio-environmental shocks posed by the pandemic, this proposal incorporates the first steps of a reflection process and strengthening capacities in financial management. We incorporated sessions aimed at healing the relationship with money directed to women and young community leaders that seek to contribute to the development and sustainability of fisheries projects from and for women.

Women in fishing face complex struggles that are accentuated by global impacts such as catastrophes, climate change and COVID-19 pandemic. Despite the efforts made to value their socio-environmental contributions, the economic approach still needs to be

more present since it represents a powerful source of power. Women know the domestic economy well, however it is time to conquer economic spaces traditionally reserved for men, such as the financial management of professional activities and the public sphere. This ultimately nurtures their economic self-determination and their opportunities for freedom.



**VULNERABILITY AND SAFETY OF WOMEN FISHERS ON HYDRO-METEOROLOGICAL HAZARDS IN SMALL ISLAND COMMUNITIES OF CARLES, ILOILO, PHILIPPINES**

**Darlene Joy D. Calsado\* and Sashah B. Dioso**

Center for West Visayan Studies, College of Arts and Sciences, Iloilo City, Philippines

\**ddcalsado@up.edu.ph*

Small island communities are particularly vulnerable to the impacts of hydro-meteorological and anthropogenic hazards. Exposure to these hazards directly and primarily affects their fisheries livelihood. This study looks into the progression of vulnerability and safety of women fishers from these hazards in the small island communities of Carles, Iloilo, Philippines particularly the Gigantes group of islands. Various strong typhoons such as Fensheng in 2008, Haiyan in 2013, and Phanfone in 2019 ravaged them. These communities also commonly experience localized microclimate phenomena like *pugada* (squall) and *halakay* (prolonged strong winds that last for days or weeks). This study uses the Pressure and Release (PAR) Model as a tool for analysis through key informant interviews and focus group discussions. This model demonstrates how disasters occur when natural hazards affect vulnerable people. Results show the complex and dynamic pressures of vulnerability of women fishers such as geographical isolation; incapacities to address underlying risk conditions; boom and bust of tourism, among others. These dynamic pressures put them in unsafe conditions such as: high poverty incidence, malnutrition, high birth rates, poor sanitation, dependence to extractive and unsafe livelihoods, and exposures to various natural and human-induced hazards. Based on the PAR Model, in order to release the “pressures”, the vulnerability must be reduced. Among those reduction mechanisms identified by women fishers are: capacity building measures, diversification of livelihood sources, social and economic buffers such as access to food, cash and credit, health, and welfare services to cushion the trauma or stress of disasters. When root causes of dynamic pressures are addressed, vulnerabilities are reversed towards safety, sustainability, and resilience.

## **PANGABUHI SA PANDEMYA: COVID-19 CHALLENGES AND RESPONSES OF WOMEN SHELL FISHERS IN SMALL ISLAND COMMUNITIES**

**Lovella Mae M. Magluyan**

University of the Philippines Visayas, Miagao, Iloilo, Philippines

*lmmagluyan@up.edu.ph*

Shell fishery is a thriving industry in the Philippines providing employment, income and revenue for the country. Shellfish meat is a cheap but important protein source for poor coastal communities. The Gigantes group of islands in the municipality of Carles, Iloilo, Philippines, is one of the exploited sites of shellfish production in the Philippines. Commercially traded shellfish in the area are scallops known locally as “*tikab*”, spiny oysters known locally as “*bukol bukol*” and ark shells locally called “*litob*”. These species are not cultured and are usually collected by gleaning and diving during their seasonal occurrences in Panay Island.

In 2020, a global pandemic was declared because of the emergence of the corona virus disease. Despite being a health issue, the pandemic brought about unprecedented controls on travel and social distancing protocols, significantly impacting agricultural and fishery distribution and food chain disruption. The pandemic brought even greater physical and psychological demand for the women shell fishers who continuously face diverse risks in the entire process of shell collection (gleaning), shell meat removal (shucking), and shell trading.

This study highlights the challenges and responses of women shell fishers to the pandemic from March 2020 to June 2022 through semi-structured survey interviews. These challenges include cessation of income due to forced fishing restriction, financial burdens, struggles of home schooling and temporary disconnection from the mainland due to strict travel protocols. These challenges exacerbated the multiple layers of marginalization of women shell fishers in small islands on top of being mothers, wives and community workers. Their responses include shifting income generating activities from fishing, providing emotional support to family members, helping in enforcement of community quarantine, accessing help in module preparation/ home schooling and availing high interest loans from financiers as they have no access to formal lending institutions. Despite these challenges, women shell fishers remain positive and hopeful in navigating life towards the pandemic.

## **GENDERED VULNERABILITY OF COASTAL FISHER COMMUNITIES TO CLIMATE CHANGE IN KERALA STATE, INDIA**

**Aswathy N\*, P.U Zacharia, P.V.Sunil, Shyam S Salim and Athira N.R**

ICAR-Central Marine Fisheries Research Institute, Kochi-682 018, India

*\*aswathy.icar@gmail.com*

Climate change poses one of the greatest challenges the world faces today and its impacts are far severe and faster than predicted jeopardising the sustainability of environment and socio-economic development. United Nations Framework Convention on Climate Change (UNFCCC) identified the state of Kerala along the south west coast of India as one of the climate vulnerable hotspots threatened by extreme events including sea level rise. Coastal fisher communities across the world are highly vulnerable to climate change in view of their dependence on fishery based livelihoods, depletion of marine resources, low resource possession, lack of fishing rights and other environmental hazards. Climate change hazards cause disproportionate impacts on women and gender based livelihood vulnerability assessments are essential for effective decisions on adaptation strategies within the constraints of local resources and infrastructure. The paper portrays the results of the gendered vulnerability assessment of coastal fisher households in Ernakulum district of Kerala state. A composite livelihood vulnerability index (LVI) was developed based on the data on 400 small scale fisher households. The LVI was constructed across 8 major components consisting of socio-demographic particulars, livelihood strategies, health, water, food, infrastructure and financial capital, social networks, natural disasters and climate variability. The results indicated that female- headed households had significantly higher vulnerability (LVI-0.40) compared to male -headed households (LVI- 0.36) and suggest the need for gender inclusive approach in the national, state and local level action plans on climate change adaptation and disaster - risk reduction programmes.

## **THE IMPACT OF COVID-19 ON THE SMALLHOLDER WOMEN VEGETABLE FARMERS IN THE EASTERN TARAI REGION OF NEPAL**

**Dipika Das\* and Sanjeev Poudel**

Global Institute for Interdisciplinary Studies, Chakupat, Lalitpur, Nepal

*\*dipika.das@gmail.com*

Disasters and shocks often present a myriad of challenges to smallholder farmers. The COVID 19 pandemic affects smallholders disproportionately specially on low-income women and marginalised groups compared to their counterpart. The study examined the impact of COVID-19 on the marginalised women smallholder farmers in the Eastern Tarai region of Nepal including their coping strategies implemented during the time of pandemic using a feminist political ecology framework. We investigated how women smallholder vegetable farmer in Saptari district of Eastern Tarai of Nepal had coped during the COVID-19 pandemic and in what ways there were impacted at household level. On the basis of this analysis, we draw out implications to develop gender friendly strategies to support the women smallholder farmers. We employed a qualitative method by interviewing 30 respondents and 5 focus group discussions with the women smallholder vegetable farmers and key informants from the Saptari district. We found that the COVID-19 induced lockdown disrupted the market access, financial abilities and the stay-at-home protocol increased women vegetable farmers work burden along with less time to sell their produce for instance mobility restriction time allocated by the administration. Institutional support was needed to access the market to sell their vegetables. Until the lockdown was lifted the women managed their livelihood by selling vegetables from door-to-door, relying on social networks, and depending on high interest credit availabilities locally. We argue that understanding coping strategies of small landholder women farmers is critical in developing support measures during the shocks or to establish effective restrictions strategy in the times of shock such as COVID-19.

## ENHANCING LIVELIHOODS THROUGH ACCESS TO POULTRY FEEDS AMONG SMALLHOLDERS IN POST COVID-19 ERA IN EASTERN KENYA: A GENDER PERSPECTIVE

Wilckyster N. Nyarindo<sup>1\*</sup>, Hezron N. Isaboke<sup>1</sup>, Robyn Alders<sup>2</sup>

<sup>1</sup>Department of Agricultural Economics and Extension, University of Embu, Kenya

<sup>2</sup>Development Policy Centre, Australian National University

\*nyarindo.wilckyster@embuni.ac.ke

In Kenya, poultry production is a key enterprise among smallholders, with about 70% of the rural folks deriving at least part of their livelihood from poultry farming. The subsector has experienced slow growth attributed to a rise in costs of inputs, lack of access to quality feed, and incomplete information about the input and output markets, as well as the recently emerged Coronavirus disease-19 (COVID-19). Hence the need to determine how small-scale farmers', especially women's, livelihood strategies and investments in chicken farming technologies interact and influence vulnerability and resilience to COVID-19.

We present preliminary findings that show high cost of feeds, lack of output markets, inadequate resources to formulate own feeds, lack of resources for disease vaccination, drought and inadequacy of water has highly affected the poultry sector. In addition birds are also highly exposed to the risk of predators as a result of scavenging.

Some coping strategies adopted by farmers in the post COVID-19 era include; reduction of poultry stock, group / bulk buying of chicks, feeds, vaccines and marketing. Also farmers reduced the frequency of feeding the poultry to once in a day and letting them scavenge and made own feed formulation e.g. (mixture of cowpeas and maize). Other farmers also crushed maize combs, while some mix commercial feeds with sand to feed the chicken. Alternative sources of proteins for the poultry included termites, white ants, maggots from the poultry manure, *omena*, croton tree (*Croton megalocarpu*) branches owing to its nutritional value.

The poultry sector is dominated by women and youths who are mostly organised in groups. There is growing consensus among all stakeholders that with the introduction of improved indigenous poultry breeds, the pure indigenous breed has seriously reduced and if no action is taken to preserve the breed, they will soon extinct. Further, it was established that COVID-19 pandemic posed a significant challenge on poultry production which is yet to be well documented and understood.

## COVID-19 AND THAI MARINE CAPTURE FISHERY IN THE GULF OF THAILAND: A CASE OF SMALL-SCALE FISHERY VERSUS INDUSTRIAL FISHERY

Watcharapong Chumchuen<sup>1</sup>, Shiela Villamor Chumchuen<sup>2\*</sup>, Krisada Kajonrit<sup>1</sup> and Kraison Krueajun<sup>1</sup>

<sup>1</sup>Marine Fisheries Research & Development Division, Department of Fisheries, Bangkok, Thailand

<sup>2</sup>Secretariat, Southeast Asian Fisheries Development Center, Bangkok, Thailand  
*\*svchumchuen@gmail.com*

By the end of 2020, Thailand had a low number of COVID-19 cases in comparison to other countries; however, the socio-economic well-being of the country was also severely affected, including the fisheries sector. The objectives of this research were to identify the impacts of COVID-19 on fishers in the small-scale fishery (SSF) and industrial fishery (IDF) and to distinguish the support received as well as additional government support requested by fishers in SSF and IDF. This research also aimed at discussing fishing technology extension to correspond with the additional government support. Data were collected from 171 Thai fishers (97 in SSF and 74 in IDF) through interviews in five coastal provinces along the Gulf of Thailand from July to November 2020.

The majority of the interviewed fishers were men for both SSF and IDF, and the gender ratio (women:men) was 1:31 in SSF and 1:24 in IDF. The roles of interviewed fishers were skipper, worker onboard, steersman, mechanic, and vessel owner; besides, most of them were skippers for both SSF and IDF. Some women in SSF were vessel owners and workers onboard, while some women in IDF were vessel owners. Most fishers in SSF and IDF experienced similar impacts of COVID-19, i.e. decreased number of market channels, price of fish, and revenue from the catch. They received support from the national government (i.e., financial assistance and fishing gear), the local government and private sector (i.e., financial donations and subsistence supplies), and the government banks (i.e., low-interest bank loans). However, 67.0 % of fishers in SSF and 74.3 % of fishers in IDF requested additional government support which was categorized into 1) fishing vessel and gear technology, 2) workers onboard recruitment system, 3) regulations, policies, and measures, 4) marine environment and fishery resources, 5) investment and marketing system, 6) infrastructures, and 7) other support. The extension of fishing technology and other support were discussed to address the additional government support and sustain the marine capture fishery. It is crucial to continue supporting fishers in both SSF and IDF during the persistence of the COVID-19 pandemic and consider the prevention or mitigation measures for other pandemics or disasters in the future.

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**ECONOMIC EMPOWERMENT OF WOMEN AND HOUSEHOLD RESILIENCE  
DURING COVID 19 PANDEMIC: INSIGHTS FROM SMALL SCALE FISHER  
HOUSEHOLDS IN KERALA STATE**

**Aswathy .N\*, Anuja A R., Sunil P .V and Vipinkumar V. P**

ICAR-Central Marine Fisheries Research Institute, Kochi-682 018, India

*\*aswathy.icar@gmail.com*

The COVID 19 pandemic disrupted all facets of human life and created disproportionate impacts on various sections of the society. The vulnerable population including workers in the informal sector, migrant labourers and women having low access to productive assets and lack of social protection measures suffered most during the pandemic. The paper attempts to analyse the effects of economic empowerment of women on the resilience of small scale fisher households during the COVID 19 crisis. Small scale fisher households in Alappuzha and Ernakulam districts in Kerala state were selected for the study. The effects of the pandemic on household income, expenditure, and indebtedness were analysed. The women in the selected fisher households were employed as house maids, workers in peeling sheds, fishing allied activities and workers under Mahatma Gandhi National Rural Employment Guarantee Act. The average earnings of women working in peeling sheds of Alappuzha district was higher than other category workers during the pandemic. There was 30% reduction in monthly household expenditure in the households in Ernakulam district compared to 21% reduction in Alappuzha district during the pandemic. The decline in household income increased the indebtedness of small scale fisher households and more than 75% of the households borrowed money to tide over the financial constraints. Although the average monthly income earned by the women workers was more in Alappuzha district, freedom to spend money was less. Increase in gender based violence (37%) and household work (67%) were reported by the respondents in Alappuzha district during the pandemic. The results of the study revealed that economic empowerment of women enhanced the resilience of small scale fisher households and stresses the need for improving the gender equality in fisher households.





**Session 4:**  
**Gender justice & institutional roles: Policy regime, roles of  
civil society, academia and other formal and informal  
institutions at local, national and global levels**





## WOMEN ROLE IN SHARK FISHERIES IN INDONESIA

Muhammad Ichsan

University of Sunshine Coast, 90 Sippy Downs Dr, Sippy Downs QLD 4556, Australia  
*Muhammad.Ichsan@research.usc.edu.au*

Indonesia is the biggest shark fishing country in the world, with a year production of more than 100,000 tons. The annual export value of shark products from Indonesia is reportedly around USD 10 million. Furthermore, high volumes of sharks are caught incidentally or as valuable secondary catch in small-scale, mixed-species tropical fisheries, which contribute to food security in poor and developing nations. The shark fisheries in its right is a controversial topic by itself, not to mention the gender role in the full chain of its utilization. The fact that women have a huge role in fisheries chain especially in processing and trade are still not acknowledge properly, under-studied and most of the time excluded from fisheries management policies especially development countries. We take example from two communities of targeted artisanal shark fisheries in Southwest Aceh and Tanjung Luar, some of the largest shark fisheries hotspot in the world.

The results of the assessment in Southwest Aceh and in Tanjung Luar show that shark fisheries are an important livelihood in this community in many aspects including social, economic, and cultural. There is an urgency that we need to involve more women as our management subject for example fisher's wives or any other female that contribute to coastal community livelihood since they have very important roles (as traders, processor, household financial manager). The management in fisheries will affect them in many aspects. However, their attendance and representation is currently at minimum and leadership role for women still need more encouragement. From this assessment, some recommendation includes a community-based management approach and exploring sustainable alternative livelihoods. This assessment hopefully will contribute to future decision-making processes aiming at alleviating poverty for shark fishing communities.



Figure 1. Women in shark fisheries: Processing (left) and packaging (right).

## **DIALOGUE FROM THE FIELD: EMBRACING STRENGTHS AND VOICES TO CODESIGN A GENDER INCLUSIVE SEAWEED PROGRAM**

**Libby Swanepoel<sup>1, 2\*</sup>, Courtney Anderson<sup>1, 2</sup>, Barbara Pamphilon<sup>3</sup>, Silva Larson<sup>2</sup>, and Ulusapeti Tiitii<sup>4</sup>**

<sup>1</sup>Australian Centre for Pacific Islands Research, University of the Sunshine Coast, Australia

<sup>2</sup>School of Health and Behavioural Sciences, University of the Sunshine Coast, Australia

<sup>3</sup>Centre for Sustainable Communities, University of Canberra, Australia

<sup>4</sup>Ministry of Agriculture and Fisheries, Apia, Samoa

\**lswanepo@usc.edu.au*

Participatory research approaches, such as codesign, contest existing power structures through collaborative and bottom-up engagement, thus aligning with constructs of decolonization. Within the global landscape of agricultural research for development, we are seeing shifts in how projects are designed and delivered towards more inclusive and “horizontal partnerships”, working with communities from the bottom-up. In this project, we followed a participatory approach to codesign a gender inclusive seaweed program to support Samoan communities to work collaboratively in the planning and management of seaweed activities across the village level value chain.

Seaweeds are a traditional food in Samoa, valued in culture and tradition as well as providing livelihood, food and social capital. Women play a prominent role in many stages of the seaweed value chain, including gleaning, processing, marketing and cooking. Improving participation and economic outcomes for women requires taking a strengths-based approach to promote and build on existing assets and capabilities of women. The existing collaborative nature of Samoan villages provides ready opportunity to follow a strengths-based process of appreciative cooperation to support women and men, from the bottom up, to use their unique village assets to codesign their own solution to needs and issues.

We set out to codesign a gender sensitive seaweed program that drew upon the strengths and assets within Samoan village culture. Our work was couched in a participatory approach, using appreciative inquiry, and embracing the strengths and voices within both communities and institutions. By directly involving people in the codesign of the program that will shape their lives, we further aimed to build ownership and sustainability of the program and its outcomes.

This presentation will offer a dialogue between two researcher teams, one from Samoa and the other from Australia, on the codesign of a gender sensitive village-based seaweed development program. We will present the four stages of the codesign process within a framework of appreciative inquiry and offer insights and commentary from both Samoan and Australian perspectives- Discovery; Dreaming; Design; and Delivery.

## **GENDER DIFFERENCES IN PERCEIVED IMPACTS OF CORAL REEF MANAGEMENT IN FIJI, INDONESIA, KENYA, MADAGASCAR, PAPUA NEW GUINEA AND SOLOMON ISLANDS**

**Sarah Harper<sup>\*1</sup>, Emily Darling<sup>2</sup>, Sangeeta Mangubhai<sup>3</sup>, Georgina G. Gurney<sup>4</sup>, Natalie Ban<sup>5</sup>**

<sup>1</sup>School of Environmental Studies, University of Victoria, Victoria, Canada

<sup>2</sup>Marine Program, Wildlife Conservation Society, United States

<sup>3</sup>Talanoa Consulting, Suva, Fiji

<sup>4</sup>Australian Research Council, Centre of Excellence for Coral Reef Studies, James Cook University, Australia

<sup>5</sup>School of Environmental Studies, University of Victoria, Canada

*\*sharper8@uvic.ca*

Coral reefs are among the most diverse marine ecosystems on the planet, and are a critical source of livelihoods, cultural identity and food security for millions of people who depend on the fisheries connected to these environments. As linked social-ecological systems, coral reefs are a critical case study for investigating environmental governance through an equity lens, whereby social and ecological objectives and outcomes are evaluated. Focusing here on gender equity, we examined gender-differentiated outcomes of coral reef management using data collected by the Wildlife Conservation Society's coral reef management programmes in Fiji, Indonesia, Kenya, Madagascar, Papua New Guinea, and Solomon Islands. This dataset, that includes demographic information, provides a unique opportunity to explore gender differences in perceived impacts (costs and benefits) of management. This was done through a gender analysis of responses to a household survey conducted by local practitioners across 150 coral reef sites in six countries in the Indo-Pacific, where small-scale fisheries provide important social, cultural, health and economic benefits to women, men, and children. The open-ended survey responses and themes emerging from them were grouped into various domains of human wellbeing to investigate what aspects of human wellbeing are being supported or challenged by coral reef management efforts, and how these differ by gender. The findings respond to increasing emphasis on making progress towards gender equality and the empowerment of women as articulated within the Sustainable Development Goals, the Convention on Biological Diversity's post-2020 biodiversity framework, the Voluntary Guidelines for Sustainable Small-scale Fisheries and other norm setting international policy frameworks. The insights from this analysis aim to also contribute to broader conversations in coral reef management on how to reconcile environmental and development objectives and outcomes within environmental governance, and specifically how to assess and advance gender equitable outcomes across various country contexts where fisheries play a substantial role in the lives of coastal peoples.

## GENDER BASED INFORMATION ON PATENTING ACTIVITIES IN THE INDIAN FISHERIES SECTOR

**Santosh N. Kunjir\*, Arpita Sharma and Vinod K. Yadav**

ICAR-Central Institute of Fisheries Education, Panch Marg, Yari Road, Mumbai, India

*\*santosh.fexpa906@cife.edu.in*

It is reported that women make up only 28% of the workforce in Science, Technology, Engineering and Math (STEM), and men vastly outnumber women majoring in most STEM fields in college. As per World Intellectual Property Organization (WIPO), gender gap persists in the status of women in patenting and with reference to India women inventors had 28.33 % share of Patent Cooperation Treaty (PCT) applications in 2017. However, there is no gender disaggregated information about inventors who were granted patents in the Indian fisheries sector and this paper addresses this research gap. To achieve the objectives, patents granted since last 10 years (2012-2021) were mined from the official journal of the patent office published weekly by the Indian Patent Office and available online. Thereafter, patent title and Abstract - TS were read manually and patents related to fisheries and aquaculture were extracted and data was collated. In addition, this information was also corroborated from websites/annual reports of ICAR fisheries institutes, College of Fisheries, published articles/database wherever possible. However, it was seen that in the official journal of the patent office, gender of the inventors was not mentioned. So, based on discussion with experts and verification by searching the inventors from their respective organizations' portals, judgements were made. The study revealed that 61.86% of patents were granted to Indian applicants while foreign applicants accounted for 38.14%. It was found that out of total Indian inventors 80.54% were male and 19.46% were female inventors and there was a statistically significant difference. The ratio of female to male inventors was about 1:4. Further it was observed that since 2012 number of male inventors have increased. Some studies have also indicated that the women who are already in STEM fields engage in the patent system far less frequently than their male counterparts and women hold only small share of patents. Government of India has schemes and interventions to encourage participation of women in science and technology so as to reduce the gender gap in patenting activities, to promote innovation and entrepreneurship amongst women.

## **WOMEN, WATER AND LIVELIHOOD OF COMMUNITY IN LOK BAIN TAN – MARTAPURA RIVER, SOUTH KALIMANTAN, INDONESIA**

**Rahmi Widyanti, Farida Yulianti, Lamsah, Mentari Anggun Djatayu<sup>1</sup> and Indah Susilowati<sup>1\*</sup>**

Universitas Islam Kalimantan – Indonesia

<sup>1</sup>Diponegoro University-Indonesia

*\*prof.indah@gmail.com*

Kalimantan or Borneo is one of the biggest islands in Indonesia. South Kalimantan has a great abundance of natural resources and is famous with the title of “thousands rivers”. The most efficient and favourable transportation with a unique of swamp land since ancient time is river.

The objectives of the study were to analyse the vulnerability and resilience of women in maintaining their livelihoods in the study area; to formulate the strategies to improve community livelihoods with highlighting the role of women and water; and to outline blueprint of sustainable resource management of Martapura river.

Both quantitative and qualitative approach (mixed method) were used to analyse the data which comprised of primary and secondary data. We carried out in depth interview to informant or competent persons of the stakeholders (academician, business, government and community) and also applied a photo voice technique. There are two floating markets in South Kalimantan, namely: Muara Kuin and Lok Baintan. The study area is situated along Martapura River with floating market of Lok Baintan.

Majority of the traders and consumers in floating market are women. Every day, traders leave their villages very early in the morning and bring assorted agriculture, forest and other commodities on their small canoe alone from far away to the floating market. The results indicated that the efforts of women to support their family and community are really important. The big question now is whether millennial women in the study area will take over their mothers or women’s peers roles?

## **GENDER PERSPECTIVE IN WILD SEAWEED VALUE CHAIN: A CASE FROM GULF OF MANNAR AND PALK BAY, TAMIL NADU**

**M.S Ahila<sup>1</sup>, Neha W. Qureshi<sup>1\*</sup>, Ananthan P. S.<sup>1</sup>, Shivaji Argade<sup>1</sup> and Johnson, B.<sup>2</sup>**

<sup>1</sup>ICAR-Central Institute of Fisheries Education, Mumbai

<sup>2</sup>ICAR- Central Marine Fisheries Research Institutl, Mandapam

*\*nehaq@cife.edu.in*

Promoting women's equal footing with men has become a pressing issue in many development programs, leading to the advent of gender-inclusive value chain approaches. Gender-inclusive value chains essentially aim to reflect the different roles that women and men play in value chains and capture the gains of marginalized groups in the market systems. Gender-disaggregated data on employment in the wild seaweed value chain, as well as on incomes and wages, remain lacking. Therefore, the present study analyses the wild seaweed value chain in the Gulf of Mannar and Palk Bay region from a gender perspective. Data were collected from 185 respondents using structured interview schedules and focused group discussions. Value chain mapping, descriptive analysis, and marketing efficiency tools were used for the data analysis. The harvester, agent, and processor were three key players in the wild seaweed value chain. Women were apparent in the different nodes of the chain and played a pivotal role in collecting wild stocks, post-harvest, and processing segments. About 57% of the seaweed harvesters were women, and 61% had it as their primary source of income. All seaweed agents were men. They hire women to dry the seaweed and men to load and transport it. At the downstream level, the seaweed processing plants were owned by men, and they employed both men and women for processing. However, compared to the harvesting stage, the involvement of the women were less obvious at the downstream level. The processors receive the lion's share of profit among the value chain players'. Gender analysis of the wild seaweed value chain facilitates the exposition of women's and men's contributions and their roles, which the usual market analysis would not be able to present. It is recommended that in order to develop gender-inclusive policies and interventions in this sector, a systematic large-scale study can be conducted to gather more empirical facts and figures.

## **WOMEN'S EMPOWERMENT IN SMALL-SCALE FISHERIES AND AQUACULTURE: TOWARDS A MORE EFFECTIVE GENDER-INCLUSIVE PROGRAM DESIGN IN SOUTHEAST ASIA**

**Amanda Morelli**

MSc Development Studies

London School of Economics and Political Science, United Kingdom

*Arosemorellix@gmail.com*

Although current policies and programs are now recognizing the need for gender equality in small-scale fisheries and aquaculture (SSFA), the impacts and implications of their efforts in connection to women's empowerment has not yet been well understood.

The main objective was to explore how the designs of current gender-inclusive programs in SSFA can directly influence local women's empowerment in Southeast Asia.

This secondary qualitative research utilized a combined gender analysis framework, called the Empowerment and Equality Analytical Framework, to assess three current gender-inclusive program designs in SSFA in the countries of Cambodia, Myanmar, and Indonesia. The study analyzed how local gender relations take form in each regional case study community. It then assessed which direct levels of empowerment the program designs are looking to address, followed by which changes in norms and structures the program designs are looking to engage with. Lastly, the study sought to understand how the aims of the program designs influence local women's empowerment in the targeted communities.

All three gender-inclusive program designs in SSFA regard women's economic dependence and exclusion as the problem, and thus seek to create equality and empowerment through the strengthening of women's engagement in productive roles. Overall, local women in the targeted communities are being empowered through access and conscientization, as well as engaged through the baseline level of welfare. Moreover, gender equality is being created through individual changes involving resources, consciousness, and capabilities. The program designs largely do not engage with neither the empowerment levels of participation and control nor the systemic changes of social norms, deep structures, rules, and policies.

The research identified a broad range of limitations to, and potentially dangerous implications in, the aims and approaches of these gender-inclusive program designs. These insights include: The disregard of men's crucial engagement in gender equality and women's empowerment; the sole concentration on strengthening and expanding women's pre-established productive roles; the emphasis of neoliberal market solutions to gender marginalization; an exacerbation of the triple burden women must face in their everyday life; and a missing gap in directly supporting one of the most vulnerable subgroups of women in these regional communities, which comprise of local fisherwomen. The results of this study show that many efforts have been made to improve gender equality in SSFA in

Southeast Asia, yet a gender transformative approach, whereby root causes of gender inequality and unequal power relations are addressed and reshaped, has been overlooked.

Critical shifts in current dominant gender equality narratives and assumptions, as well as an embrace of multi-level empowerment strategies, provide opportunities for development initiatives in SSFA in Southeast Asia to make local, sustainable, and transformative progress toward gender equality and women's empowerment.



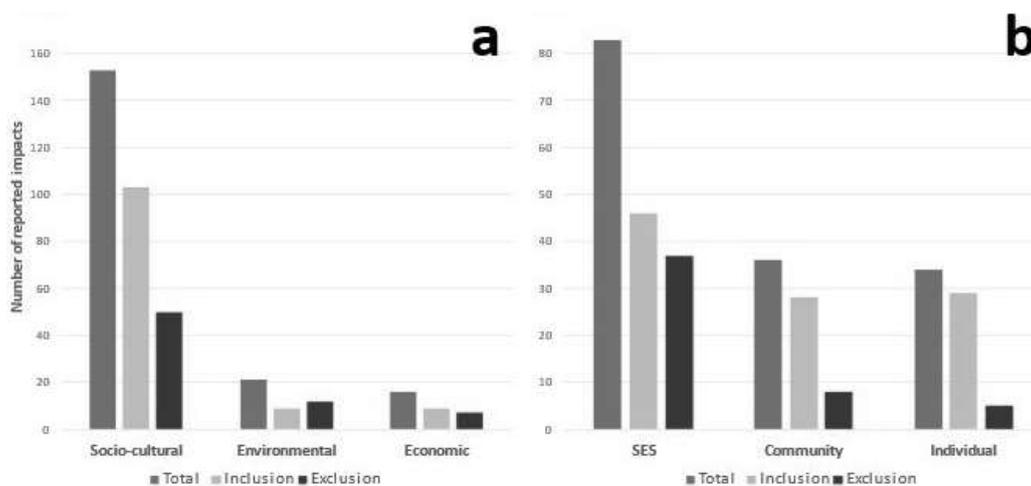
## MAKING WAVES IN SMALL-SCALE FISHERIES: A SYSTEMATIC REVIEW OF GENDER-INCLUSIVE MANAGEMENT

Mouna Chambon<sup>\*1</sup>, Sara Miñarro<sup>1</sup>, Santiago Alvarez Fernandez<sup>1</sup>, Vincent Porcher<sup>1</sup>, Victoria Reyes-Garcia<sup>1,2</sup>, Huran Tonalli Drouet<sup>3</sup>, Patrizia Ziveri<sup>1,2</sup>

<sup>1</sup> Institute of Environmental Science and Technology, Universitat Autònoma de Barcelona, (ICTA-UAB), Barcelona, Spain, <sup>2</sup> Institutio Catalana de Recerca i Estudis Avancats (ICREA), Barcelona, <sup>3</sup> Université libre de Bruxelles, Avenue Franklin Roosevelt 50, 1050, Bruxelles.

\**Mouna.Chambon@uab.cat*

While women make up half of the fisheries workforce globally, their contribution to the sector has long been overlooked with implications for fisheries management. To assess trends, barriers, enablers, and impacts of women's participation in small-scale fisheries (SSF) management, we conducted a systematic review of peer-reviewed literature (n= 124 case studies). Research on women's participation in SSF management is a growing field, with a particular interest in tropical marine fisheries in co-managed settings. Women had no or limited participation in more than 80% of the examined case studies. Where women did participate in SSF management, they also engaged in other SSF activities, especially production. Limited participation of women in SSF management was higher in co-managed sites. While women face many socio-cultural barriers to be included in SSF management, specific policies can provide the enabling conditions that leverage their participation in SSF management. The literature suggests that women's participation in SSF management is associated to multiple positive socio-cultural impacts, whereas their exclusion results in negative social outcomes. Impacts of women's participation in SSF management spread to their community and the social-ecological system as a whole. We conclude by highlighting the need to address structural socio-cultural barriers that prevent women to actively participate in SSF management and to favour more participatory approaches to move towards gender-inclusive management in SSF.



**Figure 1-** Bar charts displaying the number of reported impacts per impact category and participation level of women in SSF management (n= 190 reported impacts) (a), and the number of reported socio-cultural impacts per social level and participation level of women in SSF management (n= 153 reported socio-cultural impacts) (b).

## **AUGMENTING LIVELIHOOD AND KNOWLEDGE OF ABORIGINES AND IMMIGRANTS OF ANDAMAN AND NICOBAR ISLANDS THROUGH VALUE ADDITION IN FISHERIES**

**Sreepriya Prakasan\*<sup>1</sup>, U Abarna<sup>2</sup>, Ajina S. M<sup>3</sup> and Gladston Y<sup>3</sup>**

<sup>1</sup>ICAR-Central Institute of Fisheries Technology, Willingdon Island, Kochi-682 029, India,

<sup>2</sup>ICAR-Central Island Agricultural Research Institute, Port Blair, Andaman and Nicobar Islands-744 105, India

<sup>3</sup>Regional station, ICAR-Central Island Agricultural Research Institute, Minicoy, Lakshadweep

*\*sreebfsc@gmail.com*

The Andaman and Nicobar is a union territory of India having a group of 572 Islands in the Bay of Bengal in close proximity to South East Asian countries. 37 Islands are inhabited mainly by the immigrants from Mainland, India and aborigines inhabit the remote Islands. There are six native tribal groups namely Nicobarese, Great Andamanese, Shompens, Onges, Jarawas and Sentinels. Marine fishery sector forms a major source of livelihood due to their secluded geographical location with diverse marine resources. There is acute shortage in knowledge flow to the Islanders as the exposure is limited due to lack of connectivity. Considering the imminent need to attract the unemployed youths towards fisheries sector especially value addition as Islands are blessed with untapped rich marine biodiversity, various trainings and sensitization programmes were conducted. The Islanders including nicobarese were sensitized on the potential of fishery resources and how best they could be capitalized for socio economic and livelihood development through fish processing. Car Nicobar is completely tribal based with restricted entry for outsiders. Almost 99% of the Nicobarese belong to ST community. Out of 175 beneficiaries, 115 (66%) were women stakeholders including students in which 58% belong to tribal community and 68% were immigrants. Participants were exclusively trained to develop ethnic, mince based and coated products and by-products. Stakeholders have started earning auxiliary income from the sale of the fishery based products within the Island, participating in exhibitions and seafood festivals. Tribal participants showed a positive attitude towards self-employment through fisheries beyond subsistence fishing.



**Session 5:**  
**Understanding women's rights: Tenure, resources,**  
**institutions, inputs, foods, nutrition**





## LOOKING AT FISHERIES AND AQUACULTURE THROUGH A GENDER LENS

Meryl J Williams<sup>1\*</sup> and Victoria M. Syddall<sup>2</sup>

<sup>1</sup>Gender in Aquaculture and Fisheries Section, Asian Fisheries Society, Malaysia

<sup>2</sup>Institute of Marine Sciences, University of Auckland, New Zealand

\**MerylJWilliams@gmail.com*

Bringing together knowledge from many sources, we are writing a book on the impacts of the political economy on women in aquaculture and fisheries. A particularly rich source that started in 1990 comes from the studies presented at events, in publications, and in position statements led by Asian Fisheries Society Indian Branch (AFSIB), Asian Fisheries Society (AFS) and (since 2017) Gender in Aquaculture and Fisheries Section of AFS (GAFS). The AFS-linked sources have gradually grown in substance and authority. The growth has come through the work of all participants, including presenters and authors who shared their wisdom and scholarship from earlier studies in Asia and other regions. Gender in aquaculture and fisheries (GAF) now represents a meaningful contribution to the collection of feminist knowledge-building projects occurring in fields from economics and global political economy to science, technology, agriculture, forestry, water, and climate.

Our book is focusing on why women in the fish sectors apparently are becoming more technologically excluded, economically ostracized, and politically powerless – hence the political economy framework. Our presentation will outline the content of the book and introduce its analytical framework. The framework comprises: (1) the production elements of the fish sectors (fisheries and aquaculture); (2) the organisation of the fish economy; and (3) its organising institutions. This framework can be considered from different perspectives that differ in their conceptions of the nature of society, the economy, and people. We will introduce, briefly, three different perspectives and use one, intersectionality and feminism, in examining the systemic and structural practices and ideologies that can discriminate against women. Our approach also situates, within the framework, many of the familiar narratives on women and fisheries, such as “women are invisible,” “women don’t fish,” “women can’t get access to technology,” “women lack political power,” and “social norms determine the gender divisions of labour.” The framework can help practitioners work out where to intervene in sectoral (and social) practices in ways that could lead to better outcomes for gender equality. We present this as a work-in-progress and welcome feedback.

**“BETWEEN THE SHORE AND THE REEF, THERE IS A SCHOOL”: WOMEN’S FISHERIES ARE CRITICAL FOR THE INTERGENERATIONAL TRANSFER OF INDIGENOUS KNOWLEDGE AND VALUES IN PALAU**

**Caroline E. Ferguson<sup>1\*</sup> and Surech Bells<sup>2</sup>**

<sup>1</sup> Bren Hall, 2400 University of California, Santa Barbara, CA 93117, United States

<sup>2</sup> Republic of Palau

*\*carolineferguson@ucsb.edu*

Intangible cultural heritage is inextricably tied to tangible natural heritage in coastal communities, so the degradation of marine resources directly threatens cultural practice. Meanwhile, shifting incentives and lifestyles under the capitalist political economy have alienated people from resources and created incentives for overexploitation. Drawing upon qualitative and quantitative data collected in Palau between March 2018 and April 2021, we show that gleaning is a critical site for the intergenerational transfer of the ecological knowledge and values that underpin successful ocean management in Palau, and that commodification of gleaned resources has undermined gleaning as a ‘classroom’. We highlight the centrality of women’s fisheries to Indigenous governance and value systems. If these trends continue, a vital space for the transmission of cultural and natural heritage in Palau will be lost, threatening local management practices and marine ecosystems. This has alarmed traditional leaders and stimulated gleaners to act.



Figure: A mother and her two kids take a lunch break from gleaning on a Saturday in Palau.

## LAND TENURE AND INSTITUTIONS IN SMALL-SCALE SHRIMP FARMING IN SOUTH-WEST COASTAL AREAS OF BANGLADESH: AN ASSESSMENT OF GENDER ROLE

Mohammad Nuruzzaman<sup>1\*</sup> and Niaz Ahmed Khan<sup>2</sup>

<sup>1</sup>Program Specialist (Fisheries), Krishi Gobeshona Foundation (KGF)

<sup>2</sup>Professor, Department of Development Studies, University of Dhaka

*\*nuruzzaman07@gmail.com*

Development of coastal shrimp aquaculture has been contributing significantly in food security and nutrition, household income, employment generation, rural development and foreign exchange earnings in the economy of Bangladesh. To date many studies have been conducted on sustainability questions for its environmental and social impacts of coastal shrimp farming in which land tenure, institutional affairs and gender role were not well-informed and updated. This paper will attempt to unfold the land related matters and analyze the institutional relations as well as find out the gender relations pertinent to land tenurial system and institutions in shrimp farming areas of south-western coastal districts.

Results from a random survey of total of 244 shrimp farming households from three south-western coastal districts in 2015-2016 revealed that 68% households (hh) in Khulna and Satkhira, 78% hh from Bagerhat fall under small-scale (0.02-1.0 ha) category in terms of total land holding. In terms of farm size, 85% shrimp farms from Bagerhat, 56% from Khulna and 43% shrimp farms from Satkhira are small sized ( $\leq 1.0$  ha). Land tenure and ownership pattern at household level revealed that 93% hh possess land in the name of male members while only a few cases reported fraction of family land owned by their mother or wife. The land use types for shrimp farming, 82% farmers found using their own land while only 18% respondents leased in land for shrimp who usually enjoy 3 to 5 years of lease tenure depending on regular payment of annual land rent. Absence of influential outsiders, fragmentation of large shrimp farms in to smaller size, farming shrimp in own land, higher land rent, lower productivity, disease risk and less profitability resulted reduced land related litigations and illegal encroachment of adjacent crop lands by shrimp farmers.

In small-scale fisher households, it was found that 100% of Bagerhat farmers cultured fresh-water shrimp, finfish, raised rice and vegetables in family-owned land where household labor including women and children are involved. Similarly, Khulna farmers are practicing integrated rice-shrimp and dyke cropping of fruits and vegetables leaving better space for household labor including women. In case of Shatkhira, having higher salinity problems compared to Bagerhat and Khulna, 71% farms were practicing Black Tiger shrimp and finfish without rice and vegetable, leaving limited options for women participation in shrimp farming activities. Although good number of women from the poor households were engaged in wild shrimp PL collection in Satkhira. At post-harvest level however, the shrimp processing factories have had employment opportunity for thousands of women workers, but majority of the factories are not functioning well due to shortage of raw materials.

The study found weak and invisible institutional role for the development of shrimp farming in the study areas. The *de-facto* institutions found were informal money lenders, shrimp depot owners, *Faria, Mohajon*, PL suppliers and input sellers supplying credit to the shrimp farmers. Contributions from public sector institutions like Department of Fisheries, Fisheries Research Institute and government banks for technical and financial support not been mentioned by the majority of respondents.



## MASCULINITIES: CHALLENGES AND OPPORTUNITIES FOR WOMEN'S ACCESS TO THE MANAGEMENT OF FISHERY RESOURCES

Neyra Solano<sup>1\*</sup>, Alejandra Salguero-Velázquez<sup>2</sup>, Francisco J. Fernandez-Rivera Melo<sup>1</sup>,  
InésLópez-Ercilla<sup>1</sup>, Jorge Torre<sup>1</sup>

<sup>1</sup> Comunidad y Biodiversidad, A.C., Isla del Peruano 215, Lomas de Miramar, 85448  
Guaymas, Sonora, Mexico

<sup>2</sup> Facultad de Estudios Superiores Iztacala, Universidad Nacional Autónoma de México,  
Mexico

\**nsolano@cobi.org.mx*

According to the Food and Agriculture Organization of the United Nations, women constitute only 14% of the fisheries workforce involved in harvesting. However, when pre- and post-production activities are also considered, women make up half of fisheries workers worldwide. Even so, women do not usually become members of fishing cooperatives given that the activities they often participate in are not considered to directly contribute to the fisheries, except in cooperatives that are exclusively comprised of women. Belonging to a fishing cooperative, regardless of gender, is considered a right of association in the Mexican constitution. The advantages of being a member of a fishing cooperative include ownership rights (e.g., shared permits or concessions), guaranteed work, economic income, and the benefits derived from formal employment, such as health care and education.

Gender inequalities associated with access to fisheries and participation in decision-making are largely due to the cultural construction that the fishing world belongs to men. This construction incorporates gender cultures in most of the organizational systems of fisheries like cooperatives, legitimizing male privilege based on a historically constructed idea that men are the ones who should fish and extract resources due to bodily attributes like physical strength, toughness, and endurance. These expressions of masculinity are detrimental for women in that it prevents them from benefiting from the complete set of rights awarded to male fishers; In other words, masculinities in the fishing sector are part of the institutional structures that influence the ability of women to exercise voice and vote and condition their participation in leadership positions.

The outcomes of the conference “Men, Masculinities and Gender Equality in Africa, the Caribbean and Latin America: Interregional Dialogues” (in Mozambique, Africa), emphasized that to meet the goals of the 2030 Agenda for Sustainable Development regarding the democratization of social relationships and gender equality, it is essential to work and collaborate with men. In this context, Comunidad y Biodiversidad (COBI) has developed a qualitative study to characterize the expressions of masculinity and their influence on the participation of women in fisheries in three marine ecosystems of Mexico: the northern Mexican Pacific, the Gulf of California, and the Mexican Caribbean.

The results show four expressions of masculinity: 1) reluctant traditional masculinity (>50 years) believed that their point of view was what mattered, and they did not accept the participation of women in fisheries, 2) flexible traditional masculinity (40-50 years) accepted

the participation of women in the working areas of the fisheries, 3) transitional masculinity (30-40 years) were those who incorporated notions of gender equality and who were open to the participation of women in fisheries, and 4) apprentice masculinity (<30 years) depended on their supervisors to guide them. The fishers with transitional masculinity will help young people to be raised under the principles of gender equality and advocate for women's access to organizational systems for the management of fishery resources.



## MALPE FISHERWOMEN CO-OPERATIVE SOCIETY: A BEACON LIGHT TO FISHERWOMEN

**Gunakar S<sup>1\*</sup> and Ramachandra Bhatta<sup>2</sup>**

<sup>1</sup>Associate Professor, Pompei College, Ikala, Mangaluru

<sup>2</sup>President, Snehakunja Trust, Kasarkod

\**gunakarsurathkal72@gmail.com*

The cooperatives as a means of collectivization of farmers were established during early 1900, when they were first established in India under the cooperative societies act. Even today although many new forms of organization were evolved fisheries cooperatives play a crucial role in input supply and marketing of fish and fishery products. In dried fish sector the fisherwomen work with unorganized local market, small volumes, limited and scattered product range, irregular supply line, lack of information on domestic demand and product attributes preferred by the consumers, prices and qualities, lack of consumer awareness, absence of fair trade practices, insufficient storage and post-harvest facilities as well as adequate technical knowledge, lack of segregated cold storage facilities for perishable products, unreliable transportation systems and lack of education. Interestingly there are very few cooperatives which manage supply chain system for the inputs and outputs but also play the role of a collective in getting access to common resources such as physical port space for fish drying, water supply and storage services. Karnataka has 43,395 fisheries co-operatives and 76% adult fisher folk have membership in fisheries co-operatives. There are 32, 479 marine fishermen families in the state with total population of 1, 57,989 and 68% of them are engaged in activities like fish marketing, peeling, curing/processing. The Marine Census 2016 reports that 84% of the marine fishermen families are BPL families (CMFRI 2016). Malpe Fisherwomen co-operative society was established in the year 1977 with initial capital of Rs. 35,000 contributed by the 297 members with objective of striving for the socioeconomic development of fisherwomen by extending financial assistance for buying, selling, processing and preservation of fish and also helping the members in availing collective services such as drying yard from the port authorities. The procurement and distribution of salt required by the members at fair price is one of its main functions. At present cooperative have 2,600 members and access to the leased in port land of 21,672 sq. feet land for fish drying and other facilities. The equitable distribution of the entire leased in land to its members based on their respective business volume is another major service of the Cooperative. The major challenge of the cooperative is to act as a collective trade association to retain its customary lease rights over the port land and other utilities. This paper outlines the challenges faced in the supply chain management followed by the society in the distribution of inputs (salt) and the collective management of leased in property and resources, its struggle in accessing the port land on long-term lease basis and the problems encountered in providing/ implementing government schemes.

## **SOCIO-PERSONNEL PROFILE OF FISH CONSUMING WOMEN FROM THE TRIBAL POPULACE OF WAYANAD AND THEIR KNOWLEDGE AND PERCEPTION OF HEALTH BENEFITS ON FISH CONSUMPTION**

**Gopika. R\* , Joshy C. G., Sajeev M. V., Akshay. P, Mohanty A. K. and Suseela Mathew**

ICAR-Central Institute of Fisheries Technology, Kochi, Kerala, India

*\*gopikaremadevi17@gmail.com*

Globally, fish is considered as an important source of protein. The presence of omega-3 fatty acids along with the essential vitamins and minerals makes it one of the important delicacies among the people. Fish consumption varies with regions. In the present study the socio-personnel profile and fish consumption of women from the tribal populace of Wayanad district of Kerala has been studied. The per capita fish consumption along with the knowledge and perception of health benefits while consuming the fish were investigated. Data collection of 150 respondents from different tribal households was conducted through a structured questionnaire. It was revealed that 38.5% of the respondents had primary level of education and 39.5% of them were unemployed. The average annual income of the respondents was estimated as Rs. 19,800 and the per capita fish consumption of women was estimated as 1kg/month. The knowledge and perception on health benefits of fish consumption among the surveyed women respondents of the tribal populace was studied. It was found that 49.5% of the respondents had a medium level of knowledge while 31% had a low level on perception of health benefits of fish consumption, respectively. The Pearson's correlation between the knowledge and perception on health benefits was found to be significant at 0.01 level (2-tailed).

## LIVELIHOOD ENHANCEMENT OF TRIBAL FISHERFOLK OF SHRIVARDHAN, MAHARASHTRA - A CASE STUDY

Jeyakumari, A<sup>1</sup>, Narasimha Murthy L.<sup>2</sup>, Priyanka Ajay Nakhawa<sup>3</sup>,  
Tulsiram Wagmarae<sup>3</sup> and K.K. Asha<sup>3</sup>

<sup>1</sup>ICAR- Central Institute of Fisheries Technology, Cochin -682 029

<sup>2</sup>National Fisheries Development Board, Hyderabad, 500 052

<sup>3</sup>Mumbai Research Centre of ICAR-CIFT, Navi Mumbai – 400 703

\*jeya131@gmail.com

A study was undertaken to livelihood enhancement of tribal fisherfolk of Shrivardhan. Shrivardhan, a taluka under Raigarh district of Maharashtra. One *Adiwasi Koli Vividh Karyakari Sahakari Sanstha Maryadit*, a registered Society at Danda Koliwada, Taluka Shrivardhan, Raigad district with 162 members is functioning well and meeting fisherfolk requirement. The Society has been involved in buying and selling fish and supplying subsidized diesel to the boats of member fisherfolk. However, they were in lack of knowledge on Hygienic handling of fishes and value-added fishery products. ICAR- Mumbai Research centre of CIFT has made intervention for livelihood enhancement of tribal fisherfolk of shrivardhan in collaboration with *the Adiwasi koli macchimar vividh karyakari sahakari sanstha maryadit*, Shrivardhan from Shrivardhan under Tribal sub-plan (TSP) of Govt. of India. Major intervention includes Hygienic handling of fish, preparation of value added fishery products from marine and fresh water fishes and preparation of hygienic salted dried fish using of solar drier. The study revealed that tribal fisherfolk of the society gained the knowledge on hygienic handling of fishes, recent development in post-harvest technology and preparation of value-added fishery products. Moreover, they are effectively utilizing solar dryer for making various value-added products and it helps in improving their livelihood status.

## **WOMEN PERCEIVE BENEFITS OF FISH CONSUMPTION DIFFERENTLY: EMPIRICAL EVIDENCE FROM KERALA, INDIA**

**Sajeev M.V.\*, Rejula K, Nikita Gopal and A.K. Mohanty**

ICAR-Central Institute of Fisheries Technology, Cochin, Kerala, India

*\*sajeevmv@yahoo.co.in*

The present study was conducted in the state of Kerala, India with an objective to assess the consumption and perception differences among women and men fish consumers with reference to health, safety and quality issues. Purposive random sampling method was followed and 263 women and 137 men fish consumers from 2 coastal districts (Ernakulam and Kozhikode) and 2 inland districts (Kottayam and Palakkad) were surveyed. The study covered a representative sample of fish consuming households in terms of socio-demographic characteristics such as gender, age, family size, education, occupation and place of residence. Monthly fish consumption of the households surveyed varied between one kg to 50 kg, and per capita fish consumption of women varied from as 0.11 kg to 9.33 kg per month. Significant difference in consumption and perception was observed wherein coastal households had a significantly higher (12.89kg) monthly fish consumption ( $t= 3.619$ ,  $p= 0.000$ ) and a significantly higher per capita fish consumption (3.13kg) than that of inland district households ( $t= 2.027$ ,  $p= 0.043$ ). Women recorded a significantly higher perception than men with respect to nutrition and health benefits of fish ( $p=0.033$ ) depicting her effort to ensure the nutritional requirement of her family. This study on gender differences in perception reveals that while men require more customized information about health benefits of fish, women were in need of customized information on quality and safety risks associated with fish consumption. The study calls for better customisation of scientific communication about nutrition and health benefits of fish specifically designed for members of both genders residing in coastal and inland regions.

## **COGNITIVE TESTING TO IMPROVE QUESTIONS IN THE WOMEN'S EMPOWERMENT IN FISHERIES AND AQUACULTURE INDEX (WEFI)**

**Surendran Rajaratnam<sup>1\*</sup>, Rahma Adam<sup>2</sup>, Katie Sproule<sup>3</sup>, Nirmallya Mandal<sup>4</sup> and Kaustuv Mukhopadhyay<sup>4</sup>**

<sup>1</sup>Centre for Research in Psychology and Human Well-Being, Faculty of Social Sciences & Humanities (FSSK), Universiti Kebangsaan Malaysia

<sup>2</sup>Gender theme, WorldFish, Jalan Batu Maung, Batu Maung, Penang, Malaysia

<sup>3</sup>Sproule Research Group, California, USA

<sup>4</sup>Ecociate Consultants Pvt. Ltd., B – 160, Sector 51, Noida, Uttar Pradesh, India – 201301

\**surendran@ukm.edu.my*

Millions of people throughout the world rely on fisheries and aquaculture food systems for food, nutrition, and a source of income. However, persistent gender gaps in the food system prevent not only women and men from benefiting from and progressing in the sector but also perpetuate inequalities that affect their future generations. Interventions that aim to eliminate discrimination against women and girls and empower women to achieve gender equality need survey instruments that can monitor progress and evaluate interventions. To meet this need, the Women's Empowerment in Fisheries and Aquaculture Index (WEFI) is being developed to assess changes in empowerment brought by project interventions. The WEFI was adapted from the WEAI and it measures the empowerment, agency, and inclusion of women in the fisheries and aquaculture food systems in order to identify strategies for overcoming the barriers women and girls face in the systems. We conducted cognitive testing of the WEFI with 52 adult male and female informants in Bengali language-speaking communities in West Bengal, India. The informants were assessed for their comprehension, retrieval, judgement, and response when the questions from the WEFI were asked. The findings from this study enabled the study team to revise the WEFI by determining which versions of specific modules and their questions to use and how to better structure questions for respondents' comprehension.





**Session 6:**  
**Women achievers: Success stories of women entrepreneurs**  
**in aquaculture and fisheries**





## WOMEN IN FISH PROCESSING IN NAM XOUANG RESERVOIR, LAO PDR

Dongdavanh Sibounthong\*<sup>1</sup>, Ratana Tiaye<sup>2</sup>, and Jariya Sornkliang<sup>2</sup>

<sup>1</sup>Department of Livestock and Fisheries, Lao PDR,

<sup>2</sup>Southeast Asian Fisheries Development Center, Thailand

\*apone53@gmail.com

The Southeast Asian Fisheries Development Center (SEAFDEC) cooperated with the Department of Livestock and Fisheries (DLF), Lao PDR, to implement the project, “Facilitating Fisheries Activities Information Gathering Through Introduction of Community-based Resources Management/Co-management in Lao PDR”. The project was carried out between 2017 and 2019 to improve villagers’ livelihoods in the fishing community around Nam Xouang Reservoir. To achieve this, fish processing was introduced as a group activity to supplement the income generated by women around the Reservoir. Two women’s groups, from Phonhong village (10 women) and Naxaithong village (12 women) participated in the project. The project aimed to strengthen the role of women in processing and marketing by training them in packaging, salting, maintaining food quality when producing large volumes of processed fish, and in financial aspects. After the training, the women could produce four products, i.e., wrapped sour fish (*som hor*), sour fish (*som ton*), sour fish eggs (*som khai pa*), and fermented fish (*pa dek*), which they could sell for additional income

The women plan to sell the products 2-3 times per month according to orders. They will split the income between the seller (5%) and those processing the fish (95%). Average one family can earn approximately 1,500,000 kips (USD100) per month from wrapped sour fish products alone. By doing this activity, the women in the villages feel empowered as they can contribute to the income of their households and fishing community, thereby improving their livelihoods. Since the women use existing fishery resources in their areas, they are not affected by the disruptions in the distribution of raw materials brought about by the COVID-19 pandemic. The women are now planning to increase the number of products they can make and to learn more techniques to improve product quality so their business activity can thrive.

## RURAL WOMEN ENTREPRENEURSHIP THROUGH VALUE ADDITION OF FISH

**Tanuja S\*, Lipi Das and Anil Kumar**

ICAR-Central Institute for Women in Agriculture, Plot no 50-51, Mouza Jokalandi,  
Baramunda Post, Bhubaneswar, Odisha

*\*tanujasomarajan@gmail.com*

A gender perspective on post-harvest fisheries is important because women are often the primary work force in these activities. It is important to mainstream them by promoting entrepreneurship. When economically empowered, women reinvest in their communities— leading to greater self-reliance, prosperity, and food security. Women constitute around 20% of the total entrepreneur base in India out of the total 63.3 million entrepreneurs. It is estimated that women owned enterprises can create 50-60 million direct jobs and 150-170 million indirect jobs in the country by 2030. In this 6-8 million direct jobs will be in agriculture. Rural women entrepreneurship in value added fish products has a great potential because of the ever rising demand for value added and convenience fish products in our country and abroad. To tap this opportunity, it is necessary to build the capacity of rural women by updating them with the latest technologies in value addition.

The present paper discusses a case study on development of a model of rural women entrepreneurship through value addition of fish in the State of Odisha. This involved occupational needs assessment, the study of market potential of products through consumer survey, popularisation of the value added products, master trainers development, appropriate capacity building, input support, enabling procurement of licenses and market linkages. The survey of occupational needs of 200 fisherwomen of Puri district was conducted using semistructured interview schedules. The women respondents (100%) opined that credit is their most important occupational need. Ninety two percent of the women responded that safeguard against unfair trading practices is most important for them to remain in the profession. Ninety percent of women felt that property right is least important to them to remain in their occupation. More than half of them said that in order to take up hygienic drying or value addition practices, assurance on marketing is the most important need. As a result of the gender inclusive interventions, a group of rural women from Puri District, Odisha ventured into the business of production and sale of value added fish products successfully despite the trying period of the pandemic of COVID 19. Through the skill and knowledge upgradation and the required handholding, the project motivated the rural women enough to initiate small scale enterprise to further enhance their quality of living through increased income.

## WOMEN DOMINANCE IN FISH MARKETING: A CASE STUDY OF WOMEN RETAILERS IN GOA, INDIA

Shweta Chavan<sup>1</sup>, Bharat M. Yadav<sup>1\*</sup>, M. M. Shirdhnakar<sup>2</sup>, K. J. Chaudhari<sup>1</sup>, S. S. Gangan<sup>3</sup>

<sup>1</sup> College of Fisheries, Ratnagiri

<sup>2</sup> Diploma in Fisheries Engineering, Ratnagiri

<sup>3</sup> Taraporewala Marine Biological Research Centre, Mumbai

\**cpbharat@gmail.com*

Goa one of the smallest states in India is located along the central west coast with coastline of 104 km. The state contributes about 1.85% of the total marine production of 61219 tonnes. The present study was conducted at seven fish markets of the states to access the economic status, anthropometric measurement, morbidity status, infrastructure, hygiene facilities and constraints. Information was collected from 74 retailers comprising 71 female and 3 male retailers. The result showed that the per capita income of the families of women retailers was ₹43027.37 for an average family size of 4 members. The per capita income of women retailers was less than the per capita income at the state level. The maximum expenditure of retailers was on grocery and savings was up to 13% of their total earnings. The majority of retailers used the loan for non-productive purpose. The annual turnover was 1463 kg in terms of volume (₹288374/-). The income inequality measurement with Lorenz curve resulted Gini coefficient of 0.4095 indicating a noticeable level of inequality. Most of the women retailers were within normal range of BMI and 39% were overweight. 21% of the retailers suffered from back pain followed by joint problems and blood pressure, obesity, stomach gas problems, headache, diabetes. Major constraints were fish spoilage during storage and improper facility for waste disposal. Appropriate policy support and interventions are needed for economic upliftment and improve livelihood of the women.

## CONQUERING THE MALE STRONGHOLD IN THE DOMESTIC FISH TRADE: A SPOTLIGHT ON WOMEN AUCTIONEERS FROM NORTH COASTAL ANDHRA PRADESH

J. Charles Jeeva<sup>1\*</sup>, Muktha Menon<sup>1</sup>, S.S. Raju<sup>1</sup>, M. Satishkumar<sup>1</sup>, V.P. Vipin Kumar<sup>2</sup>,  
Shubhadeep Ghosh<sup>1</sup>

<sup>1</sup>Visakhapatnam Regional Centre of ICAR-Central Marine Fisheries Research Institute,  
Visakhapatnam

<sup>2</sup>ICAR-Central Marine Fisheries Research Institute, Kochi, India

\*jcjeeva@gmail.com

Fisherwomen are among the most industrious but the most vulnerable section of society. There are, however, certain exceptions to this situation. Here we highlight the women auctioneers in north Coastal Andhra Pradesh who dictate terms in fish trade in the marine artisanal sector. While a majority of the 1.6 million fisherwomen in India are engaged in fish processing and marketing, this exceptional group of women auctioneers operate successfully in a male dominated field. These women auctioneers earn a guaranteed income to run their family and have managed to educate their wards, perform the wedding of their daughters, and establish assets from the income earned from the trade over the years.

Out of the 35 auctioneers involved in auctioning the landings from motorized and non-motorized sectors in Visakhapatnam fishing harbour, 30 are women. These fisherwomen from nearby fishing hamlets spend about 5 hours from 5 am in the fishing harbour for auctioning the landings. All of them are non-literate and belong to the fisher community *Jalari*. Each auctioneer covers about 10-15 crafts, for which they provide financial assistance for operational expenses, and the fishermen are forced to dispose their landings through these auctioneers only. From the value of landings, they charge 10% as the commission for auctioning. Their daily earning from auctioning ranges from Rs. 200 to 1000. About 40 % of them also involved in fish vending after their auctioning, from 10 am to 1 pm, from which they earn an income of Rs. 200 to 800 per day. The mean annual family income and expenditure is Rs.8.0 lakhs and Rs. 4.0 lakhs respectively. Mobile advisories and peer group are their major source of information on fisheries. Their social mobility spans over a radius of 15 km, as they are also involved in auctioning in other beach landing centres in addition to Visakhapatnam fishing harbour. The level of activity is individual, and not as a group. There is no association for them. The source of their finance is their own savings and private money lenders. They also provide financial assistance to the tune of Rs. 20,000 as lump sum per year to the fishermen on festive occasions.

Nearly 75% of the landings are from motorized crafts and 25% from non-motorized crafts at Visakhapatnam fishing harbour. The landings from mechanized boats are handled separately by about 80 male auctioneers, who are mostly the family members of the boat owners. The prospective takers of the marine landings include commission agents and wholesalers who are male, and retailers and vendors who are female. From the landings, 50% goes to the local markets and the rest 50% to distant and export markets. The major

resources traded are; seer fish, barracudas, snappers, small groupers, ribbon fish, silver bellies, polynemids, mackerel etc. The mean volume of business traded by a woman auctioneer is 70 kg per day. During the pandemic, there was nil business, and resilience was facilitated from the savings due to reduction in family expenditure (58.55%) and free public distribution system by the government (58.55%) followed by government pension and other employment such as daily wage labour. Non-institutional finance through private money lenders and gold loans also supported household expenditure to an extent.

The gender issues include less appreciation to women's work and economic contributions, more household responsibilities and lack of supportive services like child care. The socio-cultural and economic constraints reported were poor access to institutional finance, tedious field operations and lack of access to dynamic market information. No other gender issues such as gender disparity in benefit sharing, exploitations and conflicts were observed. Strengthening the infrastructural facilities at the landing centres such as shelter, toilets and source of potable water was the only perceived need. Formation of an association for strengthening their activities and cooperative societies of their own will add impetus to their business. They expressed that they are fully satisfied with their present occupation, as they involve in this for about 20 to 30 years. The women auctioneers have thus made a mark in the marine fisheries sector of Visakhapatnam and are empowered enough to actually dictate terms in the fish trade of the region.

## **A SUCCESSFUL WOMEN FARMER IN BRACKISH WATER SHRIMP FARMING: CASE FROM SOUTH KONKAN REGION, MAHARASHTRA**

**Naik, B. V.<sup>1\*</sup>, Patil, S. V.<sup>1</sup>, Yadav, B. M.<sup>1</sup>, Chaudhari, K. J.<sup>1</sup>, Wasave, S. M.<sup>1</sup>, Shingare, P. E.<sup>1</sup>.  
Yewale, V.G.<sup>2</sup>, Gitte M. J.<sup>3</sup> and Kamble S.C.<sup>1</sup>**

<sup>1</sup>College of Fisheries (Dr. B. S. Konkan Krishi Vidyapeeth), Ratnagiri, Maharashtra

<sup>2</sup>Krishi vigyan Kendra, Lanja, District, Ratnagiri

<sup>3</sup>Krishi vigyan Kendra, Roha, District Raigad, Maharashtra

\*naikbv97@gmail.com

White leg shrimp (*L.vannamei*) farming is one of the most important species of brackishwater aqua farming. South Konkan region of Maharashtra comprising Ratnagiri and Sindhudurg district. Around fifty-nine farmers are operational in South Konkan region. Owners of these farms are mostly men but few farms are registered on the name of women but those are operated by men only. As far as South Konkan region of Maharashtra is concerned only one shrimp farm has been successfully operated by women farmer. Therefore, study was undertaken to document success story of women shrimp farmer in South Konkan region, Maharashtra. Direct personal interview and interview schedule was used to elicit the data from women shrimp farmer. The results revealed that this women farmer from Ratnagiri / Sindhudurg district, Maharashtra had been engaged in shrimp farming since last five years. Her own self-interest and the motivation given by family members encouraged to take up brackish water shrimp farming. Initially, farm was taken on lease basis, having a farm area about 2.0 ha. She is educated in fisheries and possessing good technical knowledge about farming, then also faced lot of problem during actual shrimp farming. But these problems were overcome through experience and by discussing with progressive shrimp farmers, inputs agents and experts from fisheries institutions. Now she is successfully doing shrimp farming. she has expanded her shrimp farming activity across the district. The study also revealed that this women farmer doing marketing of her farm produce on its own and also act as a feed and medicine dealer of one of the reputed aqua companies located in South Konkan region of Maharashtra. Analysis of the case study showed that women can take part in different parts of the shrimp aquaculture value chain. Women with education exhibited high entrepreneurship skills, usually with family support, and could manage complex aquaculture activities. Challenge is to create more opportunities by constructing an environment conducive to their participation and benefit.

## UNPACKING THE GENDER PERSPECTIVES OF SEAWEED FARMERS: ENVISIONING FUTURE PATHWAYS AND CALL FOR ACTION

**P.S.Swathi Lekshmi<sup>1\*</sup>, Nikita Gopal<sup>2</sup>, Radhakrishnan Kalidoss<sup>3</sup> and Vinuja Viswambharan<sup>4</sup>**

<sup>1&4</sup> ICAR-Vizhinjam Regional Center of CMFRI, Post Box No 9, Vizhinjam,  
Thiruvananthapuram, Kerala

<sup>2</sup> ICAR-Central Institute of Fisheries Technology, Willingdon Island, Cochin, Kerala

<sup>3</sup> ICAR-CIFE, Panch Marg, Off Yari Road, Versova, Andheri West, Mumbai-400061

*\*swathi.lekshmi263@gmail.com*

Women seaweed farmers have shaped and defined the socio-economic scenario of seaweed farming in India for more than two and a half decades. Shouldering the archetypical roles of home maker as well as farmer, in a family based system, women seaweed farmers have contributed across different scales ranging from the levels of household, community and nation. In spite of their overarching roles, ranging from ensuring economic and social security of their families to ecological conservation, women transcend across various scales of operation, but remain relegated and ignored in the mainstream development process. Gender is often construed as a missing link in development programs and policies. Our investigation among the women seaweed farmers of Ramanathapuram district, Tamil Nadu, India through a series of case studies, envisaged a common platform for the women to voice their concerns, promote engagement of fishers, farmers, researchers, policymakers, NGOs and industry representatives in participatory and interactive dialogues on gender and to generate relevant implications for policy. Besides, the study identified the enabling and disabling factors of women in the seaweed sector and illuminated their struggles at domestic as well as at the work front. Poor quality of planting material, low price of seaweed, lack of proper infrastructural facilities, insufficient Government support for value addition and marketing were the key insights evinced through the dialogues, which called for immediate transformative action.

## **“WOMEN IN FAMILY FARMING” - HOMESTEAD CAGE AQUACULTURE SHOWS THE WAY**

**Vinuja S\* and Swathi Lekshmi P S**

ICAR, Central Marine Fisheries Research Institute, Vizhinjam Regional Centre,  
Thiruvananthapuram, Kerala, India

*\*Vinuja.s.v@gmail.com*

The concept of family farming is becoming increasingly popular in the Global South. Women's well-being is closely interlinked to her role in household economy which indirectly contributes to the overall development of the family as well. Women's productive roles in farm and home fronts become more effective as well as pronounced, when operating in tandem, within the family structure and dynamics rather than in isolation. Proximity to households, aligning household duties with on farm work, and responsibilities as care givers to family members and children especially in homestead farms adds to women's productivity and ease of operations. The foregoing case study of a woman situated in family farming of cage aquaculture, in the south-west coast of Kerala, India is a prototype of this notion, which lends credence to our findings.

Practice of cage farming as monoculture (Pearlspot and Tilapia) by the woman farmer has promoted her pecuniary contributions to the household coupled with an increase in her valorization, self-esteem, self-confidence and recognition contributing to family as well as societal well-being. The woman farmer has received institutional support and rewards, and has emerged as an entrepreneur and seller in her own right. She has carved an identity of her own as a change agent, in her ability to offer services to her fellow farmers as a para-extension worker in the areas of cage farm production, disease management and market dynamics.

## A RISING TIDE? THE ROLE OF SOCIAL NETWORKS FOR WOMEN OYSTER FARMERS IN MAINE AND NEW HAMPSHIRE, USA

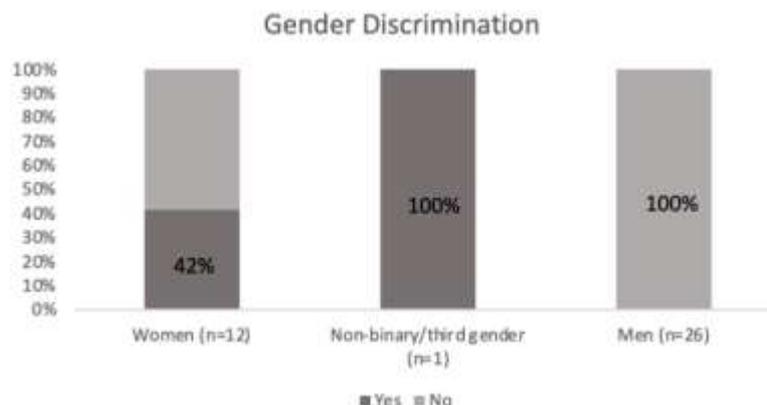
Natalie Lord, \*Catherine Ashcraft, Lindsey Williams and Julia Novak Colwell

Department of Natural Resources and the Environment, University of New Hampshire,  
134 James Hall, 56 College Road, Durham, NH 03824 USA

\*natalie.lord@unh.edu

New England is a leader in sustainable aquaculture practices and, in comparison with other parts of the United States, it has high numbers of woman-operated leases for shellfish cultivation. Integrating gender analysis in aquaculture development is critical to ensure equal access and opportunity for women to a viable business, a social support system, and the ability to produce food with positive impacts on ecosystem biodiversity, water quality, and a small or neutral carbon footprint. However, data on gender are not currently collected, for example, as part of the aquaculture permitting process. We surveyed a subset of oyster farmers (n=39) in Maine and New Hampshire to allow for analysis by gender of institutional barriers and opportunities, for example in differences in the role of funding opportunities, training programs, social networks, and gear. We also implemented a Photovoice case study, a participatory action research methodology, with women oyster farmers (n=4) to share stories about their experiences as oyster producers in the aquaculture sector and to understand the role of social networks in how women start and build businesses on the water. Our findings provide a baseline of data shedding light on the role of gender in oyster farming in Maine and New Hampshire to foster equal economic opportunities for working on the water and growing local, sustainable seafood. More broadly, our findings contribute to emerging research applying gender and social-ecological systems analyses to understand how gender dynamics impact barriers and opportunities for aquaculture producers in the United States.

**Figure 1. Percent of survey respondents reporting differential treatment at work in the oyster aquaculture industry in ME and NH by gender. Relationship between gender and differential treatment is statistically significant ( $p < 0.001$ ).**



## **SUCCESSFUL WOMEN ENTREPRENEURS IN AQUACULTURE AND FISHERIES: CASE STUDIES FROM NIGERIA AND SELECTED WEST AFRICAN COUNTRIES**

**Siyambola A Omitoyin**

Department of Aquaculture and Fisheries Management, University of Ibadan, Nigeria  
*sbomitoyin@yahoo.com*

Aquaculture, an industry that is in the stage of revolution is the fastest growing food production system contributing to employment generation, improved food and nutrition security and livelihood all over the world. In Africa, Nigeria is the second largest fish producer after Egypt. There are many activities in fisheries and aquaculture production and value chain which women are engaged in with its attendant opportunities. However Sex-disaggregated statistics that could track women in aquaculture and fisheries are scarce, and therefore women's presence, influence and interests are invisible. Also, Women's opportunities in aquaculture have not kept pace with the rapid growth of the sector. Over the years, there had been great insinuations that women are not making any success in the field of aquaculture and fisheries because of the many limitations / constraints been faced as a result of their gender. Their contributions are under rated, flagging their reproductive activities above their productive activities. These constraints are not peculiar to the field of aquaculture and fisheries alone. Despite the challenges, a number of women have been able to break through the barriers or constraints and are making substantial contributions in their spheres of operation. This paper will therefore show case some of the women that have made significant impact along the value chain of aquaculture and Fisheries under the following headings: Processor, Producer, Marketer (marketing and distribution), Input supply, Logistics, fish feed production/sales and supply, Institution / Policy, Export, Academia (education, and training), Research, Advocacy and Sea food.

The respondents were purposively selected from across Nigeria and a few from other West African countries (Ghana, Mali, Sierra Leone) using a combination of data collection methods (questionnaire, interview, focus group, farm visit, telephone call, email) using Snow ball technique. The questionnaire was used to elucidate information on their various activities. Descriptive statistics was used to analyse the data collected.

The result show that more women are in processing and value addition but their activities were limited by non- availability, poor access to required resources and gender bias thus affecting overall performance and productivity as the use of production resources is key to high productivity and profits.

It therefore show that women are making giant strides as entrepreneurs in their activities along the aquaculture and fisheries value chain but the reporting is poor. All hope is not lost in the journey of women making great strides in being entrepreneurs. There is thus the need for more support so that more women will be assisted to aim and climb higher, breaking all barriers.

## **CASE STUDY ANALYSIS OF WOMEN FISH VENDORS: REINFORCING THEM TOWARDS MARKET LED EXTENSION SYSTEM**

**Ipsita Biswas\*<sup>1</sup>, Suman Dey<sup>2</sup>, M.S.Kundu<sup>1</sup> & M.L. Meena<sup>1</sup>**

<sup>1</sup> Dr. Rajendra Prasad Central Agricultural University, Pusa, Samstipur-848 125

<sup>2</sup> ICAR- Central Institute of Fisheries Education, Mumbai- 400 061

*\*ipsita@rpcau.ac.in*

The growing concern for global fish markets, infrastructural modernization and artisanal fishing communities deal with competition. They are considered backward in terms of their socio-economic conditions. Among them fisherwomen in particular, face challenges with regards to poverty and financial insecurity. Unfortunately, fish marketing is restrained by a lack of coherent policies in setting up price structures and apt conducive milieu promoting the business. To address market-related issues of women vendors, analysis of the socio-economic profile from a holistic perspective in conjunction with market structure as well as income and expenditure pattern needs to be analysed. Accordingly, the present study was conducted to understand the socio-economic profile and constraints related to women fish vendors in eastern part of India in a village Dholi of Muzaffarpur district, Bihar. A comparative case study analysis was conducted using a semi-structured interview schedule for two women fish vendors to elicit the activity profile and analyse their business pattern. Graphical and tabular representation techniques were employed to represent the data. Moreover, to present the similarities and dissimilarities among the two case studies, thematic analysis was employed using NVivo12 software. The study revealed about the changing roles of fisherwomen in market driven approaches and the room for improvement albeit the constraints found which may be curtailed by legitimating suitable participatory approaches all across the globe.

## WOMEN ENTREPRENEURSHIP DEVELOPMENT: A SUCCESS STORY FROM KхарWA FISHING COMMUNITY IN VERAVAL, GUJARAT

Renuka. V<sup>\*1</sup>, Remya. S<sup>1</sup>, Ashish Kumar Jha<sup>2</sup>, Anupama T K<sup>1</sup>, Toms Joseph<sup>1</sup>

<sup>1</sup> ICAR-Central Institute of Fisheries Technology, Willingdon Island, Cochin, Kerala

<sup>2</sup> Veraval Research Centre, Matsyabhavan, Bhidia Plot, Veraval 362 269, Gujarat

\**renuka.v@icar.gov.in*

Seafood plays an important role in food and nutritional security of nearly one-fifth of global population. In India there are 5.4 million people directly or indirectly engaged in fisheries activities, of which, 3.8 million are fishermen and 1.6 million are fisherwomen. Among the maritime states, Gujarat continued to be in second position since 2019 with 5.32 lakh tonnes production (CMFRI, 2020). Traditionally, fishing was the subsistence occupation of kharwa community in Veraval, Gujarat. In *Kharwa* community, women play a significant role in maintaining household and community needs. They are mostly involved in selling of fish in the local market and are employed as labours in different seafood processing plants of Veraval. Their role in fishery sector is unarticulated and unacknowledged. *Kharwa* fisherwomen generally don't venture into entrepreneurship, primarily due to lack of skills and marketing opportunities. ICAR-Veraval Research Centre (VRC) of CIFT has been engaged in identifying and implementing potential livelihood options for the *Kharwa* fisherwomen through technologies developed at the institute. Value added products can be an option to expand the marketing of fishery products. A team of scientists gave the hands on training on value addition & product development of fish and fishery products to the fisherwomen community of Veraval to equip them for entrepreneurship. With the financial support from NFDB, a series of skill development programmes were conducted on local specific and need based value added product like fish cheese ball, fish cutlet, fish burger, fish samosa, shrimp pickle, fish pickle, fish pizza, fish finger and fish sandwich. Along with the training on value added products, VRC of ICAR-CIFT also facilitated them to interact and liaison with state Fisheries Department, FSSAI, local fish export units and banks for loan under MSME to enhance the awareness and technical know-how, enabling them to start self-generating business. One of the trained fisherwomen group named as "Sagar Manthan Machhimar Utthan Mandal (SMMUM)" has started enterprise named "Real taste of Seafood". A MoU (memorandum of understanding) was signed between ICAR-CIFT and SMMUM for technical guidance in the production of fish based products. The group also participated in the various Food festivals including "Somnath Mela", "Chrowad Mela" and "Diu Festival". They come up with a profit of more than 30% from these food festivals encouraged. They started a restaurant and registered their society as Producer Company under the Ministry of Corporate Affairs, Government of India.

**ICAR-CIFT INTERVENTION IN WOMEN ENTREPRENEURSHIP  
DEVELOPMENT AND LIVELIHOOD ENHANCEMENT: A SUCCESS STORY  
FROM VERAVAL, GUJARAT, INDIA**

**S. Remya<sup>1\*</sup>, V. Renuka<sup>1</sup>, C. O. Mohan<sup>1</sup>, A. K. Jha<sup>2</sup> and Toms C. Joseph<sup>1</sup>**

<sup>1</sup>ICAR-Central Institute of Fisheries Technology, Cochin-682 029, Kerala, India

<sup>2</sup>Veraval Research Centre of ICAR-Central Institute of Fisheries Technology, Veraval, Gujarat  
*\*remya03cof@gmail.co*

The project was undertaken to assess and improve the socio-economic well-being of *Sidi* tribal women and *Kharwa* fisherwomen in Veraval, Gujarat, India. '*Sidi*' or '*Habshis*' is a unique tribal group with African ancestry, who have been transported to Gujarat as slaves in an easterly slave trade, controlled mainly by Arabs and many of them are still living below poverty line. Farm-based activities constituted the main source of livelihood for the inhabitants of the *Sidi* population. As the single source of livelihood, traditional farm incomes were not enough to meet even subsistence needs and the poor tribal families were forced to combine traditional cultivation with the collection of minor forest produce, maintaining small livestock and migration to urban areas for wage labour. They were not involved in the fisheries related post-harvest processes because of lack of knowledge and the fisheries activities in the Veraval region are dominated by fishermen communities like *Kharwas*. ICAR-CIFT felt a need to raise awareness amongst these women about improved fish processing activities and intervened through a Department of Science and Technology (DST) funded project to develop entrepreneurial skill in the extremely poor tribal women and fisherwomen to improve their social status. The project thus focused on imparting various skill development programmes to *Sidi* women and *Kharwa* fisherwomen aiming at livelihood enhancement. With the technical backing of ICAR-CIFT, *Sidi* women and *Kharwa* women started selling hygienically dried fish and value-added fishery products in quality packages with attractive label in the local markets. In spite of facing several challenges of marketing of their produces, their experiment is proving a success.

## SKILLING WOMEN IN MODERN FISH DRYING PRACTICES AND IMPACT ON EMPLOYMENT AND INCOME

Chandrasekar. V\*, A. K.Mohanty, V.Geethalakshmi and Nikita Gopal

ICAR-Central Institute of Fisheries Technology, Kochi - 682 029,

\*vcsecon@gmail.com

The fisheries sector plays an important role in generating income and employment among the coastal population, especially to the women who belong to the weaker section of society. Providing skill development training on hygienic fish and shellfish drying using Solar cum electric backup dryer makes them self-employed specifically in rural areas, where other employment avenues are scarce. A survey was conducted on women beneficiaries who participated in the hands-on training cum demonstration program conducted by the ICAR-CIFT in collaboration with KVK Sikkal, Nagapattinam district of Tamil Nadu. This coastal district is abundant with fishery resources with bulk landings ensuring availability of fish all around the year. The economics of operation was calculated for the drying unit using the capital investment made solar cum electric backup dryer of 10 kg capacity. The enhanced income due to hygienic drying processes of locally available fishes (*mackerel, ribbon fish and anchovy*) and shellfish (*shrimp*) following strict protocol on cleaning, drying, packaging and marketing dried fish and shellfishes into the nearby markets as well as the KVK sale counter was estimated. The rural women could generate an additional average income of Rs.21,093 per household per annum.

Since the dryer can be operated both using electric power as well as solar energy it saves electricity consumption worth amount of Rs.10,125 per annum. However, the amount will vary according to the weather, which will be equivalent to the additional employment generation of about 40 days per annum which significantly reduce the unemployment situation prevailing normally in the rural areas where the existing 100-day employment is provided under MGNREGA schemes by GOI.



# **SPECIAL SESSIONS**





**WOMEN AND THE CHANGING TIDE: BREAKING THE BIAS IN SMALL-SCALE  
FISHERIES AND AQUACULTURE IN THE CONTEXT OF IYAFA 2022**

**organised by  
IYAFA, FAO of the UN**

**Chair(s): Jennifer Gee, Maria Cecilia Pastores and Yuki Chidui**

The proposed panel would be part of the IYAFA event series on women in small-scale fisheries and aquaculture.



**VOICES OF YOUNG GENDER RESEARCHERS IN FISHERIES**  
**organised by**  
**ICAR-Central Institute of Fisheries Education, Mumbai, India**

**Chair(s): Arpita Sharma Chair; Ananthan P.S. and Shivaji Argade**



## **FIVE COMPONENTS AND COMBINATORY APPROACH BASED COPYRIGHTED TOOL GENDER ANALYSIS TOOL FOR FISHERIES AND AQUACULTURE (GATFA©)**

**Arpita Sharma**

ICAR-Central Institute of Fisheries Education, Panch Marg, Yari Road, Mumbai  
*arpitasharma@cife.edu.in*

This paper presents a 'Gender Analysis Tool for Fisheries and Aquaculture' (GATFA©) which has been granted a copyright by the Indian Copyright Office in year 2022. This tool has been used to perform gender analysis of fisheries sector in reservoir fisheries, tank based fisheries and fish markets of Telangana state and for different aquaculture based livelihoods like unitary and integrated farming system, paddy-cum fish culture, pig-cum-fish culture and fish markets of Mizoram in India.

This tool uses combinatory approaches for understanding profile, capacities, roles, time use, workload, needs, access, control, decision making, constraints and vulnerabilities of fisher men and fisher women using 5 components. First component records information about household, profile and capacities of fisher men and fisher women including Government schemes and institutional support. Second component includes gender roles where activities performed by fisher men, fisher women, others are listed along with recording time use and workload using rate of perceived exertion scale. Third component records gender and fishery needs perceived by fisher men and fisher women using five point scale of importance. Fourth component records access, control and decision making of fisher men and fisher women over household/community, financial and fisheries resources using five point scale. Fifth component records different vulnerability contexts and severity of constraints faced by fisher men and fisher women using five point scale.

Information can be collected through interviews and Focused Group Discussions with fisher men and fisher women separately. Analysis using simple percentages, graphs, t test is suggested for quantified data. For scores obtained using scale; normalization and classification is suggested. Thereafter, Mann-Whitney U test can be performed to check for difference in scores of fisher men and fisher women. GATFA© can provide information on which strategies can be developed for gender mainstreaming and integrating gender perspective into fisheries and aquaculture sector. It is recommended that researchers use this scientific tool to bring forward the gender issues in the fisheries and aquaculture sector, which will be helpful for designing appropriate policies for equitable and sustainable development.

## NEED OF WOMEN SPECIFIC INTERVENTIONS FOR EQUITABLE AND SUSTAINABLE BRACKISHWATER SHRIMP AQUACULTURE DEVELOPMENT IN MAHARASHTRA

S. V. Patil<sup>1\*</sup>, Arpita Sharma<sup>2</sup>, K. J. Chaudhari<sup>1</sup>, B. M. Yadav<sup>1</sup>, S. M. Wasave<sup>1</sup>, B. V. Naik<sup>1</sup>, V. G. Yewale<sup>1</sup>, P. E. Shingare<sup>1</sup> and S. C. Kamble<sup>1</sup>

<sup>1</sup>College of Fisheries (Dr. B. S. Konkan Agricultural University), Ratnagiri-415629, M.S.

<sup>2</sup> ICAR-Central Institute of Fisheries Education, Versova, Mumbai

\*sandeshpatil17@gmail.com

Brackish water shrimp farming is one of the fastest growing forms of aquaculture and India stands at second position with production of 8.2 lakh tons. Latest agriculture census has shown rise in percentage of female farmers. Government has earmarked 30% of budget allocation for women beneficiaries and seeks to ensure that women farmers get enhanced access to resources such as credit, technology, training and gender specific interventions. In brackish water aquaculture also, women specific interventions are urgently required. Taking a case of Maharashtra, this study explores changing roles of women in brackish water aquaculture. Maharashtra is selected for study as its strength lies in large under/ un-utilized brackish water resources (9044 ha) with 165 shrimp farms. Study was carried out in four coastal districts of Maharashtra state. The data was collected from all registered shrimp farms (151) out of the total shrimp farmers in Maharashtra. A pilot study was done on 25 shrimp farmers and based on the pilot study an interview schedule was prepared. Our study on 151 farms revealed that only 6% of farms are registered on women's name and at ground level run by men. In 1990's participation of women was in pond digging, wild seed collection, feed material collection, feed making and post-harvest handling. Modernization like use of machines, hatcheries, factory feed, automatic feeder, zero water exchange system, use of IoT, direct marketing through companies have impacted women who were involved as workers. Pond construction is now done by machines, wild seed collection is replaced by seeds from hatcheries, feed is from feed industries, feeding is done by automatic feeders and marketing is done through sea food companies. On other hand, there has been consistent increase in shrimp production resulting in profits to shrimp farmers who are usually men showing that masculinity of capital seems to have inclined towards investing resources among men. This has created segregated workforce with certain occupational spaces appearing to privilege particular gendered dispositions due to reasons like high investment, high risk, remote location of farms, specialized skill and field work. However, with 15<sup>th</sup> October earmarked as Women Farmers Day by Government of India, it is time to integrate women in brackish water aquaculture by ensuring enhanced access to resources like credit, technology and training. Women need to be owners, farmers and entrepreneurs and not just labourers in shrimp farms and providing them with these entitlements will be the key for sustainable and equitable development. It is expected that an inclusive approach, from policy to implementation, will bring women in brackish water shrimp farming into mainstream. To ensure that women utilize their full potential in profitable activities like shrimp aquaculture, it is necessary to provide capacity building support like 'farming couples', 'women only' training programmes.

**ANALYSING THE FISHING COMMUNITY OF KASHMIR THROUGH GENDER LENS****Naila M. Bhat <sup>1</sup>, Arpita Sharma <sup>1\*</sup>, Vinod Yadav <sup>1</sup>, Rizwana Malik <sup>2</sup>**<sup>1\*</sup>ICAR-Central Institute of Fisheries Education, Mumbai<sup>2</sup>Faculty of Fisheries, Sher-e-Kashmir University of Agricultural Sciences and Technology*\*arpitasharma@cife.edu.in*

Gender analysis is an essential tool in planning and addressing inequalities in policies, programs, and projects. Few researchers have focused on gender analysis in the Indian fisheries sector, and even fewer studies have been done with reference to cold water fisheries. Coldwater fisheries occupy an essential place, and the Union Territory (U.T.) of Jammu and Kashmir is one of the major contributors (31%) to the cold water fish production of India. A study was done with the objectives of evaluating roles, time use survey (TUS), workload, needs, access/control to resources and constraints faced by men and women in the fisheries sector. Interview and observation method was used to collect information from randomly selected 160 fishermen and 160 fisherwomen from same fisheries dependent households in the vicinity of three important lakes Wular (60), Dal (60) and Manasbal (40). Roles were recorded as per Moser's Triple role framework, TUS as per United Nations System of National Accounts, workload as per the rate of perceived exertion (RPE), access and control to resources through Harvard Analytical Framework and needs were studied using Moser framework. Appropriate scales with scores which were later normalized were used. The weighted average was used for constraints analysis, and Mann Whitney test was performed to test if there was a significant difference between men and women. It was found that all were Muslims, majority belonged to Dar caste, were semi-literate and had nuclear families. Reproductive roles in all three lakes were predominantly done by fisherwomen. Productive roles were done by both fishermen as well as fisherwomen in Wular and Dal Lake. In Manasbal Lake, only men were involved in fishing. In community roles, both fishermen and fisherwomen were involved. Access and control profile revealed women had relatively more control only over financial resources in Wular and Dal Lake. There was a significant difference between the practical and strategic gender needs of fishermen and fisherwomen. Constraint analysis also showed that there was a significant difference between fishermen and fisherwomen except for political constraints. The study has revealed that roles, time use, RPE, needs, access, control and constraints were significantly different for fishermen and fisherwomen.

## POSTURAL ANALYSIS OF MARINE FISH RETAILERS IN THE COASTAL STATE ODISHA, INDIA

**Suchismita Prusty\*, Arpita Sharma, Vinod Kumar Yadav**

ICAR- Central Institute of Fisheries Education, Versova, Mumbai

*\*suchismita.fexpa903@cife.edu.in*

Women's participation as fish retailers has been reported by many researchers. Some studies have reported that retailers face ergonomic problems and body pains due to the nature of work and the different postures adopted by them. However, there is a research gap on ergonomic and postural analysis of work done in fisheries sector. To address this research gap, a study was undertaken with an objective to analyse the fisheries activities and postures adopted by marine fish retailers. Study was conducted in Odisha which is one of the maritime states of India and holds 6th position in marine fish landing in India. State have 3rd highest number of fisher folk population (5, 17,623) and out of this, 50% are fisher women (2, 63,514). Most fisher women are involved in fish retailing activities for livelihood generation but statistics on their numbers is not available. In the present study information was collected from 120 marine fish retailers (60 fresh fish retailers and 60 dry fish retailers) from coastal districts Puri and Ganjam. Through non-participant observation method daily fisheries activity chart was prepared. This chart was used as a reference in postural analysis and Time use survey (TUS) for undertaking different activities. For postural analysis, Ovako Work Posture Analysis System (OWAS) method which is a standard working posture analysis method to identify unsafe work postures that cause musculoskeletal injuries was used. In addition, weight was recorded using weighing machine, height was recorded using measuring tape and age was recorded by interview. Using weight and height values Body Mass Index (BMI) values was computed and compared with recommended values. The study found that the average age of fresh fish retailers was 45 years and 43 years for dry fish retailers. Average BMI for both was as 23 kg/m<sup>2</sup> which could be categorized as normal. Daily fisheries activity chart revealed that, the fresh fish retailers were involved in collection of fish from landing centres, sorting of fish, commuting to the fish market, cleaning of fish and selling. The activities of dry fish retailers were collection of fish from landing centres/wholesalers, sorting, commuting to fish market, cleaning, salting, drying and selling. On an average total 12 hours/day were spent on fisheries related activities and maximum time i.e., 8 hours/day i.e., 66% of time was taken up in fish selling activity. OWAS revealed that various postures like sitting on stool, squatting, standing etc. were adopted by retailers during fish collection, sorting, cleaning, drying and selling. As per OWAS, these could be categorised as type 4 which is excessive risk which can lead to harm in the long run if no corrective measures are taken. This is because uncomfortable body postures, as well as repetitive movements, are adopted for long periods of time and becomes the cause of musculoskeletal disorders and body pains. Health and safety at work directly influences fisheries sector and it is necessary that interventions are designed. In addition, fish retailers can take the benefit of Government health schemes like Pradhan Mantri Jan Arogya Yojana (PM-JAY), Aam Admi Bima Yojana (AABY), Rashtriya Swasthya Bima Yojana for which awareness programmes are required.

## **PARTICIPATION OF FISHERWOMEN IN FISHERIES COOPERATIVE SOCIETIES OF BARGI RESERVOIR, MADHYA PRADESH**

**Nidhi Katre\*, S.N. Ojha, Arpita Sharma, Vinod Kumar Yadav and Rajpal Yadav**  
ICAR- Central Institute of Fisheries Education, Panch Marg, Andheri West, Mumbai  
*\*nidhi.fexpb006@cife.edu.in*

Reservoir fisheries have the potential to provide income and livelihoods to people. In India 3.15 million ha of area are under reservoirs. Among all the Indian states, Madhya Pradesh has the highest (460,384 ha) area under reservoirs. In this state, Bargi reservoir is among the top five largest reservoirs (27,296.05 ha) and has 41 fisheries-dependent villages. The objective of this study was to explore participation and constraints faced by fisherwomen of 6 villages. Interviews were conducted with 6 chairpersons of fisheries cooperative societies (FCS), 180 women. Participation of women was recorded by daily work routine chart, Participatory Rural Appraisal (PRA) techniques and time used in productive, reproductive and community works. Constraints were recorded by Focus Group Discussions with chairpersons of FCS and fisherwomen. Rank Based Quotient (RBQ) method was used for constraint analysis. Results of the study revealed that 5% of fisherwomen were members of FCS as the only heads of the family (usually a man) were considered to become a member. However, 80.54% of fisherwomen were participating in productive works of fish smoking (33.33%), fish trading (12.22%), fish harvesting (11.11%), and net making/repairing operations (23.88%). It could be established, that they were engaged for 8 hours/day in productive works and 9 hours/day in reproductive and community works. The remaining 19.46% of women were involved in reproductive and community work. RBQ analysis revealed that poor social status, poor social acceptance and lack of ownership of assets were major social constraints faced by women. Less income, lack of working capital, and lack of alternative livelihood opportunities during closed season were major economic constraints. Gender bias in getting membership in FCS, limited access to training and extension services, lack of access to saving schemes were main institutional constraints. Production constraints were lack of skills in operation of craft and gear, decline in stocked and native fish species and operation of destructive fishing gears. Even with 80.54% participation by fisherwomen in productive fisheries activities, they are not considered to become members of the FCS is not encouraging for women. Thus, it is strongly recommended to consider women to become members of the FCS. This will enable women to access and avail benefits which members of FCS get like attending training programmes, provision of getting fishing license, saving cum relief scheme, craft and gear subsidy and deferred wages scheme which will result in equitable livelihood opportunities.

## USING THE GENDER ANALYSIS TOOL FOR FISHERIES AND AQUACULTURE (GATFA©) IN THE INLAND CAPTURE FISHERIES OF NAGARJUNSAGAR RESERVOIR, TELANGANA

Priyanka Mushkam<sup>1</sup>, Arpita Sharma<sup>1\*</sup>, Vinod Kumar Yadav<sup>1</sup> and Suhas Mahadeo Wasave<sup>2</sup>

<sup>1\*</sup> ICAR- Central Institute of Fisheries Education, Deemed University, Mumbai

<sup>2</sup>Dr. Balasaheb Sawant Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra

\*arpitasharma@cife.edu.in

In India, Telangana is catching up in fisheries by expanding its potential in all the possible resources. Fisherwomen and fishermen in the state are performing various fisheries-related activities. However, their role and extent of participation in the state fish production are not documented and studies on gender issues are few. So, gender analysis was carried out using a copyrighted tool 'Gender Analysis Tool for Fisheries and Aquaculture' (GATFA©). First component of GATFA recorded information about household profile and capacities of men and women including government schemes and institutional support. Second component recorded gender roles, time use pattern and workload. Third component recorded gender and fishery needs and fourth component recorded access, control, and decision making over resources. Fifth component recorded different vulnerability contexts and severity of constraints. Study was conducted in Nagarjunsagar reservoir, which is the biggest reservoir in Telangana and fishing is a significant economic activity, which provides livelihood to a substantial number of fishing households. Information was collected from fishermen and fisherwomen and non-parametric Mann-Whitney U test was used to check if there was a significant difference between them. Household profile revealed that average family size was 4.47 with 85% having nuclear family. A total of 45% of households had land holding between 0.02 to 0.04 acres and about 5% of households were having no land holding. All fishers belonged to *Bestha* caste and majority were Hindus. There was significant difference in the income earned by fishermen (Average: Rs. 2.29 lakh/annum) and fisherwomen (Average: Rs. 68,900/annum). About 37% of fisherwomen were involved in fish harvesting with mean fishing experience of 13.5 years. There was no significant difference in involvement of men and women in case of all fisheries-related activities. Women's competencies were higher (0.82) in post-harvest sector. For fisherwomen marketing constraints were ranked first, whereas for fishermen, economic constraints ranked first followed by extension constraints. Among different vulnerability contexts, economic vulnerability was high for both fisherwomen and fishermen. Significant difference was found in terms of time use and work load with respect to reproductive and productive roles. But there was no significant difference with respect to community roles. Significant difference was found between needs, control and decision making over household, financial and fisheries resources. Findings of this study bring into focus that in Telangana, reservoir fisheries is an important livelihood activity for both men and women. Some of the interventions suggested are establishment of fish market infrastructure nearby reservoir, formation of FFPO for marketing and ecotourism purposes. Providing license for fisherwomen for fishing in reservoir is recommended. Reforming an economic system to treat women and men as equal participants is fundamentally a socio-political issue and gender analysis using the GATFA © tool has brought this in forefront.

## EXPLORING THE ROLE OF FISHERWOMEN IN KOTA, AJMER AND UDAIPUR DIVISIONS OF RAJASTHAN, INDIA

Rajpal Yadav \*, Arpita Sharma, Bhanu Kumar Sharma, Laxmi Lal Sharma, S.N. Ojha and Nidhi Katre

ICAR- Central Institute of Fisheries Education, Panch Marg, Andheri West, Mumbai

*\*rajpal.fexpa802@cife.edu.in*

Fisheries in India are an important economic activity creating employment opportunities in the rural sector and contributing to the country's food security. The sector provides livelihood to about 28 million fishers and fish farmers at the primary level and twice the number along the value chain. The total expenditure for developing the fisheries sector was 64025.86 lakh during 2019-20. Inland fisheries have emerged as a major contributor to the overall fish production in the country. The states like Andhra Pradesh, West Bengal, Uttar Pradesh, Odisha and Bihar are top in inland fish production. Rajasthan state has vast and significant water resources in reservoirs, ponds/tanks, rivers, canals, and waterlogged areas with huge but largely underutilized and untapped potential for fish production and livelihood development. A large number of freshwater, as well as saline water resources, are available in the state, in which 4.23 lakh ha freshwater area excluding 30,000 ha is rivers and canal system, 80,000 ha is waterlogged, and 1.80 lakh ha is salt-affected/land saline area at Full Tank Level (FTL). Total fish production was 116 MT in 2019-20. Both fish and seed production in the state has been rising steadily in the recent past. A study was done to explore the role of fisherwomen and access to resources in fisheries activities in Rajasthan. For this, 320 fishing households were selected from 3 divisions Kota (80), Ajmer (80) and Udaipur (160). A semi-structured interview schedule was used to collect information. It was found that about 87.5% of the women were involved in netting, liming, manuring, harvesting and post-harvest work. Women (83.75%) were involved in net mending, selling fish (81.12%) and 38.12% were involved in feeding fish in the nursery/pond. But women reported that their participation was low in decision-making related to fisheries management. Regarding access to resources, 73% of fisherwomen had access to family and fisheries resources but only 8.7% had control over the resources. On an average, fisherwomen spent 7 hours in fisheries related works and 9 hours in household works. Comprehensive studies on gender analysis of the fishery sector in Rajasthan are required so that policy interventions can be designed for equitable and sustainable fisheries development.

**GENDER ANALYSIS OF PADDY-CUM FISH CULTURE IN MIZORAM STATE, INDIA**

**B. Lalmuansangi<sup>1</sup>, Arpita Sharma<sup>1\*</sup>, Amitava Ghosh<sup>2</sup> Swadesh Prakash<sup>1</sup>, Rajpal Yadav<sup>1</sup>  
Shubham Soni<sup>1</sup> and Nidhi Katre<sup>1</sup>**

<sup>1</sup>ICAR-Central Institute of Fisheries Education, Andheri west, Mumbai

<sup>2</sup>College of Fisheries, Central Agriculture University, Lembucherra, Tripura

*\*arpitasharma@@cife.edu.in*

Fisheries sector provides livelihood to millions of men and women as paid or unpaid workers. There are studies related to gender in fisheries in different parts of India and few in the North Eastern region but so far, gender analysis for fisheries sector in Mizoram has not been done. So gender analysis of aquaculture based livelihoods in Mizoram was conducted. Study was conducted for paddy-cum fish culture in Champhai district. Information was collected from men and women fish farmers using a copyrighted tool 'Gender Analysis Tool for Fisheries and Aquaculture' (GATFA ©). First component of GATFA recorded information about household, profile and capacities of men and women including Government schemes and institutional support. Second component included gender roles, time use pattern and workload. Third component recorded gender and fishery needs and fourth component recorded access, control, and decision making over resources. Fifth component recorded different vulnerability contexts and severity of constraints. It was found that in most cases head of household and ownership of land was in the name of men. With reference to capacities, constraints and vulnerabilities there was no significant difference between men and women. Time use pattern and workload for reproductive roles was more for women with a significant difference. But, for productive and community roles no statistical significant difference existed between men and women. From these results, it is clear that men and women both are actively involved in paddy-cum fish culture. In case of practical gender needs and access to resources there was no difference but difference was there for control over resources and participation in decision making of resources. Both men and women were found to contribute significantly to the family's income, savings, expenditure, and loan repayments. Further, there was a significant difference between men and women in terms of income but no difference in savings and expenditure. The GATFA © tool was able to highlight that women's participation is not just limited to post harvest activities as it is often assumed. They are involved in pre-harvest, harvest and post-harvest activities. In addition, it has also indicated that men play a role in post-harvest activities. It can be concluded from the study that aquaculture is an important livelihood not just for men but also for women. Therefore, while designing policy interventions, selection of beneficiaries should not be just head of the household (who is usually a man) but all who are involved in that livelihood system.

## **GENDER AND THE SOCIAL ECONOMY OF DRIED FISH**

organised by

**DFM Central, University of Manitoba, Canada**

**Chair(s): Holly Hapke<sup>1</sup>, Derek Johnson<sup>2</sup> and Nikita Gopal<sup>3</sup>**

<sup>1</sup>University of California-Irvine, USA

<sup>2</sup>University of Manitoba, Canada

<sup>3</sup>ICAR-Central Institute of Fisheries Technology, India

For many people across the world, dried fish is of vital nutritional, economic, social, and cultural importance. Yet, the diverse and complex economy that produces and distributes dried fish are all but invisible in research and policy. Papers in this session focus specifically on gender and the way gender relations and ideologies construct the social economy of dried fish production and consumption in different countries and regions.



**GENDER THEORY AND PRACTICE IN AN INTERNATIONAL PARTNERSHIP ON  
THE SOCIAL ECONOMY OF DRIED FISH**

**Derek Johnson\*** and the Dried Fish Matters team

\*Derek.Johnson@umanitoba.ca

Gender theory figured prominently in the framing of the Dried Fish Matters SSHRC Partnership Grant (DFM) in recognition of the centrality of gender in social economies of dried fish. In this presentation, we contrast the initial intentions of the project in terms of its integration of a gender approach to fisheries research with the actual work accomplished. Three broad themes structure the presentation:

1. The integration of gender theory and methods into research design and research implementation;
2. An assessment of the degree to which the project as a collective undertaking has been able to incorporate lessons from gender theory in its process;
3. The impact of a gender-informed approach on findings and collaborative process.

To set the stage for the presentation and the panel to follow, the presentation begins with a brief orientation to the DFM project as a whole.

## GENDERED ENGAGEMENT IN DRIED FISH VALUE CHAINS IN SRI LANKA

Koralagama D N\*, Adikary A, Wickrama S and Weeratunge, N.<sup>1</sup>

Department of Agricultural Economics, Faculty of Agriculture, University of Ruhuna, Sri Lanka

<sup>1</sup>International Center for Ethnic Studies, Colombo 08, Sri Lanka

\* dilanthik@gmail.com

Scholarly literature often points to female predominance in the dried fish industry, especially in the processing and trading nodes of value chains in developing countries. The qualitative research carried out in Sri Lanka exploring processor, wholesaler and trader segments in six dried fish producing and trading sites (Matara, Negombo, Puttalam, Trincomalee, Jaffna, Colombo) reveals gendered dried fish value chains with disproportionate contribution of male and female at different nodes. While there is some consistency with global literature in the preponderance of women in the processing node of some value chains (for example, of Maldivian fish), it appears that procurement of raw fish, dried fish processing and trading overall is done mostly by men in Sri Lanka. Even though women act as processors, collectors and traders, they are often found in local segments of value chains, handling smaller quantities than men. Dried fish wholesalers and retailers in popular markets in urban cities (Maharagama, Gampaha, and Kamburupitiya) and retail shops in remote locations (Moneragala and Wellawaya) are mostly men, with women supporting these enterprises as wives or hired employees, often in the role of cashiers. In contrast, women wholesalers and retailers are common in village-based fair and markets (Kamachchodaya, Chilaw, Matara, and Arachchikattuwa). Thus, the middle and upper streams of long value chains with several actors and agents are usually operated by men (80% - 90%). In contrast, short local value chains with one or two actors are driven by women who are either collectors/suppliers or traders. Bulk purchases with big quantities worth LKR 200,000 – 300,000 are exchanged within value chains predominated by men. In contrast, most of the value chains operated by women are confined to transactions of LKR 50,000 – 100,000. Ethnicity also determines women's involvement. Most of the dried fish industry is operated by men in the Muslim community, while female involvement is greater in Sinhalese and Tamil communities. The findings indicate that despite of the significant women contribution (50%-60%) in the processing stage (lower stream) of local value chains, men's engagement at the middle and higher streams is more significant. Thus, dried fish value chains in Sri Lanka are gendered with the men's and women's contribution varying according to location, length, geographical spread and transactional quantity of the value chain, as well as the ethnicity of the actors.

## **SEEING LIKE HAJIRAS: CONTEXTUALIZING GENDERED INTERSECTIONS OF SES IN THE DRIED FISH SECTOR OF THE INDIAN SUNDARBANS**

**Raktima Ghosh<sup>1\*</sup> and Jenia Mukherjee<sup>2</sup>**

<sup>1</sup> Rekhi Centre of Excellence for the Science of Happiness, <sup>2</sup> Department of Humanities and Social Sciences, Indian Institute of Technology, Kharagpur

\*ghosh.rak12@gmail.com

In a long discussion about their activities in a *shabar* of Frasergunj village, one of the women *hajira* dry-fishers lamented, “The eyesight of my mother-in-law is gradually deteriorating as she ages above 60. She is soon to become incapable of walking daily from our home to the *shabar* and, she will be replaced with young recruits by the *shabar* owners. We will lose one of the earning members of our household”. Dried fish organizations, locally called *shabar* in the Indian Sundarbans are contributed by many such daily-wage women workers who, alongside ‘serving’ the households, perform an array of duties ranging from raw fish cleaning to fish drying and dried fish packaging. Apart from a constricted access to resources and benefits in and outside the dried fish organization, a sector typically associated with men, these ‘third world’ womenfolk are exposed to unprecedented atmospheric and environmental changes that are threatening the fragile deltaic frontier for past couple of years. Thus, the livelihoods, life ways, and vulnerabilities of the *hajira* workers are disparately shaped by a combined and mutually reinforcing social-ecological complexities attached to fish drying practices. Even though the dried fish sector heavily relies on the involvement of the women dry-fishers, both the academic and policy circles have failed to take into account the expertise, challenges, and benefits of the marginalized women who reap a subsistence from the ‘common property resources’ or labour for a low wage in the Indian Sundarbans. As a part of the Dried Fish Matters Project, this research aims to carve out the gendered patterns of risks (fish stock reduction, shrinkage of islands, poor daily wage/income, women trafficking, cyclones), relationalities (position, discrimination, participation), and potentialities experienced, perceived and adapted to by the women dry-fishers of the Frasergunj village using the conceptual framings of social ecological systems. To accomplish this, the authors have conducted a systematic literature review, complemented by field-based ethnographic methods, to trace out linkages, feedbacks, and changes within the gendered dimensions of dried fish resource system. Finally, they conclude by drawing in the imperatives for including women in action-focused participatory approaches in pursuit of voicing livelihood security, equitable outcomes, policy recognition for gender-acquainted fisheries of the region.

## UNVEILING AND ADDRESSING GENDER INEQUALITY IN DRIED FISH SECTOR: A BANGLADESH PERSPECTIVE

Mostafa A. R. Hossain<sup>\*1</sup>, Mirza T. Sultana<sup>2</sup>, Md. S. Rahman<sup>2</sup>, Md. Shahjahan<sup>1</sup>, Md. S. Alam<sup>1</sup>,  
Sayeed Ferdous<sup>2</sup>, Rasheda Akhtar<sup>2</sup> and Mahmudul H. Sumon<sup>2</sup>

<sup>1</sup>Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

<sup>2</sup>Department of Anthropology, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh

\* *marhossain@bau.edu.bd*

Women play a vital role in fisheries and aquaculture sector in Bangladesh, as fishers, fish farmers, processors and traders. They accounts for nearly 50% of the workforce in fish processing inclusive fish drying and fermentation. Yet, women have been facing substantive challenges in benefiting equitably from the sector.

The dry fish sector has made a strong position in the economy of Bangladesh. It is estimated that half of the total marine catch and substantial proportion of the freshwater catch are dried. Fish drying, like other fisheries sectors, is not immune to gender disparity, and women often tend to experience the burden of inequality as undervalued and underrepresented actors. We conducted interviews and FGDs with yard owners, labours, fishers, and traders in fish drying facilities across Bangladesh. We analyzed the importance and degree of participation of women in fish drying and trading and decision-making process.

In dried fish sector, the environments, options, constraints and benefits are gender-biased, often being pro-men. A combination of factors, such as, limited access to and control over resources, coercing gender norms and taboos, little or no decision making power, and time and labor burdens of unpaid and ill-paid work is key to disadvantage women. These factors are shaped by a number of cross-cutting issues such as societal, pecuniary, ethnicity/caste affiliation, training and education. The result is women having fewer opportunities and receiving smaller returns from processing and trading than men including substantial lower income for the same/similar job and being socioeconomically vulnerable and left in positions of poverty. Women who belong to marginalized groups such as refugees bear more severe brunt of these inequities.

Most of the women working in dried fish sector are not well-reported under the influence of the patriarchal conceptions of economic activity. For the same/similar work, men receive 1.5-2.0 times higher wages than women, although women often work longer hours than men. The decision making power particularly the pricing and investment decisions is concentrated among male members of the family. The status of the Rohingya refugee women is highly vulnerable and yard owners force them to work at any available opportunity, out of an urgent economic compulsion.

Gender equality in the fish drying can bring many potential benefits including household incomes, and positive livelihood and nutritional outcomes. Future works must

focus on gender equity, to ensure that research and development interventions are inclusive, equitable in process and outcome, and meet the specific needs of women. The innovative research-based policies and development interventions using gender transformative approaches (GTA) can close the gender gap in dried fish sector of the country, without increasing women's time and labor burdens.



## THE IMPACTS OF ACUTE POLITICAL CONFLICT IN MYANMAR ON WOMEN'S ENGAGEMENT IN DRIED FISH VALUE CHAINS

Wae Win Khaing\* and Derek Johnson

University of Manitoba

*\*khaingww@myumanitoba.ca*

Women from Myanmar face complex gendered roles in households, workforce, and communities. Traditions that prioritize men and male-dominant culture are embedded in Myanmar society. Gendered roles are often determined by the existing legal structures, which contribute to the patriarchal culture. The generalization of women being more patient but less strong and men having greater strength and technical skills are shared in the rural communities according to the available literature on Myanmar. However, women's involvement in fisheries in Myanmar is significant especially in dried fish processing. They take part in fish processing after capture, such as a processor, trader, labourer and retailer. Although their involvement in the dried fish sector is significant, they have multiple roles within their households with care and financial responsibilities. The double burden of work is acute for women working in the dried fish sector in Myanmar and strongly shapes their lives.

On February 1, 2021, Myanmar had the military coup and since then the country has suffered from crisis and conflicts that have led to insecurity, financial problems, livelihood loss, and human rights abuses. In addition to the existing problems faced by women in dried fish sectors, it is crucial to understand how the political change has affected their work and status, and how they are coping with this period of turmoil.

## RETHINKING MARGINALIZATION: WOMEN IN SMALL SCALE FISH PROCESSING IN CAMBODIA

<sup>1</sup>Gayathri Lokuge\*, <sup>2</sup>Kyoko Kusakabe, <sup>3</sup>Prak Sereyvath

<sup>1</sup>CEPA, Sri Lanka

<sup>2</sup>Asian Institute of Technology, Thailand

<sup>3</sup>Cambodia Institute for Research and Rural Development

\**gayathri@cepa.lk*

Cambodians are one of the largest fish eaters in the world with per capita fish consumption to be around 60kg per year. Freshwater fish productivity is dependent on the seasonal flood around the Great Lake of Tonle Sap that grows to six or seven times larger during the rainy season compared to the dry season. The seasonal fluctuation of fish catch has given birth to a large variety of processed fish in Cambodia. Even though fish processing has been an ancient practice in Cambodia and processed fish is a staple food for Cambodian dishes, there has been little statistics and academic work on this subject. This study provides an overview of processed fish in Cambodia, taking into consideration the gendered division of labour in the whole value chain. Fish processing production, marketing and food preparation from processed fish, are largely dominated by women, but the limitations in processing and packaging tools/equipment and modern technology as well as limitations in marketing is restricting the growth of the market for these products. Further new players are joining the market that might marginalize the traditional producers and push them out of their livelihood and a main source of protein. The study explores the bottlenecks and the potential for processed fish from a gender perspective, highlighting the opportunities for small-scale women producers and sellers.

## **AN INTEGRATED FRAMEWORK TO BETTER UNDERSTAND GENDER RELATIONS IN DRIED FISH VALUE CHAINS**

**Madu Galappaththi \*, Andrea Collins, Derek Armitage and Prateep Nayak**

University of Waterloo, Canada

\*Madu.Galappaththi@uwaterloo.ca

This presentation aims to advance a comprehensive framework that integrates gender within the study of dried fish value chains to better understand the complexity of gendered value chain experiences. Women comprise a significant portion of the workforce in dried fish value chains, a hidden sub-sector within small-scale fisheries. Through their participation in value chains, women generate significant and diverse benefits including income, employment, food, social connections, and cultural values. Despite the benefits, women face constraints that severely restrict their ability to fully participate in and benefit from value chain activities compared to men (e.g., lack of access to good quality fish, gendered norms of access to markets). Moreover, women belonging to marginalized groups such as lower castes, widows, and refugees bear the brunt of these inequities.

However, existing frameworks to examine gender perspectives within value chains pay little attention to the diverse benefits supported by the value chains or the context-specific factors that shape such benefits. To address this gap, we developed a new integrated framework that helps systematically unpack the complexity of gender relations within dried fish value chains. In doing so, we linked three complementary areas of scholarship — social wellbeing, intersectionality, and value chains. Social wellbeing literature helps emphasize the range of benefits generated through dried fish value chains including both material and non-material dimensions. An intersectional perspective reveals how relational structures of oppression operating within value chains (e.g., caste, ethnicity) can intersect with gender to uniquely position women and men in relation to the benefits they can generate. Furthermore, the value chain analysis provides guidance to understand the structural organization of dried fish activities. Most importantly, the term ‘value’ in value chain analysis opens up an opportunity to rethink the process of value generation within value chains with special attention to non-financial benefits and the nuances of how women embed value. Our point of departure from existing literature in developing the framework is the notion of relationality (i.e., creation of experiences in relation to one another within a given context).

We demonstrate the relevance and contribution of the integrated framework by applying it within dried fish case examples from Bangladesh, Tanzania, and Sri Lanka. The framework can result in a ‘thick description’ of gender relations including rich insights on how women and men are positioned differently within the value chains in relation to the benefits they can generate, underlying forms of discrimination, and the root causes of inequities operating in value chains. Such insights can inform policy frameworks, practice interventions, and program development towards achieving equitable outcomes for everyone participating in value chains.

## PRECARITY, GENDER AND WELLBEING IN THE DRIED FISH PROCESSING IN BANGLADESH

**Md Mahfuzar Rahman**

Department of Anthropology, University of Manitoba, 508-26 Gaylene Pl. Winnipeg, MB,  
Canada, R3T4G7

*rahman15@myumanitoba.ca*

Dried fish processing in Bangladesh is labour intensive, although the level of intensity varies depending on the species, their sizes, and the processing method. However, the dried fish processing, both marine and freshwater, is gendered; women comprise most processing labourers. These female labourers work in a precarious environment- low pay, zero benefits, no fixed schedule, insecurity, and harassment. Yet, despite the precarious environment, many women processing labourers, lacking an alternative livelihoods in the locality, recognized the processing work as critical to their survival.

Enterprises involved in dried fish processing in Bangladesh are greatly diverse, ranging from household production to fully commercial production units resulting in various labour arrangements for production. Significant distinctions are noticed in labour arrangement depending on the location, size and nature of the processing unit and the fish processed; even a single production unit can have multiple labour arrangements depending on its needs. This study found various types of labour arrangements in Nazirtek, Cox's Bazar and Kuliarchar, Kishorgonj, such as season-contract, daily basis, fish contract, and pay per piece, among others. These labour arrangements are highly gendered; all season-contract labourers are male, whereas most day labourers are women. Significant wage and benefit differences are noticed among the arrangements that critically impact labourers' wellbeing and working conditions. While the season-contract labourers get benefits like meals and accommodation in addition to salary, day labourers are paid only the wages. There are also notable wage differences between male and female day labourers; the female day labourers are paid around forty percent less than their male counterparts, although their working hours and workloads are the same.

Both processing sites lack a standard recruitment system; all labourers are recruited on verbal contracts resulting in a denial of rights if the employer breaks the contract or words. This informal and oral recruitment made the women processing labourers more vulnerable to exploitation; increased job insecurity and higher competition getting the job made the women labourers to exploit themselves to ensure regular work for survival. The processing workers usually work nine to ten hours daily, but often they work longer hours without additional payment on employer demands. Moreover, there is no fixed schedule; women labourers typically have to report to the processing unit once the raw fish arrives or the employer calls; they sometimes have to do overnight shifts without prior notice. The workers have little or zero role in deciding the schedule; denying any work shift means less shift and income in the following days, losing the job that affects their life critically. Moreover, the women labourers also face more health issues due to the long working hours and lack of proper sanitation facilities in the processing sites.

## WHY FISH MATTERS FOR WOMEN? INSIGHTS FROM A SCOPING STUDY IN GUJARAT

**Tara Nair\* and Durga Fofandi**

Gujarat Institute of Development Research, Ahmedabad, Gujarat, India

\*tara01@gmail.com

Despite women's significant participation in the post-harvest activities in the fisheries sector their work is invisible and grossly undervalued. Not only that the fisheries value chain is structured in gendered ways, but women workers located as they are within distinct value chains experience specific challenges arising from the patriarchal social relations as also the peculiar production relations that characterize the fisheries sector. In other words women fish workers' lives and livelihoods are simultaneously affected by constraints emanating from production, market, and climate crises as also cultural constructions of gender.

This paper presents the findings of a study that has explored how women retail traders, a critical node in any local fish value chain, negotiate their lives and work. The main purpose of the study is to understand the factors that drive women to participate in the local market and to unravel the peculiar challenges they face at the personal level and at the level of the market. The study was undertaken in the retail fish market of Kharakua located close to the Veraval harbor in the Gir-Somnath district of Gujarat, which is the largest producer of marine fish among all districts in the state.

The Kharakua market is an exclusive domain of women retail traders. It accommodates close to 300 regular retailers of fresh fish and 25 wholesalers. Dried fish retailers are few – about 16. Apart from them, a number of women use the market premises to sell the catch from motorized boats (fitted with outboard motors or OBM) and from multi-day, long trip trawlers in the mornings. In the evenings, again, women from nearby areas sell fresh fish that land in short-trip trawlers.

The paper draws on the findings of a study we conducted among 15 dried fish retailers and a purposively selected sample of 33 fresh fish retailers and vendors in the market, all belonging to the Kharwa community. The women were interviewed with the help of a semi-structured questionnaire, which focused on their personal and family profile, information on their business, their experiences of being part of the value chain and operating from within the market, and their reflections on these experiences. It was found that most of dried fish retailers were widows and they started the activity after the death of their husbands. On the other hand, for a larger proportion of women who sell fresh fish in the market the activity is a source of additional household income. Interestingly, 90 % of the women surveyed said that income from fish sales constitutes the major source of household income. About 73 % of them also control the use of the income generated from the activity. The study findings illustrate how women in fisher households negotiate livelihood choices in response to the peculiar needs and constraints faced by the households.

## IMPACTS OF COVID19 ON WOMEN DRIED FISH PROCESSORS OF KARNATAKA: SOME EMPIRICAL EVIDENCE

Prasanna Surathkal<sup>1\*</sup>, Ramachandra Bhatta<sup>2</sup> and Amalendu Jyotishi<sup>3</sup>

<sup>1</sup>Azim Premji Foundation, Bengaluru, Karnataka, India

<sup>2</sup>Snehakunja Trust, Kasarakod, Honnavara Taluk, Uttara Kannada district, Karnataka, India

<sup>3</sup>India School of Development, Azim Premji University, Bengaluru, Karnataka, India

\**pras.kota@gmail.com*

Women play a dominant role in the dried fish value chain in Karnataka, as much of the production and retailing of dried fish is carried out by thousands of fisherwomen in the coastal districts of the state. Dried fish production and retailing are small-scale operations. Most of the fisherwomen in the state use common-pool resources such as the beach shore, open spaces close to harbors etc. to produce dried fish. Dried fish, being nutritionally dense, contribute to regional food and nutritional security.

Dried fish producers in coastal Karnataka have come increasingly under stress from anthropogenic and natural factors. Some such prominent factors include: decades of coastal industrialization, including the recent Blue Economy initiatives; threats to the ecological integrity of fisheries; development of industrial-scale fish processing, mainly fishmeal and fish oil production; lack of support from policymakers and absence of political representation, since these are unorganized and informal activities. In addition, prolonged market distortions caused by the *novel Coronavirus disease 2019* (COVID-19) pandemic are expected to make the dried fish producers even more vulnerable. One of the most drastic developments was the 21-day national lockdown enforced across the country by the Government of India on March 24, 2020. The lockdown created severe bottlenecks in the food supply chain across the country, and put insurmountable challenges to consumers in buying even necessities. A sense of chaos, uncertainty and anxiety marked this period among the actors in the food supply chain.

Not much details are available to the extent of impacts of COVID19 on the dried fish segment. This is not surprising, since the segment has been neglected for decades. This study surveyed dried fish producers across coastal Karnataka to understand the profile of producers, analyze dried fish production and marketing, and to understand the perceived impacts of COVID19 on the producers' activities. 30 dried fish producers each were interviewed in and around nine major fishing harbors of Karnataka during the months of April-June 2021. Preliminary results show that though producers feel that market demand for dried fish increased during COVID19, restrictions on movement of products and people might have prevented them from capitalizing on the increased demand. Further analysis on the COVID19 impacts on dried fish producers of the state are being carried out.

## **BARRIERS TO WOMEN'S EQUITABLE ENGAGEMENT IN TRADITIONAL DRY FISH INDUSTRIES OF INDIAN SUNDARBANS: SOME CROSS CUTTING ISSUES**

**Aparna Roy\*, Basanta Kumar Das, Pranaya Kumar Parida**

ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata,  
West Bengal, India, Pin-700120

*\*aparnandrister@gmail.com*

In coastal Indian Sundarbans, winter migratory bagnet fishery is a typical feature where a large number of fishers migrate specially during mid of October to early of February and set up temporary fishing camps. The winter bag net fishery has key contribution in total fish production from Hooghly Estuary and majority of the catches are used as dry fish. In small scale fisheries sector, various fish processing activities are generally undertaken by women by tradition. In Indian Sundarbans, in the transitory dry fish camps women are actively involved as dry fish workers. However, the women engage in traditional dry fish industries are facing some cross cutting issues related to social, socio-ecological, economical and policy context. A study was conducted to identify the gender barriers faced by the women engage in traditional dry fish industries in Indian Sundarbans.

Primary data was collected from 160 women dry fish workers by means of face to face questionnaire interview, through focus group discussion and key informants' interview from Fresarganj, Bakkhali, Kalisthan and Sagar. It was found that the conventional method of sun drying of the fish was adopted as a low-cost method by the traditional dryfish industries of Sundarbans areas.

Women involved in the traditional dry fish industries perform activities like: washing and cleaning of the fish, grading and sorting of fish, drying of the fish and watch and ward of the fish drying process. However, women forces in the transitory camps are worked as paid labourer and get lesser amount of wages than a men labourer. In a society the women's role often defined by the gender norms. To work as a dry fish worker in the camps 71% of the women have to seek permission from their in-laws or husbands. About, 67% of the women informed that their earning from dry fish industries significantly contribute to their family income. Managing households and children is the primary responsibility of the women, so often women involved in fish drying have to compromise their own time and health for earning livelihoods for their own family and it was reported by 54% of the sampled women. About, 65% of the women expressed that security at workplace is a major issue faced by them. Dry fish industries are seasonal, moreover, interference of the muscleman, imbalance between supply and demand of fish, natural calamities sometimes cause livelihood insecurity to them. The involvement, constraints, hurdles, opportunities, benefits are different for the men and women involved in small scale dry fish industries. Therefore, short term and long term strategies may develop based on gender transformative approach to ensure the gender equity and equality.

## **GENDER ANALYSIS OF THE CHANGING IN PRODUCTION AND CONSUMPTION OF FERMENTED FISH PASTE (PRAHOK) IN CAMBODIA**

**Uon Sokmoly**

Asian Institute Of Technology, P.O. Box 4, Klong Luang Pathumthani 12120, Thailand,  
*st122436@ait.asia*

Fisheries play a vital role in ensuring the national economy, household food security, and livelihoods for Cambodian people across locations in the country. In terms of fish processing in general, it is recognized as a significant process that can create numerous employment for Cambodian people, especially poor women surrounding Tonle Sap lake. In particular, the processing of fermented fish paste (prahok) has provided job opportunities for people who lived on the Tonle Sap lake, especially women. Indeed, fermented fish paste (prahok) is a very famous food ingredient for Khmer traditional food in Cambodia and can be severed as food preservation for long-term consumption. Currently, many Cambodian fishers who lived in the floating villages of the Tonle Sap lake were displaced from their living areas due to the announcement of the Cambodian government to re-organized the environment of Tonle Sap lake. Due to the change in living patterns and access to fish resources, it has affected the changes in production and consumption of fermented fish paste (prahok) among Cambodian fishers, especially women processors. Besides, the changes of the environment and ecosystem of the Tonle Sap lake such as decreasing level of water and number of freshwater fish also affected fishing and processing activities among Cambodian fishers.

The overall aim of this study is to explore the changes in production and consumption of prahok among fishers in the Tonle Sap lake and analyse how these changes link to gender issues among fisher households who make prahok. In addition, this study focused on fishers who used to make prahok before and they still continue to make prahok at the present, and those who used to make prahok before, but no more processing prahok at the present. Furthermore, the areas of this study focused on three main categories: (i) the area that has very good access to fish (floating village); (ii) the area that formerly had good access to fish but now no more access to fish (displaced village); (iii) the area that has seasonal access to fish but less access to fish now (flooded plain area).

The qualitative method (phenomenology) was applied in this study which aimed to document the feeling and perceptions of meanings of fermented fish paste processing for fish processors due to the changes in their production and consumption, pay attention to different experiences (if any) and perceptions of women and men fish processors. The significance of this study can be useful for further research and project implementers who prefer to explore and work related to Cambodian fish processing, geographical identification of dried fish products (prahok), women's empowerment in fish processing or prahok processing, and so on.

## **WOMEN IN DRIED FISH PROCESSING IN BANGLADESH: NEGOTIATING AND BARGAINING WITH PATRIARCHY**

**Mirza Taslima Sultana<sup>\*</sup>, Yeashir Arafath, Dyuti Tasnuva Rifat, Sayeed Ferdous, Mahmudul Hasan Sumon**

Department of Anthropology, Jahangirnagar University, Savar, Dhaka

*\* m.taslima@juniv.edu*

This paper searches women's socio-economic challenges and strategies while involved in the dried fish processing in Bangladesh, which is written based on the scoping field work in the three major areas (Sylhet, Sunamganj, Atrai, Ninguin, Kuliarchar) of the inland dried fish processing zones. Most of the relevant literature argue that women's income generating activities in the fisheries and dried fish processing and their leadership in managing the entrepreneurship will change the gender relationship of the community. However, in our study areas neither the income generating activities of the women in dried fish nor the entrepreneurship/leadership of the women change the gender relationship. Studies on garments and other income-generating activities in Bangladesh show that only women's participation in the economy did not change their subordinated gender status in society, nor it ensures the empowerment of women; economic empowerment brings changes in lifestyle, education of their children and sometimes challenges the gender norms too. In this study, we find that the patriarchal norms are internalized to the interviewed women. Therefore, during the interviews the interviewees were discursively reproducing the existing gender norms. Also, we find that their involvement in the dried fish activities is sometimes the tool for "bargaining with the patriarchy". Therefore, we argue that through the women's involvement in dried fish processing activities, the gender relationship is negotiated and challenged; consequently, the patriarchy has been shaping and reshaping.

## **UNDERSTANDING SOCIAL WELL-BEING AND VALUE OF THE DRIED FISH: A STUDY OF MYANMAR MIGRANT WOMEN PROCESSORS IN THE DRIED FISH VALUE CHAIN IN SAMUT SAKHON PROVINCE, THAILAND**

**Si Thu Lin**

Asian Institute of Technology, Khlong Luang, Pathum Thani, Thailand  
*st122570@ait.asia*

Women play an essential role in the processing and marketing sectors of the small-scale fishing industry. They prepare fish for sale by drying, salting, smoking, and preparing fish and shrimp. They are also primary caregivers in the fishing homes, responsible for ensuring the safety of food and nutrition. Dried fish has been one of the essential components of south and Southeast Asian countries' food supplies. Dried fish products contribute significantly to the economic opportunities of players in the entire fishery value chain.

This industry employs millions of people, especially women, who comprise the majority of fish-drying labor in many places. Women make up almost half of those working in the production and sale of dried fish. The industry also encounters and generates significant challenges, such as concerns about the safety of the food and exploitation of working conditions. In Southeast Asia, women are more likely to work in the fish processing industry than in fishing itself. Women processors receive a range of benefits, such as income, employment opportunities, nutritional support, cultural linkages, and household resilience.

Several Myanmar women apparently run their own dried fish processing business from their homes in Samut Sakhon, Thailand. Men also work in this business as dried fish processors or traders. Most of their customers are Myanmar migrants as well, and dried fish has important nutritional value and cultural attachment to them. Dried fish processors must communicate with other actors in the fresh fish input and dried fish output markets. Their relationships and experiences in these two markets influence their income levels and socioeconomic status. Migrant women who take part in the production and trade of dried fish face obstacles across the value chain. Women producers have poor negotiating power with buyers as a result of normalized historical gender inequalities in the workplace and society.

This study will examine how the dried fish business contributes to the general social well-being and the significance of this contribution to Myanmar migrant women processors. It aims to gain a better understanding of their access to fish stocks and the power relations that are embedded in their day-to-day lives. The majority of the people who take part in the study will be women who are engaged in the processing of dried fish on a small scale in the province of Samut Sakhon. This study places the majority of its emphasis on the mid-stream component, which consists of processors and merchants, as well as the downstream segment (retailers).

## PHOTO NARRATIVE ON WOMEN IN DRIED FISH SECTOR IN KERALA, INDIA

**Nikita Gopal<sup>\*</sup>, Abhijith S, Jiswin Joseph, Holly Hapke<sup>2</sup>, Ramachandra Bhatta<sup>3</sup> and Amalendu Jyotishi<sup>4</sup>**

<sup>1</sup>ICAR-Central Institute of Fisheries Technology, Kochi, Kerala, India

<sup>2</sup>University of California-Irvine, USA

<sup>2</sup>Snehakunja Trust, Kasarakod, Honnavara Taluk, Uttara Kannada district, Karnataka

<sup>3</sup>India School of Development, Azim Premji University, Bengaluru, Karnataka

*\*nikiajith@gmailcom*

Through a series of field photographs, this presentation will tell the story(ies) of women (and men) in the dried fish sector in Kerala, India. These photos are a reflection of the varied activities that women are involved in the production and marketing of dried fish across the different districts of the state and indicate the significant role they still play in producing and marketing this product within and outside the state.



## **UPSCALING COMMUNITY-BASED FISHERIES MANAGEMENT (CBFM) AND THE GENDER DIMENSIONS IN THE PACIFIC**

**organised by  
The Pacific Community (SPC)**

**Chair(s): Pacific Community (SPC), Natalie Makhoul (SPC)**

**Format:** Videos (pre-recorded and access to videos via youtube), panel discussion, interactive and engaging

The Pacific's rich community landscape in a sea of islands – often remote and exposed to nature's forces – is the Pacific's solution to managing natural resource from the heart of community. Traditional communal lifestyles remain strong pillars of organised village life with respect to cultural practices, traditional knowledge and co-existence with the natural environment and its resources. Coastal lifestyles have long shaped Pacific people's sense of belonging and identity. Scaling-up community-based fisheries management (CBFM) has become more and more evident as the way forward to achieving sustainable marine resource management for coastal communities. CBFM is a strategy to achieve widespread community coverage to enable self-decisive management by the community as opposed to localised, site-based interventions driven at national level. CBFM in the context of the Pacific means that fisheries management approaches are community-driven and encompass an ecosystem approach that will sustain livelihoods and ensure resilient island communities<sup>1</sup>. This has led to the Fisheries Ministers endorsement of the Pacific led regional framework on scaling-up CBFM in 2021 providing a regional directive. But what are the roles, risks, and opportunities for women and other marginalised groups in this scaling-up effort? This session discusses the gender dimensions of scaling up CBFM in the Pacific context. We will look at existing inequalities and power dynamics at community level as well as associated gender risks and mitigation strategies when scaling-up. In addition, the special event will explore how gender responsible and sensitive CBFM scaling-up can positively contribute towards transformative change.

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<sup>1</sup> Pacific Framework for Action on Scaling up Community-based Fisheries Management: 2021 - 2025

**THE GENDER RHETORIC IN GLOBAL SEAWEED SECTOR: WOMEN'S  
CONTRIBUTION IN SEAWEED FARMING, WILD HARVEST, VALUE CHAIN AND  
SOCIETAL DEVELOPMENT**

**&**

**'TRANS'-THE THIRD GENDER: AN INCLUSIVE PERSPECTIVE OF GENDER  
MAINSTREAMING IN THE INDIAN FISHERIES SECTOR**

organised by  
ICAR-Central Marine Fisheries Research Institute, Kochi, Kerala, India

Chair(s): P. S. Swathi Lekshmi, B. Johnson, Vipin Kumar V



## ECONOMIC AND SOCIAL PROSPERITY THROUGH SEAWEED FARMING – A RHETORIC FROM THE SEAWEED BELT OF INDIA

Johnson. B.<sup>1\*</sup>, Tamilmani, G.<sup>1</sup>, Sakthivel, M.<sup>1</sup>, Rameshkumar, P.<sup>1</sup>, Anikuttan, K. K.<sup>1</sup>,  
Bavithra, R.<sup>1</sup>, Swathi Lekshmi, P. S.<sup>2</sup>, K. Madhu<sup>3</sup>, and A. Gopalakrishnan<sup>3</sup>

<sup>1</sup>ICAR – Central Marine Fisheries Research Institute, Mandapam Regional Centre,  
Mandapam Camp – 623 520, Tamil Nadu, India, <sup>2</sup>ICAR-Vizhinjam Regional Center of CMFRI,  
Post Box No 9, Vizhinjam, Thiruvananthapuram-692521, <sup>3</sup> ICAR – Central Marine Fisheries  
Research Institute, Post Box No.1603, Ernakulam North-P.O., Cochin- 682 018

\*jsfaith@gmail.com

Seaweeds (marine macroalgae) are an important coastal resource invaluable for societal and ecosystem benefits. In India, seaweed farming is one of the effective diversified livelihood options and income stream for the marine fishers. It has high potential to supplement marine production and can provide sustainable income to the coastal fishers, especially fisherwomen. Seaweed farming has emerged as a prototype of family farming underpinned by female labour; as seen elsewhere in South-east Asia and East Africa. Expansion of seaweed farming in the country will enhance the socioeconomic status of coastal fishers and will be helpful in mitigating the negative effects of climate change, while protecting the marine ecosystems from ocean acidification and ocean de-oxygenation. Owing to its importance, the Government of India is promoting seaweed farming through Pradhan Mantri Matsya Sampada Yojana (PMMSY) by providing financial, marketing and logistical support.

The ICAR-Central Marine Fisheries Research Institute (CMFRI) has been pioneering in seaweed research and spearheading capacity building activities in the last few decades. The institute is promoting the seaweed farming activity along the Indian coast through Scheduled Caste Sub-Plan (SCSP) programme, a strategy intended for the socio-economic upliftment of the depressed classes. Around 30 fisherwomen families from the villages of Puthukudi, Thondi, Ramanathapuram District of Tamil Nadu formed the sample study. They belong to traditional fishing community (“*Kadaiyar*” caste). They derive their main source of livelihood from fishing. Due to dwindling fish catch and diminishing revenue from capture fisheries, they were looking for diversified income streams to support their families. At this juncture, the ICAR- CMFRI, Mandapam has provided hands on training, input supply in the form of seeding material and technical guidance for establishment of seaweed farming at Puthukudi and Thondi villages through SCSP programme during 2019. Initially with the institute support each fisherwoman family-initiated farming with 20 monoline units (equivalent to 20 bamboo rafts) using *Kappaphycus alvarezii* seaweed. Owing to good revenue in first year, each family expanded the farming with 20 additional monoline units. At present, each fisherwoman family is practicing farming with 40 monoline units and earning around INR 11,000/- as monthly net income. The fisherwomen are highly appreciative of the Governmental support for bolstering them with better livelihood options which in turn ensures quality education for their children.

Traditionally, preparation of ropes, seeding, binding of seeded ropes, harvesting and drying are mainly carried out by women. Erection of poles, preparation of the monoline units and maintenance of rafts are men centric activities. In exceptional cases (as in five fisherwomen families) the entire gamut of activities was carried out by women themselves. The following paper discusses the ways in which women seaweed farmers have emerged as agents of economic and social change catalyzed by institutional support and enhanced transformative spaces. The Covid-19 pandemic has interestingly, unfolded the dynamics in gender division of labour. During the country wide lockdown, when bans were imposed on fishing, seaweed farming was the only livelihood income sources for them.



## **'TRANS'-THE THIRD GENDER: AN INCLUSIVE PERSPECTIVE OF GENDER MAINSTREAMING IN THE INDIAN FISHERIES SECTOR**

**Vipinkumar V.P\*., Swathilekshmi P.S., Reshma Gills and Charles Jeeva**

ICAR-Central Marine Fisheries Research Institute, Kochi, Kerala, India

\* vipincmfri@gmail.com

An attempt to reconnoitre the empowerment paradigm of the transgender stakeholders in the fisheries sector while examining the LGBTQ+ categories was made as a part of the research endeavour '*Trans-gender as an inclusive perspective*'. The 'Trans' category faces different kinds of discrimination on the socio-political and economic fronts. This study aims to provide a depiction of the entrepreneurial potentials of various fishery-based interventions as a livelihood supporting activity for transgender persons in the Indian context in an action research mode. The various activities planned and implemented are the creation of a firm database on transgender stakeholders with their preference to take part in fishery-based microenterprises, organization of the sensitization programmes and Entrepreneurial Capacity Building training conclaves for the marginalized category of LGBTQ+/transgender category of respondents in appropriate fishery based microenterprises. Data collection concerning various objectives was done through standardized data gathering protocol and case study methods. The baseline data were gathered from 100 transgender people (41 transmen and 59 transwomen), and their preference for fishery-based start-ups was assessed. Fish value addition entrepreneurial activity has gained maximum preference scoring, followed by ornamental fish culture, aqua tourism and fish vending. The successful case studies of transgender beneficiaries of fishery-based ventures were documented with indicative economics. The general constraints faced by transgender stakeholders and various activities, in particular, were analyzed. Constraint analysis using Friedman's test revealed that social isolation followed by financial liability and gender marginalization were the severe problems they faced. An ample number of success cases were brought out, which could be used as case facsimiles or practical manuals for similar categories of fishery-based entrepreneurial ventures.

## **OVERCOMING THE ENTREPRENEURIAL FEAR OF FAILURE: A CASE STUDY OF EMPOWERMENT OF TRANSGENDER THROUGH FISHERY-BASED INTERVENTION**

**Reshma Gills\*, Vipinkumar V.P., Ramachandran C. and Anuja A.R.**

ICAR-Central Marine Fisheries Research Institute, Kochi

\* reshma1818@gmail.com

Entrepreneurial aspects of the transgenders and other LGBTQ+ populations are least explored and studied. Though an element of calculated risk is always associated with entrepreneurial activities in general, the main challenges and restrictions faced by transgender people may differ in their severity from those faced by cis-gender people. In general, the limited societal acceptance that transgender people experience worsens the paranoid thinking that goes along with the gender dysphoria they experience. Even though entrepreneurship is regarded as a livelihood-supporting activity, transgender people experience a higher level of entrepreneurial fear of failure due to barriers like gender-based discrimination, a lack of resources, challenges with marketing, social isolation even for the products they produce, etc. Providing entrepreneurial capacity-building training and enhancing resource accessibility through input provision are some of the beginning steps in addressing this issue. This paper describes the gender empowerment action research through fishery-based intervention done by the gender research team at ICAR- CMFRI Kochi, which helped a transgender couple from Kerala, to overcome the trepidation of starting a business and how they succeeded.

**GAF 101 TRAINING-WORKSHOP: GENDER ANALYSIS IN AQUACULTURE AND FISHERIES SOCIAL SCIENCE RESEARCH**

organised by  
**GAFS & AFSSRN of the Asian Fisheries Society**

**Organisers: Marieta Sumagaysay, Paul Ramirez, Nikita Gopal, Neha W Qureshi**  
**Resource Persons: Marieta Sumagaysay, Alice Joan Ferrer, Nikita Gopal, Zumilah binti Zainalaludin, Kafayat Adetoun Fakoya, Neha W Qureshi Paul Ramirez**

Mainstreaming gender in social science research and development in fisheries and aquaculture is a common goal and interest of the Asian Fisheries Society - Gender in Aquaculture and Fisheries Section (GAFS) and Social Science Research Network (AFSSRN). To this end, the AFSSRN is partnering with GAFS to host a half-day training-workshop session in the upcoming GAF8 that will introduce to new and future researchers, scientists, and development practitioners the value of gender integration in social science research. This training-workshop will immerse the student-participants on the growing range of gender analysis in aquaculture and fisheries social science research and development in the hopes that they start thinking and engaging on innovative gender analysis in their own fields of research and work.

At the end of the training-workshop, participants should be able to:

- i) appreciate the value of gender integration and mainstreaming in social science research,
- ii) familiarize themselves with generating gender-specific research and development questions, and
- iii) understand when and how to use various gender analysis tools and approaches in their respective social science research.

## **GENDER ANALYSES ON THE VULNERABILITY TYPES SUFFERED BY POOR AND OLDER FRESHWATER FISHERIES COMMUNITY MEMBERS IN PENINSULAR MALAYSIA**

**<sup>1</sup>Norehan Saidi, <sup>1,2</sup>Zumilah Zainalaludin\* & <sup>1</sup>Askiah Jamaluddin**

<sup>1</sup>Faculty of Human Ecology, Universiti Putra Malaysia, 43400 Serdang, Selangor Darul Ehsan,

<sup>2</sup>Malaysian Research Institute on Ageing, Universiti Putra Malaysia, 43400 Serdang, Selangor Darul Ehsan.

\*zumilah@upm.edu.my

This paper aimed to measure the vulnerability type that predicts the likelihood of the respondents in poor category of household income by sex-disaggregated data. There were  $n=322$  respondent are from Padang Terap, Kedah; Pekan, Pahang, Kuala Pilah Negeri Sembilan, and Hulu Perak, Perak. They suffer from at least one out of six types of vulnerability asked in the questionnaire. The respondents are on average older people (around 66 years old mean age of male and female respondents). HO1 (no type of vulnerability predicts male in poor category of household income), and HO2 (no type of vulnerability predicts male in poor category of household income) were tested through Binary Logistic Regression (BLR) Model respectively and rejected. Both models were fit and significant ( $p<0.05$ ) to predict the male and female respondents in poor category of household income. BLR Model 1 (male respondents) significantly predicted Handicapped Male and Single Fathers with 3.60 times and less than 93.9 percent of the likelihood respectively for them to be in the poor category of household income. For BLR Model 2 (female respondents), Single Mother and Handicapped Women predicted 16.15 times and 72.5 percent less of the likelihood respectively for those in the poor category of household income. This paper concludes the vulnerable members in the fisheries community are on average older people, vulnerable women are poorer than vulnerable men, and handicapped men and single mothers are the poorest in freshwater fisheries communities.

## GENDER ANALYSIS OF THE TUNA FISHERIES VALUE CHAIN IN GENERAL SANTOS CITY, PHILIPPINES

Marieta Bañez Sumagaysay<sup>1,2\*</sup> Harold M. Monteclaro<sup>1,2</sup>, Rosario H. Asong<sup>2</sup>,  
Ida M. Siason<sup>1,2</sup>, Alice Prieto-Carolino<sup>1,2</sup>, Rowena Paz L. Gelvezon<sup>1,2</sup>

<sup>1</sup> *University of the Philippines Visayas,*

<sup>2</sup> *National Network on Women in Fisheries in the Philippines*

\*mbsumagaysay@up.edu.gov.ph

The interest in integrating and mainstreaming gender in fisheries research and extension has far-reaching implications, such as in the area of sustainable fisheries management (SFM) and ecosystem approach to fisheries management (EAFM). In a traditionally male-dominated economic sector, gender mainstreaming at all nodes of the tuna fisheries value chain is critical if only to promote inclusive and sustainable development (SDG 5).

In 2017, the National Network on Women in Fisheries in the Philippines (WINFISH) conducted a USAID-assisted gender analysis of the tuna fisheries in General Santos City, the tuna capital of the Philippines. A gender-responsive value chain analysis (GRVCA) was used as the framework along with USAID's six gender dimensions namely: access to assets; beliefs (including knowledge and perceptions); practices and participation; time and space; legal rights and status; and power and decision making. Both small-scale (municipal) and large scale (hand line and purse seine) value chain players were included in the study, together with value chain enablers.

There was a survey among 219 respondents (109 males and 110 females) representing the producers, processors and traders. Twenty two key informant interviews (5 males and 17 females), and 8 Focus Group Discussions (2 all-male, 3 all-female, and 3 mixed male-female FGDs) were likewise conducted.

The empirical evidence on existing gender differentials guided the crafting of strategic gender interventions to address gender biases and issues, and consequently enhance women's engagement in the tuna value chain, promote gender equality and women's empowerment. Gender-responsive entry points for intervention include: capacity building of both male and female value chain players and enablers; gender-sensitive knowledge product development and utilization; forging partnerships with value chain enablers; and promoting a gender-responsive governance. With these interventions, women in the fisheries value chain are likely to expand work spaces, improve gender relationships, and address their practical and strategic gender needs.

## GENDER ANALYSIS IN SMALL-SCALE FISHERIES: NIGERIA

**Kafayat Fakoya<sup>1\*</sup>, Ayodele Oloko<sup>2</sup>, and Ismot Olabamiji<sup>1</sup>**

<sup>1</sup>Lagos State University, Ojo, Lagos State, Nigeria.

<sup>2</sup>University of British Columbia, Vancouver, Canada.

\* kafayat.fakoya@lasu.edu.ng

Small-scale fisheries in Nigeria provide employment and a means of sustenance for both men and women. Value chains are diversified, often complex, and evolving. Depending on culture and tradition, religion, perspectives, and norms regarding resource access and control, mobility, the technology used, and the product involved, men and women participate in a fishery system in different ways. Wealth, family heritage, and social capital are crucial factors that influence gender participation in the value chain, as well as access to, control over, and accrual benefits from resources. On average, men are more involved in fishing, investing in fishing crafts, nets, and other equipment. They have a monopoly on the governance of fisheries and are also involved in activities complementary to fishing. Women, on the other hand, dominate processing and trading, can be found at all nodes of the value chain, and perform complementary activities, the majority of which are unpaid. Women's influence in fisheries management is limited, except where they traditionally harvest the fishery resource. Gender is frequently misunderstood and focused as "women's issues" at the expense of gender identities and power relations. Consequently, both government and non-governmental organizations have primarily focused on empowerment in the post-harvest nodes of value chains, giving the impression that "one size fits all," and have overlooked increasing women's capacity in participation in the harvest node and fisheries governance. There is no gender policy that is specific to small-scale fisheries, despite the fact that women in fisheries have been included in agricultural policy instruments in the past and present. The 2019 National Policy on Gender in Agriculture aims to address gender disparities in agriculture, including fisheries and aquaculture. Policy failure, on the other hand, is imminent if elements supporting effective gender mainstreaming are hampered by a lack of political will and resources, including information and capacity.

## STATUS AND WAY FORWARD FOR STRENGTHENING GENDER STUDIES IN INDIAN FISHERIES AND AQUACULTURE

<sup>1\*</sup> **Neha W Qureshi and Nikita Gopal**

<sup>1</sup>ICAR-Central Institute of Fisheries Education, Mumbai, Maharashtra, India

<sup>2</sup>ICAR-Central Institute of Fisheries Technology, Kochi, Kerala, India

\*nehaq@cife.edu.in

No country can ever tread the path of progression till the disparity between men and women is reduced to a substantial level. In India, women constitute about one third of the workforce (44%) in fisheries. Women play a very crucial role and their contribution towards fisheries development cannot be ignored. It's substantiated through various studies that concerted efforts of both men and women are required to be quantified for the better development of the sector. This necessitates gender studies in fisheries and aquaculture. In Indian context many studies have been conducted in terms of addressing gender issues in fisheries and aquaculture. This paper captures the detailed review of research/studies conducted across India and identifies the gaps in terms of three broad categories; use of methodological frameworks, data collection and sampling framework. There are 9 major frameworks documented to be used in gender analysis. In India, many studies were found to be theoretically sound but lacks a proper methodological (gender) framework and majority studies have concentrated only on documenting roles of women, access and control, constraints faced by fisherwomen in pre-harvest, post-harvest and value chain activities. A scientometric analysis of gender studies in India also revealed patriarchal notions and reflected fishing occupation as largely male centric. Gender is a social construct but majority studies have excluded the role of other constructs and inter-sectorial issues like ethnicity, caste, religion etc. as an effective means to study the gender dynamics. There is a need to create a platform wherein young researchers and scholars can be oriented and trained regarding use of various methodological frameworks for analysing various dimensions of gender research and also use of gender sensitive participatory processes to ensure holistic development.

## WOMEN'S ROLE IN FISHERIES: SHARING EXPERIENCES

organised by

International Collective in Support of Fishworkers (ICSF) Trust, Chennai

**Chair(s): Nalini Nayak<sup>1</sup> and N. Venugopalan<sup>2</sup>**

<sup>1</sup>Trustee, ICSF Trust (Panel)

<sup>2</sup>Programme Officer, ICSF (Film presentation)

The women fisher's involvement in the sector follows a similar arc the world over, despite wide differences in society, culture, politics and economics. This 30-minute film is an effort to understand and identify the main factors affecting this over the past decade causes that have shaped their role, both positively and negatively.

The 5 member Panel will focus on the following questions: questions are:

- Can we say that our discourse explicitly recognises women's human rights, labour rights (including occupational safety and health), environmental rights (participation in resource management, climate change coping mechanisms, differential impact of disasters on women) and social impacts (the role played in community and in ownership rights in near shore fisheries)?
- Are women Organized better now? How many Organizations are there and how attentive are they at the national or international levels to gender and women's issues?
- What are the effects of increasing mobility and participation in multiple activities as fisher, trader and wage labourer in processing industry; as farmers in aqua farms; as migrant workers; as women employed in seafood industry; and as caregivers, among others?
- What is the major change in developing coping mechanisms in your country or in the fisheries you are familiar with? Is there a marked change at the occupational level?
- What are the legislative or policy supports at the national or international levels? Are there data available about women's employment and participation in fisheries?
- Empowerment and agency of women are important for community development. What is the nature of progress made? What are the major factors of negative impacts? What are the major factors of positive impacts? What is the resistance to these changes? Where does it come from?

## **RUPTURE, GENDERED ADAPTATION AND THE SOCIAL ECONOMY OF SMALL-SCALE FISHERIES IN THE INDIAN OCEAN**

**organised by  
Indian Ocean Collaboratory on Small Scale Fisheries**

**Chair(s): Gayathri Lokuge<sup>1</sup>, Kyoko Kusakabe<sup>2</sup> and Holly Hapke<sup>3</sup>**

<sup>1</sup>Centre for Poverty Analysis, Sri Lanka

<sup>2</sup>Asian Institute of Technology, Thailand

<sup>3</sup>University of California-Irvine, USA

Small-scale fisheries are diverse and vitally important resource economies that underpin the livelihoods of millions of people across the Indian Ocean region. Yet, these economies are enmeshed in political ecologies of change that are heightening their vulnerability. Changing physical environments, in tandem with competing economic demands, “big capital”, blue economy policies, shifts in governance and other institutional pressures, are shrinking the space for small-scale fisheries across the Indian Ocean region. Drawing on a series of deliberations conducted by the Indian Ocean Collaboratory on Small-scale Fisheries, Rupture and Gendered Adaptations, we present an approach to understanding environmental and economic change that is grounded in notions of rupture and shrinking space. We critically re-evaluate ideas about adaptation and change in social-ecological systems thinking from a feminist economic geography perspective. We are interested in how the mounting, synergistic threats that small-scale fishing communities in the region face are differentially experienced in gender and broader intersectional terms. Our analysis emphasizes variations in the experience of exclusion across space, but also how a gender lens opens up new possibilities for collective action. We illustrate the analytical potential of our approach through examples of collective action from Kenya, India, Sri Lanka and Cambodia.

The Indian Ocean Collaboratory on Small-scale Fisheries, Rupture and Gendered Adaptations includes the following members:

Gayathri Lokuge, Amalendu Jyotishi, Holly M. Hapke, Ramachandra Bhatta, Karin Fernando, Derek Johnson, Kyoko Kusakabe, Ajit Menon, Betty Nyonje, Francis Okalo, Sereyvath Prak, Joeri Scholtens, Nadiya Azmy, Nuwanthika Dharmaratne, Channaka Jayasinghe, Nicholas Karani, Prasanna Surathkal, Prabhakar Jayaprakash, Bhagath Singh A.

## **WORKING TOWARDS CLOSING THE GENDER DATA GAP IN SMALL-SCALE FISHERIES WITH INSIGHTS FROM THE ILLUMINATING HIDDEN HARVESTS PROJECT**

**organised by**

**IHH Project of FAO of the UN, Duke University & WorldFish**

**Chair(s): Sarah Harper<sup>1</sup>, Kafayat Fakoya<sup>2</sup> and Claudia Deeg<sup>3</sup>**

<sup>1</sup>School of Environmental Studies, University of Victoria, Victoria, Canada

<sup>2</sup>Department of Fisheries, Lagos State University, Ojo, Lagos State, Nigeria

<sup>3</sup>Duke University, Durham, North Carolina, United States

This workshop will focus on best practices for collecting, analysing and sharing of gender disaggregated data. Gender disaggregation of small-scale fisheries data should be the minimum standard for all monitoring and research informing fisheries policies and programmes. Yet, for many countries and contexts such data remain limited and elusive. In this session we will draw on the findings of the Illuminating Hidden Harvests (IHH) Project, a multidisciplinary study led by the Food and Agriculture Organization of the United Nations (FAO), Duke University and WorldFish, that involved over 800 collaborators from around the world. You will hear insights from several of the 28 gender advisors that informed this work – to bring forward hidden and often overlooked contributions by women in small-scale fisheries and explain how, despite considerable efforts to uncover additional data, gender-disaggregated data remain limited, obscuring the contributions that SSF make to sustainable development. In this session we will describe ongoing efforts that emerged from this project to outline best practices for collecting SSF data and specific gender-disaggregated indicators to better represent the overlooked contributions by women in national fisheries datasets and especially those informing policies and practices. We will break into small groups to discuss the challenges of collecting gender-disaggregated data and how to overcome these as an important step in advancing gender equity and equality in small-scale fisheries governance and beyond. All participants in this session will be invited to share their experiences and insights and discuss pathways towards closing the gender data gap. Participants will also be invited to contribute to a collaborative paper to share these insights broadly through a peer-review publication.

## WAVES OF ART

organised by

BOBP-IGO, Arnawaz Charities of Cholamandal Artist's Village, Chennai, ICAR-CIFT and  
GAFS of AFS

**Chairs: S Jayaraj<sup>1</sup>, B. O. Shailesh<sup>2</sup> and Sheela Maradi<sup>3</sup>**

<sup>1</sup>Bay of Bengal Programme Inter-Governmental Organisation, Chennai

<sup>2</sup>Arnawaz Charities, Cholamandal Artist's Village, Chennai

<sup>3</sup>Art Instructor, Cholamandal Artist's Village, Chennai





# PARALLEL EVENTS







**Parallel Event 1:  
Interventions for control of AMR: Harnessing one health  
knowledge**





## INTERVENTIONS FOR CONTROL OF ANTIMICROBIAL RESISTANCE: HARNESSING ONE HEALTH KNOWLEDGE

**Rajesh Bhatia\***

WHO Regional Office for South-East Asia, Delhi, India

*\*drrajesh.bhatia1953@gmail.com*



Antimicrobials are the medicines used to prevent and treat infections caused by bacteria, viruses, fungi, and parasites. Antimicrobial resistance (AMR) is the ability of a microorganism to stop an antimicrobial (such as antibiotics, antivirals, antimalarials etc.) from working against it. As a result, response to standard treatments become ineffective, infections persist longer, may spread to others, cause unfavourable treatment outcomes for complex surgeries, and inflict huge economic losses to the individual, society, and the country.

In absence of urgent actions for the containment of this unseen pandemic, AMR is estimated to cause devastating impact within a generation time. Deaths due to drug-resistant diseases can increase to 10 million, globally, every year by 2050 from the current estimates of 1.27 million if no action is taken. Extensive analyses on data from 204 countries shows rapidly growing menace of AMR in developing and developed countries across the globe. Its role in impeding the achievement of Sustainable Development Goals, and thus human development is also worrying policy makers and global leaders.

Antimicrobial resistance is a complex multifaceted phenomenon and is a result of several interlinked causes. Many of these are not fully understood and need research to elucidate possible reasons and solutions. The complex and interlinking drivers of antimicrobial resistance have led international organisations and research communities to adopt the **'one-health'** approach; that focuses on collaborative efforts by multiple sectors. One Health is a validated, holistic approach which is simple and powerful concept with an extremely complex implementation process It warrants multi-sectoral, multi-institutional and multi-disciplinary approach. It aims to bring about a policy shift to de-sectoralize human, animal, plant and ecosystem health. One Health activities shall be evidence driven and based on research for a better understanding of risks and benefits in local context. One Health is a future imperative and efforts must be made now to change the narrative of national response to AMR and zoonoses.

Using this One Health approach and to respond in a well-coordinated way, WHO, in collaboration with FAO and OIE developed a Global Action Plan on AMR in 2015. India's National Action Plan on AMR provided the framework for an effective and collaborative response to AMR in the country. During 2017-2021, India's AMR containment activities were guided by its first National Action Plan. It is well established that antibiotics usage is the

greatest driver of selection and dissemination of AMR. Two actors that play major role in use of antibiotics are antibiotics prescribers and dispensers (in any sector and level) and antibiotics users. Physicians, veterinarians, pharmacists and general public contribute to antimicrobial use and hence to AMR. Appropriate education leading to change in behaviour for rational use of antibiotics is the key to contain AMR.

AMR is a multifaceted challenge that has technical, educational, regulatory, economic, administrative and political dimensions which need a whole-of-society sustained response if we wish to prevent our world sliding into dark post-antibiotic era.





**Theme 1- Combating antimicrobial resistance**  
**Sub theme 1: Biological strategies**





## VACCINE AND VACCINATION FOR PREVENTION AND CONTROL OF ANTI-MICROBIAL RESISTANCE

R. P. Singh\*

ICAR-Directorate of Foot and Mouth Disease, Bhubaneswar

\**Rabindra.Singh@icar.gov.in*

Antimicrobial Resistance (AMR) has been an important global one health issue due to its widespread growing impact during recent years. It is said that human death due to AMR which is estimated to the tune of 0.7 Million/annum now will increase to about 10 Million/annum by the year 2050. Impact of AMR is likely to affect the lives of all but more (about 90%) to the most vulnerable population in Asia and Africa during next 2-3 decades. Most often livestock sector is blamed for enhanced antimicrobial resistance. The important factors which are accountable for AMR from livestock and poultry sector is use of antibiotics as a feed additive/growth promoter for rearing of livestock and poultry, the products from these reach to food chain, enhancing the impact of AMR. Pig feed and Poultry feed have indiscriminate use of antibiotics and also use of antibiotics in cattle feed in beef eating countries additionally. In addition, use of antibiotics/ antifungal/ antiprotozoal for treatment of animals suffering from bacterial, viral, fungal and protozoal diseases also contribute a lot towards AMR. It seems that widespread antimicrobial resistance is initiated by livestock sector, however its progression with use of advanced drugs/third generation antibiotics used in human treatment helps in progression of AMR at a faster pace leading to one health issues. The aquatic animals get affected most often as they are most vulnerable in this ecosystem. Development of sustainable alternate solutions for AMR is need of the hour now and development of vaccine and vaccination strategy is one of them with great promise.

System of application of vaccines (preventive immunization) versus antibiotics (treatment after disease occurs) in animal/human can be compared with adoption of natural farming/organic farming and use of insecticide in agricultural sciences. Effective application of vaccines and high vaccination coverage in animals and human being is seen as one of the important solutions for reducing AMR (more than 50% on several occasions) due their continuous and long-term sustainable effect. Vaccines are considered to be natural (as immunity is nature's law) and environment friendly and sustainable solutions for infectious disease control and thereby have a huge scope for reducing the use of antimicrobial drugs. High level of immunizations against specific diseases with an effective vaccine has led to reduction of infections and AMR to the tune of 50-70% in several cases and needs to be encouraged. Antibiotics are not only used in bacterial infections but also in viral infections in order to check secondary bacterial infections. Further, there has been a significant decline in development and licensing of antibiotics during last three decades and their licencing. Whereas development and application of vaccines has increased several folds during this time. Recent pandemic of COVID-19 in humans and Lumpy Skin Disease (LSD) in cattle has indicated that the major solution to these problems came only through the vaccines, reducing the use of antibiotics significantly at mass scale. Even though use of antimicrobials to check secondary bacterial/fungal infections cannot be avoided in animals and human

being who already got infected from these and similar diseases. Overall, the vaccine and vaccination accounted for huge reduction in use of antibiotics and in turn AMR. Further, the endemic diseases of livestock like Foot and Mouth Disease (FMD) in cattle and buffalo, Peste des petits ruminants (PPR) in goat and sheep, Pasteurella infection in Buffalo and Cattle are important from Indian perspective. Though two of these diseases are viral in nature and have a lot of influence on AMR due to widespread use of antibiotics to check secondary bacterial infections. The efforts made by India in developing the appropriate vaccines and diagnostics technologies against these and their extensive application for control of FMD and PPR during last two decades has led to the reduction of disease to the tune of around 70% at national level, and there by reducing the use of antibiotics to similar level. Similarly, Tuberculosis and Salmonella related infections (e.g *S. Typhi*) and many more diseases in human being have been important inducing AMR and use of effective vaccines against these are of great significance in reducing AMR. It is worth to mention here that most of the pathogens have zoonotic significance and aquatic life and environment is equally affected by all such factors.

In conclusion application of vaccines is likely to reduce use of antibiotics and thereby lower the rate of AMR to great extent. An antibiotic can be used for a longer duration with effective vaccine and vaccination strategy, requiring less of newer antibiotics. In addition, if the vaccine technology is combined with other approaches like use of bacteriophages, useful microbes, innovative diagnostic tools can further reduce AMR.

## BIOFILM PRODUCING METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* FROM BOVINE MASTITIS AND ITS MITIGATION

Mayank Roshan<sup>1\*</sup>, Manisha Behera<sup>1,2</sup>, Ila Singh, Chanchal Rana<sup>1</sup>, Ashutosh Vats<sup>1</sup>, Devika Gautam<sup>1</sup>, Shiveeli Rajput<sup>1</sup>, Rakesh Kumar<sup>1</sup>, Sachinandan De<sup>1</sup>

<sup>1</sup> ICAR-National Dairy Research Institute (NDRI), Haryana

<sup>2</sup> Hindu College, University of Delhi, Delhi

\*mayankjimmy16@gmail.com

*Staphylococcus aureus*, an opportunist pathogen, is one of important causative agents of bovine mastitis that express wide array of virulence factors, toxins and involved in biofilm formation. Biofilm is an embedded extracellular matrix that makes antibiotics difficult to reach to the target cell. Chronic cases of mastitis that lasts for several months are usually caused by biofilm producers.

A total of 56 *S. aureus* isolated from 215 bovine mastitis milk samples from peri-urban regions of Delhi, NRC, India, were evaluated for antimicrobial resistance (AMR) profile, virulence factors, and adhesion genes. Antimicrobial resistance profile against six antimicrobial agents depicted that the isolates were resistant to vancomycin (30.30%), oxacillin (48.2%), cefoxitin (42.8%), lomefloxacin (53.5) and tetracycline (3.5%). None of isolates were resistant to chloramphenicol. The antibiotic resistance genes, *mecA* and *blaZ* were present in 41.07% and 58.9% of the isolates respectively. Molecular profiling of virulence determinants revealed that factors such as *coa* (100%), *nuc* (75.0%), *hlg* (76.7%), *pvl* (33.9%), *tsst-1* (60.7%), *spa* (85.7%), as well as enterotoxin genes *sea* (26.7%) and *seg* (62.5%) were present in the isolates. Genotypic analysis of adhesion genes demonstrated that 76.7% and 78.5 % of the isolates were positive for *icaA* and *icaD*, respectively. The prevalence rates of other adhesion genes *ebps*, *fnbpA* and *eno* were approximately 80%. Of the 56 *S. aureus* isolates, 23 (41.07%) were identified as *Methicillin-resistant Staphylococcus aureus* (MRSA). Among 23 MRSA isolates 65.2% (15/23) were biofilm-producers while the rest were non-biofilm-produces.

In the present study three plant ethanolic extracts were investigated for anti-biofilm and antibacterial activity against strong biofilm producing MRSA isolate and found one of the plant extracts had antimicrobial and anti-biofilm activity at concentration ranging from 0.125 mg/ml to >5 mg/ml and 0.0625 to >1 mg/ml respectively against MRSA.

**ORGANIC EXTRACT FROM *FICUS TALBOTII* FRUITS FOR MITIGATION OF METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* (MRSA)**

Pankaj Kishore\*, Murugadas, V., Ranjit K. Nadella, Minimol, V. A., Devananda Uchoi, Mohan C. O., Satyen K. Panda

ICAR-Central Institute of Fisheries Technology, Cochin

\*pkishore2007@gmail.com

In recent years, the increased incidence of antimicrobial resistance in several infectious diseases is a major threat globally. The excessive misuse of antimicrobials needs to be controlled by formulating effective and safe strategies.

In the present study, the organic extracts of fruits of *Ficus talbotii* of *Moraceae* family were studied for their antimicrobial potential against methicillin resistant *Staphylococcus aureus* (MRSA). Extraction was carried out using water and methanol. The recovery was better with methanolic extraction (1.61 g) compared to aqueous extraction (0.38 g). The methanol extract was used for antibacterial susceptibility test. Antibacterial activity was assessed by agar well diffusion method. Four different concentrations (4, 8, 40 and 80 mg per ml) of extract were used to observe susceptibility against MRSA as well as different CLSI strains comprising *Staphylococcus aureus*, *Escherichia coli*, *Enterococcus faecalis*, and *Pseudomonas aeruginosa*. Highest inhibition was observed for MRSA (2.2 cm) followed by *E. faecalis* (1.5 cm) and *S. aureus* (1.4 cm) at concentration of 80 mg per ml. *E. coli* and *P. aeruginosa* were resistant to the all concentrations used. The decrease in concentration resulted in the decrement of inhibition activity against susceptible organisms. The result indicated that *Ficus* plant fruit extracts can be an alternative for combating MRSA, which is most prevalent in nosocomial infections. This can be further evaluated for usage in clinical application.

## SCREENING OF ANTIMICROBIAL ACTIVITY OF PYOCYANIN AGAINST INFECTIOUS PATHOGENS

Meenu Martin, Sulikha P. M. \*, Anu Ruby Benny

MES College, Marampally, Aluva

\*sulikhapm99@gmail.com

Bacterial pigments have various applications in current scenario. In the current study, 25 spoiled fish samples were collected and bacteria were isolated by streak plate method. Based on the colony morphology on nutrient agar and cetrimide agar, 13 colonies were identified by phenotypic and genotypic methods as *Pseudomonas aeruginosa*. Among these, two isolates which showed characteristic green color of pyocyanin pigment on the plates were chosen for further study. These two isolates were employed for pyocyanin pigment extraction using chloroform solvent extraction method. Pyocyanin was identified as the pigment by FTIR and UV-Visible spectroscopy. FTIR analysis was able to determine the various functional groups (-OH, -CH<sub>3</sub>, -C=N, Rhamnose, etc.) that make up the aromatic structure of pyocyanin and the highest absorption spectra of both pigments A and B were found to be at 370 nm. Four bacterial test organisms; *E. coli*, *Klebsiella* sp., *Bacillus* and *Pseudomonas* sp. were tested against pyocyanin A and B using well diffusion method.

Pyocyanin A showed maximum zone of inhibition towards *E. coli* and *Klebsiella* sp. (26mm) and pyocyanin B showed zone of inhibition of 22 mm by *E. coli*. The pigments were tested against four fungi, i.e., *Aspergillus niger*, *A. flavus*, *Penicillium digitatum* and *P. commune*. Both pigments hardly exhibited antifungal activity.

## GENOME GUIDED INVESTIGATION OF NATURAL PRODUCT REPOSITORY OF MANGROVE DERIVED *STREPTOMYCES MURINUS*

Vineetha Das <sup>\*1,2</sup>, Lalitha K.V. <sup>1</sup>, Niladri Sekhar Chatterjee <sup>1</sup>, Toms C. Joseph <sup>1</sup>

<sup>1</sup>ICAR-Central Institute of Fisheries Technology, Cochin

<sup>2</sup>Cochin University of Science & Technology, Cochin

\*vineethadas001@gmail.com

*Streptomyces*, one of the largest genera belonging to the phylum *Actinobacteria*, contribute to more than 60% of the clinically relevant antibiotics. The present study outlined the genomics and the metabolomics of a mangrove derived *Streptomyces* sp. strain (*S. murinus* THV12). The Illumina HiSeq 2500 platform based whole genome sequencing of *Streptomyces* strain generated a consensus sequence of 8,363,247 bp with 107 contigs and 7345 protein coding genes, which shared significant homology with genes from *Streptomyces murinus*. The detection of secondary metabolite biosynthetic gene clusters (smBGCs) in the genome done using the pipeline antiSMASH v6.1.1 revealed that the strain harbored 47 secondary metabolite clusters, which represented 17.9% of 8.3 Mb genome. The smBGCs belonged to the following metabolite categories; PKS, NRPS, ectoine, lassopeptides, lantipeptides, melanin, siderophores, terpenes and other putative products. The strain showed broad spectrum antimicrobial activity with a zone of inhibition up to 30 mm against Methicillin resistant *Staphylococcus aureus* (ATCC 43300), *Aeromonas hydrophila* (ATCC 35654), *Edwardsiella tarda* (ATCC 15947), *Klebsiella pneumoniae* (ATCC 700603), *Enterococcus faecalis* (ATCC 29212), *Listeria monocytogenes* (ATCC 15313), *Bacillus cereus* (ATCC 14579) and *Candida albicans* (NCIM 3100). The secondary metabolite profiling of the crude extracts from the fermentation broth of THV12 was done with HPLC system coupled with Orbitrap Exploris120 high resolution mass spectrometer. The molecular annotation was given using the databases such as Natural Products Atlas 2.0, Chempider, mzCloud, BioCyc and Human Metabolome database. As predicted by genome mining, compounds such as actinomycin D, actinomycin X, pentamycin, desferrioxamin B and cinnabaramide A were detected by MS/MS analysis. Apart from that nearly 20 compounds belonging to different chemical scaffolds such as cyclic and linear peptides, polyaromatics, linear polyketides, terpenoids etc. were also present in fermentation broth of the strain when cultivated under OSMAC (One Strain Many Compounds) approach.

Thus, the combined strategy of genome mining and metabolomics of the mangrove derived strain aided in exploring chemical diversity of BGCs and novel chemical entities which can contribute to the drug leads.

**EFFECT OF PLANT-DERIVED ESSENTIAL OILS ON ANTIMICROBIAL RESISTANT  
*ESCHERICHIA COLI* AND *AEROMONAS* SPP.**

**Ahamed Basha Kusunur<sup>\*</sup>, Chandana Rajanala, Anusha, Gurugubelli, Shanmukha Sai  
Mogilipuri, Madhusudana Rao Badireddy**

ICAR-Central Institute of Fisheries Technology, Visakhapatnam Research Centre,  
Andhra Pradesh

*\*ahamedfishco@gmail.com*

The continuous emergence of antimicrobial resistance (AMR) in fisheries necessitates the need to explore new dimensions of therapeutical measures for mitigating AMR bacteria. Essential oils (EOs) from traditional plants might be a promising alternative for the control of AMR pathogens.

In this study, AMR *E. coli* (n=26) and *Aeromonas* spp. (n=14) isolates recovered from fish and fishery environment were exposed to 16 commercial EOs to test their antimicrobial efficiency following agar-well diffusion method. The results showed that, among all the EOs, Cinnamon oil showed the maximum antibacterial activity against 93.75% of *Aeromonas* spp., followed by Clove oil (81.25%), Thyme oil (62.5%) and Peppermint oil (43.75%). Out of the 16 EOs tested against MDR *E. coli*, Clove oil, Cinnamon oil, Thyme oil and Tea tree oil produced inhibition zone for 100% of isolates. However, antibacterial activity was not observed with Bergamot, Cedarwood, Cardamom, Camphor, Garlic, Ginger, Neem, Lavender, Peppermint, Rosemary, Lemongrass and Wintergreen oils. In conclusion, Cinnamon oil and Clove oil possess superior antimicrobial activities against AMR *E. coli* and *Aeromonas* spp., and hence may find applications in the control of these pathogens in the aquaculture environment.

## HIGH-THROUGHPUT APPROACH FOR EVALUATING ANTIBACTERIAL ACTIVITY OF FISH EPIDERMAL MUCUS

Visnuvinayagam S\*, Toms C. Joseph, Murugadas V., Ezhil Nilavan S.

ICAR-Central Institute of Fisheries Technology, Cochin

\*visnuvinayagam@yahoo.co.in

Fish epidermal mucus (FEM) is a source of antimicrobial peptides (AMP), contributing to the innate immunity of fish. Recently, the use of these FEM-AMPs to combat diverse human illnesses has gained traction in the scientific community. The level of AMPs in the mucus varies depending on the infection and stress situation; hence screening of FEM for AMPs is required prior to FEM collection. Currently, there are no easy or quick protocols for screening FEM for antimicrobial activity.

In the present work, a modified optical density reduction (MODR) approach was optimised to screen the FEM for antimicrobial activity within 8 hours. The collected FEM was tested against five pathogens that included *S. aureus*, *E. coli*, *Salmonella*, *P. aeruginosa* and *V. cholerae*. In the 96 well-micro-titre plates, optical density value for both sample and control were recorded every two hours and significant inhibition on growth as compared to control is considered for the antimicrobial activity. Wells inoculated with *S. aureus* had a reduction in the OD value in mucus sample up to 8 h in the 96-well-micro-titre-well plate compared to the positive control. From the 10<sup>th</sup> h onwards, the OD values started increasing. In the case of all other bacteria, the OD value was continuously increasing, which indicates that the FEM sample possesses antibacterial activity against *S. aureus* only. It was concluded that the MODR is a low-cost, rapid and solvent-free method that can be used for initial screening of FEM against many pathogens using multi-well plate. In addition, a sample with low antibacterial property can also be tested using this method.



## Sub theme 2: Phage therapy





## ONE HEALTH APPROACH TO COMBAT MULTIDRUG RESISTANCE THROUGH BACTERIOPHAGES: OUR CLINICAL EXPERIENCE WITH CHRONIC AND ACUTE WOUNDS

Gopal Nath \*

Institute of Medical Sciences, Banaras Hindu University

\*[gopalnath@gmail.com](mailto:gopalnath@gmail.com)

A wound is a breach in the skin or other body tissues due to injury. Traditional chronic wound treatment strategies (e.g., compression, warming, vacuum-assisted closure device, irrigation) are often successful in healing wounds. Still, many wounds have been observed to recalcitrance to these treatments, leading to persistence and recurrent infections. Both infections (caused by multidrug-resistant strains) and subsequent biofilm formation are the primary cause of the persistence of the wounds because conventional antibiotic therapy does not work. Search for alternatives to antibiotics is now has become a compulsion. Fortunately, bacteriophage therapy is a reemerging solution to the antibiotic. Bacteriophages exhibit numerous potential advantages as an alternative antimicrobial therapy for treating MDR bacterial infection. The advantages include clinical safety, bactericidal activity, increased concentration where needed, negligible disturbance to the microbiome, biofilm degrading activity, ease and rapidity in isolation and cost-effectiveness of pharmaceutical formulations. In addition, the phages are known to penetrate poorly vascularised tissues and have been seen to be poor in inducing immunological responses. Most notably, "phages are the only medicine that multiplies".

We have used phage therapy for acute and chronic infected wounds in animals and in clinical studies. We have also shown their efficacy against *Pseudomonas aeruginosa* in a mice wound model. In addition, we have evaluated the efficacy of phage cocktails in the infections in animal models, both acute and chronic osteomyelitis caused by methicillin-resistant *Staphylococcus aureus*. Moreover, we have also observed biofilm eradication from K wire in rabbit wound infection model.

Clinical trials are necessary to demonstrate the safety and efficacy of data generated in the preclinical experiments before getting translated reliably into clinical practice. Clinical trials of phage therapy initiated by the Institute have reported the efficacy of topical phage in healing chronic wounds in three prospective exploratory studies and no adverse events mimicking the results of in *vivo* animal models.

Clinical studies demonstrated the significant role of bacteriophage therapy in chronic wounds associated with antibiotic-resistant bacteria. The study employed a total of twenty patients with chronic non-healing ulcers for more than six weeks duration. A significant improvement could be achieved by completing wound epithelization within a few weeks. Another clinical study employing forty-eight patients having a minimum of one eligible full-thickness wound that did not heal in 6 weeks with conventional wound management showed a promising result, and significant improvement was observed in the wound healing in > 82% by the end of follow-up of three months. Furthermore, the study projected that

specific phage therapy is equally effective regardless of diabetic or non-diabetic status. However, healing was comparatively delayed in diabetic patients.

Both studies provide nearly unequivocally that topical phage therapy attributed to complete clinical wound healing in patient's refractory to conventional therapy. Furthermore, the status of antibiotic resistance of the bacteria implicated in chronic wound not influence the therapy outcome.

Another successful recently published non-randomized prospective, open-blinded, case-control study by Bhartiya et al.(2021) to see the effect of bacteriophages has shown encouraging results on the healing process of infected acute traumatic wounds. The average number of days required for complete granulation of wounds and attaining sterility and healing with primary intention was half compared to control, i.e. on conventional therapy.

Due to phage's high specificity for their bacterial host, phage cocktail formulations usually guarantee a broader spectrum of activity and decrease the likelihood of the emergence of phage-resistant bacterial mutants. Therefore, all of these studies employed a cocktail of bacteriophages for therapy.

Topical phage therapy represents a safe, promising, and potentially transformative treatment for recalcitrant infected cutaneous wounds and warrants concerted research in light of the current embodiment of MDR and the drying pipeline of effective antibiotics in our armamentarium. The history of bacteriophage therapy goes for ~100 years, with a good safety record. However, the phages are not being used at a broader level due to a relative lack of regulatory approval. Even if this therapy is used for topical infections, the menace of AMR may come down to at least 30%. Therefore, global regulatory bodies must agree on the judicious use of bacteriophage therapy in all the relevant fields given One Health Concept.

## PHAGES FOR THE CONTROL OF ANTIMICROBIAL RESISTANCE

**Madhusudana Rao Badireddy \***

Visakhapatnam Research Centre of ICAR-Central Institute of Fisheries Technology,  
Visakhapatnam

*\*bmrcift@gmail.com*

Antimicrobial resistant (AMR) bacteria were responsible for 1.27 million deaths in 204 countries and territories in 2019 and AMR is expected to further impose huge burden on human and animal health sectors, globally. Lytic bacteriophages, the viral entities that devour bacteria, have regained interest as natural antimicrobials in the fight against AMR bacteria for protecting human health, terrestrial and aquatic animal health. Bacteriophages are abundant in nature, diverse, relatively easy to isolate, have species specific host range and are not affected by antimicrobial resistance trait of the target bacteria. Phages are non-toxic and avoid collateral damage to beneficial microbiota and hence are promising candidates for use in human care and animal health management. Phage cocktails i.e., polyphage formulations comprising of a combination of individual phages help in overcoming the limitations of narrow host range and circumvent phage resistant mutants. Our studies on the use of coliphages for the control of AMR *E. coli* isolated from fish farms, shrimp farms, retail markets and the assessment of *in vitro* bactericidal effectiveness of 10-phage cocktail against a cocktail of 20-AMR *E. coli* indicated the usefulness of polyphage formulations as a promising means for phage therapy.

## ISOLATION AND CHARACTERIZATION OF COLIPHAGES AND THEIR LYTIC EFFECTS ON MULTIDRUG RESISTANT *ESCHERICHIA COLI* STRAINS

Adwitiya Das<sup>1\*</sup>, Dilip Kumar Sarma<sup>2</sup>, Rajeev Kumar Sharma<sup>3</sup>

<sup>1</sup>Indian Veterinary Research Institute, Hebbal, Bengaluru

<sup>2</sup>College of Veterinary Science, Assam Agricultural University, Khanapara

<sup>3</sup>College of Veterinary Science, Assam Agricultural University, Khanapara

\*Adi.adwitiya01@gmail.com

The present study was conducted at College of Veterinary Science, AAU, Khanapara, Guwahati for the presence of *E. coli* specific phages in pig shed effluents. Bacteriophages infecting *E. coli* are called coliphages. *E. coli* is responsible for severe economic losses in livestock health including piggery industry. Since antimicrobial resistance has become a global risk especially in bacteria like *E. coli*, phages can be used as an alternative for curbing this menace.

Using host bacteria *E. coli* ATCC 43888, bacteriophages were isolated from a total of 26 pig shed effluents collected from different sources by employing preliminary methods like turbidity reduction test, streak plate test and spot test followed by Double Agar Lay method. The isolated phages were further characterized by Transmission Electron Microscopy and Restriction Enzyme digestion pattern. Further, lytic effects of the isolated phages were tested on 46 Multi Drug Resistant (MDR) *E. coli*.

A total of 12 bacteriophages were isolated from a total of 26 (46.15%) pig shed effluents collected. Statistical analysis revealed that turbidity reduction test (50%), streak plate test (30.76%) and spot test (46.15%) were equally efficient for preliminary detection of coliphages. Phages appear to have dissimilar profiles of the nucleic acid fragments generated by digestion of their DNA with restriction enzymes like *NdeI*, *SspI*, *EcoRV*, *EcoRI*, *TaqI* and *HindIII*. However, digestion pattern was more distinct with *HindIII* restriction enzyme. Study on lytic effects revealed that the 12 phages could exhibit lytic effects on 20 number of MDR *E. coli* isolates out of the total 46 MDR *E. coli* isolates tested. The *in-vitro* lytic effects of phages on virulent MDR *E. coli* isolates from piglet diarrhoea in the present study has opened up future scope on the application of phages in clinical cases of piglet diarrhoea caused primarily by pathogenic MDR *E. coli* and exploring the possibility of using coliphages against *E. coli* of other sources.

## BACTERIOPHAGE TO CONTROL MULTIPLE DRUG RESISTANT *ENTEROCOCCUS FAECIUM* IN FERMENTED MILK

Archana Chandran\*<sup>1</sup>, Durga R.J.<sup>1</sup>, Rathish R.L.<sup>2</sup>, Murugadas Vaiyapuri<sup>3</sup>, Beena A.K.<sup>4</sup>

<sup>1</sup>College of Dairy Science and Technology, Pookode, Wayanad

<sup>2</sup>College of Veterinary and Animal Sciences, Pookode, Wayanad

<sup>3</sup>ICAR- Central Institute of fisheries technology, Cochin

<sup>4</sup>Vergheese Kurien Institute of Dairy and Food Technology, Mannuthy, Thrissur

\* [archanac@kvasu.ac.in](mailto:archanac@kvasu.ac.in)

Phage therapy is gaining importance as an alternative strategy for eliminating bacterial infections in the current scenario of antimicrobial resistance (AMR). Enterococci are inhabitants of mammalian intestine and are ubiquitously found in soil and water. The presence of this species is often detected in traditional fermented milk, but the safety of enterococci is a matter of debate as many of these are multiple drug resistant and can cause nosocomial infections.

The objective of the study was to assess the antibiotic resistance pattern of *Enterococcus faecium* strain isolated from household curd and to isolate bacteriophage to control them. The phenotypic and genotypic characterization of *E. faecium* was done by polyphasic approach. Antimicrobial susceptibility testing against sixteen antibiotics were performed by disc diffusion method as per Kirby-Bauer. Bacteriophage against *E. faecium* was isolated from curd samples. The *E. faecium* strain showed resistance to gentamicin, ofloxacin and cefazolin. Transmission electron micrograph displayed phage particles EFPhi91 with an isometric head and a non-contractile flexible tail morphologically suggestive of the family *Caudovirales*. The one step growth curve and adsorption assay showed the ability of phage to control *E. faecium* strain. The results of the study suggests that the phage EFPhi91 has potential applications in the control of *E. faecium*.

## ISOLATION AND PARTIAL CHARACTERIZATION OF *STREPTOCOCCUS* PHAGE SAP-5 AGAINST MULTI DRUG RESISTANT *STREPTOCOCCUS AGALACTIAE*

Preenanka R.\*, Safeena M. P.

Kerala University of Fisheries and Ocean Studies, Cochin

\*preenanka@gmail.com

Bacterial disease is one of the major constraints in the aquaculture sector, causing major stock losses to both large- and small-scale producers in the world. Among them, streptococcosis caused by *Streptococcus agalactiae* is a major disease imparting devastating effect in the aquaculture, globally. For a long period, management of streptococcosis mainly relied on the application of antibiotics and indiscriminate use of antibiotics has resulted an afflictive increase in the antibiotic resistant strains in aquaculture systems. In this scenario, there is an urge for a safe and cost-effective bio-therapeutic agent for the control of *S. agalactiae* infection. Recently, phage therapy is getting more attention as it is eco-friendly, can be auto dosed, ease of application and cost effectiveness.

In this study, specific *Streptococcus* phage, SAP-5 was isolated from tilapia farm, Kerala, India. Lytic potential of the phage was evaluated against *S. agalactiae* (OP580171), a multidrug resistant (MDR) strain showing resistance to 7 structurally different classes of antibiotics with a multiple antibiotic resistance (MAR) index of about 0.6. The phage SAP-5 exhibited a morphotype of *Siphoviridae* family with narrow lytic spectrum. Biological characterization of the phage revealed the burst size of phage as 110 PFU/ml and the optimal multiplicity of infection as 0.01 with a phage titre of about 7.84 log PFU/ml. The phage was found to be stable at various physicochemical parameters such as temperature, pH and salinity. Nucleic acid analysis revealed that it possesses DNA as its genome and PCR based screening for lysogenicity in SAP-5 showed its lytic character. Based on the characterization of the phage SAP-5, it was found that the phage is highly specific and lytic against MDR *S. agalactiae*. After the complete characterization of *Streptococcus* phage SAP-5 by whole genome sequencing, it may be applied as a therapeutic agent against *S. agalactiae* infection in aquaculture.

## COLIPHAGE CONSORTIA TREATMENT FOR BETTER REDUCTION IN MULTI-DRUG-RESISTANT *E. COLI* IN SEAFOOD SAMPLES

Karthika R.\*,<sup>1</sup> Visnuvinayagam S.,<sup>1</sup> Murugadas V.,<sup>1</sup> Manikantha V.,<sup>2</sup> Madhusudana Rao B.<sup>2</sup>

1. ICAR-Central Institute of Fisheries Technology, Cochin
2. Visakhapatnam Research Centre of ICAR-Central Institute of Fisheries Technology, Andhra Pradesh

\*[karthikarr77@gmail.com](mailto:karthikarr77@gmail.com)

Combining different bacteriophages (consortia) when applying to food holds potential benefits over using a single bacteriophage therapy. In the present study, coliphage consortia (CC) consisting of 10 coliphages ( $10^{12-17}$  pfu/mL) that have a wide range of lytic activities against a maximum of (22 *E. coli*) was tried in the food samples to reduce the *E. coli* contamination.

Fish samples obtained from the retail fish market were cleaned using potable water and steamed for 10 minutes at 70°C to remove the *E. coli* from the samples. Then the samples were spiked with known *E. coli* and treated with CC. Similarly, another batch of fish procured from the retail fish market was directly treated with CC (without spiking). The fish samples were incubated at room temperature and the results were observed for 1 h and 4 h. *E. coli* counts were determined on the spike study samples using the spread plate technique and the pre-set TBX agar. For the non-spiking investigation, *E. coli* were enumerated using the MPN technique. In the case of the spike study, around 1 and 1.5 log reduction of *E. coli* was observed compared to control for 1 h and 4 h treatment respectively. In the non-spike study, a greater reduction was observed compared to the control at 1 h.

It was concluded that coliphage consortia would be a potential solution to reduce multidrug resistant (MDR) *E. coli* in the fish. Coliphage Cocktail treatment for 1 h followed by chill storage condition would improve the safety of the food.

**ISOLATION AND PARTIAL CHARACTERIZATION OF BACTERIOPHAGE PB1 AND ITS EFFICACY AS A BIOCONTROL AGENT AGAINST *PSEUDOMONAS AERUGINOSA* ISOLATED FROM ICE STORED FRESH FISH**

**Anu Ruby Benny\*, Safeena M. P.**

Kerala University of Fisheries and Ocean studies, Cochin

*\*anuruby@gmail.com*

Microbial spoilage of fish is an area of global concern. It is estimated that around 30% of the landed fish are lost through microbial spoilage alone. Among the Specific Spoilage Organisms *Pseudomonas aeruginosa* is the most prominent bacteria responsible for organoleptic rejections. Despite advances in modern technologies the fishery industry is continuously challenged with the threat of microbial spoilage. The indiscriminate and overuse of antimicrobials and antibiotics escalated the emergence of multidrug resistant forms of food borne bacterial strains. In this scenario phage biocontrol is gaining more attention focused on their use to improve food safety. Different phage products approved by USFDA and USDA support their GRAS status in food safety applications. Uniqueness in host specificity, long term survival and inability to adsorb on more complex organisms added its acceptance.

This study focused on the isolation and partial characterization of bacteriophage PB1 and its efficacy as a biocontrol agent against *Pseudomonas aeruginosa* isolated from ice stored fish. The phage PB1 isolated from marine water showed a relatively large and clear plaques on TSA against *Pseudomonas aeruginosa* isolated from Sardine fillets. Spot test and efficiency of plating confirmed its broad lytic spectrum. TEM analysis and one step growth curve showed that PB1 belongs to the family Siphoviridae having a latent period of 20 minutes with a high burst size of 8.5 log PFU/ml under an optimal multiplicity of Infection (MOI) 0.1. It showed promising results in the genomic analysis suggesting the absence of genes for lysogeny and also persistence over a wide range of physicochemical parameters such as temperature ranging from 4-37°C, pH 4-10 and salinity 1-8%. Though the biocontrol efficacy of phage PB1 is proved, further characterization is required to assess the safety to use it as a potential and environmentally friendly tool against emerging multidrug resistant (MDR) strains of *Pseudomonas* in fishery industry.

## VIBRIOPHAGE- $\phi$ LV6: A *SIPHOVIRIDAE* PHAGE FOR THE CONTROL OF LUMINESCENT VIBRIOS IN *PENAEUS VANNAMEI* SHRIMP HATCHERIES

Manikantha Benala<sup>1</sup>, Murugadas Vaiypauri<sup>2</sup>, Visnuvinayagam Sivam<sup>2</sup>, Karthika Raveendran<sup>2</sup>, Madhusudana Rao Badireddy<sup>1\*</sup>

<sup>1</sup>Visakhapatnam Research Centre of ICAR-CIFT, Andhra Pradesh

<sup>2</sup>ICAR-Central Institute of Fisheries Technology, Cochin

\**bmrift@gmail.com*

Luminescent vibrios are important pathogens affecting the survival of post-larvae in shrimp hatcheries leading to economic losses. Disease management strategies using antibiotics in the production of aquatic animals is discouraged to prevent food safety hazards to the consumers and to avoid the emergence of antimicrobial resistance in fish pathogens. The use of vibriophages to control harmful luminescent vibrios is an alternative strategy for aquatic animal health management. Six luminescent vibrios (LV36, LV38, LV40, LV44, LV45 and LV6) isolated from the larval tanks of *P. vannamei* shrimp hatcheries were used as hosts strains for the isolation of vibriophages.

A Vibriophage- $\phi$ LV6 isolated from shrimp hatchery water caused lysis of all the six luminescent vibrios in spot assays. The whole genome sequence (WGS) analysis and transmission electron microscopy (TEM) images indicated that Vibriophage- $\phi$ LV6 belonged to *Siphoviridae* with a genome size of 79862 bases. The Vibriophage-  $\phi$ LV6 survived under the different salt conditions ranging between 5 ppt to 50 ppt. The optimum multiplicity of infection (MOI) of vibriophage- $\phi$ LV6, as determined in the 2-step microtiter assay, was MOI-0.71 for LV44, MOI-1.5 for LV45, MOI-29.3 for LV38, MOI-33.6 for LV36, MOI-41.5 for LV40 and MOI-79 for LV6. The efficacy of the isolated vibriophage- $\phi$ LV6 formulation to control induced luminescent vibrio infection at the optimized MOI against a single luminescent vibrio- LV6 ( $10^6$  cfu/ml) was tested in glass tanks containing seawater (10L) and post-larvae ( $n=250$ ) of *Penaeus vannamei* shrimp. There was continuous increase in OD<sub>600</sub> values of water in bacteria control tank indicating uncontrolled proliferation of bacteria whereas the vibriophage- $\phi$ LV6 treated tank showed negligible increase in OD600 values, lower luminescent bacteria counts but very high counts of vibriophage and higher post-larvae survival. The effectiveness of vibriophage- $\phi$ LV6 on the growth of multiple luminescent vibrio hosts ( $n = 6$ ) hosts at different concentrations viz.,  $10^3$  cfu/ml and  $10^9$  cfu/ml was tested in seawater containing post-larvae and the results indicated higher PL survivability, lower sucrose non-fermenting vibrio loads in phage treated tanks compared to bacteria spiked tanks. Phage activity was detected only in vibriophage treated tanks but not in control or bacteria spiked tanks. The results indicate that Vibriophage-LV6 can be a suitable candidate for the control of of luminescent vibrios in shrimp hatcheries.

## BIOCONTROL OF SPECIFIC SPOILAGE BACTERIA FROM INDIAN MACKEREL BY LYTIC PHAGES

**Ammu Lakshmi D.\*<sup>1</sup>, Murugadas Vaiyapuri<sup>1</sup>, Visnuvinayagam Sivam<sup>1</sup>, Remya P.<sup>1</sup>, Rekha M.<sup>1</sup>, Sreejith V. N.<sup>1</sup>, Reshmi. K.<sup>1</sup>, Madhusudana Rao B.<sup>2</sup>, Toms C. Joseph<sup>1</sup>**

<sup>1</sup> ICAR-Central Institute of Fisheries Technology, Cochin, Cochin

<sup>2</sup>Visakhapatnam Research Centre of CIFT, Andhra University

\*ammulekshmi13@gmail.com

Fish provides nutritional security. However, fresh fish is highly susceptible to spoilage, which can be caused by the growth of specific spoilage organisms resulting in chemical changes and deterioration or spoilage. The important prime step in controlling spoilage organisms is identifying and characterizing potential spoilers.

In the present study, pooled samples of Indian mackerel from various retail outlets in Kochi, Kerala, were taken to isolate potential spoilage bacteria. Forty-five bacteria were isolated from Indian mackerel as presumptive potential spoilers from peptone iron agar media. Genus-specific PCR identified that 35 bacteria belonged to *Shewanella* sp. The 16S rRNA gene sequencing analysis revealed that SSO belonged to two major groups *Shewanella* sp. (n=24), *Aeromonas* sp. (n=15), followed by *Brochothrix* sp. (3) and one each of *Vagococcus* sp., *Acinetobacter* sp., and *Enterobacter* sp. All the *Shewanella* sp., and *Aeromonas* sp. isolated, was able to reduce trimethylamine oxide to trimethylamine with the production of off odours indicating spoilage. Lytic phage isolation studies against these specific spoilage bacteria revealed that five lytic phages were able to control 4 *Shewanella* sp. and 1 *Aeromonas* sp. host. The study also emphasizes that targeting a greater number of hosts will likely overcome the rapid spoilage of fish.



## **Sub theme 3: Nanotechnology driven solutions/chemical strategies**





## NANOBIOTECHNOLOGICAL STRATEGIES FOR COMBATING ANTIMICROBIAL RESISTANCE IN AQUACULTURE

**Baskaralingam Vaseeharan\***

Alagappa University, Tamil Nadu

\*vaseeharanb@gmail.com

Aquaculture is one of the world's fastest-growing food industries in recent years used for human consumption worldwide and for boosting global economic status. Aquaculture production has been declining due to diseases caused by pathogenic microbes. Due to the indiscriminate use of antibiotics and chemotherapeutics in fish and crustacean farming, many disease-causing microbes in fish have acquired resistance to commonly used antibiotics. The transfer of antimicrobial resistant pathogens from aquaculture environment to natural aquatic environment could lead to the emergence of antimicrobial resistance in wild fishes and the related food products. This has prompted the need for new therapeutic approaches to overcome this challenge. Recent nanotechnological inventions were used as alternative antimicrobials to combat the emergence of microbial resistance to antibiotics in aquaculture. Several eco-friendly synthesised nanoparticles are proposed to control diseases in aquaculture. This study discusses about various nanobiotechnological strategies in the control of antibiotic resistant bacteria in the aquatic environment. The antimicrobial mechanism of nanoparticles is associated to the formation of free radicals and subsequent free radical– induced membrane damage. We have reported that, *S. wightii* based ZnO NPs shows high antibiofilm activity against Gram-positive *B. subtilis*, *S. aureus* and Gram-negative (*S. sonnei*, *P. aeruginosa*) pathogens. Probiotics *B. licheniformis* Dahb1 based Ag NPs shows antibiofilm activity against *Vibrio parahaemolyticus*. Ph $\beta$ -GBP-Se NWs (*Portunus pelagicus* beta glucan binding protein-based selenium nano wires) shows antibacterial activity against aquatic pathogen *Aeromonas hydrophila*. Purified Pp-Lec (*Portunus pelagicus* based lectin) shows biofilm inhibition against clinically important Gram-negative bacteria *C. amalonatius*, *P. vulgaris*, *P. aeruginosa* and *V. parahaemolyticus* with the stain of acridine orange is demonstrated by CLSM. Results of the study show that, various eco-friendly nanotechnology-based solutions have been used to enhance antimicrobial resistance and play a significant role for the long-term sustainability of aquaculture.

## ANTIMICROBIAL EFFICACY OF SILVER NANOPARTICLE, CARBON DOT, AND CARBON DOT STABILIZED SILVER NANOPARTICLE AGAINST SXT RESISTANT BACTERIAL ISOLATES OF SEAFOOD ORIGIN

Minimol V. A. \*, Ashraf M., Reshmi K., Pankaj Kishore, Visnuvinayagam S., Ezhil Nilavan, Toms C. Joseph

ICAR-Central Institute of Fisheries Technology, Cochin

\* [minimol.a@icar.gov.in](mailto:minimol.a@icar.gov.in)

The threat of Trimethoprim-Sulphamethoxazole (SXT) resistance among bacteria necessitate effective and safe treatment options in combating infectious diseases. The application of nanotechnology has been recently recognized by scientific community for its antimicrobial activity against wide range of bacteria. A total of 16 SXT resistant bacterial isolates were recovered from 60 seafood samples procured through online markets, Cochin. The isolates were identified by 16S rRNA sequencing and characterized by antibiotic resistant gene elements. Fish scale derived carbon dot, silver nanoparticle synthesized by chemical reduction method using sodium borohydride ( $\text{NaBH}_2$ ) (2mg/ml), and carbon dot stabilized silver nanoparticle synthesized by reducing it with carbon dot (50  $\mu\text{g}/\text{ml}$ ) and  $\text{NaBH}_2$  (2 mg/ml) were studied for its antimicrobial effect against SXT resistant bacterial isolates. Antimicrobial screening of different nanoparticles was determined by minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) using microwell diffusion method followed by sub culturing it on agar plates. Antibiotic genes detected were *dfri* (100%), *strA* (68.75%), *qnrD* (31.25%), *catI* (25%), *sulIII* (18.75%), *tetA* (12.5%), *catII* (12.5%), *qnrA* (12.5%), *emrD* (12.5%) and *sul1* (6.25%). The SXT integrase gene of conjugative transposable element was detected in one isolate (*Providencia rettgeri*). The results of antibacterial tests showed that both carbon dot and silver nanoparticle were effective against SXT resistant bacteria with MIC range of 50-150  $\mu\text{g}/\text{ml}$  for carbon dot and 4-16  $\mu\text{g}/\text{ml}$  for silver nanoparticle. The MBC ranged from 25-150  $\mu\text{g}/\text{ml}$  for carbon dot and 4-16  $\mu\text{g}/\text{ml}$  for silver nanoparticle. The stabilization of silver nanoparticle with carbon dot resulted in reduction of MIC values of silver nanoparticles. To best of our knowledge, this is the first study that evaluated the potential of carbon dot, silver nanoparticle, and carbon dot stabilized nanoparticle in combating the spread of SXT resistant bacterial isolates. However, the small size and rapid penetrating power of the tested nanoparticles demand toxicity analysis towards mammalian cells to ascertain their further use in clinical paradise.

**ANTIMICROBIAL EFFICACY OF GREEN SYNTHESIZED SILVER NANOPARTICLES AGAINST MULTIDRUG RESISTANT *KLEBSIELLA PNEUMONIAE* ISOLATES FROM BOVINE CLINICAL MASTITIS**

**Janus. A. \*, Deepa. P. M., Jess Vergis, Vijayakumar K.**

College of Veterinary and Animal Science, Pookode

\*janusa@kvasu.ac.in

Mastitis is the most economically significant disease in dairy cattle. *Klebsiella pneumoniae* is one among the major bacteria causing clinical mastitis in cattle. Multidrug resistance is a biggest challenge faced by veterinarians in therapeutic management of mastitis. Antimicrobial resistance is a public health threat also. Emergence of antibiotic resistance in *Klebsiella* spp. warrants the need for alternative therapeutic interventions like nanotechnology. In the present study multidrug resistant *Klebsiella pneumoniae* were isolated from clinical mastitis cases which were unresponsive to almost all antibiotic treatment. Silver nanoparticles (AgNPs) were biologically synthesized using *Ocimum sanctum* leaves. The synthesized silver nanoparticles were characterized using UV-Vis absorption studies, Fourier Transform Infrared Spectroscopy, Xray Diffraction studies, Energy dispersive spectroscopy, Scanning electron Microscopy and Transmission electron Microscopy. Absorbance, hydrodynamic size, functional groups and morphology of AgNPs were evaluated. Morphologically the silver nanoparticles were triangular, rod shaped and spherical. Silver nanoparticles were evaluated for their antibacterial activity against multidrug resistant *Klebsiella pneumoniae* isolates. Biologically synthesized silver nanoparticles showed an MIC of 62.5 µg/ml and MBC of 125 µg/ml respectively against the isolates.

## ENHANCEMENT OF CHITOSAN'S ANTIBACTERIAL ACTIVITY BY ADDITION OF COPPER OXIDE NANOPARTICLE

Visnuvinayagam S. \*, Murugadas V., Sivaraman G.K., Teena G., Anandan R., Pavan Kumar D., Toms C. Joseph

ICAR-Central Institute of Fisheries Technology, Cochin

\**visnuvinayagam@yahoo.co.in*

Chitosan (CH) possess a better antimicrobial activity, which can be enhanced by the addition of Copper Oxide Nanoparticles (CuO-NP). Very scant information is available on the combined effect of CH and CuO-NP (CuO-NP-CH). In the present study, CuO-NP-CH was prepared and the antibacterial activity was assessed by comparing it with the CuO-Bulk particle incorporated chitosan (CuO-BP-CH). CuO-NP was prepared by the sol-gel method, and the nano-size was confirmed by UV-spectrophotometer, dynamic light scattering, Fourier transform infrared spectroscopy and scanning electron microscope. Then the composite was prepared by adding CUO-NP/BP in 1% chitosan (in 1% acetic acid). Different combinations of chitosan and CuO-NP and BP (0.25, 0.5, 0.75 and 1%) were prepared and the antimicrobial activity was assessed by agar-well-diffusion-assay. Based on the experiments, 0.5% CuO-NP-CH showed better antibacterial activity compared to 0.25%. The optimized ratio of the combination was tested with various foodborne pathogens. CuO-BP-CH antibacterial activity was almost equal to the chitosan antibacterial activity. On continuous incubation of well-diffusion-assay-plate, in CuO-BP-CH well, there was no reduction in the zone especially in gram-negative bacteria; but, reduction in the zone of inhibition was observed in gram-positive bacteria. The study concluded that the optimum ratio for the better antimicrobial property of the combination was 0.5% CuO-NP with 1% chitosan. Chitosan antimicrobial activity can be enhanced by the addition of CuO-NP; but not by CuO-BP. Still, CuO-BP can prolong the antimicrobial activity of the chitosan much longer period for the gram-negative bacteria.

## ANTIBACTERIAL ACTIVITY OF FISH SCALE CARBON DOT ALONE AND IN COMBINATION WITH OTHER ANTIMICROBIAL AGENTS

Minimol V. A. \*, Ashraf M., Pankaj Kishore, Ranjit Kumar Nadella, Muthulakshmi T., Toms C. Joseph

ICAR-Central Institute of Fisheries Technology, Cochin

\* [minimol.a@icar.gov.in](mailto:minimol.a@icar.gov.in)

Emergence of antimicrobial resistance among bacterial population requires effective and safe treatment strategies. Combination treatment strategies have been in practice by combining different antimicrobial chemicals or drugs or nanomaterials to achieve maximum antibacterial activity with minimum dose. Compared to traditional antibacterial chemicals, carbon dot is nontoxic and have emerged as a potent antimicrobial agent due to its photodynamic property when it comes in contact with suitable light sources. In the present study, antibacterial activity of carbon dot alone and in combination with other antimicrobial agents; hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), chitosan, ascorbic acid, and citric acid were carried out against *E. coli*. Minimum inhibitory concentration (MIC) was determined using microdilution method and fractional inhibitory concentration (FIC) of the combination treatments were done by checkerboard assay. MIC value of 1.25 nM H<sub>2</sub>O<sub>2</sub>, 80 mg% chitosan, 0.125 % ascorbic acid, citric acid 0.0625% and carbon dot 100 µg/ml was observed against *E. coli*. Among the different combinations of antimicrobial agents with carbon dot, synergetic effects were observed with FIC value of 0.03125 nM H<sub>2</sub>O<sub>2</sub> & 25 µg/ml carbon dot, 20 mg% chitosan & 25 µg/ml carbon dot, 0.125% Ascorbic acid & 25 µg/ml carbon dot, 0.015% citric acid & 25 µg/ml carbon dot. The study indicated that the combination treatment has inhibitory effect on the growth of *E. coli* cells. However, to get a better understanding about the infection prevention and control, the data gaps in research related to the risk imposed by the antimicrobial agent alone and in combination with other antimicrobial agents on ecosystem, human health and the possible mechanism of bactericidal actions need to be explored.

## OZONE TREATMENTS FOR SURFACE DECONTAMINATION OF TOMATO

**Ardra C. Babu \*, Rajesh G. K.**

Kelappaji College of Agricultural Engineering & Technology, Tavanur

\* *ardracbabu@gmail.com*

Food safety emphasizes the importance of minimising pathogenic and spoilage microorganisms in horticultural products. Tomato (*Solanum lycopersicum*), an edible berry of the Solanaceae family and one of the most versatile and widely consumed fruit due to its abundance in various nutritional components like carotenoids, phenolic compounds etc. The tomatoes are highly susceptible to the attack of numerous microorganisms. Conventionally, chemical preservatives are employed for the surface decontamination of tomatoes and their products. However, these techniques pose a negative impact on product quality and storage life. In this regard, non-thermal processing methods could successfully be utilised for the same. Ozone technology is an emerging non-thermal technique which is highly effective in enhancing storage life in addition to disinfection of food products. The impact of gaseous ozone treatment on various quality characteristics of tomato and its efficacy in removing the surface microflora from tomato samples were evaluated in the study. A treatment chamber specifically for treating tomatoes were designed and developed for the experiment. Consequently, response surface methodology was explored to optimise the ozone treatments with three independent variables: concentration (% weight/weight), temperature (°C), and treatment time (min) based on twelve physio-chemical response variables of tomato. The optimised treatment conditions were 30% ozone concentration, 10 °C temperature and a time of 11.7 min. Ozonation treatment retained all the quality parameters of tomato along with a significant reduction in the microbial count of the fruits. This study demonstrated the microbicidal effectiveness of ozone and its efficacy in the retention of various physio-chemical and organoleptic attributes of tomatoes.

**EVALUATION OF ANTIMICROBIAL AND ANTIBIOFILM ACTIVITY OF  
ECOFRIENDLY COMPOUND (COMBINATION OF DOLOMITE AND TURMERIC)  
AS AN ALTERNATE THERAPEUTIC STRATEGY TO MITIGATE ANTIBIOTIC USAGE  
AND ANTIMICROBIAL RESISTANCE IN AQUACULTURE**

**Ferolin J. G. \*, Rehna A., Devika Pillai, Suresh Kumar**  
Kerala University of Fisheries and Ocean Studies, Cochin  
*\*ferolin1998@gmail.com*

The current global trend is the extensive imprudent use of antimicrobial agents in animal food production systems, including aquaculture for the growth promotion/health management/treatment/prevention of infectious diseases, which are considered to be the most important potential risk factor involved in the development and dissemination of antimicrobial resistant (AMR) bacterial strains between human and animal through the environment, food products, and/or by direct contact. Recently, an alternative approach of using eco-friendly compounds including medicinal plants and the application of nanotechnology has shown promise as alternative approach to help reduce the use and overall negative impact of antimicrobial drugs in aquaculture systems. *Aeromonas hydrophila* is an important gram-negative biofilm-forming opportunistic bacterial pathogen responsible for disease outbreaks in many species of fish. Biofilm formation is recognised as a key driver for antibiotic resistance and pathogenicity in many bacterial infections including *A. hydrophila*. Therefore, the present study focused on the assessment of the in-vitro antibacterial and anti-biofilm efficacy of a combination of dolomite and turmeric extract in the ratio (9:1) against multi-drug resistant *A. hydrophila*. The antibacterial activity was determined by Resazurin-based broth microdilution for determining the Minimum Inhibitory Concentration (MIC) and Crystal violet-based biofilm inhibition assay was performed to find out the biofilm inhibition capability of the test compound. The results showed that the test compound combination in the ratio (9:1) at a concentration of 4.096 mg/ml, inhibited the visible growth of resistant bacterial strain and the biofilm formation propensity was reduced by changing the bacterial community from strong biofilm formers to moderate biofilm formers. The current investigation ascertains the potential synergistic action of dolomite and turmeric, as a remedial measure in containing the infectious bacterial disease and mitigating the spread of antimicrobial-resistant strains. The pharmacological action of the combination can be attributable to the presence of the phytochemical constituents in turmeric and pH regulating properties of dolomite that can aid in strengthening the delicate relationship between host, pathogen, and environment in the aquaculture farms.

## GLYCOLIPID BIOSURFACTANT FROM MANGLICOLOROUS YEAST *GEOTRICHUM CANDIDUM* PV 37: AN ALTERNATIVE TO ANTIBIOTICS IN AQUACULTURE

Nimsi K. A. \*, Manjusha K.

Kerala University of Fisheries and Ocean Studies, Cochin

\**nimsishiraz@gmail.com*

There is a demand in aquaculture for eco-effective solutions against various bacterial fish pathogens in the current scenario of the spread of multi-drug resistance (MDR). The search for renewable and sustainable control methods, including environment-friendly treatments, has pointed to the use of biosurfactants as a possible solution. Biosurfactants (BS) represent a structurally diverse group of secondary metabolites produced by bacteria, yeasts, and filamentous fungi. Though bacteria have been identified as significant producers of biosurfactants; yeast biosurfactants are found to be more chemically versatile. Thus, the present study was aimed at investigating the antibacterial potential of the biosurfactant from the yeast *Geotrichum candidum* PV 37 isolated from mangrove vegetation. In this study biosurfactant production was carried out in the modified Hua medium, incubated for 7 days in a rotary shaker for 120 rpm at 30 °C. The biosurfactant was extracted from the cell-free supernatant and this was used for the chemical characterization and antibacterial studies. Chemical characterization using TLC, and FTIR revealed that the biosurfactant was glycolipid in nature. The biosurfactant exhibited antibacterial activity against Gram-negative fish pathogens such as *Vibrio* spp. (*V. cholerae*, *V. parahaemolyticus*, *V. vulnificus*, *V. fluvialis*, *V. alginolyticus*, *V. proteolyticus*, *V. harveyi*) and *P. aeruginosa*. It also showed strong antioxidant activity at a concentration of 100 µg/ml. The cytotoxicity of the biosurfactant was assessed in the invertebrate model *Artemia salina* and was found to be non-toxic with a survival rate of 86%. The finding of this study has great significance as this glycolipid biosurfactant from the GRAS strain *G. candidum* PV 37 can possibly serve as an alternative to chemotherapeutics against bacterial pathogens in aquaculture.

## CHEMICAL INACTIVATION OF ANTIBIOTIC RESISTANT BACTERIA FROM SHRIMP CULTURE ENVIRONMENT

Ranjit Kumar Nadella \*, Panda S. K., Madhusudana Rao B., Uchoi, D., Minimol, V.A., Kishore P., Anuj Kumar, Ahaned Basha K., Muthulakshmi T., Mothadaka Prasad M.

ICAR-Central Institute of Fisheries Technology, Cochin

\* [nranjeetkumar@gmail.com](mailto:nranjeetkumar@gmail.com)

Antibiotic resistance in culturable heterotrophic bacteria is widely reported from different food production sectors including shrimp culture system. Mitigation of antibiotic resistant bacteria in waste water from shrimp culture farms released to natural environment during harvest has gained importance in the recent years. Although several stringent strategies have been formulated and implemented in the ground level regarding application of antibiotics, the resistant pattern of bacteria to different antibiotics has been showing increasing trend in the recent times. In this study an experiment trial was carried out to mitigate the antibiotic bacteria from water samples collected from shrimp culture system by employing three disinfection agents *viz.*, Fenton's reagent, chlorination, and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>). Water samples collected during the standing crop was treated with different concentrations of disinfection agents for defined time intervals and inactivation of total bacterial counts (TPC) and tetracycline resistant bacterial counts (TRC) were enumerated as per standard microbiological methods. It was found complete inhibition of both the TPC and TRC from water samples at higher concentrations of disinfection agents. However, treating the water samples with mild concentrations for 1h time period showed a significant reduction of TRC. Among three disinfection agents studied, the highest inactivation efficacy was shown by Fenton's reagent chlorination at a concentration of 2 mM Fe<sup>2+</sup> + 20 mM H<sub>2</sub>O<sub>2</sub> as evident from 2.65 log CFU ml<sup>-1</sup> reduction of TPC and 1.66 log CFU ml<sup>-1</sup> reduction of TRC. This study concludes that the antibiotic resistant bacteria released through waste water during harvest from shrimp culture ponds could be effectively mitigated by using specified disinfection agents at mild concentration levels.

## DEPLETION STUDY OF FLORFENICOL DURING THERAPEUTIC APPLICATION IN SILVER POMPANO AS AN ESSENTIAL STEP IN ANTIMICROBIAL RESISTANCE CONTAINMENT

Suja G.<sup>\*1</sup>, Krupesha Sharma S. R.<sup>1</sup>, Sumithra T. G.<sup>1</sup>, Vishnu Prasad<sup>1</sup>, Ambarish P. Gop<sup>1</sup>, Anil M.K.<sup>1</sup>, Rajisha R.<sup>2</sup>, Panda, S.K.<sup>2</sup> Patil P. K.<sup>3</sup>

<sup>1</sup>ICAR-Central Marine Fisheries Research Institute, Kerala

<sup>2</sup>ICAR-Central Institute of Fisheries Technology, Kerala

<sup>3</sup>ICAR-Central Institute of Brackishwater Aquaculture, Tamil Nadu

*\*suj1078@gmail.com*

Intensive and semi-intensive farming practices and species diversification have led to the emergence of several bacterial diseases in aquaculture, resulting in huge economic losses, which in turn made the application of antimicrobials an inevitable option. Conversely, lack of knowledge on the tissue residue level of drugs and their metabolites after therapeutic exposure is often associated with antibiotic residues and consequent development of antimicrobial resistance (AMR), posing threats to consumer and environmental health. The information on the fillet residues after therapeutic exposure help in estimating the time lapse between the cessation of treatment of the fish and human consumption. Accordingly, the corresponding data of florfenicol (FFC), a drug approved for aquaculture, in snubnose pompano (*Trachinotus blochii*) under warm water temperature, were targeted through the present study. The marker residue for FFC was calculated as the sum of FFC and its major metabolite FFA (florfenicol amine). The results showed that FFC elimination from the muscle occurred in two phases; a rapid initial elimination phase and a slow secondary elimination phase, as there was no significant difference ( $P$ -value  $\leq 0.05$ ) in residue concentration between sampling points after the 7th-day post-cessation of feeding. Further, the detection of FFA showed the FFC metabolizing ability of the fish species. More importantly, the total residue concentration in the edible portion reached  $238.23 \pm 29.05 \mu\text{g Kg}^{-1}$  three days after the termination of medicated feeding. In other words, the mean tissue residue concentration was below the MRL ( $1000 \mu\text{g Kg}^{-1}$ ) for FFC from day three post-termination of medicated feeding, suggesting a withdrawal period of a minimum of three days for snubnose pompano after therapeutic exposure.

## CITROBIOSHIELD: A NATURAL ORGANIC ANTIMICROBIAL PRODUCT SUITABLE SUBSTITUTE FOR SYNTHETIC FOOD PRESERVATIVES

Reshmi B.<sup>1\*</sup>, Reshma C.<sup>1</sup>, Toms C. Joseph<sup>1</sup>, Visnuvinayagam S.<sup>1</sup>, Murugadas V.<sup>1</sup>, Naidu R. N.<sup>2</sup>, Prakash T. K.<sup>3</sup>, Anil Jose<sup>3</sup>

<sup>1</sup>ICAR-Central Institute of Fisheries Technology, Cochin

<sup>2</sup>Germ Kill India, Bangalore

<sup>3</sup>Archer Diagnostics Pvt. Ltd, Ernakulam

\*reshmibinil@gmail.com

Globally, awareness of synthetic-based antimicrobials in food and aquaculture products is growing due to their potentially harmful effects on health. Hence, food processing industry is seeking alternative to synthetic preservative agents. Recently plant-derived extracts have qualified presumption of safety (QPS) status and also as generally recognized as safe (GRAS) for food preservation. Citrobioshield, a natural and organic antimicrobial solution, possess numerous natural compounds, such as plant phenolics and terpenoids, which have potent antibacterial activities against food-borne microorganisms. In the present study, Citrobioshield was tested against 15 microorganisms including 12 bacterial and 3 fungal isolates, by agar well diffusion assay and broth dilution method *i.e.*, minimum inhibitory concentration (MIC) and Minimum bactericidal concentration (MBC). Based on the well diffusion assay, Methicillin-resistant *Staphylococcus aureus* (MRSA), *Staphylococcus aureus*, *Listeria monocytogenes*, *Bacillus cereus*, and extended-spectrum-beta-lactamase (ESBL) *E. coli* were most sensitive (3.8 µl/mL). Concentration of 2 µl/mL was adequate to inhibit the fungi. Based on the broth dilution method, the lowest MIC value was for *B. cereus* and ESBL *E. coli* (0.36 µl/mL). The MIC value ranged between 0.4 to 01.4 µl/mL for *S. aureus*, MRSA, *Salmonella*, *V. harveyi*, *E. coli*, *Aeromonas hydrophila*, *Listeria monocytogenes*, and *V. parahaemolyticus*. The highest MIC was observed for *Pseudomonas aeruginosa* (11.8 ± 4 µl/mL). The MIC of *Aspergillus* sp. (0.54±0.16 µl) was the lowest among the fungal species tested, followed by *T. mentagrophytes* (0.74±0.48 µl) and *S. cerevisiae* (1.46±0.48 µl). Based on the study it was concluded that Citrobioshield is an effective antimicrobial product against most of the foodborne microorganisms (including multi-drug resistant) from aquaculture and food.





## **Sub-theme 4: Probiotics, Microbiome, Metagenomics & Non-antibiotic approaches**





## MICROBIOME AS A TOOL TO ADDRESS ANTIMICROBIAL RESISTANCE THREATS

**Debjit Chakraborty, Sulagna Basu, Shanta Dutta\***

ICMR-National Institute of Cholera and Enteric Diseases, Kolkata

*\*drshantadutta@gmail.com*

Antimicrobial resistance has been considered as the next big public health crisis. Various attempts are being made to tackle the problem which includes new methods for point-of-care diagnosis, genotypic- driven antibiotic decisions, enhanced surveillance, new vaccines against drug-resistant bacteria and efficient implementation of antimicrobial stewardship programs.

Treatment generally focuses on the antimicrobial susceptibility patterns of the infecting microbes and the role of the microbiome is under-recognised. The term 'human gut microbiome' is defined as the microorganisms, their genomes and the environmental milieu of the human intestinal tract. The gut is a prime reservoir for antibiotic resistance (AR) genes and is also a niche for the exchange of these genes. Most AR genes are acquired by any organism through mobile genetic elements such as plasmids, transposons and integrons.

In addition, the structure and function of the human microbiome help shape immune system development, nutritional status, and other processes in early life preparing the host for future environmental and microbial exposures. The manipulation or change of the microbiome will thus help reduce antibiotic resistance by replacing resistant pathogens with sensitive ones. This talk will focus on several approaches to deal with the possibility of changing the microbiome with the use of probiotics, transplantation of fecal microbiota, or the use of alteration in diets or administration of specific foods.

Approaches in tackling antibiotic resistance need to be multi-dimensional and novel approaches such the modification of the gut microbiome both in humans and animals may be the way forward in the near future.

## NON-ANTIBIOTIC APPROACHES TO COMBAT URINARY TRACT INFECTION

**Sarguru Subash\***

Texas A&M University, College Station, TX

\*[sarguru@cvm.tamu.edu](mailto:sarguru@cvm.tamu.edu)

The urinary tract, especially the bladder, is one of the most common sites of bacterial infection in humans. Uropathogenic *Escherichia coli* (UPEC) is the predominant cause of urinary tract infection (UTI). Women, children, the elderly, and individuals with catheters, uroliths, or diabetes mellitus are highly susceptible to UTI. There is an immediate need for novel strategies to manage UTI because of an alarming increase in antibiotic resistance in UPEC globally. Our long-term research goal is to define the molecular and cellular features of host-pathogen interaction during UTI to identify targets for therapeutic development. High levels of fulminant UTI in patients with Menkes disease (who cannot absorb dietary Cu) highlight an important and novel biological role for Cu in the protection against UTI. Here, I will present data that demonstrates that copper (Cu) is mobilized to urine as a host response during clinical UTI in patients. A non-human primate model of UTI recapitulates urinary Cu mobilization observed in human UTI. Mice that are deficient for Cu are susceptible to increased bacterial colonization during UTI. Additionally, I will share evidence that supports that homeostasis of Cu and iron are intricately linked in UPEC. The rationale for our ongoing work is that understanding Cu mobilization, and its impact on UPEC survival are critical to develop therapeutics that bolster this innate response to resolve UTI. Collectively, Cu emerges as an important mediator of host defense during UTI and has the potential to be developed as a host-directed therapeutic agent.

## THE RISING TIDE OF ANTIMICROBIAL RESISTANCE IN AQUACULTURE: CAN PROBIOTIC BE THE ANSWER?

**Toms C. Joseph\***

ICAR-Central Institute of Fisheries Technology, Cochin

*\*tomscjoseph@gmail.com*

Aquaculture accounts for more than 50% of world seafood production and offers vital supply of nutritious food for human consumption. However, diseases in aquaculture have a negative impact on the socioeconomic status and economic development of aquaculture farmers. Treatment with chemotherapy medications has a detrimental effect on the aquatic ecosystem. As a result, there is an increasing need for finding alternatives that are safe, non-antibiotic-based, and environmentally friendly. Probiotics has gained increasing prominence as an alternate to antibacterial drugs in the aquaculture sector for growth promotion, better metabolism, improved immunological response, and water quality maintenance. Bacteria belonging to Firmicutes phylum contains some of the most investigated probiotic candidates, such as LAB (lactic acid bacteria) and *Bacillus* spp.. Even though there is substantial research on the efficacy and actions of probiotic strains, many aspects remain unanswered. The use of prophylactic health products such as probiotics, prebiotics and synbiotics are generally considered as safe, which reduces the use of antibiotics and has no adverse impact on the environment. The consumption of probiotics has increased recently due to concerns about the spread of antimicrobial resistance among pathogens. Probiotics are considered to have possibility to replace the use of antibiotics in aquatic animals. However, there is risk for transfer of AMR genes from probiotics to natural flora including pathogens present in the gut or natural environment. Before commercial use, all the probiotic strains must be tested for the presence of antibiotic resistant genes before commercial use.

Additional and future research could focus on gut bacteria transcriptome and proteome profiling, host/microbe interactions, interactions among gut microorganisms, gut immune status, antioxidant status, antagonistic activity, and knowledge on the side effects of probiotics.

**PROBIOTIC POTENTIALITY OF LACTIC ACID BACTERIA (LAB) ISOLATED FROM BRACKISHWATER FISH GUT AND THICKLY SET CURD**

**Sanjoy Das\***, Leesa Priyadarsani, Debasis De, Prem Kumar, Gouranga Biswas,  
Neha Kumari, Tapas Kumar Ghoshal

ICAR- Central Institute of Brackishwater Aquaculture, West Bengal

\*sanjoy125@yahoo.co.in

Different species of Lactic acid bacteria (LAB) are proven for their probiotic characteristics in terms of controlling the growth of different pathogenic bacteria. In the current study, isolation of different LAB species was attempted from gut of different brackishwater fish species and thickly set curd prepared from cow milk. The isolates of LAB were screened for the inhibitory property against pathogenic *Vibrio mimicus*, growth in presence of NaCl and bile salt and tolerance to low pH. Based on the different probiotic properties, two isolates viz. *Enterococcus faecalis* SDKRC- 9 and *Weissella confusa* SDKRC- 10 were selected for in-vivo studies. Feed supplemented with these two LAB isolates could improve the survival of juvenile *Penaeus vannamei* to a great extent while challenged with virulent *Vibrio mimicus* SDKRC- 12 strain. After 8 days of challenge study, survival was 72.5 and 30% in LAB-supplemented and control groups, respectively. The load of total *Vibrio* was found significantly ( $p < 0.05$ ) less in case of shrimp fed with LAB-supplemented diet ( $4.434 \pm 0.241 \text{ Log}_{10} \text{ CFU/g}$ ) as compared to control group ( $5.974 \pm 0.363 \text{ Log}_{10} \text{ CFU/g}$ ). The haemocyte count in haemolymph was found higher in LAB-supplemented group as compared to control although there was no significant difference ( $p < 0.05$ ). The present study indicated that two selected species of LAB, viz. *E. faecalis* and *W. confusa* can be considered as good candidates for development of gut probiotics for shrimp aquaculture.

## TAXONOMIC AND FUNCTIONAL DIVERSITY OF RHIZOSPHERE MICROBIOTA ALONG SANDALWOOD SPIKE DISEASE INFECTION GRADIENT

Reshma Bhasker T. \*, Suma Arun Dev

Kerala Forest Research Institute, Peechi, Thrissur

\*reshmabhaskert24@gmail.com

*Santalum album* Linn. (East Indian Sandalwood or chandan), a hemi-parasitic tropical tree, native to southern India and Southeast Asia has been commercially valued for its timber, and heartwood derived essential oil for centuries. In several sandalwood populations across India, degeneration of trees due to sandal spike disease caused by phytoplasmas has led to the decline of natural populations.

Appropriate soil restoration strategies involving rhizosphere microbiota in correlation with physicochemical properties of the soil can enhance the tree health and overall resistance. 16S-rRNA based amplicon sequencing performed using MinION Nanopore sequencer were used to assess the impact of infection gradient in sandalwood tree rhizosphere soils. Samples were collected from individual trees on the basis of infection gradation; healthy, early stage of infection and severely infected samples. The sandal tree rhizosphere, which is composed of both pathogenic and beneficial microbes along with their colonization and dominance in the rhizosphere definitely seemed to have an impact on disease incidence. Microbes identified such as *Rhizobacter*, *Nocardioides*, among others, which signify soil health and fertility, can be used as indicators for soil quality in future restoration programmes. Rhizosphere microbiome engineering strategies using microbes as potential biocontrol agents against pathogens either by direct inoculation or co-inoculation with several other strains or mixed cultures of endophytes or PGPRs, would enable combined niche exploitation and alleviate tree health.

**EVALUATION OF SELECTED DIETARY PROBIOTICS ON GROWTH PERFORMANCE AND NUTRIENT UTILIZATION OF *LABEO ROHITA***

**Amit Sharma \*, Raghuvanshi S.K.**

*Bareilly College, MJP Rohilkhand University, Uttar Pradesh*

*\*amitsharma88887@gmail.com*

A 60 days experiment was conducted in lab conditions to assess the potentiality of preferred probiotics on growth performance, feed efficiency and nutrient utilization to develop cost-effective quality feed for *Labeo rohita*. The fish (average weight  $11.45 \pm 0.24$  g) were randomly distributed in five experimental groups along with control into triplicates in a series of aquarium (70L each) containing 10 fishes that were captured from Ramganga river. After acclimatization for 10 days, the fishes with similar body weight were distributed randomly into five treatment groups in the laboratory. These fishes were given basal feed containing *L. acidophilus* and *S. cerevisiae* in five concentrations viz., 0.5 (T1), 1.0 (T2), 1.5 (T3), 2.0 (T4) and 2.5 (T5). Experimental diets were formulated together with basal diet by selecting two types of probiotics *Lactobacillus acidophilus* as bacterial probiotics and fungal probiotics as *Saccharomyces cerevisiae* and were provided either in single as well as in combination and a control diet with no probiotics. The fishes were fed thrice a day at a rate of 4% of their body weight. At the end of the feeding trial, highest net weight gain, percentage weight gain, specific growth rate (SGR), feed conversion efficiency (FCE) and Feed conversion ratio (FCR) were observed ( $P < 0.05$ ) in the T4 group. FCR was lowest in T4 group ( $P < 0.05$ ) which was significantly different from other groups except T2 group. The proximate carcass composition differs significantly ( $P < 0.05$ ) among different experimental groups. These results clearly suggest that the addition of bacterial probiotic in the form of *Lactobacillus acidophilus* can improve growth performance, nutrient utilization and feed efficiency in *L. rohita*.

## PROBIOTIC PROPERTIES OF LACTIC ACID BACTERIAL STRAINS ISOLATED FROM FISH GASTROINTESTINAL TRACT

Nayanthara A.C.\*, Greeshma James, Rejishkumar V. J.

\*nayanthara10ammu@gmail.com

The gastrointestinal tract (GIT) of fish supports a dynamic microbial ecosystem that is essential for the epithelial development, immune system activation, and disease prevention. Antibiotics are widely used in aquaculture industry to control the pathogenic microflora formed on the aquatic environments. The indiscriminate use of antibiotics results in the prevalence of antibiotic resistance microorganism and imbalance in the gut flora of fishes. An alternative approach to manage fish health in the aquaculture industry is use of probiotics that enhances the aquaculture production. Lactic acid bacteria (LAB) are potential probiotic candidates in aquaculture and are also known to be present in the intestine of healthy fish. Several LAB have been reported as probiotics in aquaculture for controlling the diseases. Hence, the present study was aimed to isolate LAB from the fish GI tract and to analyse its antimicrobial and enzymatic activity for its further application as a probiotic in aquaculture. Fish sample were collected from three locations of Ernakulam district. The 33 isolates were subjected to biochemical tests for the identification of LAB. Among the 33 isolates, 11 displayed the characteristics of LAB. By 16S rRNA sequencing, 06 isolates were confirmed as Lactic acid bacteria. *Enterococcus casseliflavus*, *Enterococcus gallinarum* and *Weissella cibaria* were the LAB isolated from the gastrointestinal tract of fish. *E. casseliflavus* showed antibacterial activity against *Vibrio parahaemolyticus* whereas *W. cibaria* and *E. gallinarum* showed antibacterial activity against *Edwardsiella tarda*. The *E. casseliflavus* exhibit protease, amylase and lipase activity whereas *E. gallinarum* displayed amylase activity and *W. cibaria* exhibited lipase activity. This study reveals the probiotic potential of Lactic acid bacteria isolated from the fish GI tract.

## PREVALENCE OF ANTIBIOTIC RESISTANCE GENES FROM CORE SEDIMENTS OF COCHIN ESTUARY

Jasna Vijayan <sup>\*</sup>, Sabira P. A., Akhil Prakash E., Parvathy K. R., Reshmi, Sunil P. S.,  
Mohamed Hatha Abdulla

Cochin University of Science and Technology, Cochin

*\*jasnavijayan@gmail.com*

The world's largest source of organic carbon is found in marine sediments, which are a significant component of the marine ecosystem. Sediment microorganisms are important regulators of major geochemical and eco-environmental processes in marine environments, especially nutrient dynamics and biogeochemical cycles. Despite their importance, core marine microorganisms are virtually unknown due to a lack of consensus on how to identify them. Most core microbiotas have been characterized thus far based on species abundance and occurrence. The combined effects of habitat and depth on benthic bacterial communities and ecological functions were examined using next-generation sequencing and PICRUSt predictive functional profiling at the surface (0cm) and bottom depth (250cm). The findings demonstrated that bacterial diversity and richness were much higher in the surface sediment sample, with *Proteobacteria*, *Acidobacteria*, *Chloroflexi*, and *Bacteroidetes* being the most prevalent phyla. *Actinobacteria* (25.69%) and *Alphaproteobacteria* (18.65%) were the two largest classes in the surface sample, while *Alphaproteobacteria* (43.16%) and *Gammaproteobacteria* (37.21%) were the two major classes in the bottom sample. The primary metabolic processes were metabolism, followed by genetic and environmental information processing. The major antibiotic resistance gene observed in both surface and bottom was *rpoB* resistance gene.

## METAGENOMIC PROFILE OF ANTIBIOTIC RESISTANCE GENES AND BACTERIAL PATHOGENS FROM A FISH FARM LOCATED IN KERALA, INDIA

Reshma Silvester\*, Mujeeb Rahiman K. M., Mohamed Hatha, Harikrishnan Mahadevan,  
Jesmi Yousuf

Cochin University of Science and Technology, Cochin

\*sanasilvester@gmail.com

Antimicrobial resistance (AMR) is a one-health problem. It poses severe threat to aquaculture animals leading to disease outbreaks by multi-drug resistant pathogens, that is beyond control; thereby affecting the overall aquaculture production and also posing significant risk to human and environmental health as well. The present study aims to provide metagenomics-based evidence on the status of AMR and bacterial pathogens in a tilapia fish farm located in Cochin, Kerala. Human pathogens such as *Pseudomonas aeruginosa*, *Escherichia coli*, *Salmonella enterica* and *Klebsiella pneumoniae* were prevalent in the study area. Resistome analysis revealed that the farm environment to be highly contaminated with antibiotic resistance genes (ARGs) (n=683) conferring resistance to multiple classes of antibiotics such as aminoglycoside, amphenicol, b-lactam, fluoroquinolone, glycopeptide, macrolide, tetracycline, polymyxin, sulfonamide etc. Genes encoding for multidrug efflux pumps such as *acrB*, *axyY*, *ceoB*, *msbA*, *mexBCFNQWY*, *mtrA*, *smeR* and those conferring resistance towards macrolide (*macB*), fluoroquinolone (*oqxB*, *arlR*), rifamycin (*rpoB*), novobiocin (*novA*), tetracycline (*tetA*, *tetB*) and vancomycin (*vanR*) accounted for the majority of the ARGs from this farm. Moreover, detection of ARGs conferring resistance towards last resort drugs such as colistin, 3<sup>rd</sup> generation cephalosporins, carbapenem, vancomycin etc. further exacerbates the situation. Overall, this study presents a complete metagenomic profile that sheds light on the distribution of ARGs and bacterial pathogens in the fish farm environment. The study thus provides clear evidence that aquaculture environments can act as hotspots for clinically relevant ARGs and hence necessary actions are needed to prevent the transmission of ARGs from the aquafarms to humans and other environmental compartments.





## **Theme II- Molecular diagnostic solutions for AMR**





## ORIGINS OF MRSA: HOW *mecC* EMERGED IN WILDLIFE BEFORE THE HUMAN USE OF ANTIBIOTICS

**Mark A. Holmes\***

University of Cambridge, UK

\*mah1@cam.ac.uk

Antibiotics were discovered over 80 years ago and have led to great improvements in human and animal health. Animals can act as a reservoir and source for the emergence of novel methicillin-resistant *Staphylococcus aureus* (MRSA) clones in human beings. We discovered a strain of *S. aureus* isolated from bovine milk that was phenotypically resistant to methicillin but tested negative for the *mecA* gene. We used whole-genome sequencing to establish the genetic basis for the observed antibiotic resistance identifying the *mecC* gene. This divergent *mecA* homologue was 70% identical to *S. aureus* *mecA* and found in two main MLST lineages (CC130 and ST425), initially in dairy cows and subsequently in people. It is known that antibiotic resistance in environmental bacteria is very old while resistance in human pathogens is thought to be a modern phenomenon, driven by the clinical use of antibiotics. We were surprised to discover that *mecC* MRSA were present in the European hedgehog with a prevalence of up to 60%. Work from New Zealand in the 1960's had linked beta-lactam resistant *S. aureus*, found on hedgehogs, with the presence of dermatophyte (skin fungus), *Trichophyton erinaceid*. We were able to show that this fungus produces two  $\beta$ -lactam antibiotics that provide a natural selective environment in which methicillin-resistant *S. aureus* isolates have an advantage over susceptible isolates. We undertook a phylogenetic analysis of a large collection of *mecC* MRSA to show that *mecC* lineages first separated from MSSA in the late 19th century. Our findings suggest that *mecC* resistance emerged before the human use of antibiotics as a co-evolutionary adaptation of *S. aureus* to the colonization of dermatophyte-infected hedgehogs.

## DYNAMIC AMR PATHOGEN IN ANIMAL HUSBANDRY PRACTICES AND THEIR MITIGATION STRATEGIES

Sachinandan De \*

National Dairy Research Institute, Karnal, Haryana

\*sachinandan@gmail.com

Antibiotic resistance in bacterial pathogens poses a severe danger to the health of humans, animals, and the environment, which has an impact on the idea of one health. Lack of understanding, excessive use of antimicrobials, improper disposal of contaminated milk or animal tissue, and insufficient animal health care are to responsible for the development of antibiotic resistance in bacteria from dairy farms, which has an adverse impact on human health via the food chain. The transfer of AMR pathogens to the food chain also happens when raw meat, eggs, milk, shellfish, and some fermented dairy products are consumed. Animal protein should be guaranteed to be a safe food source and free of AMR illnesses. Bovine mastitis is one of the most frequently diagnosed diseases of dairy cattle resulting in the complete damage of the udder. *Staphylococcus aureus* and ESBL producing pathogens are the most common cause of bovine mastitis with huge economic loss. Emergence of Methicillin-resistant *Staphylococcus aureus* (MRSA) among bovine mastitis is a matter of concern for animal health and dairy industry. The CTX-M, TEM, SHV, OXA are examples of ESBL enzymes mostly produced by *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Proteus mirabilis* to become resistant to extended-spectrum penicillin, cephalosporins, carbapenems and monobactams. The mobile genetic elements including ISEcp1, IS26 and Tn2 play an important role in the dissemination of ESBL resistance genes.

To explore the prevalence of MRSA and ESBL-producing MDR pathogens in mastitis infection in Delhi NCR, 600 mastitis milk samples were analyzed. A total of 126 *Staphylococcus* isolates were identified and 42 were identified as MRSA strains harboring virulence genes *mecA*, *coa* and *nuc*, *hlg*, *pvl* and *spa*. Further, a total of 112 ESBL-producing *E. coli* isolates containing TEM, CTX-M-1, CTX-M-9, CMY-2, OXA-1 were identified. The mastitis *E. coli* pathogens are similar to human *E. coli* ExPEC-ST131. The ExPEC-ST131 defining SNP associated with *mdh* was found in 85.7 % of the isolates. The CTX-M is one of the most important ESBL widely found in animal and human infections. For better understanding of CTX-M variations and epidemiology, a total of 2210 CTX-M sequences were retrieved, revealing maximum incidences of CTX-M genes in China (n = 508), USA (n = 354) and Japan (n = 180). Single amino acid substitution in the domain region of CTX-M ESBL lead to survival benefits to the bacteria. A total of 31 different variations were found of which D240G was the most common mutation found in India. Further, the data suggest that CTX-M-15 was the most prevalent ESBL enzyme, mainly associated with *Escherichia coli* and *Klebsiella pneumoniae*, majorly found in human isolates.

Major strategies are required to combat AMR including quick point-of-care diagnosis of pathogenic bacteria. Nanoparticle-based assay for rapid detection of *E. coli* specific DNA in milk of cows affected with mastitis was developed. Other strategies include proper sanitation in animal sector, rational use of antibiotics and use of potent biological molecules



## ANTIBIOTIC RESISTANCE IN SEAFOOD-BORNE ENTEROBACTERIALES: SOURCES, GENOTYPES, AND DISSEMINATION

Sanath Kumar H.\*

ICAR-Central Institute of Fisheries Education, Mumbai

\*sanathkumar@cife.edu.in

The recent rise in the occurrence of multidrug-resistant (MDR) bacteria in wild-caught fish and shellfish reflects on the emergence and dissemination of such bacteria from diverse sources, the most important being the anthropogenic contamination of coastal-marine environment. Since seafood is a globally traded commodity, the presence of MDR bacteria is a genuine food safety concern. Resistant bacteria can reach geographical regions far away from their places of emergence via seafood. Enteric pathogens resistant to multiple drugs are increasingly being reported from seafood, which include the Extended spectrum- $\beta$ -lactamase (ESBL) producing and the carbapenem-resistant *Enterobacterales* (CRE). Nearly two-thirds of MDR *Enterobacterales* isolated from fresh seafood in Mumbai, India are ESBL-positive, with more than 90% of the isolates being resistant to third-generation cephalosporins, with the widespread occurrence of ESBL-encoding genes such as *bla*<sub>CTX</sub>, *bla*<sub>SHV</sub> and *bla*<sub>TEM</sub>. The CRE from seafood carry the metallo-lactamase-encoding genes *bla*<sub>OXA</sub>, *bla*<sub>NDM</sub> and *bla*<sub>VIM</sub>. The New Delhi metallo- $\beta$ -lactamase gene (*bla*<sub>NDM</sub>)-harbouring *E. coli* resistant carbapenems, fluoroquinolones and colistin further confounds the seafood safety management. The whole genome sequence of *S. Infantis* carrying pESI (plasmid emergent *Salmonella infantis*) conjugative megaplasmid, a rapidly spreading MDR clone, from seafood in India suggests novel mechanisms of antibiotic resistance. The plasmids encoding ESBLs, pNDM and pESI are highly in the aquatic environment raising concerns about the wider dissemination of resistance genotypes. The presence of MDR bacteria in seafood is an emerging food safety issue, which can also adversely affect the global seafood trade.

## SPREAD OF CTX-M-TYPE ESBL-MEDIATED RESISTANCE IN GRAM-NEGATIVE BACTERIA FROM ANIMAL AND HUMAN

Chanchal Rana<sup>1\*</sup>, Manisha Behera<sup>1,2</sup>, Mayank Roshan<sup>1</sup>, Devika Gautam<sup>1</sup>, Ashutosh Vats<sup>1</sup>, Shiveeli Rajput<sup>1</sup>, Rakesh Kumar<sup>1</sup>, Sachinandan De<sup>1</sup>

<sup>1</sup>National Dairy Research Institute (NDRI), Karnal, Haryana

<sup>2</sup>Hindu College, University of Delhi, Delhi

\*chanchalrana@gmail.com

Antimicrobial resistance (AMR) has become a severe threat worldwide due to global emergence of new resistance mechanisms and limited drugs available for treatment. The largest group of ESBLs are CTX-M that have become globally disseminated. To investigate the spread of CTX-M ESBL in different bacterial genus and to study the incidence pattern in animal and human infections, a total of 2210 bacterial isolates containing CTX-M sequences were retrieved from the NCBI as on 20<sup>th</sup> December 2020. The CTX-M genes were most prevalent in *Escherichia coli* (n=1041), followed by *Klebsiella pneumoniae* (n=655) and *Proteus mirabilis* (n=62). Total 53 bacterial species have been known to carry CTX-M genes including *Pseudomonas aeruginosa*. Out of 2210 CTX-M genes, 1263 (57.43%) genes were members of CTX-M-1 group. The CTX-M-15 (628/1263, 49.72%) was most prevalent, found frequently in *Klebsiella pneumoniae* (335/628, 53.34%) followed by *Escherichia coli* (221/628, 35.19%) and was found less in *Proteus mirabilis* (10/628, 1.59%). The CTX-M-15 genes were rarely found in other bacterial species. The study also reported that CTX-M genes were found in human, animal and food sources. The 732 CTX-M positive isolates were excluded from the study due to lack of information on NCBI. Total 880 (895/1478) isolates of CTX-M-1 group members were included, out of which CTX-M-15 (482/880) was the dominant ESBL majorly found in human blood stream (329/467) suggesting the major contributors for the spread of CTX-M-15. The CTX-M-15 was also found in urine (58/467), faeces (41/467), water (16/467) and fish (15/467) samples. Only few CTX-M-15 were found in food and animal isolates suggesting, that these sources had merely contributed to the dissemination of CTXM-15. Our finding from the available data reveals that CTX-M-15 was the most prevalent ESBL enzyme, mainly associated with *Escherichia coli* and *Klebsiella pneumoniae*, majorly found in human isolates. Major strategies are required to combat AMR including proper disposal of waste product, prevention of unnecessary growth of resistant pathogens, quick identification of pathogenic bacteria and rational use of antibiotics.

**BETA-LACTAMASE PRODUCING *KLEBSIELLA QUASIPNEUMONIAE* SUBSP. *SIMILIPNEUMONIAE* WITH SEQUENCE TYPE 1699- A FIRST REPORT FROM RETAIL MARKET FISH, INDIA**

**Gopalan Krishnan Sivaraman<sup>1\*</sup>, Sudha Sajeev<sup>1</sup>, Muneeb Hamza<sup>1</sup>, Sandeep Ghatak<sup>2</sup>, Rakshit Ojha<sup>3</sup>, Suresh Kumar Mendem<sup>3</sup>, Devi Murugesan<sup>3</sup>, Claire Raisen<sup>4</sup>, Bibek R. Shome<sup>3</sup>, Mark A. Holmes<sup>4</sup>**

<sup>1</sup>ICAR-Central Institute of Fisheries Technology, Cochin

<sup>2</sup>ICAR Research Complex for NEH Region, Umiam

<sup>3</sup>ICAR-National Institute of Veterinary Epidemiology and Disease Informatics, Bengaluru

<sup>4</sup>University of Cambridge, UK

\* [gkshivraman@gmail.com](mailto:gkshivraman@gmail.com)

The study presents the genomic insights of *Klebsiella quasipneumoniae* from retail market fish from North-East India. PATRIC assisted RASTtk enabled annotation pipeline revealed the size of the genome to be 5.24 Mb with 5,166 protein coding sequences (CDS), 85 transfer RNA (tRNA) genes, and 15 ribosomal RNA (rRNA) genes. With 205 contigs, an average G+C content of 57.80% and N50 value of 2,870,775 bp, the annotated genome acknowledged the presence of *bla*<sub>CTX-M-15</sub>, *bla*<sub>OKP-B-1</sub>, *fosA5*, *oqxAB* and virulence genes. The strain with ST1699 and serotypes KL52 and OL103 also harboured insertion sequences (ISs): *ISKpn26* and *ISEc9*. Three complete phage genomes were identified in contigs 1 and 6 of the bacterial genome, enhancing the prospects of genome manipulation. The study highlights the pitfall of conventional microbiological identification methods to distinguish *K. pneumoniae* and *K. quasipneumoniae*. This is the first Indian study documenting the incidence of extended-spectrum beta-lactamase (ESBL)-producing *K. quasipneumoniae* subsp. *similipneumoniae* belonging to ST1699 from a non-clinical environment, equipped with virulomes and associated mobile genetic elements. As fish and associated environment can be potential drivers for transmission of antimicrobial resistance genes, our findings have paramount importance on human health.

**GENETIC DETERMINANTS OF ANTIBIOTIC RESISTANCE IN *SALMONELLA ENTERICA* SUBSP. *ENTERICA* SEROVAR TYPHIMURIUM FROM SEAFOOD OF COCHIN, KERALA**

**Greeshma S. S.<sup>1\*</sup>, Devika Pillai<sup>2</sup>, Toms C. Joseph<sup>3</sup>**

<sup>1</sup>Mumbai Research Centre of ICAR- Central Institute of Fisheries Technology, Cochin

<sup>2</sup>Kerala University of Fisheries and Ocean studies, Cochin

<sup>3</sup>ICAR-Central Institute of Fisheries Technology, Cochin

\**greeshma.ambadi@gmail.com*

Antimicrobial resistance profiling of 46 *Salmonella* Typhimurium strains isolated from raw seafood of Cochin region, Kerala was carried out using disc diffusion assay. In this study, 71.05 % (n=27) of the *S. Typhimurium* exhibited resistance to at least one antibiotic and 57.9 % (n=22) of the isolates were found to be multidrug resistant (MDR). This study reveals new resistant phenotypes of *S. Typhimurium* with high levels of hexa resistance pattern *Viz.*, 'AAzCCoCiG' (43.21%; n=13) and tetra resistant pattern 'AAzCiG' (13.15%, n=5). Minimum Inhibitory Concentration (MIC) with E-test reveals that 100% of the isolates were resistant up to the highest concentration of antibiotics tested for co-trimoxazole (32 µg/ml), ampicillin (256 µg/ml) and chloramphenicol (256 µg/ml). Out of 23 gentamycin resistant isolates of *S. Typhimurium*, 65.21% (n=15) exhibited resistance up to 256 µg/ml; while 4.3% and 8.6% exhibited MIC value of 32 µg/ml and 16 µg/ml, respectively. Two tetracycline resistant isolates of *S. Typhimurium* exhibited MIC of 48 µg/ml and 24 µg/ml. Among 7 ciprofloxacin resistant strains of *S. Typhimurium*, 14.2% exhibited MIC of 6 µg /ml while 85.8% exhibited MIC of 4 µg /ml. Azithromycin resistant isolates of *S. Typhimurium* exhibited different MIC values ranging from 16-96µg/ml. Molecular confirmation of antibiotic resistance was carried out by PCR targeting the respective genes. The findings of this study revealed the status of antibiotic resistance among *S. Typhimurium* from seafood of Cochin region and the data generated may help for decision making to control the spread of antibiotic resistance.

## VIRULENCE PROFILE OF *KLEBSIELLA* SPP. FROM CATHETER ASSOCIATED URINARY TRACT INFECTION

Honey Gopinathan<sup>\*</sup>, Athira A. S., Sarita Ganapathy Bhat

Cochin University of Science and Technology, Kochi

<sup>\*</sup>haneygputhur@gmail.com

*Klebsiella pneumoniae* is one of the most important opportunistic pathogens that usually causes nosocomial infections such as pneumonia, urinary tract infections, invasive infections and surgical site infections. This study sought to explore the biofilm formation, antibiotic susceptibility profiling and virulence profile of *Klebsiella* spp. (n = 23) isolated from indwelling urinary catheters. All the *Klebsiella* spp. were evaluated for their ability to form biofilm on both polystyrene and Natural Rubber Latex surface by crystal violet quantification method. All strains were assessed for their antibiotic susceptibility by modified Kirby- Bauer method. Multiple antibiotic resistance (MAR) index of all *Klebsiella* spp. was also calculated. *Klebsiella* spp. were also screened for their  $\beta$ -lactamase production. The detection of virulence genes (*bla<sub>SHV</sub>*, *bla<sub>TEM</sub>*, *fimH-1*, *entB*, *ybtS*, *mrkD*, and *uge*) was performed by PCR. All the 23 *Klebsiella* strains in the study formed biofilms on both polystyrene and natural rubber latex surfaces, but the biofilm formation on the latex material is stronger when compared to the polystyrene material. In this study, among the CAUTI associated *Klebsiella* spp., 95.6 % were resistant to multiple antibiotics with high-level resistance to third-generation cephalosporin antibiotic Ceftazidime and  $\beta$ -lactam antibiotic Cefotaxime. All organisms except *Klebsiella pneumoniae* strain BTPCE1 showed high MAR indices implying high antibiotic resistance. 73.91% *Klebsiella* spp. were Extended Spectrum  $\beta$ -Lactamase producers and 4.34 % *Klebsiella* spp. were Metallo  $\beta$ -Lactamase producers. 23 isolates presented extended-spectrum beta-lactamase-producing *bla<sub>TEM</sub>* (n=17,73.91%), *bla<sub>SHV</sub>* (n = 22, 95%) variants genes. The virulence-associated genes found among the 23 *Klebsiella* spp. were *mrkD* (n = 22, 95%), *fimH-1* (n =16, 69.5%), *uge* (n= 22,95%) *entB* (n= 21,91%) and *ybtS* (n = 3, 13%). The extensive diversity of MDR *Klebsiella* spp. harboring  $\beta$ -lactams and virulence genes strongly suggests a necessity for the implementation of effective strategies to prevent and control the spread of antibiotic resistant infections.

## ANTIMICROBIAL RESISTANCE PROFILING OF COAGULASE NEGATIVE STAPHYLOCOCCI ISOLATED FROM BOVINE MASTITIS

Krupa Rose Jose\*, Vijayakumar K.

College of Veterinary and Animal Sciences, Mannuthy, Thrissur

\*krupaputhuparampil@gmail.com

Milk and dairy products have been considered as the nature's most complete food and play a vital part in the diets of nearly six billion people worldwide. The demand for safe and wholesome milk has risen to the top of global health agenda due to impending food security concerns such as its potential for transmission of many zoonotic diseases, antibiotic residues, bacterial toxins as well as organisms carrying numerous resistance and virulence factors. Therefore, the present study was conducted to investigate the antimicrobial resistance profile of coagulase negative staphylococci (CNS) isolated from bovine mastitis. Out of the 83 clinical mastitis (CM) samples examined, CNS (40.29 per cent) was the most frequently isolated bacteria based on the morphological, cultural and biochemical characterization as well as by monoplex polymerase chain reaction. It was also concluded that majority of the CNS isolates were multidrug resistant. The results from *in vitro* disc diffusion assay revealed that 77.77%, 14.81%, 25.93% and 48.15% isolates were resistant to penicillin, methicillin, tetracycline and enrofloxacin respectively whereas, all the isolates (100 per cent) possessed *blaZ* gene, 40.74 per cent had *mecA* gene and 14.81% had *tetM* gene. None of the isolates were found to carry *gyrA*. The result depicts a significant difference between the phenotypic and genotypic resistance of CNS against penicillin, methicillin and tetracycline. This outcome on the interaction of phenotypic and genotypic antimicrobial resistance profiling is intriguing and it opens a huge scope for future studies on the transcriptomic and proteomic aspects of drug resistance. A better knowledge of the antimicrobial resistance profile guides the dairy producers in developing prompt intervention strategies, which in turn helps in tackling antimicrobial resistance and reduces the threat of its zoonotic transmission.

## STUDY OF ANTIMICROBIAL RESISTANCE IN EFFLUENT TREATMENT PLANTS

Saranya A. S.<sup>1\*</sup>, Lea Mathew<sup>1</sup>, Swarnalatha K.<sup>1</sup>, Sheela A. M.<sup>2</sup>

<sup>1</sup>College of Engineering, Thiruvananthapuram

<sup>2</sup>Kerala State Pollution Control Board, Thiruvananthapuram

\* *saranyaasadhi@gmail.com*

The study has been carried out to analyse the presence of antimicrobial resistance in effluent treatment plants of hospitals. Antibiotic susceptibility analysis was carried out using disc diffusion technique with antibiotics like ampicillin (10µg), tetracycline (30µg), amikacin (30µg), gentamycin (10µg), ciprofloxacin (5µg), chloramphenicol (10µg), colistin (10µg), and amoxicillin (30µg). Antibiotic susceptibility analysis showed that 90% screened organisms were resistant to the tested antibiotics. The bacteria belonging to the Family *Enterobacteriaceae*; *E. coli* and *Enterobacter* were isolated from the hospital effluent samples collected from six different hospitals. The study showed a correlation between the antibiotics used in the hospitals and the emergence of antimicrobial resistance among the treated effluents. The results of the study indicate the need for strict control over use of antibiotic in the environment and to limit the rapid evolution and spread of antimicrobial resistance.

## DEVELOPMENT OF A 3 IN 1 REPORTER STRAIN ASSAY FOR *IN-VITRO* HIGH THROUGHPUT SCREENING OF NOVEL ANTIBIOTIC POTENTIATORS TO RE-SENSITIZE MDR PATHOGENS

Lekshmi N. \*, Bhabatosh Das

Translational Health Science and Technology Institute, Faridabad

\*lekshmin@thsti.res.in

Antimicrobial resistance in clinically important microbes is today a global challenge. The dwindling antibiotic discovery pipeline has necessitated discovery of alternatives to antibiotics. Antibiotic resistance reversal or antibiotic potentiation is the mechanism by which the effective action of the antibiotic is revived by the addition of natural or synthetic compounds that by itself do not have antimicrobial activity. Today, high throughput screening of such compounds/molecules for their potentiation activities are largely carried out by in-silico method which might not always be effective *in-vitro* and *in-vivo*. To overcome this limitation, a 3 in 1 reporter strain assay was developed for *in-vitro* high throughput screening of compounds to identify their antibiotic potentiation, synergistic or antimicrobial activity. The reporter strain library was constructed by cloning resistance genes with a constitutive promoter (htpG) and transferring it into *Vibrio cholerae* N16961, an isolate more than ten times sensitive to most of the antibiotics as compared to the canonical *Escherichia coli*. The recombinant vector introduced into N16961 strain was stably expressed as it integrates at specific 'dif' site into the bacterial genome preventing curing off of the resistance gene. The genetically engineered resistant reporter strains were used to screen Selleckchem natural compound library (n =803) and MedChemExpress FDA approved compound library (n =3614) to identify antibiotic potentiators. Twelve compounds (synergistic and potentiating) against  $\beta$ -lactam, eight compounds against aminoglycoside and forty-six compounds against chloramphenicol antibiotic with varying degree of activity (30-100%) were identified from the screening of the two compound libraries. The current study identified a novel prospective  $\beta$ -lactam potentiator, BLM (92F8) that showed 100% growth inhibition against the serine- $\beta$ -lactamases possessing clinical isolates including *Klebsiella pneumoniae*, *Escherichia coli*, *Salmonella* sp. and *Shigella boydii*. Thereby, combinatorial activity of the antibiotic and its potentiator found in this study provides new insight into therapeutic option of MDR clinical pathogens.

**ANTIMICROBIAL PROFILE OF THE MICRO EPIFLORA OF *HENIOCHUS*  
*DIPHREUTES* OF LAKSHADWEEP CORAL REEF**

**Shabeena K. S.<sup>1\*</sup>, Manjusha K.<sup>1</sup>, Idreesbabu K. K.<sup>2</sup>, Sureshkumar S.<sup>1</sup>**

<sup>1</sup>Kerala University of Fisheries and Ocean Studies, Cochin

<sup>2</sup>Department of Science and Technology, Kavaratti, UT of Lakshadweep

\*shabeenashabi1996@gmail.com

Lakshadweep is one of the least exploited areas worldwide, renowned for its unique atolls and remarkable aquatic life. Like every other place on Earth, the impact of anthropogenic activities is changing this ecosystem and it can be felt at the microbial level too. In this regard, the influence of antibiotics is an inevitable one. It is a proven fact that antibiotics are the most effective agents for the control of pathogens. However, bacteria are developing resistance to antibiotics due to sublethal levels of exposure. The current study investigates the antibiotic susceptibility profile of the ecto microflora of schooling bannerfish (*Heniochus diphreutes* Jordan, 1903) in an attempt to indirectly measure antibiotic exposure in these environments. Using the Kirby-Bauer disc diffusion method we assessed the antimicrobial resistance pattern of 47 strains of bacteria spanning 15 genera of which *Bacillus* was the predominant one followed by *Staphylococcus* and *Acinetobacter*. The multiple antibiotic resistance (MAR) index for 14 antibiotics was calculated. The results showed that only 12.7% of the total isolates were resistant to multiple antibiotics (MAR $\geq$  0.2). Strains identified as *Proteus mirabilis* and *Pseudomonas stutzeri* showed resistance to tetracyclines, glycopeptides, and macrolides. Though the majority of the isolates were susceptible to the antibiotics tested, the presence of resistant strains is indicative of a lingering threat in these pristine waters of the coral reef ecosystem and the immediate need to take preventive measures. It would be beneficial to expand studies to these areas to propose strategies for conserving such pristine and unique ecosystems.

**PLASMID-BORNE ANTIMICROBIAL RESISTANCE IN VIBRIOS AND OTHER BACTERIA ASSOCIATED WITH SHRIMP (*LITOPENAEUS VANNAMEI*) FARMS**

**Prabina Das<sup>1\*</sup>, Raja Swaminathan<sup>2</sup>, Sowmya P Mohandas<sup>2</sup>, Anjana J. C.<sup>1</sup>, Manjusha K.<sup>1</sup>, Preena P. G.<sup>1</sup>**

<sup>1</sup> Kerala University of Fisheries and Ocean Studies, Kochi

<sup>2</sup> ICAR-National Bureau of Fish Genetic Resources, CMFRI Campus, Kochi

\*prabinadas123@gmail.com

For the sustainable farming of disease-free and healthy shrimps, antimicrobial usage is frequent nowadays in the shrimp-cultured systems. This could lead to the emergence of serious antimicrobial resistance (AMR) in the whole ecosystem. Considering the severe impact of global AMR, the present study was focused to investigate the prevalence of antimicrobial resistant vibrios and other pathogens among the infected shrimps (*Litopenaeus vannamei*) from two brackish-water cultured farms of different geographic locations. The dendrogram generated 5 representative clusters for samples from farm 1 and 6 for those from farm 2 using NtSys software. Diverse species of vibrios viz. *V. alginolyticus*, *V. parahaemolyticus*, *V. cholerae*, *V. mimicus*, *V. fluvialis*, as well as other bacterial species such as *Aeromonas hydrophila*, *A. salmonicida* and *Shewanella algae* were recovered from the shrimps on TCBS medium. *V. alginolyticus* was found to be the most resistant isolate by showing MAR index of 0.60 followed by *V. mimicus* (0.54) and *V. parahaemolyticus* (0.42). Shannon wiener diversity index,  $H'$  (loge) was found to be 1.506 for the isolates from farm 1 and 1.69 for farm 2. Among the 35 antibiotics of 15 different classes tested, tetracyclines, beta lactams and cephalosporins were found as the most resistant antibiotic classes. All the isolates from both farms were found to be resistant to tetracycline and ampicillin and sensitive towards erythromycin, ciprofloxacin and cefazolin. Antimicrobial resistance shown by the studied isolates towards new generation cephalosporins is also challenging. An increased altered resistance phenotype and a drastic change in MAR index were noticed after plasmid curing. Since the studied samples are of significance in the food sector and plasmid-borne AMR is prevalent among them, public health is also alarming. This baseline information may help the authorities to curb antimicrobial use and pave the way for establishing new alternative strategies by undertaking a multidimensional "One-Health" approach.

**INCIDENCE AND MOLECULAR CHARACTERIZATION OF  
FLUOROQUINOLONE RESISTANCE IN ESBL-PRODUCING *ESCHERICHIA COLI*  
ISOLATES FROM DAIRY CATTLE WITH BOVINE MASTITIS**

Manisha Behera<sup>1,2\*</sup>, Mayank Roshan<sup>1</sup>, Chanchal Rana<sup>1</sup>, Devika Gautam<sup>1</sup>, Ashutosh Vats<sup>1</sup>,  
Shiveeli Rajput<sup>1</sup>, Soma M Ghorai<sup>2</sup>, Rakesh Kumar<sup>1</sup>, Sachinandan De<sup>1</sup>

<sup>1</sup>National Dairy Research Institute (NDRI), Haryana

<sup>2</sup>Hindu College, University of Delhi, Delhi

\* *beheramanisha16@gmail.com*

Antimicrobial resistance is a global threat to antibiotic treatment against bacterial infections like mastitis in cattle. Among wide range of organisms causing mastitis, *Escherichia coli* is one the most common pathogen. Global dissemination of multidrug-resistant (MDR) pathogenic *Escherichia coli* to humans, domestic animals, and wildlife is of significant concern. This study presents the molecular strategies identifying the distribution of AMR genes and their new variants in pathogenic *E. coli* causing bovine mastitis. A total of 110 *E. coli* were isolated from 325 bovine mastitis milk samples collected from different regions of Haryana. The isolates of *E. coli* were found phenotypically resistant to antibiotics cefotaxime, ciprofloxacin, imipenem, co-trimoxazole, and streptomycin. The ESBL-producing genes were identified in 100% of the *E. coli* isolates. The incidence of fluoroquinolones due to mutations in QRDRs and PMQR genes was detected in 95% and 13% of the isolates, respectively. The co-resistance of ESBL and fluoroquinolone was observed in 83% of the isolates. The mobile genetic elements identified in *E. coli* isolates include IS26, *intI1*, *IncFIA*, *IncFIB*, *IncFII*, and *IncI1*. The class 1 integron gene cassettes *dfrA7*, (*dfrA17* + *aadA5*) and (*dfrA1* + *aadA1*) were detected in *E. coli* isolates. The Single-Strand Conformational Polymorphism Gel Electrophoresis (SSCP) and sanger sequencing of the *aadA5* gene detected, one of the isolates with mutation E235G reported earlier only in a human clinical isolate from Belgium and the first time in the Indian subcontinent. The sequencing results of *aadA5* genes also detected 4 novel variants of the *aadA5* gene in different isolates. Different molecular strategies like PCR, SSCP, and sequencing are promising for the surveillance of multidrug resistance patterns and the spread of new variants among different microbiomes. The consequent implementation of prevention measures is needed to avoid further spread of multidrug-resistant bacteria and cross-contamination between human and animals.

## ANTIBIOTIC RESISTANCE AND PATHOGENIC GENES OF *ESCHERICHIA COLI* ISOLATES FROM DIARRHOEIC PIGLETS

Adwitiya Das<sup>\*1</sup>, Dilip Kumar Sarma<sup>2</sup>, Rajeev Kumar Sharma<sup>2</sup>

<sup>1</sup>Indian Veterinary Research Institute, Hebbal, Bengaluru

<sup>2</sup>College of Veterinary Science, Assam Agricultural University, Khanapara

\*Adi.adwitiya01@gmail.com

The gut commensal *Escherichia coli* is a leading cause of piglet diarrhea causing frequent death and increasing economic loss in piggery industry. However, rise in multidrug resistance in *E. coli* has further aggravated this problem. The goal of the study was to isolate pathogenic *E. coli* from rectal swabs of diarrheic piglets and examine them for antibiotic resistance and occurrence of pathogenic genes for Enterotoxigenic *E. coli*, Enteropathogenic *E. coli* and Shiga toxin-producing *E. coli*. Isolation and identification of *E. coli* was done using standard methods. The antibiotic sensitivity of the *E. coli* was carried out using disc diffusion technique and the pathogenic genes of the *E. coli* isolates were identified by multiplex polymerase chain reaction (mPCR). 92 (90.2%) out of 102 rectal swab samples from diarrhoeic piglets yielded *E. coli* from different sources with 41 (91.12%) out of 45 samples collected from ICAR-AICRP/MSP on Pig, College of Veterinary Science, Assam Agricultural University, Khanapara and 32 (88.89%) out of 36 samples collected from ICAR-National Research Centre on Pig, Rani, Guwahati, Assam and 19 (90.48 %) out of 21 samples collected from different unorganized farms had *E. coli*. All the 92 strains of *E. coli* were examined for the presence of *stx1*, *est1*, *elt1* and *eaeA* gene using standard primers and the study revealed that 25 isolates were positive for *stx1* gene (27.17%), 18 for *est1* gene (19.56%), 6 for *elt1* gene (6.52%), 3 for presence of both genes *est1* and *elt1* (3.26%) and 12 for *eaeA* gene (13.04%). Determination of antibiotic sensitivity on 92 isolates showed that the highest percentage (71.74%) of the *E. coli* isolates were resistant to tetracycline and least percentage of the *E. coli* isolates (4.34%) were resistant to imipenem.

## OCCURRENCE OF DISINFECTANT-RESISTANT BACTERIA IN A FISH PROCESSING PLANT

Aiswarya K. P.<sup>\*</sup>, Safeena M. P., Preenanka R.

Kerala University of Fisheries and Ocean Studies, Kochi

<sup>\*</sup>*aiswaryaaishukp@gmail.com*

Chemical disinfectants are commonly used in the seafood processing industry to control spoilage and pathogenic microflora that develop on food surfaces and in processing environments. Overuse and abuse of disinfectants due to a lack of scientific management and proper planning will result in the emergence of disinfectant resistance among bacteria. In the current study, 18 sodium hypochlorite disinfectant resistant bacteria were isolated from 15 samples collected over a three-month period from a seafood processing plant in Kerala's Alappuzha District. The 18 isolates were subjected to a series of biochemical tests to identify disinfectant resistant bacteria at the generic level. Four isolates were confirmed as *Staphylococcus hominis* by 16SrDNA PCR and sequencing, two isolates as *Micrococcus yunnanesis*, two isolates as *Bacillus velezensis*, two isolates as *Cytobacillus firmus*, and one isolate as *Exiguobacterium aurantiacum*, and two isolates as *Mesobacillus thioparans*. Three isolates were identified as *Micrococcus luteus*. The disinfectant susceptibility test against Sodium hypochlorite solution by agar well diffusion method at concentrations ranging from 1 to 4% revealed that all 18 isolates were resistant at 1% disinfectant concentration and sensitive at 3 and 4%, while 10 isolates were resistant to NaClO at 2% concentration. *Mesobacillus thioparans* had the highest MIC value of 2.5%. This study provides an insight new light on disinfectant-resistant bacteria found in seafood processing plants and highlights its importance in terms of foodborne pathogen contamination.

## ANTIBIOTIC RESISTANCE PROFILE OF *CAMPYLOBACTER JEJUNI* ISOLATED FROM RETAIL CHICKEN IN KERALA

**Binsy Mathew<sup>\*</sup>, Latha C., Sunil B., Sethulekshmi C.**

Kerala Veterinary and Animal Sciences University, Mannuthy

*\*binsymathew@kvasu.ac.in*

Campylobacteriosis is a predominant cause of foodborne infection throughout worldwide. It is a potential agent responsible for several undiagnosed cases of diarrhoea in developing countries including India. As the natural reservoirs of *Campylobacter* spp. are intestinal tracts of domesticated and wild birds and mammals, eating or handling raw or undercooked meat, especially poultry, is considered to be major risk factors for human campylobacteriosis. The drugs of choice used in the clinical therapy of campylobacteriosis are macrolides and fluoroquinolones. Six hundred retail chicken samples were collected from across the state of Kerala and were subjected to the isolation of *Campylobacter* spp. The isolates were then subjected to the molecular confirmation of *C. jejuni* by targeting the *mapA* gene. All the confirmed isolates were subjected to the study the antibiotic resistance profile against ampicillin, cefotaxime, chloramphenicol, ciprofloxacin, erythromycin, nalidixic acid, streptomycin, tetracycline, trimethoprim and trimethoprim/suphamethoxazole by disc diffusion assay followed by molecular confirmation of drug resistance genes using uniplex, duplex and mismatch amplification mutation assay PCRs. The overall prevalence of *C. jejuni* was 12.8 percent. The MAR index ranged from 0 to 0.5 and multiple drug resistance was detected in 23.94 percent of the isolates. Seventeen different patterns of resistance were noted among the isolates. The isolates showed resistance to ciprofloxacin, erythromycin, nalidixic acid, tetracycline and trimethoprim. Molecular confirmation of the following antimicrobial resistance (AMR) genes were detected *viz.*, *tetA* (80.43%) and *tetB* (8.70%), *dfrA1* (60%), point mutation in *gyrA* (36%) and *parC* gene (24%), and *ermB* (63.64%) genes. The detection of resistance to several antibiotics critical in human medicine is a real public health issue which needs to be addressed.

## ANTIBIOTIC SUSCEPTIBILITY OF *LISTERIA MONOCYTOGENES* ISOLATED FROM THE ICE AND SEAFOOD OF VERAVAL COAST

Anupama T. K.<sup>1\*</sup>, Parmanand Prabhakar<sup>2</sup>, Ashish Kumar Jha<sup>3</sup>, Renuka V.<sup>1</sup> Toms C. Joseph<sup>1</sup>

<sup>1</sup>ICAR-Central Institute of Fisheries Technology, Cochin

<sup>2</sup>College of Fisheries, Kishanganj, Bihar

<sup>3</sup>ICAR-Central Institute of Fisheries Technology, Veraval Research Centre, Veraval

\*anupamatk.tk@gmail.com

*Listeria monocytogenes* is an important foodborne pathogen, that can cause life-threatening listeriosis, a lethal disease in humans. The present study was conducted to assess the antibiotic resistance pattern and index of multiple antibiotic resistance (MAR) of *L. monocytogenes* in ice and seafood of Veraval. A total of 120 samples, including 80 ice, 20 each of water and fish, were collected from the landing centres, ice plants and fish hold of fishing boats. *Listeria* spp. and *Listeria monocytogenes* were present in fish and ice at an incidence level of 3.3% and 2.5%, respectively. All the *L. monocytogenes* isolates carried virulence genes such as (*hlyA*), internalin (*inlA*, *inlC*, *inlJ*), phosphatidylinositol phospholipase C (*plcA*), and virulence regulator (*prfA*) and belonged to 1/2a, 3a serogroups. Antimicrobial susceptibility testing was performed against 25 antimicrobials of clinical significance. The antimicrobial resistance rate was 100% (n = 5) against penicillin, oxacillin, cephalothin and cefotaxime, 60% (n=3) against erythromycin, 40% (n=2) ampicillin and 20% (n=1) to linezolid, chloramphenicol, tetracycline, gentamicin, rifampicin, clindamycin and vancomycin. All strains showed resistance to multiple antibiotics (>3) also. Furthermore, the MAR index ranged from 0.2 to 0.4. Therefore, the presence of antimicrobial resistant *L. monocytogenes* strains in seafoods can be considered as a potential threat and effective control strategies should be taken to reduce the risk posed by this ubiquitous pathogen.

**PREVALENCE OF EXTENDED SPECTRUM BETA-LACTAMASE RESISTANCE (ESBL) AND *bla*<sub>CTX-M-1</sub> GENE IN *ESCHERICHIA COLI* FROM THE WATER AND SEDIMENT OF URBANIZED MANGROVE ECOSYSTEMS OF KERALA**

**Gopika Sivan<sup>\*</sup>, Mohamed Hatha A. A.**

Cochin University of Science and Technology, Cochin

*\*mohamedhatha@gmail.com*

The aim of the study was to determine the prevalence of extended spectrum beta-lactamase resistance and *bla*<sub>CTX-M-1</sub> gene in *Escherichia coli* from the water and sediment of three urbanized mangrove ecosystems of Kerala. A total of 119 *E. coli* isolates were screened for susceptibility to 16 antibiotics. Phylogenetic analysis of *E. coli* isolates revealed that non-pathogenic phylotype A and pathogenic phylotype D (29.41% and 23.52% respectively) were the predominant phylotypes found in water samples. However, non-pathogenic phylotypes A and B1 (27.94% and 26.47% respectively) were the predominant phylotypes in sediment samples. All the *E. coli* strains were resistant to cefotaxime and colistin (100%). Significant difference in the prevalence of *bla*<sub>CTX-M-1</sub> was observed among *E. coli* isolates in water samples ( $p < 0.05$ ). The results indicate a high prevalence of beta-lactamase harbouring *E. coli* in the mangrove ecosystems which can hamper mangrove-dependant aquaculture practices and human health.

**OCCURRENCE OF EXTENDED SPECTRUM BETA-LACTAMASE RESISTANCE (ESBL) AND THE *bla*<sub>CTX-M-1</sub> GENE IN *VIBRIO SPP.* ISOLATED FROM THE WATER AND SEDIMENT OF SELECTED MANGROVE ECOSYSTEMS IN KERALA**

**Hridya, V. K., Gopika Sivan, Reshma Silvester<sup>\*</sup>, Mohamed Hatha A. A.**

Cochin University of Science and Technology, Cochin

*\*sanasilvester@gmail.com*

Multidrug resistant pathogenic vibrios are of great concern as they cause several diseases in humans and in aquaculture systems. In the present study, we investigated the prevalence of ESBL gene *bla*<sub>CTX-M-1</sub> in *Vibrio spp.* from the water and sediment of three mangrove ecosystems of Kerala. A total of 120 isolates of *Vibrio spp.* were tested for antibiotic susceptibility to 14 antibiotics. Results revealed that *Vibrio spp.* with multi-drug resistance were prevalent in all the three mangrove stations. Resistance to ampicillin (94.1% and 89.1% among *V. cholerae* and *V. parahaemolyticus* respectively) and piperacillin (70.5% and 84.7% among *V. cholerae* and *V. parahaemolyticus* respectively) was very high among *V. cholerae* strains (n=17) and *V. parahaemolyticus* (n=46) from the water samples. Though the isolation of *V. cholerae* (n=4) from sediment was low, all of them were resistant to ampicillin. *bla*<sub>CTX-M-1</sub> gene was detected in 26.9% of *V. parahaemolyticus* (n=46) and 14.2% of *V. cholerae* isolates (n=17). There was significant difference in the prevalence of *bla*<sub>CTX-M-1</sub> gene among *V. cholerae* and *V. parahaemolyticus* from the water and sediment samples (p<0.05). The findings revealed the presence of multi-drug resistant *Vibrio spp.* in mangrove ecosystems, could be a result of human activities and antibiotic residues from the aquaculture farms into these mangrove ecosystems.

**ANTIBIOTIC SUSCEPTIBILITY PATTERNS OF NON-TYPHOIDAL *SALMONELLA* *ENTERICA* (NTS) ISOLATED FROM FRESH SEAFOOD IN MUMBAI**

**Parmanand Prabhakar<sup>1\*</sup>, Manjusha Lekshmi<sup>2</sup>, Toms C. Joseph<sup>3</sup>, Binaya Bhusan Nayak<sup>2</sup>,  
Sanath H. Kumar<sup>2</sup>**

<sup>1</sup>College of Fisheries, Kishanganj, Bihar

<sup>2</sup>ICAR-Central Institute of Fisheries Education, Mumbai

<sup>3</sup>ICAR- Central Institute of Fisheries Technology, Kochi

\*parmanand1986@yahoo.com

Non-Typhoidal *Salmonella enterica* (NTS) is a major cause of food-borne enteric infections worldwide involving various food types including fish and shellfish. The recent trends of increasing antimicrobial resistance (AMR) in NTS have confounded the problem of treating NTS-associated food-borne infections and also raised concerns about foods such as fish and shellfish, which are not natural hosts of NTS, acting as vehicles of *Salmonella* transmission. In this study, 94 NTS isolated from fresh seafood were screened for their antimicrobial susceptibility patterns. The isolates exhibited 15 different antibiotic susceptibility profiles. All (100%) the isolates were susceptible to ceftazidime, chloramphenicol, ertapenem, meropenem and aztreonam, while more than 90% of the isolates were susceptible to ampicillin, cefoxitin, cefpodoxime, ceftazidime, ceftriaxone, cefuroxime, co-trimoxazole and chloramphenicol. Among resistant isolates, 11.7% were resistant to cefotaxime, followed by 10.63% to piperacilin/tazobactam, 7.45% each to nalidixic acid and co-trimoxazole, 5.32% to ciprofloxacin, 4.2% each to cefpodoxime and tetracycline, 2.2% to cefuroxime. One isolate each (1.1%) was resistant to ampicillin, cefoxitin, ceftriaxone and imipenem. Further, 12.76% of the isolates were multidrug resistant, showing resistance to two to five antimicrobial agents. Two isolates had a maximum MAR (multiple antibiotic resistance) indexes of 0.30 with a resistance profile of CPD-CIP-NA-TE-CTR and CPD-CIP-NA-TE-CT. The multiple antimicrobial susceptibility profiles of NTS from seafood suggest that the isolates have originated from several different sources or host types. The study emphasizes the need to continuously monitor the AMR patterns of NTS in seafood to track and contain the possible emergence and spread of MDR strains through seafood.

## OCCURRENCE OF MDR FAECAL INDICATOR BACTERIA IN SHELLFISH HARVESTED FROM COCHIN ESTUARY WITH SPECIAL REFERENCE TO CARBAPENEM, COLISTIN, VANCOMYCIN AND TEICOPLANIN RESISTANCE

Ally C. Antony<sup>1,2\*</sup>, Reshma Silvester<sup>2</sup>, Aneesa P. A.<sup>3</sup>, Mini K. Paul<sup>1</sup>, Mohamed Hatha A. A.<sup>2</sup>

<sup>1</sup>MES College, Marampally, Aluva

<sup>2</sup>Cochin University of Science and Technology, Cochin

<sup>3</sup>Sree Sankara College, Kalady

\*allyjoemon@gmail.com

Antibiotic resistance among microorganisms is one of the most serious problems encountered during disease management. The prevalence of antibiotic resistance and antibiotic resistance genes in two important faecal indicator bacteria - *E. coli* and enterococci isolated from shellfish harvested from Cochin estuary was assessed. Antibiotic sensitivity of 50 *E. coli* strains towards colistin as well as carbapenem antibiotics, imipenem and meropenem was tested by agar disc diffusion method. PCR based detection of plasmid encoded colistin resistance gene, *mcr-1* as well as extended spectrum beta lactamase genes (*bla*<sub>TEM</sub> and *bla*<sub>CTX-M</sub>) were undertaken. Antibiotic sensitivity of 30 enterococci strains towards vancomycin and teicoplanin were tested. The enterococci were also screened for presence of vancomycin resistance genes *vanA*, *vanB* and *vanC* by multiplex PCR. Approximately 90%, 92% and 22% *E. coli* strains exhibited resistance against colistin, imipenem and meropenem respectively. *Mcr-1* gene could be detected in 4 strains (6%). Plasmid curing experiment revealed that the *mcr-1* gene detected was plasmid encoded. Co-resistance to the carbapenem antibiotics was exhibited by the *mcr-1* positive strains. *Bla*<sub>CTX-M</sub> gene and *Bla*<sub>TEM</sub> genes were detected in 26.4% and 21.6% of the *E. coli* strains respectively. Co-occurrence of *Bla*<sub>CTX-M</sub> gene and *Bla*<sub>TEM</sub> genes were exhibited by 21.6% strains. Approximately 73.9% and 56.5% enterococci strains showed resistance towards vancomycin and teicoplanin respectively. *VanB* gene was detected in one *E. faecium* strain isolated from shellfish. Contamination of foods with antibiotic resistant bacteria could be a significant threat to public health, as it may result in its entry into food chain. *E. coli* as well as enterococci are ideal candidate vehicles for horizontal transmission of antibiotic resistance to other commensal bacteria or potential human pathogens as they constitute common flora of the gastrointestinal tracts and survives well in other environments also. Present study reveals the probable health hazards associated with consumption of shellfish harvested from this estuary.

## ANTIMICROBIAL RESISTANCE PATTERN OF *VIBRIO PARAHAEMOLYTICUS* IN COMMERCIAL BIVALVES ALONG THE WEST COAST OF INDIA

Remya B. \*, Krupesha Sharma S. R., Reynold Peter, Sumithra T. G.

ICAR-Central Marine Fisheries Research Institute, Kochi

\*remyabhaskaran1@gmail.com

*Vibrio parahaemolyticus* are naturally occurring marine bacteria of public health significance. Bivalves are filter feeders and can serve as a repository for a diverse microbial community. Antimicrobial-resistant infections have become more challenging to treat with available antibiotic drugs, resulting in infections with higher morbidity and mortality, imposing enormous costs on our society. Due to the increased cost and duration of treatment consequent to treatment failures, AMR is now recognized as a significant public health concern. In comparison to the monsoon season, the study found that the post-monsoon season had the highest levels of bacterial abundance in mussels and oysters. In terms of antimicrobial resistance, 87% of *V. parahaemolyticus* isolates tested positive for at least one antibiotic. The most resistance was observed against ampicillin (78 %). Chloramphenicol was effective against all the isolates. The multiple antimicrobial-resistant isolates and isolates that are resistant to ampicillin were identified and subjected to plasmid profiling and curing. After curing, 44% of the isolates were sensitive to ampicillin and 11% showed intermediate resistance. The study discovered that resistance to cephalosporins (cefotaxime and ceftazidime) changed after curing, indicating that the resistance gene may be plasmidal. The current study identified that the Ampicillin resistance genes are plasmidal in some strains and chromosomal in others.

**OCCURRENCE OF METHICILLIN RESISTANT COAGULASE-POSITIVE AND NEGATIVE *STAPHYLOCOCCUS AUREUS* IN FISH SOLD IN ONLINE RETAIL MARKETS IN COCHIN**

**Ezhil Nilavan S.\*, Murugadas V., Visnuvinayagam S., Muthulakshmi T., Minimol V. A.,  
Toms C. Joseph**

ICAR-Central Institute of Fisheries Technology, Cochin

\* *theezhilnilavan@gmail.com*

Every year the number of infections caused by multidrug-resistant bacteria is increasing worldwide. Among several pathogens, *Staphylococcus aureus* is responsible for serious multi-drug resistant infections in human beings and animals. Seafood handled in unhygienic conditions may harbor these pathogenic bacteria that can be transmitted to human beings through ingestion or contact with contaminated seafood. The occurrence of *Staphylococcus aureus* on seafood is a sign of either post-harvest contamination brought by unhygienic practices. The study was carried out to isolate and identify *S. aureus* from 94 fish samples from online fish markets in Cochin, Kerala, India. The antibiotic sensitivity pattern of the isolated bacteria against nine available antibiotics was carried out using the Kirby-Bauer disk diffusion method and interpreted as per CLSI, 2022 (M100). A total of 37 *Staphylococci* isolates were confirmed from 18 (20%) seafood samples, while 15 (16%) samples harbored coagulase-positive *S. aureus*. The presence of *mecA* gene was confirmed by PCR in 5 isolates of coagulase-negative *S. aureus* (MR-CoNS) and 2 coagulase-positive *S. aureus* (MRSA). Resistance to at least one antibiotic was observed among 74% of the *S. aureus* isolates. The increasing order of antibiotic resistance was cotrimoxazole (3.1%), gentamicin (3.7%), chloramphenicol (7%), linezolid (7.4%), ciprofloxacin (14%), tetracycline (22%), erythromycin (40%) penicillin (44%), ceftiofur (51%) and 18% of the total isolates were multi-drug resistant. The study reveals that multi-drug resistant *S. aureus* and MRSA have entered the seafood production and distribution chain is a case of concern. The study also underpins the remedial measures to be in place to control MRSA in the seafood production chain.

## DOES CEFOTAXIME RESISTANCE IN *E. COLI* FROM ONLINE SEAFOOD MARKETS INDICATE THE PRESENCE OF ESBL?

Muthulakshmi T. \*, Parvathi S., Ezhil Nilavan S., Sivaraman G. K., Toms C. Joseph  
ICAR-Central Institute of Fisheries Technology, Cochin  
\* [muthuocean@gmail.com](mailto:muthuocean@gmail.com)

Ninety-four seafood samples purchased from online markets were screened for the presence of *E. coli* by MPN method. The *E. coli* strains were screened for the cefotaxime resistance by incorporating 1 microgram per ml cefotaxime in the culture media. *E. coli* was present in 67% of the samples with MPN ranging from 3-1100 per gram. The cefotaxime resistant *E. coli* was present in 24 % of the samples. The strains resistant to cefotaxime were further tested against 17 antibiotics. *E. coli* strains were resistant to augmentin (98%), cefpodoxime (88%), ceftazidime (60%) and aztreonam (58%). The resistant isolates were further screened for the presence of ESBL genes (*bla<sub>ctxm 1</sub>*, *ctxm2*, *ctxm9*, *TEM*, *SHV*, *OXA*). The ESBL genes were present 16% of the strains. This study provides the resistance trends of indicator organism (*E. coli*) in online fish samples from Cochin, India. The findings reinforce the need of regulatory guidelines for online seafood markets to protect the health of consumers.

## PRECISE QUANTIFICATION OF BIOFILM BY ABSORPTION MAXIMA OF CRYSTAL VIOLET

Teena George<sup>1,2</sup>\*, Visnuvinayagam S.<sup>1</sup>, Murugadas V.<sup>1</sup>, Anandan R.<sup>1</sup>, Pavan Kumar D.<sup>1</sup>,  
Sivaraman G. K.<sup>1</sup>, Toms C. Joseph<sup>1</sup>

<sup>1</sup>ICAR-Central institute of fisheries Technology, Cochin

<sup>2</sup>Cochin University of Science and Technology, Cochin

\*12teenageorge34@gmail.com

Crystal violet (CV) is most frequently used for quantifying biofilm based on its optical density (OD). But, different OD set values (570 and 585nm) were employed by various researchers to quantify the biofilm. The variation in the biofilm level was observed due to different set values. So, the present research was conducted to resolve ambiguity on the UV-Spectrophotometer OD set value for the crystal violet-stained biofilm resolubilized with 33% acetic acid. A total of 114 *E. coli* bio-films were produced in the microtiter plates (in triplicates) and were stained with 0.1% crystal violet (in distilled water) for quantification. After washing and drying, these stained biofilms were resolubilized with 33% acetic acid, and the OD was measured at 570 and 585nm. Based on the findings, a significant difference between 570 and 585nm has been found, particularly in categorizing weak and moderate biofilm producers. The UV spectrophotometer's limited filter availability in the old-model instruments is the cause of the difference in the OD set value. Even though the absorbance maxima ( $\lambda_{max}$ ) of the crystal violet is 585nm, the old instrument may not have the filter to check the OD at 585nm. Therefore, the researchers might have picked a wavelength close to 585 nm, *i.e.*, 570. Ironically, most modern devices have monochromatic UV-spectrophotometer, capable of detecting all wavelengths from 200 to 800 nm, including 585 nm. However, most researchers continue to adhere to the 570nm standard set forth in earlier published work. Based on the study, it has been concluded that 585nm is appropriate for determining OD for biofilm detection.

## ANTIBIOTIC RESISTANCE PROFILING OF *VIBRIO PARAHAEMOLYTICUS* ISOLATED FROM FISH AND FISHERY PRODUCTS IN MUMBAI REGION

Abhay Kumar\*<sup>1</sup>, Murugadas V.<sup>2</sup>, Toms C. Joseph<sup>2</sup>, Ezhil Nilavan<sup>2</sup> and Asha K. K.<sup>1</sup>

<sup>1</sup> ICAR- Central Institute of Fisheries Technology, Mumbai Research Centre, Mumbai

<sup>2</sup> ICAR-Central Institute of Fisheries Technology, Cochin

\*kumarabhay275@gmail.com

*Vibrio parahaemolyticus* is a Gram-negative halophilic bacterium found in estuarine, marine and coastal environments. *V. parahaemolyticus* is the leading causal agent of acute gastroenteritis following consumption of raw, undercooked, or mishandled marine fishery products. The present study was aimed at determining the prevalence of *V. parahaemolyticus* in fish and fishery products and characterized its antibiotic resistance pattern. A total of 154 fresh seafood samples, including finfish, shellfish and molluscs from retail markets and supermarkets from Vashi, Bhansali, Airoli, and Thane, were screened for *V. parahaemolyticus*. The prevalence of *V. parahaemolyticus* was 7.14%, and eleven isolates were confirmed biochemically for Gram staining, oxidase, catalase, sugar fermentation (mannitol, glucosamine), Indole, VP test, ONPG and amino acid utilization (Arginine, Lysine and Ornithine), and salt tolerance for the presence of *V. parahaemolyticus*. The isolates were molecularly confirmed by PCR targeting *V. parahaemolyticus* gene (*toxR*), producing an amplicon size of 368bp. The disk diffusion assay performed for the 11 potentially pathogenic *V. parahaemolyticus* isolates from seafood revealed that all the isolates were sensitive to ceftazidime, chloramphenicol, ciprofloxacin, gentamicin, tetracycline and trimethoprim/sulfamethoxazole. The increasing order of antimicrobial resistance observed in the study were amoxicillin (9%), cefotaxime and cefoxitin (18.1% each), ampicillin (26.2%), and cefepime (36.3%). Multidrug resistance was observed in 18.1% of the isolates. The presence of cefotaxime resistance is a matter of concern in the *V. parahaemolyticus* isolated from the retail fish markets of the Mumbai region.

**CHARACTERIZATION OF SPECIFIC SPOILAGE BACTERIA FROM INDIAN MACKEREL(*RASTRELLIGER KANAGURTA*) FOR ANTIMICROBIAL RESISTANCE**

**Ammu Lakshmi D.<sup>1\*</sup>, Murugadas Vaiyapuri<sup>1</sup>, Visnuvinayagam Sivam<sup>1</sup>, Sreejith V. N.<sup>1</sup>,  
Rekha M.<sup>1</sup>, Reshmi K.<sup>1</sup>, Madhusudana Rao B.<sup>2</sup>, Toms C. Joseph<sup>1</sup>**

<sup>1</sup>ICAR-Central Institute of Fisheries Technology, Cochin

<sup>2</sup>ICAR-Central Institute of Fisheries Technology, Visakhapatnam Research Centre,  
Visakhapatnam

\*ammulekshmi13@gmail.com

Indian mackerel (*Rastrelliger kanagurta*) is one of the major fishery resource of our nation. Specific Spoilage Organisms (SSO) such as *Shewanella* sp. and *Aeromonas* sp. play a key role in causing its spoilage. There is a scarcity of information on the host characterization of SSOs for their antimicrobial resistance (AMR) and the implementation of molecular typing tools on host characterization on Indian Mackerel. In the present study, 39 presumptive SSOs, which consisted of 24 *Shewanella* sp. and 15 *Aeromonas* sp. isolated from Indian mackerel and confirmed by 16S rRNA sequencing were taken for antibiotic susceptibility testing by disk diffusion assay and molecular typing by ERIC PCR for host characterization. The DDA was carried out for ten antibiotics, and MIC using E-strip was carried out for Colistin. The study revealed that all the *Shewanella* sp. and *Aeromonas* sp. isolates were susceptible to gentamycin, chloramphenicol, tetracycline, co-trimoxazole and ciprofloxacin except one *Aeromonas* sp. *Aeromonas* sp. (n=2) showed resistance to piperacillin-tazobactam and one isolate of *Shewanella* sp. was resistant to ceftazidime. *Shewanella* sp. (n=2) and *Aeromonas* sp. (n=1) were resistant to cefepime. *Shewanella* sp. (n=9) and *Aeromonas* sp. (n=1) were resistant to Colistin. The study also revealed that isolated SSO hosts belonging to *Shewanella baltica* (n=18), *Shewanella putrefaciens* (n=5), *Aeromonas hydrophila* (n=2), *Aeromonas veronii* (n=3), *Aeromonas salmonicida* (n=4), *A. molluscorum* (n=3) and other isolates were different from each other at least at the level of 15% by ERIC-PCR analysis. The study emphasizes that the determination of carbapenem resistances in the SSOs has to be further confirmed.

## ANTIBIOGRAM OF COMMUNITY-ASSOCIATED METHICILLIN RESISTANT *STAPHYLOCOCCUS AUREUS* (CA-MRSA) OF AQUACULTURE ORIGIN

Muneeb Hamza<sup>1,2\*</sup>, Gopalan Krishnan Sivaraman<sup>1</sup>, Mukteswar Prasad Mothadaka<sup>1</sup>

<sup>1</sup>ICAR-Central Institute of Fisheries Technology, Cochin

<sup>2</sup>Cochin University of Science and Technology, Cochin

\*muneebhamzakh@gmail.com

The economic contribution of aquaculture to India's GDP cannot be overstated. The rising trend of antimicrobial resistance (AMR), on the other hand, poses a significant threat to the aquaculture sector. Considering this, the main goal of the present study includes addressing the phenotypic and genetic patterns of resistance among methicillin-resistant staphylococci (MRS) from aquaculture environs. To understand the AMR burden in aquaculture settings, farm-cultured fish samples (n=179) were collected from different fish farms of Thrissur and Ernakulam districts. The samples yielded 45 MRS isolates, and therefore the MRS carriage rate in aquaculture was determined as 25.14% (45/179). Bacterial identification and antimicrobial susceptibility tests (ABST), determined by employing the BD Phoenix M50 automated system revealed that 17 isolates (37.78%) were *Staphylococcus aureus*, 4 (8.89%) were *S. epidermidis*, 4 (8.89%) were *S. haemolyticus*, 4 (8.89%), and remaining isolates were *S. lentus*, *S. pasteurii*, and *S. warneri*. According to their resistance patterns, all the isolates (100%) were resistant to ampicillin, cefazolin, ceftiofur, oxacillin and penicillin. A few isolates (6/45, 13.33%) exhibited resistance to clindamycin, whereas 4 isolates (8.89%) exhibited intermediate-resistance to clindamycin. Resistance to erythromycin, gentamicin, moxifloxacin, norfloxacin and tetracycline was recorded in 28 (62.22%), 15 (33.33%), 19 (42.22%), 20 (44.44%), and 10 (22.22%), respectively. More importantly, linezolid and vancomycin ("last resort" antibiotics) resistance was recorded in 2 (4.44%) and 1 (2.22%) isolates, respectively. Moreover, linezolid-resistant isolates were further resistant to rifampicin and teicoplanin. Unusually, this study documented the incidence of isolates (3/45, 6.66%) with "diminished susceptibility" to daptomycin. The *ermA/ermC*, *aacA-aphD*, *tetK/tetM*, *mecA* were identified as the genes responsible for conferring the resistance to erythromycin, gentamicin, tetracycline, and oxacillin, respectively. The SCC*mec* typing of the isolates identified type V as the predominant one. In short, this type of study can assist to understand the current status of AMR burden in aquaculture.

## INCIDENCE OF ESBL-PRODUCING *ENTEROBACTERIACEAE* AND METHICILLIN-RESISTANT STAPHYLOCOCCI IN SHRIMP AQUACULTURE SETTINGS OF KERALA

Vineeth Rajan<sup>1\*</sup>, Ardhra Vijayan<sup>1</sup>, Gopalan Krishnan Sivaraman<sup>1</sup>, Ravikrishnan Elangovan<sup>2</sup>, Alison Prendiville<sup>3</sup>, Till T. Bachmann<sup>4</sup>

<sup>1</sup>ICAR-Central Institute of Fisheries Technology, Cochin

<sup>2</sup>Indian Institute of Technology Delhi, New Delhi

<sup>3</sup>University of the Arts London, UK

<sup>4</sup>University of Edinburgh, UK

\*vineethr87@gmail.com

With the rampant usage of antibiotics, aquaculture is turning as a major gateway for the emergence and spread of antibiotic resistance genes (ARGs). In the present study, we characterized a collection of extended-spectrum beta-lactamase (ESBL) producing *Escherichia coli* (n=32) and *Klebsiella pneumoniae* (n=15), and methicillin-resistant staphylococci (n=47) isolated from samples (n=261) of shrimp, water and sediment from aquaculture farms (n=37) in Kerala. Identification and susceptibility testing of the isolates were performed using BD Phoenix<sup>TM</sup> M50 automated system. All ESBL-positive isolates were cefotaxime-resistant with MIC  $\geq 32$   $\mu\text{g/ml}$ . Among them, 9 (28.1%) *E. coli* and 13 (86.7%) *K. pneumoniae* showed simultaneous resistance to tetracycline, ciprofloxacin and trimethoprim-sulfamethoxazole. The major ESBL determinant among the isolates was *bla*<sub>CTX-M</sub> and the predominant plasmid types were IncF and IncHI. The major phylogenetic groups in *E. coli* were identified as B1, B2, C, D and E. Also, the isolates harbored resistance genes such as *tetA* and *tetB* (tetracycline); *sul1* and *sul2* (trimethoprim-sulfamethoxazole); *qnrB*, *qnrS*, *qepA*, *oqxB* and *aac(6')-Ib-cr* (fluoroquinolones); and *strA*, *strB* and *aadA1* (aminoglycosides). Epidemiological typing by pulsed-field gel electrophoresis revealed that *E. coli* isolates were genetically unrelated, whereas isolates of *K. pneumoniae* showed considerable relatedness. Concerning the staphylococcal isolates, multi-drug resistance was evident in the majority of isolates, with resistance observed mainly towards oxacillin (100%), erythromycin (78.7%), norfloxacin & trimethoprim-sulfamethoxazole (53.2%) and gentamicin (34%). Major ARGs identified included *mecA*, *ermC*, *aacA-aphD*, *tetK* and *tetM*. Comprehensive genotyping of MRSA isolates revealed the high prevalence of ST772-t345-SCC*mec* V, a community-associated epidemic clone. The isolates also carried many toxin (*pvl*, *sea*, *seg*, and *sei*) and biofilm-associated (*ica*, *sdr*, *fib*, *fnbpA*, *clfB* and *eno*) genes. In short, our data indicates that aquaculture settings can be reservoirs of AMR pathogens, and owing to the long and complex supply chain of shrimps, such strains can disseminate easily to other settings.

## GENOMIC FEATURES OF METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* (MRSA) ISOLATED FROM RETAIL FISH MARKETS OF ASSAM, INDIA

Muneeb Hamza<sup>1\*</sup>, Sudha S.<sup>1</sup>, Sivaraman G. K.<sup>1</sup>, Bibek Shome<sup>2</sup>, Raisen C. L.<sup>3</sup>, Mark A. Holmes<sup>3</sup>

<sup>1</sup>ICAR-Central Institute of Fisheries Technology, Cochin

<sup>2</sup>ICAR-National Institute of Veterinary Epidemiology and Disease Informatics, Bangalore

<sup>3</sup>University of Cambridge, Cambridge, United Kingdom

\*muneebhamzakh@gmail.com

The molecular characteristics of MRSA in the fishery environment are poorly understood. In this study, 94 fish samples collected from three predefined sites viz., Garchuk, Silagrang, and North Guwahati, of Assam yielded 33 staphylococcal species. Of 33 isolates, three were identified as *Staphylococcus aureus* by the automated BD Phoenix M50 system with one isolate resistant to methicillin (MRSA). Phenotypically, the resistance profile of MRSA was determined as AMP-CFZ-CLI-ERY-NOR-OXA-PEN by antibiotic susceptibility test. Whole genome sequencing of the MRSA was performed at MicrobesNG, Birmingham, United Kingdom. Genome assembly and annotation were performed by SPAdes v 1.13.4, and RAST tool kit (RASTtk), respectively. Genetic basis of resistance and virulence were identified by the downstream analysis available at Centre for genomic epidemiology (CGE) server. The present study is more likely to be first Indian report that documented the incidence of ST672-MRSA-IV/t1309 from the fishery environment. The isolate's resistome was consistent with its phenotypic resistance pattern. Fluoroquinolone resistance was mediated by antibiotic efflux genes and antibiotic target mutations, whereas methicillin resistance was conferred by the *mecA* gene. Furthermore, this study documents the MRSA carrying type IVa staphylococcal cassette chromosome *mec* (SCC*mec*) elements. According to the prior studies, type IV SCC*mec* elements are associated with an MRSA lineage called as community-associated MRSA (CA-MRSA). Type IV SCC*mec* elements are smaller in size than other types, enabling for the easy and rapid transfer of methicillin resistance determinants between staphylococcal species. Epidemiologically, MRSA of this study belonged to the sequence type (ST) 672 with a spa type of t1309, which is dubbed as emerging Indian disease clone. In short, our findings highlighted that the presence of ST672-MRSA in fishery environments may pose a risk to human health.

## CITRUS BIOFLAVONOIDS – POTENT ANTIMICROBIAL STERILANTS

**R. N. Naidu**

GermKill India, No.50, 11th Cross, Gangamma Layout, Ashoknagar,  
B S K 1<sup>st</sup> Stage, Bangalore  
*germkillindia@gmail.com*

There is an urgent need to develop new antimicrobials due to AMR. In the present situation, the clinical pipeline of new antimicrobials is dry. There is no availability of proven safe and effective chemical antimicrobials suitable for prevention & control of air and surface infections in ICU and O.T in the presence of patients and healthcare personnel. The new natural choice to AMR is Citrus Bioflavonoids. Citrus Bioflavonoids are also antioxidants and natural food preservatives that can be used to extend the shelf life of food products and cosmetics etc. Citrus Bioflavonoids are natural alternatives for harsh chemical disinfectants (Formaldehyde, Glutaraldehyde, Hydrogen peroxide, Povidone-iodine, Sodium Hypochlorite and Alcohol based products) that are toxic and irritant.

As Citrus Bioflavonoids are non-toxic, non-irritant and non-corrosive, it can be safely used at any time by fogging/ fumigation method to control infections in ICUs, Wards and quarantine areas without shifting the patients. It is also tested and proven effective on the following multidrug resistant bacteria and fungi. A clinical trial was done to establish the safety and efficacy of Citrus Bioflavonoids (CitrobioShield) in improving immunity in COVID 19 patients via inhalation & efficacy on Coronavirus.

Summary of the studies conducted in the various trials revealed that fogging with Citrus Bioflavonoid complex is easy to use, safe and very effective in reducing the viral, bacterial and fungal load. Hence, it can be implemented in prevention as well as control of cross contamination causing the spread of infection, more so in high density areas such as hospitals, critical care units. This fogging method is very useful and effective in critical care units as it can be performed in situ as it does not cause any irritation to the patients as well as being non-corrosive to the equipment. In addition, it is one of the most efficacious methods to sterilize the ventilatory tubes and other medical equipment. Thus, it saves the time consuming and laborious process of shifting the patients during the process of ICU sterilization where the patient turnover is high.

A bioflavonoid solution named **Citrobioshield®** was prepared at a specific concentration and used for oral administration and for inhalation as aerosol through a fogging machine. The experiments were conducted on animals, critical environments such as hospitals and also on the surfaces and fomites. Finally, a sample human trial was done as a proof of concept. In seafood industry Citrus Bioflavonoids (Citrobioshield) can be used for the following: Inhibition of melanosis in shrimp by dip method and incorporation in ice used for storage, Reduction of bacterial load of commercially important fish/shrimp species, Reduction in biofilm formation, Replacement of traditional preservative agents in fish/shrimp pickle, Incorporation in edible coatings and Control of shrimp/fish diseases.



INTERNATIONAL YEAR OF  
**ARTISANAL FISHERIES  
AND AQUACULTURE**  
2022

**Parallel Event 2:  
Small-scale Fisheries: Its Global and Regional Significance**





## ARTISANAL FISHERIES AND AQUACULTURE – A SOUTH ASIAN PERSPECTIVE

**Grinson George**

SAARC Agriculture Centre (SAC), BARC Complex, Farmgate, Dhaka-1215, Bangladesh

*\*sps\_fisheries@sac.org.bd*

The combined fish production from eight SAARC Member States is estimated to be around 18 million MT which is termed as small-scale based on their nature of operation. Most of the South Asian countries have constraints such as less utilization and low productivity of water bodies, vulnerability to climate change etc. However, opportunities lie in utilization of seasonal water bodies, wetlands, lotic and lentic aquatic systems. As most of the fish farming activities remain traditional with low input resulting in low productivity, there is need to enhance the productivity. Nutrition and feeding play an essential role in the sustained development of aquaculture and, therefore, fertilizers and feed resources continue to dominate aquaculture needs. Coastal aquaculture and fisheries are practiced in five countries - Bangladesh, India, Maldives, Pakistan and Sri Lanka of South Asia, all of which have abundant coastal areas with Bay of Bengal in the east and Arabian Sea in the west. The average per capita fish consumption is highest in Maldives (>200 kg/person/year), followed by Bangladesh 19.35 kg, Sri Lanka 15.8 kg, and India 9.2 kg. South Asian region is also experiencing a soaring demand for fish and the probable expansion of fish production from wild capture related resources is very minimal. In South Asia, fish contributes high dietary protein to the extent of 70% in the Maldives, 57% in Bangladesh and 55% in Sri Lanka. A fruitful effort on aquaculture and fisheries in the SAARC platform will help us in achieving the SDG 3 (good health and well-being), 8 (decent work and economic growth) 10 (reduced inequalities) and 12 (responsible consumption and production). A major peril faced by the region is the increasing temperature in the northern Indian Ocean and resulting problems in the South Asian rim countries. There are increased frequencies of weather shocks such as droughts, floods, cyclones and many more. The vulnerability of fishery and aquaculture in the South Asian region is certain. So as to improve fish production in these situations, it is important to bring unutilized water bodies as a mechanism of horizontal expansion of aquaculture. Further practicing seasonal aquaculture in water bodies as a climate change adaptation strategy is an option. SAARC Agriculture Centre conducted Regional Consultation on Climate change impact in fisheries and aquaculture and has come up with recommendations for all member States in the SAARC. This is adequately addressing SDG 13 (climate action), 14 (life below water) and 16 (peace, justice and strong institutions). A cross-section of the artisanal aquaculture and fisheries profile of South Asia will be discussed in the lecture with examples from different member countries.

## TROLL LINE FISHERY FOR LARGE PELAGICS OPERATED FROM KALAMUKKU, KOCHI, KERALA

Renjith, R.K.\*, Chinnadurai, S., Paras Nath Jha, Baiju, M. V., Leela Edwin

ICAR-Central Institute of Fisheries Technology, W. Island, Cochin - 29

\* *Renjith.rk05@gmail.com*

Observations were made from the Kalamukku harbour of Kochi, Kerala on the troll line fishery for large pelagics. The fishing is practiced from FRP boats of about 25-30 feet (LOA) fitted with single to double 9.9HP OBM engines and operated from October to March along Kochi. Approximately 70 boats are operated from the coast during the year. Boats are open type, without deck and canopy. The gear can be described as three monofilament lines, 1.5mm in diameter attached with planar board and stainless-steel hook with metal spoon. Length of lines are 10m, 25m and 30m which keeps space between the hooks and reduces the chance of entangling. The gear is towed behind the boat with a speed of 4-6 knots and is slowed down when the fishes are hooked. Operations start from 03:00 PM and last till 10:00AM of the next day. Average fuel consumption varies from 30-60 litre/day. Fishermen hailing from the Kanyakumari district of Tamil Nadu are exclusively engaged in this type of fishing. Major species caught are *Scomberomorus* sp. (19.82%), Carangids (37.84%), *Sphyraena* sp. (17.12%), *Strongylura* sp. (18.12%) and *Coryphaena hippurus* (2.70%). Average catch was recorded as 18-60 Kg/day/boat. Fishing is found to be sustainable as the troll lines are selective and no juveniles are found in the catch.

## ASSESSMENT OF GENDER ROLES IN SMALL-SCALE CULTURE-BASED SECTORS IN KERALA

Thankam Theresa Paul<sup>1\*</sup>, Arun Pandit<sup>2</sup>, Vandana Das<sup>1</sup>, Albin Albert C.<sup>1</sup>, Manoharan S.<sup>1</sup>,  
B.K. Das<sup>2</sup>

<sup>1</sup>ICAR-CIFRI, Kochi Centre, CMFRI Campus, Ernakulam, Kerala-682018

<sup>2</sup>ICAR-CIFRI, Barrackpore, Kolkata-700120

*\*thankamtheresa@gmail.com*

Aquaculture has been considered a sunrise sector in Indian fisheries. The estimated aquaculture production of the country is 13.75 million tonnes which places it at 2<sup>nd</sup> position globally. The flagship programme, PMSSY (Pradhan Mantri Matsya Sampad Yojana), targets aquaculture production at 22 million MT in 2025 along with doubling the income of farmers. In this scenario, it is important to estimate the average income of farmers and their contribution to their households. Based on this, the present study has been taken up to identify the contributions made by men and women in aquaculture farms. Nearly 300 households from selected villages of Kerala based on fish production (Ernakulam, Thiruvananthapuram, Kasargod) were surveyed. The study indicated that 69% of labour hours in farm management are contributed by permanent labourers which are wholly men and 31% by family labour, of which 26% is contributed by household women. Women spend 71.65% (94 hours/cent) of labour hours in feeding which is a major activity of farm management. The study estimated that the estimated cost for women labour in aquaculture is Rs.33, 800/cent (which is one-third of the wages for men). The study emphasizes a need to quantify the work done by women in farm management and a role as a decision maker in farm level activity.

## HOW TO ESTIMATE THE UNREPORTED FISH LANDINGS OF LARGE ESTUARINE SYSTEMS? - A SOLUTION USING CITIZEN SCIENCE AND PARTICIPATORY APPROACH

Soorya Gopan<sup>1\*</sup>, Keerthana P.S.<sup>1</sup>, Sreekanth G.B.<sup>1,2</sup> and Anvar Ali P.H.<sup>1</sup>

<sup>1</sup> Kerala University of Fisheries and Ocean Studies, Kochi, Kerala-682506, India

<sup>2</sup> ICAR-Central Coastal Agricultural Research Institute, Old Goa, Goa-403402, India

\*sooryagopan2000@gmail.com

Ashtamudi Lake is a one of the largest and deepest estuaries in India with a spread of 51.2 km<sup>2</sup>. The data on fisheries of this internationally recognized 'Ramsar Site' is currently estimated using traditional methods. It is always challenging to quantify the Lake fishery accurately, which is largely unorganized, traditional and mostly unreported. Here, we propose a fish catch monitoring system for the unreported landing points in the estuary, where the landing points will be identified, mapped and clustered based on the salinity gradient (upper, middle and lower). A progressive fisherman will be identified and trained for the data collection in each landing point and a group of fishermen will be identified for each cluster, who will report the data to a cluster coordinator & data enumerator for verifying efficacy and accuracy. A pilot scale trial of this framework could be ideal to estimate the accuracy and efficiency. Using this novel framework, it will be possible to map the unreported inland fish landing points in the Ashtamudi Lake and to develop a novel methodology for collection of data from isolated/unreported points of inland fish catch.

## IDENTIFICATION OF THE ARTISANAL FISHING/FISHERY BASED ECOSYSTEM SERVICES OF A SMALL TROPICAL ESTUARY; CHETTUVA, KERALA, WESTERN COAST OF INDIA

Sreekanth G. B.<sup>1,2,\*</sup>, Amrita Priya<sup>1</sup>, Ranjeet Kutty<sup>1</sup>

<sup>1</sup>Kerala University of Fisheries and Ocean Studies, Kochi, Kerala, 682506

<sup>2</sup>ICAR-CCARI, Goa, 403402

\**gbsree@gmail.com*

Chettuva estuary is a small and shallow tropical estuary situated in Kerala, the western coast of India. In this paper, we identified the provisional ecosystem services related to artisanal fishing and fishery derived from the estuary. Based on the stakeholders' perception, the major services identified were traditional capture fisheries (including finfish, shrimp, clams, and oysters), aquaculture (cage, pond, shrimp farming, mussel farming), shrimp/fish seed collection, fishing using FADs, hook and line and trap fishing, fish drying, clam processing, fish marketing through stalls and use of fish in traditional medicine (ITK). Currently, supply of these ecosystem services show a paradigm shift when compared for a long time frame (~30 years); 1) supply of some of these services is on the decline (finfish fishery, clam/oyster picking, shrimp farming) (~30-70%), 2) some services are non-existent (operation of Chinese dip net, fishing using FADs and mussel farming) and 3) other services are delivering at a constant rate. The major challenges faced by the fishermen are 1) sedimentation and siltation and shallowing of the estuary, 2) shrinkage of the estuary and habitat degradations (clam beds), 3) reduction in carrying capacity, and 4) decline in fish catch. Hence, we would hereby propose a preliminary management framework for the management of fishery in the estuary to ensure the sustainable delivery of the fishing-based ecosystem services.

## **CONSERVATION OF FRESHWATER FISH DIVERSITY IN KERALA USING A CITIZEN SCIENCE AND PARTICIPATORY APPROACH INVOLVING ARTISANAL FISHERMEN**

**Keerthana P. S.<sup>1</sup>, Soorya Gopan<sup>1</sup>, Sreekanth G. B.<sup>1,2</sup>,  
Anvar Ali P. H.<sup>1</sup>**

<sup>1</sup>Kerala University of Fisheries and Ocean Studies, Kochi, Kerala, 682506

<sup>2</sup>ICAR-CCARI, Goa, 403402

*\*pskeerthana65@gmail.com*

Freshwater aquatic systems are source of livelihood/subsistence for the majority of the artisanal fishermen in Kerala. As per the IUCN criteria, 18 critically endangered, 31 endangered, 18 vulnerable and 13 threatened freshwater fish species are reported from Kerala. The lack of knowledge among the fishers on the vulnerability of the freshwater species results in their overexploitation and stock depletions. Here, we define a citizen science cum participatory approach to address this problem in specific fishing regions. There are three steps involved in this process; 1) to identify the ecological features and analyse the population status of major fish species, 2) to implement the citizen science tools (motion pictures, electronic display boards, film strips, sign boards, posters, calendars, key-chains, social media) and test their efficacy in the region by rigorous interactions/interviews and 3) to set up an advisory board involving the fishermen for continuous monitoring and recording. The data collected using this methodology will be compiled and handed over to Dept. of Fisheries and Kerala State Biodiversity Board (KSBB). This data will be useful in creating awareness among the artisanal fishermen to conserve the freshwater fish diversity and to ensure the sustainability of fish populations and fishermen livelihood.

## **INDIGENOUS METHODS USED BY FISHERMEN TO REDUCE CETACEAN INTERACTION IN INDIAN FISHERIES**

**Rithin Joseph, Dhiju Das P.H., Leela Edwin**

ICAR-Central Institute of Fisheries Technology, W. Island, Cochin - 29

*\*josephrithin@gmail.com*

Indian fishermen practice their own indigenous methods for natural resource management. Through their age-old practices and close observations, the fishermen have developed the expertise and knowledge in fishing activities. Scientific attitude of these indigenous technologies of the fishers are being constantly appraised. Cetacean fishery interaction is one of the main problems faced by the fishermen as the interaction cause huge loss to the fishermen. A survey on indigenous methods used for reducing the cetacean interaction was carried out in the selected fish landing centers in Indian coast. To analyse the effectiveness of indigenous methods, ring seine and gillnets operated in Kerala were selected. The methods adopted by fishermen to reduce the cetacean interaction were classified into indigenous and modern methods. It includes physical methods, gear modification, operational changes, acoustic methods etc. This study discusses the awareness among the fishers related to interactions and also the indigenous methods used by fishermen to reduce cetacean interactions.

## FISHERS' PERCEPTION OF CLIMATE CHANGE: A STUDY ALONG FIVE ISLANDS IN LAKSHADWEEP

Mohammed Jabir K.K.<sup>1\*</sup>, Salim, G<sup>2</sup>

<sup>1</sup>Kundamkalam House, Kalpeni, U.T. Lakshadweep

<sup>2</sup>Fisheries Office, Dept. of Fisheries, U.T. Lakshadweep

*\*mohammedjabz44@gmail.com*

The Union Territory of Lakshadweep has an area of 32 sq. km and a coastline of 132 km. The total population of the territory is 64,429 according to the 2011 census. The major traditional fishing methods consist of handlines, beach seines, cast nets, harpooning and spearing for octopus. The handline and beach seines are operated during monsoon season and the rest of the gears are operated during fair season. There is a heightened awareness that island communities around tropical nations are particularly vulnerable to the effects of climate change, including the fisheries on which they rely for their livelihoods. However, relatively few studies have examined the perspective of fishermen of Lakshadweep on this topic and how they have adapted to these conditions. This study tries to understand the traditional fisher's perceptions on climate change and how this has affected them in the recent years. Semi-structured questionnaires were used to collect data from 150 fishers from five Islands, and the data collected was segregated and analysed. It was noticed that the respondents had clear perceptions about change in rainfall, seasonal patterns and increased temperature in the recent years, which they attribute to global changes in climate. More than ninety percent of fishermen said that severe seas and strong winds are now a typical occurrence at sea, and that the risks to fishermen have increased dramatically. Approximately ninety-five percent of fishermen believe that the catch has decreased in recent years, which they ascribe to climate change.

Though respondents believed that adaptation to climate change was possible through proper planning, support from the community and suitable mitigation plans by the government. Construction of safe boats, improved housing and the inclusion of community representatives in the local disaster management committee were all ranked high as requirements for adaptation policies. The outcome of the study and its implications are reported this communication.

## USE OF SAIL IN MARINE SMALL-SCALE FISHERY: A STEP TOWARDS GREEN FISHING

**Paras Nath Jha\*, Baiju M.V., Leela Edwin**

ICAR-Central Institute of Fisheries Technology, W. Island, Cochin-29

\* *parasincof@gmail.com*

Small scale artisanal fisheries involve relatively lesser amount of capital and energy, with small fishing vessels, and mainly for subsistence purpose or local consumption. As per FAO (2015), small scale fisheries contribute around half of global fish catches in developing countries and employ about 90% of the world's capture fishers. As per CMFRI marine fishery census (2016), a total of 1,66,333 fishing crafts operates in marine fisheries sector, out of which 97,659 (58.7%) are motorized. Among the motorized fishing vessels, 31,446 (32.2%) are fitted with inboard engine and 66,212 (67.8%) are with outboard engine. As per a study conducted by ICAR-CIFT, inboard and outboard engines consume 0.973 and 2.38 litre of fuel/hour respectively on an average. The fossil fuel consumption by small scale fishing vessels in the country would be 255.8 million litre/year, considering an average 25 days of fishing per month. If all the similar fishing would be partial sail assisted fishing, then the net saving of fossil fuel would be 112.9 million litre/year. This corresponds to 307 million kg of CO<sub>2</sub> emission due to burning of reduced fuel quantity.

**EVALUATION OF HAND DREDGES USED IN HARVEST OF BLACK CLAMS  
(*Villorita cyprinoides*) IN THE LOWER REACHES OF THE MUVATTUPUZHA  
RIVER, ERNAKULAM, KERALA**

**Sunbula Kareem<sup>1\*</sup>, Sreelakshmi B. Anand<sup>2</sup>, Anish Kumar K.C.<sup>3</sup>, Madhu V.R.<sup>3</sup>**

<sup>1</sup>Kerala University of Fisheries and Ocean Studies, Panangad, Cochin - 06

<sup>2</sup>Njavalinkal, Kumbalangi, Cochin- 07

<sup>3</sup>ICAR-Central Institute of Fisheries Technology, W. Island, Cochin - 29

\*zumbupk@gmail.com

*Villorita cyprinoides*, also known as the Black clam, is an important resource gathered by artisanal fishers along the backwaters of Kerala. Catches of this species have plummeted in recent years due to changes in design of fishing gear used, reductions in clam abundance and size. Therefore, a survey was carried out to assess the changes in fishing practices and other factors contributing to this change, in the regions adjacent to the mouth of the Muvattupuzha river, which is an excellent ground for black clams. About ten percent of the fifty total households engaged in clam fishing in this region were surveyed using a pre-tested questionnaire. Black clams are harvested by hand dredger (locally known as *kolli*) which comprises of a bamboo pole connected to a 186 cm aluminium rod and joined to an 86 x 12 cm metal structure. The rectangular metal structure's base includes 10-cm spikes attached to a 22-mm HDPE mesh bag. The number of active fishing units in the region has increased substantially in recent years, especially during and after the epidemic in 2020. The average length of individual clams collected reduced from 40 mm to 10 mm, with value dropping from Rs. 100 per kg to Rs. 80 per kg. Use of small mesh sized webbing in collection bags and overfishing were identified as major factors contributing to the reduction in catches, and decreased size of the clams. Lack of awareness among the new entrants in the fishery, regarding responsible fishing operations, is another problem. The gear designs being used and proposed modifications to make clam harvesting more selective is discussed.

## **AUGMENTING FISHER LIVELIHOODS THROUGH WOMEN INVOLVEMENT IN RESERVOIR FISHERIES OF KERALA, INDIA**

**Thankam Theresa Paul<sup>1\*</sup>, Albin Albert C.<sup>1</sup>, Deepa Sudheesan<sup>1</sup>, Manoharan S.<sup>1</sup>, B.K. Das<sup>2</sup>**

<sup>1</sup>ICAR-Central Inland Fisheries Research Institute, Kochi Centre, Ernakulam, Kerala-682018

<sup>2</sup>ICAR- Central Inland Fisheries Research Institute, Barrackpore, Kolkata-700120

*\* thankamtheresa@gmail.com*

Reservoirs are a source of a wide variety of tangible and intangible provisioning services, including fish production. The estimated reservoir production of India is nearly 0.1 million tonnes, of which Kerala's share of 0.22% contribute significantly to livelihoods of communities along their catchment area. The income flow in fisher's family is mainly through fish being caught and sold to co-operative societies associated with reservoirs and is found to be meagre and insufficient for supporting the livelihood of a family of average size 4.5. In this scenario, the present study conducted in Kerala evaluated the role of women in the livelihood of fishers associated with reservoirs. Nearly 120 households were surveyed from 10 culture based reservoirs (Pothundy, Mangalam, Meenkara, Malampuzha, Kanjirapuzha, Chulliyar, Walayar, Peechi, Vazhani, and Idukki) with the help of a questionnaire. The study estimated that fishers earn an average of Rs.5084 per month from the reservoir and Rs.9756 per month from alternative livelihood option. Nearly 31.03% of the reservoir fishermen's household is contributed by women in the family. They channelise the income into household expenditures, asset creation, repayment of liabilities in terms of loans etc through ALOs (Alternate livelihood Options). The study indicated that fisher families have benefited greatly from the changing roles of women at home to the workforce. With the meagre income from fishers, the balance between the income and expenditure is currently met by women. The study identifies that women could be involved in marketing so that they can contribute more to the household income.

## **SOCIO-ECONOMICS OF FISHERFOLK FROM VALAPATTANAM AND DHARMADAM ESTUARIES OF NORTH KERALA, WEST COAST INDIA**

**Swetha K.C.<sup>1\*</sup>, Jayalakshmi K.J.<sup>1</sup>, Sreekanth G.B.<sup>2</sup>**

<sup>1</sup>Kerala University of Fisheries and Ocean Studies, Panangad, Cochin – 06

<sup>2</sup>ICAR-Central Coastal Agricultural Research Institute, Old Goa, India

*\*swethakc.1@gmail.com*

Present study focuses on the existing socio-economic status of inland fisherfolk of two estuaries of Kannur district of North Kerala viz., Valapattanam and Dharmada. A total of 1614 active fisherfolk, under 5 inland fishing villages inhabits in Kannur district. An approximate of 420 and 130 fisherfolks depend on Valapattanam and Dharmadam estuary for fishing and allied works respectively. Among the fisherfolk, about 93% were men and 6.05% were women from both the estuaries. Most of them leading (65%) nuclear families having five members or less. The status of literacy rate among the community (90%) shows their interest in giving higher education to their children. Average daily fish catch varied from 2 to 25kg with prominent seasonal variations. The average income generated from fisheries was not enough to meet their daily needs which force fishers to do secondary jobs. Apart from fisheries, the estuaries are used for other economic activities such as coir retting, tourism activities etc. Currently, both estuaries were undergoing widespread degradation due to anthropogenic activities such as sand mining, sewage disposal, coir retting and wastewater discharge from domestic effluents and aquafarms. The study also highlights the measures need to be adopted for the overall upliftment of fishermen community.

## FISH CATCH COMPOSITION AND FISHERY OF CHETTUVA ESTUARY- A RAPID COUNT AND ESTIMATES

Amritha Priya<sup>1\*</sup>, Pramila Sahadevan<sup>1</sup> and Sreekanth G.B<sup>2</sup>

<sup>1</sup>Kerala University of Fisheries and Ocean Studies, Panangad, Kochi, India

<sup>2</sup>ICAR-Central Coastal Agricultural Research Institute, Old Goa, India

\*amrithapriya945@gmail.com

Chettuva is one among the significant estuaries along southwest coast of India with an area of 714 ha. A rapid survey was conducted to assess the fishery resources of estuary by collecting information directly from fishermen and using secondary data. Gillnet, cast net and stake net were the major gears and plank-built canoe were the major craft used in this estuary. A total of 68 species belonging to 34 families were reported from the exploited fishery of Chettuva estuary. Mulletts, Cichlids and the glassy perchlets were the most abundant groups and contributed major share to the landings. In addition, fishery of black clam and mussel also exists. *Meretrix casta*, which was enormously exploited until covid 19 pandemic had been completely collapsed in the estuarine fishery. This estuary forms a major source of income for a substantial number of fishermen (~100) inhabiting the nearby fishing villages. Weed infestation, siltation, conflict between aquaculture farmers and fishermen, shallowing and introduction of wave breakers were the major setbacks experienced by the fishing community in this region.

## STATUS OF ARTISANAL FISHERS OF SATPURA RESERVOIR OF MADHYA PRADESH WITH RESPECT TO SOCIO-ECONOMIC FACTORS

Mohammad Nadim Ansari\*, Abisha C., Anvar Ali P.H.

Kerala University of Fisheries and Ocean Studies, Panangad, Cochin - 06

\*mohammad786nadim@gmail.com

Satpura reservoir is one of the medium sized reservoirs of Betul district of Madhya Pradesh. Through this study, we aimed to analyse fisheries practices and the socio-economics of the fishers of the reservoir. The primary data were collected from fishers (n=185) of existing 3 co-operative societies viz. Sarni, Gopinathpur and Basanti Fisheries Co-operative Society from November, 2020 to April, 2021 through survey. In Satpura reservoir, fishery was one of the sources of income among other sources (Agriculture, Labourship, Business and others). All the fishers' were artisanal belonging to *Sanatan* religion and OBC cast with 91.44% of male and 8.66% of female fishers. Majority of whom were in the age group of 31-50 years. About 89.3% and 9.62% of fishers' were having nuclear and joint families respectively with majority having 5 family members. Majority are occupational fishers followed by seasonal and temporary fishers (58.28%, 22.45%, 6.41% respectively) with concern for marketing (83.95%). Eventhough, it is one of the most productive medium sized reservoirs in Madhya Pradesh, 83.42% of fishers' were in BPL category. About 24.59% and 4.2% fishers' are not having toilet and electricity facilities respectively. Leasing of the reservoir, improper management & weed infestation, scarcity of scientific knowledge & extension activities are some of the main reasons for lagging behind the socio-economics of these fishers'. Addressing these issues will help in improving production, employment generation, poverty alleviation and food security in the society, which will ultimately beneficial to improve the socio-economy of these artisanal fishers'.

## SPEAR HUNTING FOR OCTOPUS DURING LOW TIDES ALONG THE COAST OF LAKSHADWEEP

Sadeeda Parveen K.<sup>1</sup>, Renjith R.K.<sup>2</sup> and Leela Edwin<sup>2</sup>

<sup>1</sup>Kerala University of Fisheries and Ocean Studies, Panangad, Cochin – 06

<sup>2</sup>ICAR-Central Institute of Fisheries Technology, W. Island, Cochin - 29

\* *sadeedaparveen134@gmail.com*

Spear fishing for octopus has been practiced in most of the Lakshadweep islands practiced by men, women and children during low tides. The lagoon is regularly spotted with *Octopus vulgaris*, *Octopus membranaceus*, and *Octopus cyaneus*. However, *Octopus cyaneus* is the most often obtained species from the coast, accounting for almost 80% of the catch. An iron spear with a sharp edge that is 1 to 1.5 m in length and 2.5 to 3 mm thick is made by the local people of Lakshadweep for hunting. The operation may last for a maximum of 4 hours per day. Around 70% of octopus hunters are female (with 95% being over the age of 40), followed by 25% being male, and the remaining 5 % being children. The spearing is carried out throughout the year, but more frequently from October – May (4 – 8 days per month), with most people preferring to spear octopuses in the late afternoon. The catch is primarily used for personal consumption, which includes curries, pickles, and sun-dried octopus. In addition, the sun-dried octopus has a high market value in the locality and may cost as much as 500 rupees per kilogram. Though spear hunting is considered sustainable due to the low quantity of catch obtained, care should be taken to avoid damage to the reef by overturning the coral heads, stepping and gleaning.

## IMPROVING THE SELECTION PROPERTIES OF AN ARTISANAL CRAB TRAP: AN EXPERIMENT AT KUMBALANGI, COCHIN, KERALA

Sreelakshmi B. Anand and Madhu, V.R.

ICAR-Central Institute of Fisheries Technology, W. Island, Cochin - 29

\**madhucift@gmail.com*

Kumbalangi, an island-village (9°52'35.86"N and 76°17'12.52"E) is located on the bounds of Kochi city and is surrounded by Vembanad lake. Chinese dip nets, cast nets, gill nets, hook and lines, crab rings, and traps are the major fishing gears used in the lake. Traps are widely used in the region to specifically capture mud crab (*Scylla serrata*), which has high commercial value. Traps, with dimensions of 400x820 mm, made of galvanized iron frames are used. The mouth opening was 100x150mm and nylon mesh with a mesh size of 18mm is wrapped around the trap. An assessment of the species caught in these crab traps showed that a significant quantity of bycatch, including fishes, are caught, which is not acceptable. Therefore, this study was carried out to find if minor modification in the mouth opening of the traditional traps, can improve the size and species selectivity of these traps. The modification was only in the mouth geometry, with other dimensions remaining the same. A total of 39 simultaneous deployments, each of 24 hours duration, were made using traditional and modified traps during June to October 2022. The average CPUE calculated in grams per day of operation for *S. serrata* in the traditional and modified traps were 32.9 grams and 17.0 grams respectively. Whereas the total CPUE estimated as 33.0 grams and 32.8 grams per operation was not significantly different among the traps. GLMM modelling of the lengths of crabs showed significantly higher capture of *S. serrata* of all size classes in the modified trap, when compared to the traditional. The length at first sexual maturity (LFM) of *S. serrata* is 95 mm, which means that significant quantities of juvenile mud crabs are caught in modified trap, which although would be welcomed by the fishers, is not acceptable based on conservation point of view. The results of the findings and implications are discussed.

## AN ACCOUNT OF ARTISANAL MUD CRAB FISHERY IN COCHIN, KERALA

**Ancy Sebastian\*, Dhiju Das, M.P. Remesan**

ICAR-Central Institute of Fisheries Technology, W. Island, Cochin - 29

\* *ancbabu65@gmail.com*

Mud crab fishing and trade is an important activity among the artisanal fisherfolk in this country as it can provide a reasonably good income in a short time. Live mud crab is exported to over 41 countries and USA is the major market. In the year 2020-2021(Apr-Nov), India has exported crab worth 54.34 million USD. This study focuses on the methods of harvesting and post-harvest handling adopted by crab farmers in selected areas of Cochin backwaters, Kerala. Crab ring net and crab gill net are the gears currently used by the fishermen. Crab ring net is a simple gear made of HDPE multifilament with 25 mm mesh size attached to an iron ring of about 80-90 cm diameter and the technique involves attracting the crabs into a shallow circular net using baits. Chicken waste, flesh of catfish and eels are commonly used as bait. Nylon monofilament gill net of 0.32mm twine size and 60-80mm mesh size is also used for catching crabs. Assessment of the catch composition indicates occurrence of very low percentage of large sized crabs which are exported while the juveniles and soft-shelled crabs are sold to farmers for fattening and hardening before subsequent sales. Crab farming can be a lucrative employment for artisanal fisherfolk in our country. Pen culture in mangrove areas is an innovation that requires less investment. Inadequate supply of seed, poor water quality and catching of juvenile crabs are the problems in the sector, which needs attention to improve the livelihood of small scale fisherfolk.

## CURRENT PRACTICES IN TRADITIONAL SHRIMP FARMS OF ERNAKULAM AND ALAPPUZHA DISTRICTS, KERALA

<sup>1</sup>Sreekutty K.V., <sup>1</sup>Nisha Sasi, <sup>2</sup>Neetha S.D., <sup>1</sup>\*Pramod Kiran R. B.

<sup>1</sup>Dept. of Aquatic Biology and Fisheries, University of Kerala, Karyavattom,  
Thiruvananthapuram

<sup>2</sup>Directorate of Fisheries, Vikasbhavan, Thiruvananthapuram

\*pramodkiranrb@keralauniversity.ac.in

Traditional shrimp farms of Kerala has been following an age old practice of “trap and hold” culture depending exclusively on the tidal fluctuations for maintaining water quality and productivity of the pond. Occasional surveys of the farm operators have helped in documenting the time-tested practices followed in these farms. An attempt was made to document the current practices in traditional shrimp aquaculture systems of the state. Primary data was collected from 30 traditional shrimp farm operators based on a questionnaire specially developed for the purpose. The questions focused on the technological advancements in farm operations in the wake of the intensive shrimp culture activities followed in the shrimp aquaculture industry after the introduction of exotic *Litopenaeus vannamei*. The questionnaire also enquires the details of the input costs (sluice gates used, additional stocking material, use of supplementary feeds, etc.), production (species harvested, markets, price of the product, etc.) and the risk factors recognized by the present-day operators. The observations are discussed in comparison with the conclusions of previous survey reports.

## OPPORTUNITIES AND CONSTRAINTS IN DIFFERENT SHRIMP AQUACULTURE SYSTEMS DURING THE COVID-19 PANDEMIC: CASE STUDIES FROM KERALA

Sreekutty K.V.<sup>1</sup>, Lakshmy Suresh<sup>1</sup>, Neetha S.D.<sup>2</sup>, Pramod Kiran R.B.<sup>1\*</sup>

<sup>1</sup>Dept. of Aquatic Biology and Fisheries, University of Kerala, Karyavattom, Thiruvananthapuram

<sup>2</sup>Directorate of Fisheries, Vikas bhavan, Thiruvananthapuram

\*pramodkiranrb@keralauniversity.ac.in

The global pandemic COVID-19 and associated nation-wide lockdown had severe impact on different food production sectors in the country. However, the pandemic led to the opening of domestic markets rather than export markets for farmed shrimps. The present study aims to document and compare the opportunities and constraints in the traditional shrimp aquaculture sector and intensive pond culture of *P. vannamei* in Kerala. Farms actively involved in aquaculture during the Covid – 19 pandemic associated lockdown from both traditional as well as intensive culture systems were selected for a questionnaire based survey to generate primary data on the constraints faced and new opportunities explored during the period. Traditional shrimp farmers were selected from Ernakulam and Alappuzha whereas intensive pond culture farmers were selected from Thrissur District, Kerala. The traditional shrimp aquaculture sector faced a severe loss of value for the product, particularly for indigenous shrimps in the export market resulted in selling their product at much lower prices in the domestic market. However, the farmers of the exotic shrimp *P. vannamei* rated the pandemic period as a significant opportunity for the sector by providing a steady market price for their product. Return of migrant laborers to their native states led to a shortage of workforce in the *P. vannamei* farming sector. Shortage of laborers has little effect on the sector as the majority of the traditional shrimp farms were operated by the proprietor and his family members. The study further draws conclusions on different socio-economic aspects associated with these shrimp aquaculture sectors.

## A PRELIMINARY ACCOUNT ON ARTISANAL FISHING TECHNIQUES IN MAITHON RESERVOIR, JHARKHAND, INDIA

Sandhya, K.M.<sup>1\*</sup>, Mishal P.<sup>2</sup>, Sajina A. M<sup>2</sup>

<sup>1</sup> ICAR-Central Institute of Fisheries Technology, W. Island, Cochin - 29

<sup>2</sup> ICAR- Central Inland Fisheries Research Institute, Barrackpore, Kolkata-700120

\* sandhyafrm@gmail.com

Maithon reservoir, located in Dhanbad district, Jharkhand, India is the second largest reservoir under Damodar Valley Corporation (DVC), constructed to serve the purposes of flood control, irrigation, water supply and hydro-electricity. Besides this, fishing is one of the important activities prevailing in the reservoir and large number of fishermen are directly or indirectly involved in fisheries and allied activities. A preliminary survey was conducted to scientifically document the design and operational details of artisanal fishing techniques in Maithon reservoir, Jharkhand. Indigenous wooden boat was mainly used for fishing. Inflated tyre tubes were also used in some locations. Gillnet (90%) was the dominant gear used made of Nylon monofilament material and mesh size (25mm-150mm) varied according to season and species targeted. Targeted fishery was mainly Indian Major Carps and *Tilapia niloticus*. Headrope was made of multifilament twines (1x3, 2x3) with Thermocol/empty plastic bottle (1litre)/wooden sticks as floats and lead sheets/cylindrical shaped burnt clay as sinkers. Other artisanal gears in operation include cast net (*Khapla jal*), dragnets (*masarijal*), fyke nets (*Gogu*), plunge basket (*Polui*), floating liftnets (*Khuda jal*) etc. Drag nets and fyke nets made from very fine mesh sizes (mosquito nets) mainly targets prawns and indigenous fishes like *Chanda nama*, *Gudusia chapra*, however juveniles of commercially important species are also caught which will affect the sustainability of the fishery.

## FLOATING CAGES AS FADS: A NOVEL CONCEPT TO DOUBLE THE INCOME OF ARTISANAL FISHERFOLK

Prajith K. K.<sup>1</sup>, Risvana Barith<sup>2</sup>, Sandhya K M<sup>1</sup>, Remesan M.P.<sup>1</sup>, B. Manoj Kumar<sup>2</sup>

<sup>1</sup> ICAR-Central Institute of Fisheries Technology, W. Island, Cochin - 29

Kerala University of Fisheries and Ocean Studies, Panangad, Cochin -29

\*prajithkk@gmail.com

In the context of climate change and declining production from capture fisheries, the focus is on aquaculture to meet the demand for protein. Utilizing open water for fish culture is one of the best options for fish production in the inland and marine sectors. Cage culture is a cost-effective technology for fish farming in all types of waterbodies. The larger portion of submerged structure of cages acts as fish aggregating devices for many economically important fish species. The farmers/fishermen do not realise this opportunity and the potential resource is often left untapped. This additional resource can be harvested using suitable fishing gears with minimal effort. The present work studied the fish assemblage associated with inland fish farms of Vembanad estuary, Kerala, India, using two passive fishing gears. Traditional drift gill net and experimental hemi-spherical fish trap were operated in the vicinity of the cage site to capture the assembled fishes. A total of 1025 fishes comprising of 14 species belonging to 11 families and 7 orders were caught from the experimental site. Fish traps set near the cages recorded 260 fishes and 167 from the control site. The traps placed in the middle of the cages harvested more fishes compared to other traps placed near the cages. Similarly, in gill net, 377 fishes were recorded near the cages and 221 from the control site. Aggregation in control and experimental site showed clear dominance of *Labeo dussumieri*. Better diversity, richness and evenness indices were recorded from the gears operated near cages when deployed away from the cages (1.8, 2.8 and 1.72 for traps and 1.3, 1.7, and 1.6 for gill net). The use of passive fishing gears around the cage site is an innovative idea for harvesting the wild fishes assembled around the cages. Live fishes harvested using appropriate gears like traps can be used for fattening (capture-based culture system), which will provide additional income to the farmers.

## **ENVIRONMENTAL ISSUES OF ABANDONED FIBRE REINFORCED PLASTIC (FRP) FISHING BOATS FROM SMALL SCALE FISHING SECTOR OF KERALA**

**Manju Lekshmi N., Sreejith S. Kumar., Muhamed Ashraf P., Sandhya K.M., Leela Edwin**

ICAR-Central Institute of Fisheries Technology, W. Island, Cochin - 29

*\* manjuaem@gmail.com*

Fiberglass reinforced plastic (FRP) is a thermosetting plastic in which resin bonds the glass fibres together to create thick layers. Polyester resins make up roughly 75 percent of the FRP matrix, which is favoured for marine boat construction due to production capabilities, corrosion resistance, long shelf life, low operating costs, water resistance, maintenance, and good strength to weight ratio. Over the past two decades, FRP has become the preferred material for boat construction in the small-scale fishing industry (LoA  $\leq$  15 m). From the study it was observed that more than 90% of the abandoned boats from the small-scale fishing sector were FRP sheathed boats. Boats with FRP sheathing over wood or plywood have a lifespan of less than 10 years, compared to boats made entirely of FRP, with a lifespan of more than 30 years. The disposal of end-of-life boats has become a concern as the number of boats increases. Due to lack of recyclability, there is no simple way to dispose, and existing options are quite expensive, and it seems tempting to get rid of the problem by dumping these in the marine environment. ICAR-CIFT's study showed that abandonment of these boats can be seen in landing centres either at disposal sites or throughout high tide line. These boats were also found sunk as well as in burnt conditions. Abandoned FRP boats underwent photodegradation, weathering and backyard burning. This led to fragmentation, increasing microplastic abundance, emission of persistent organic pollutants etc, which leads to ecological, social and economic impacts on the marine environment. Hence, it is high time to come up with efficient and economically viable recycling/disposal options for the end-of-life FRP fishing boats to protect the marine ecosystems and biodiversity.

## ALUMINIUM ALLOY CANOE FOR ARTISANAL FISHING IN THE INLAND SECTOR

**Baiju M.V., Remesan M. P., Sandhya K.M., Vipin V.**

ICAR-Central Institute of Fisheries Technology, W. Island, Cochin - 29

\* *vishnubaiju@yahoo.com*

The building materials suitable for fishing boats are wood, steel and Fiberglass Reinforced Plastic (FRP). The factors considered for construction of fishing boat are cost of construction, longevity, ease and cost of maintenance, and recycling possibility. Wood is a naturally available material and has the least environmental impacts. But availability of suitable wood construction is less and is costly. Further maintenance of wooden boats involves high labour and cost. Steel has emerged as a versatile material due to its easiness in fabrication and minimal waste and maintenance is easier compared to wood and FRP. FRP has the advantages such as light weight, no corrosion and ease of manufacturing large numbers in short time. But FRP is not eco-friendly as well as it causes high emission of greenhouse gases. FRP sheathed canoes will become plastic litter after about 10 years and disposal of unserviceable boats is a big issue. Considering all this, Aluminium may be a suitable material since it can be recycled, light in weight, low corrosion rate and easy for maintenance. ICAR-CIFT has taken up a study to find out the suitability of Aluminium alloy as an alternative boat building material. Aluminium- Magnesium alloy 5000 series (5083/5383) has been selected for this purpose and 3.0m LoA Aluminium canoe for fishing in inland waters was designed and construction is initiated. Aluminium boat can be a substitute in the artisanal sector since the conventional building materials are creating environmental issues.

## IMPACT OF CLIMATE CHANGE ON CULTURE BASED FISHERY

Albin Albert C.<sup>1\*</sup>, Thankam Theresa Paul<sup>1</sup>, U.K. Sarkar<sup>2</sup>, Manoharan S.<sup>1</sup>, B.K. Das<sup>2</sup>

<sup>1</sup>ICAR-CIFRI, Kochi Centre, CMFRI Campus, Ernakulam, Kerala-682018

<sup>2</sup>ICAR-CIFRI, Barrackpore, Kolkata-700120

\*albinac03@gmail.com

Climate change manifestations could potentially impact aquaculture production in the future. Hybrid measures such as climate smart aquaculture practices can be used to mitigate climate change impacts. In this scenario, it is important to study the impact of climate change on culture practices. So, a study was conducted in a 1-acre prawn filtering system (associated with Vembanad lake) stocked with 6000 nos. of *Etroplus suratensis* (2.5cm TL) seed as a part for culture based fisheries. The growth of the species was correlated with temperature and rainfall in the region. The study indicated that with increase in temperature and rainfall, growth rate of the species decreases. The study also identifies that with the increase in temperature the number of species caught in castnet decreases. This emphasizes that with increasing temperature, the fishes search for temperature hideouts, which may increase the harvesting time. The study clearly puts across the need for suitable mitigation measures to survive in a climate changing scenario.

## **FISHING CRAFTS AND GEARS OF EZHOME FISHING VILLAGE NEAR KUPPAM RIVER, KERALA**

**Teena Elvis, Amrutha R Krishnan**

Kerala University of Fisheries and Ocean Studies, Panangad, Cochin - 682506

*\*teenaelvis456@gmail.com*

Ezhome is an inland fishing village in Kannur district near Kuppam river with 995 active fishermen. This village is designated as a census town, a higher percentage of male population in the village are engaged in activities other than agriculture. Hence a survey was conducted to study the fishing systems and catch composition of the catches. Four different locations namely Ezhome, Pattuvam, Kottakkeel and Thavam were selected for the study. The details on existing infrastructure facilities and women involvement in fishing activities were also collected using a structured questionnaire. The major fishing systems in the area include gill netting, fish and crab traps and fishing using hands (*thappal*), of which gill netting system is the dominant one. Plank built canoe ranging from 4.5m to 6m and FRP boats of 5.5m sizes are the major fishing crafts and the gears include gill net, box traps, crab traps. The maximum landings was found from gill netting fishing systems. Direct participation of women in fishing is less however they are the mainstay when it comes to mussel culture and post-harvest activities such as value addition.

## EVALUATION OF FUEL CONSUMPTION RATE OF SMALL-SCALE FISHING VESSELS ALONG THE COAST OF TAMIL NADU, INDIA

Kumarakannan Asokan<sup>1</sup>, Paras Nath Jha<sup>2</sup>, Leela Edwin, Manoj kumar B.1, Amrutha R. Krishnan<sup>1</sup>, Mathew Sebastian<sup>1</sup>

<sup>1</sup>Kerala University of Fisheries and Ocean Studies, Panangad, Cochin, Kerala – 682506

<sup>2</sup>ICAR-Central Institute of Fisheries Technology, W. Island, Cochin – 682029

*\*Kumarakannan.a@gmail.com*

Small-scale fisheries (SSF) are contribute significantly to food security, employment and poverty alleviation in developing countries. However, this sector is being neglected because they are more complex, being multi-gear and multi-species. In particular, fuel consumption in small-scale fisheries has received less attention in India than in large-scale fisheries. In this regard, the study aimed to evaluate the fuel consumption rate of different small-scale fishing vessels from selected fishing villages along southeast coast of India. Requisite data were collected randomly through primary quantitative survey method and analysed by descriptive statistics. Consequently, thirteen fishing vessels were grouped based on length and engine capacity of fishing vessel. Collectively the estimated average fuel consumption ranged from 4 to 631 litre trip<sup>-1</sup>. Fuel consumption of fishing vessel with single engine, double engine and high-power engine ranged from 4 to 39, 56 to 102.63 and 292 to 631 litre trip<sup>-1</sup> respectively. Results of this study could be a primary input for further studies in small-scale fisheries and fuel consumption.

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Zanzibar

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Director  
ICAR - Central Inland Fisheries Research Institute  
West Bengal, India

**Dr. G. Sugumar**

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Tamil Nadu Dr. J. Jayalalithaa Fisheries University  
Nagapattinam, Tamil Nadu, India

**Vice Chancellor**

The Kerala University of Fisheries and Ocean Studies  
Kerala, India

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ICAR-Central Institute of Freshwater Aquaculture  
Bhubaneswar, Odisha, India

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Director  
ICAR-Central Institute of Brackish water Aquaculture  
Chennai, Tamil Nadu, India

**Dr. Uttam K Sarkar**

Director  
ICAR-National Bureau of Fish Genetic Resources  
Lucknow, India

**Dr. P. K. Pandey**

Director

ICAR- Directorate of Coldwater Fisheries Research  
Uttarakhand, India

**Dr. Katia Frangoudes**

Researcher

Université de Bretagne Occidentale  
France

**Dr. Kumi Soejima**

Setsunan University,

Faculty of Agriculture Department of Food and Agriculture Business  
Japan

**Dr. Grinson George**

Senior Programme Specialist (Fisheries)

SAARC Agriculture Centre  
BARC Complex, Farmgate  
Dhaka, Bangladesh

**Dr. Usharani Boruah**

Librarian & Gender Coordinator of CIRDAP

Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP)  
Dhaka, Bangladesh

**Dr. Neelkanth Mishra**

Jaljeevika

Snehkunj Apartments  
Pune, India

**Dr. Joice V Thomas**

Chief Executive Officer

NETFISH-MPEDA  
Kerala, India

**Dr. Leela Edwin**

Head, Fishing Technology & Principal Scientist

ICAR-Central institute of Fisheries Technology  
Kochi, Kerala, India

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Pacific Community  
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Project Manager  
USAID Sustainable Fish Asia Local Capacity Development Activity  
Thailand

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*The Indian Council of Agricultural Research (ICAR) is an autonomous organisation under the Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers Welfare, Government of India. Formerly known as Imperial Council of Agricultural Research, it was established on 16 July 1929 as a registered society under the Societies Registration Act, 1860 in pursuance of the report of the Royal Commission on Agriculture. The ICAR has its headquarters at New Delhi. The Council is the apex body for co-ordinating, guiding and managing research and education in agriculture including horticulture, fisheries and animal sciences in the entire country. With 111 ICAR institutes and 71 agricultural universities spread across the country this is one of the largest national agricultural systems in the world. The ICAR has played a pioneering role in ushering Green Revolution and subsequent developments in agriculture in India through its research and technology development that has enabled the country to increase the production of food grains by 5.6 times, horticultural crops by 10.5 times, fish by 16.8 times, milk by 10.4 times and eggs by 52.9 times since 1950-51 to 2017-18, thus making a visible impact on the national food and nutritional security. It has played a major role in promoting excellence in higher education in agriculture. It is engaged in cutting edge areas of science and technology development and its scientists are internationally acknowledged in their fields.*

Source: <https://icar.org.in/>



# **National Fisheries Development Board**

**Department of Animal Husbandry, Dairying & Fisheries**  
**Ministry of Agriculture & Farmers Welfare, Govt. of India**

*The National Fisheries Development Board (NFDB) was established in 2006 as an autonomous organization under the administrative control of the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India to enhance fish production and productivity in the country and to coordinate fishery development in an integrated and holistic manner.*

- ❖ Providing focused attention to fisheries and aquaculture (Production, Processing, Storage, Transport and Marketing)*
- ❖ Achieving sustainable management and conservation of natural aquatic resources*
- ❖ Applying modern tools of research and development for optimizing production and productivity from fisheries.*
- ❖ Providing modern infrastructure mechanisms for effective fisheries management and optimum utilization*
- ❖ Training and empower women in the fisheries sector and also generate substantial employment*
- ❖ Enhancing the contribution of the fish toward food and nutritional security*

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*The National Institute of Fisheries Post Harvest Technology and Training NIFPHATT, erstwhile Integrated Fisheries Project, is devoted to all-round development of Post-Harvest Technologies. NIFPHATT envisages the best post harvest fish utilization and consumption with the least post harvest losses and delivery of the best quality fish and fish products. Post harvest technology upgradation through adaptive research to suit the ever increasing and fast changing consumer needs by developing new processes, products and packaging on pilot scale. Dissemination of the upgraded technology is achieved through consultancy, training, popularization of products and consumer response surveys.*



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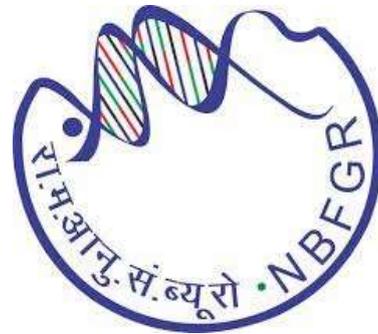


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*Started by a team of medical experts Germkill India Labs continues to strive hard to develop sustainable and eco-friendly products that are gentle when used by humans and tough when used on germs. We Spread hygiene!*



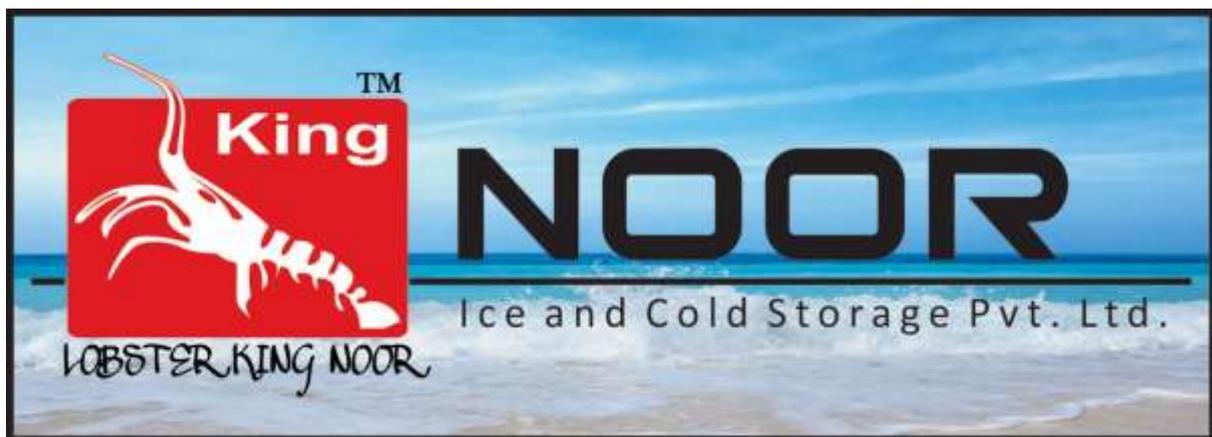
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*VKM Foods offerings to a demanding customer base globally comes from a place of utmost sincerity with concrete measures being taken to ensure a supply of best-in class products, which have supplemented our extensive growth in this domain. VKM Foods has developed three state-of-the-art plants in and around Navi Mumbai with persistent efforts across time. The company procures wild caught material from various states in the country and subsequently processes and value adds according to the customer's specification. A large team of dedicated people trained in HACCP system, carry out the processing of fish and fishery products to ensure quality and safe end products.*



*Noor Brands are well known for its quality. Marine Product is processed under strict hygiene condition & Supervision. We believe in extending quality. Noor Ice & Cold Storages Pvt Ltd. has developed a HACCP based system which assures the safety of processed foodstuffs. We have defined and documented HACCP based system with regard to food safety, thereby demonstrating the organizations commitment to safe and good quality sea food products.*

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# Envozyme

*Envozyme Technologies Private Limited in collaboration with Envozyme LLC, USA, is the best-in-class products and solution provider in biological safety and probiotic domains. Envozyme offers quality-driven biological products and aquaculture probiotics with special emphasis to get good yield, control over total organic matter. Our probiotics feeds improve cell immunity, control diseases, and upkeep the shell syndrome. Our products are true examples of high quality biological solutions.*



*Devi Fisheries Limited has risen steadily from humble beginnings to a large enterprise that now employs over 6000 personnel across its chain. With vertical integration, the company's primary activity is catering for the needs of Raw Frozen Shrimp & Cooked Frozen Shrimp for Global consumers.*

*Adhering to international standards, the company has successfully established new & promising verticals in quality, research and innovation while incorporating the latest technological advances in the field. Primary strength of the company is having direct access to several Aquaculture farmers & sophisticated sourcing methods to retain the optimum quality of Shrimp with guaranteed traceability from farm to fork.*

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*Established in 2017, Phytozymes Biotech (PB) is one of the fastest growing food companies in India, producing its durable and modified release natural enzyme (papain & Bromelain) using strong scientific ingenuity and innovative natural enzyme (papain & Bromelain) delivery system. Phytozymes Biotech continues to work towards our vision of providing accessible, efficient, safe and high quality products.*



*Forstar Instafoods is a Convenience Food Business, well-renowned in domestic and international markets for providing a diverse range of consistent & high-quality Food Products, for more than a decade.*

*Set up in 2004, the company has built a rich legacy in developing various convenience-based solutions for the food service industry. With its manufacturing facility situated at MIDC Industrial area, Talaja Navi Mumbai, Forstar Instafoods is backed by a highly experienced team of Food Technologists and a full-fledged R&D Kitchen, which continuously develops relevant, trending, viable and customized food products/solutions.*

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