JIRCAS International Symposium 2022

Artisanal Fisheries and Aquaculture in the Sustainable Food Systems

Proceedings

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National Center of Sciences Building

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In cooperation with : Ministry of Agriculture, Forestry and Fisheries (MAFF),
Japan Fisheries Research and Education Agency (FRA)

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JIRCAS International Symposium 2022
Hitotsubashi Hall,
National Center of Sciences Building,
November 22, 2022

Opening Remarks

KOYAMA Osamu
President, JIRCAS

Distinguished participants, good afternoon. As the President of the Japan International Research Center for Agricultural Sciences, JIRCAS, it is my great honor and privilege to open the JIRCAS International Symposium 2022, organized under the auspices of the Ministry of Agriculture, Forestry and Fisheries, and Japan Fisheries Research and Education Agency, FRA.

This year, we hold this symposium as a hybrid event, online as well as at the venue here in Tokyo. Since the outbreak of the pandemic, this is the first time in about three years that we are having the physical presence of the participants and some of the audience.

At this occasion, we have chosen the theme, “Artisanal Fisheries and Aquaculture in the Sustainable Food Systems” for this year’s JIRCAS International Symposium.

In building the sustainable food systems, the potential of fisheries and aquaculture is enormous. Fishery and aquatic foods supply protein and other essential micronutrients more efficiently than other food groups in terms of per-unit weight greenhouse gas emission. At the same time, fishery and aquatic foods support the livelihoods of over 800 million people, the majority of whom work in small-scale systems.

The International Year of Artisanal Fisheries and Aquaculture 2022 is expected to highlight their importance in driving the food systems transformation as well as achieving sustainable development goals.

Despite their contribution, however, the role of small-scale fishers and artisanal aquaculture tends to be underrepresented in the global food systems debates. One of the reasons may lie in the fact that artisanal fisheries and aquaculture are primarily bounded by local environment, thus facing locally specific technical challenges to which no single solution is applied. In order to unlock the full potential of fisheries and aquaculture sector for food and nutrition security without leaving anyone behind, all the stakeholders should be able to share their experiences and lessons to accelerate science, technology and innovation, or STI.

Among the Japanese agriculture, forestry, and fisheries research communities, JIRCAS has played a central role in international collaboration. One of JIRCAS research projects promotes the development and dissemination of sustainable aquaculture technologies in the tropical area based on the eco-system approach. Given that, the JIRCAS International Symposium 2022 aims at providing a forum with national and international research and academic communities to discuss opportunities and challenges for a resilient, efficient and sustainable fisheries and aquaculture sector.

On behalf of the organizers, I would like to thank Mr. KOYA Takashi, Director General of Fisheries Agency, who will deliver the welcome remarks for the Symposium participants. I would also like to

express my gratitude to our distinguished keynote speakers, Prof. YAGI Nobuyuki, of the University of Tokyo, and Dr. Shakuntala Haraksingh Thilsted of World Fish, who is the winner of 2021 World Food Prize. Let me also extend my appreciation to the Session Speakers with expertise and experience in developing innovations for the sustainable fishery and aquaculture sector, as well as the Chairpersons and Moderators, for joining us in this symposium to share their in-depth knowledge and insights.

Finally, I would like to take this opportunity to express my sincere thanks to all of our collaborators worldwide. Now, we are slowly resuming face-to-face collaborative research, which was somewhat disrupted during the COVID19 pandemic. This period has made us realize how we are interconnected despite movement restrictions, so that we need to act together to build the resilient food systems. We truly appreciate your continuous support and cooperation. Thank you very much.

Welcome Remarks

KOYA Takashi

Director General of Fisheries Agency, MAFF

「JIRCAS 国際シンポジウム 2022」の開催に当たり、一言御挨拶を申し上げます。

世界の食料供給においては、人口の増加、そして、気候変動、飢餓、貧困などの課題への対応が迫られています。このような状況の中、持続可能な食料生産システムを構築していく上で、自然の生産力を生かしつつ動物性タンパクを供給できる漁業・養殖業の重要性はますます高まっていくものと考えております。

漁業・養殖業は、国民に対して水産物を安定的に供給するとともに、漁村や関連地域の経済を担う役割もあり、持続的な産業であることが求められています。そのような状況の中、我が国では、本年３月に閣議決定された水産基本計画に基づき、水産資源の適切な管理と水産業の成長産業化に向けた取組を行っています。

また、農水省では、2021 年に「みどりの食料システム戦略」を策定し、農林水産業の CO2 ゼロエミッション化の実現など環境に配慮した持続可能な食料生産システムの構築を目指しています。

本年の JIRCAS 国際シンポジウム「持続可能な食料システムにおける零細漁業と養殖業の役割」は、熱帯域の持続的養殖技術の開発及び普及に向けた国際共同プロジェクトなど重要な取組を扱っていると承知しています。

本シンポジウムでの活発な意見交換を通じて、持続可能な食料生産システムの重要性、持続性と生産性向上の両立について、皆様の理解が深まることを期待しています。

It is a great pleasure to speak to you on the occasion of JIRCAS International Symposium 2022. Global food supply is facing challenges such as population growth, climate change, hunger, poverty, to name a few. Against this backdrop, we believe that the fisheries and aquaculture industries, which can supply animal protein while making the most of nature's production capacity, will become increasingly important in building sustainable food systems.

The fisheries and aquaculture industries need to be sustainable because they provide a stable supply of marine products to the people and also play a role in supporting the economy of fishing villages and related regions. Japan has recognized this and is making efforts toward appropriate management of fishery resources and the transformation of fisheries into a growth industry, in accordance with The Basic Plan for Fisheries approved by the Cabinet in March this year.

In addition, the Ministry of Agriculture, Forestry and Fisheries has formulated the "Strategy MeaDRI" in 2021, and we are aiming to achieve zero CO_2 emissions in agriculture, forestry and fisheries and build environmentally sensitive, sustainable food systems.

I understand that this year's JIRCAS International Symposium focuses on artisanal fisheries and aquaculture in sustainable food systems and will cover important initiatives such as international joint projects for the development and diffusion of sustainable aquaculture technologies in the tropics.

I hope that active discussions will take place in this symposium to help deepen your understanding about the importance of sustainable food production systems and the simultaneous achievement of sustainability and productivity improvement. This concludes my greetings. Thank you very much.

Keynote Speeches

The role of artisanal fisheries and aquaculture in sustainable food systems

YAGI Nobuyuki

Professor, Graduate School of Agricultural and Life Sciences
The University of Tokyo, Japan

Dr. YAGI Nobuyuki is a Professor at the University of Tokyo. His area of study includes socio-economic aspects on small-scale fishery and agriculture. He received his MBA from The Wharton School of the University of Pennsylvania, Philadelphia, USA, and his PhD from the Graduate School of Agricultural and Life Sciences, the University of Tokyo, Japan. He serves as a member of the Scientific Advisory Group (SAG) of the Globally Important Agricultural Heritage Systems (GIAHS) Program of the Food and Agriculture Organization of the United Nations (FAO) from 2019 to 2023. He was awarded the Royal Order of Sahametrei, Commander class, by the Royal Government of Cambodia in 2019.

ABSTRACT

Artisanal fisheries and aquaculture have substantial roles in sustainable food systems. Unlike industrial fisheries, that operate to maximize commercial profits and economic efficiencies, artisanal fisheries satisfy local needs for healthy food. They also contribute to the maintenance of employments, knowledge systems, traditional institutions, and sociocultural values in the rural areas.

Resource management practices for artisanal fisheries have been intensively studied. Dr. Elinor Ostrom, winner of the Nobel Prize in Economics in 2009, described that successful forms of common pool resources have eight governance characteristics, namely, (1) clearly defined boundaries (against free-riders), (2) congruence (benefit distribution), (3) collective-choice arrangements, (4) monitoring, (5) graduated sanctions, (6) conflict-resolution mechanisms, (7) recognition of rights to organize (no IUUs), and (8) nested enterprises (multiple layers)[1]. She also explained that the "tragedy of commons"[2] can be avoided where local people engage in resource management under the above conditions.

Certain threats, however, exist against artisanal fisheries and aquaculture in the modern society. Depopulation of rural areas become eminent in many areas of the world because residents in rural areas tend to move to city areas. Maintaining small-scale family businesses become difficult due to decreasing labor forces The price of their fishery and aquaculture products are weak due to increased competitions of imported food products. Climate changes may exaggerate volatilities of production outputs.

Two countermeasures exist against such threats. One is to enlarge the operation units by investing large scale industrial boats and processing facilities. The other way is to add values of local products while maintaining diversified small-scale traditional productions and processing activities. The Food and Agriculture Organization (FAO) provides support and encouragements for the latter option in fisheries and aquaculture, pointing out that states and all other parties should recognize, respect and protect all forms of legitimate tenure rights enjoyed by small-scale fishing communities[3]. In addition, FAO also has a mechanism to recognize a good practice as Globally Important Agricultural Heritage System (GIAHS) and this recognition could help local communities to increase profiles for food consumers and green tourists. Further use for these FAO tools are expected to keep the distinct values associated with artisanal fisheries and aquaculture in sustainable food systems.

[1] Ostrom, E. (1990) Governing the commons: the evolution of institutions for collective action. Cambridge University Press, Cambridge, UK.
[2] Hardin, G. (1968) The tragedy of the commons. *Science* **162** (3859), 1243-1248.
[3] FAO (2015) Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication.

The role of artisanal fisheries and aquaculture in sustainable food systems

Nobuyuki Yagi, Ph.D.
The University of Tokyo

Picture : Gifu City Government (https://www.ukai-gifucity.jp)

The triple bottom line of the sustainable development

- Environment
- Economics
- Socio-cultural

3

4


Picture: Nobuyuki Yagi


Picture: Nobuyuki Yagi


Photo: Nobuyuki Yagi

Institution theory for sustainable management


Elinor Ostrom (1933-2012)
Nobel Prize in Economics in 2009

Ostrom's 8 Principles:

1. Clearly Defined Boundaries
2. Congruence (benefit distribution)
3. Collective-Choice Arrangements
4. Monitoring
5. Graduated Sanctions
6. Conflict-Resolution Mechanisms
7. Recognition of Rights to Organize (no IUUs)
8. Nested Enterprises (multiple layers)

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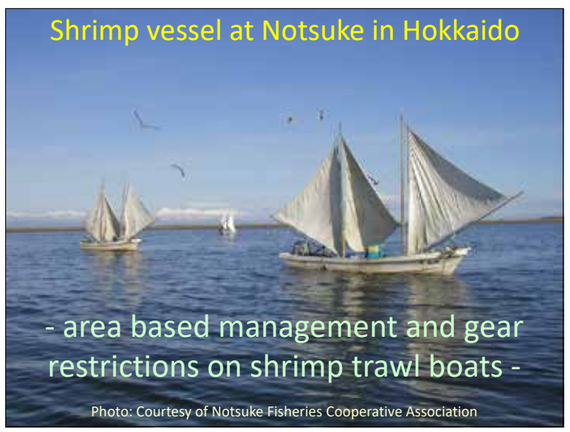
Women's involvements in fish distributions


Photo: Nobuyuki Yagi




From 1983, women's group of the Notsuke FCA started to plant trees at upstream of the river. The activity was named as "Planting tree to increase fish." Tokyo buyer of the fish has supported the activity.

（http://jf-notsuke.jp/event/event.html）

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Common threats against small-scale agriculture and fisheries

1. Depopulation of rural areas and decreasing labor forces for maintaining common goods such as water irrigation channels or ridges of rice paddies
2. Increased competitions of agricultural products with imported foods
3. Climate changes, and so on.

- Many threats are exogenous, and local people have no direct measures against them.

Asia, Africa, Pacific islands, Caribbean	Norway
Small scale boats	Large industrial boats
Many middlemen in landing markets	No landing market (only processing factories exist)
Labor intensive	Less employments
High biological diversity	Low diversity of fish
Domestic fish consumption is important	Fishing is an exporting business

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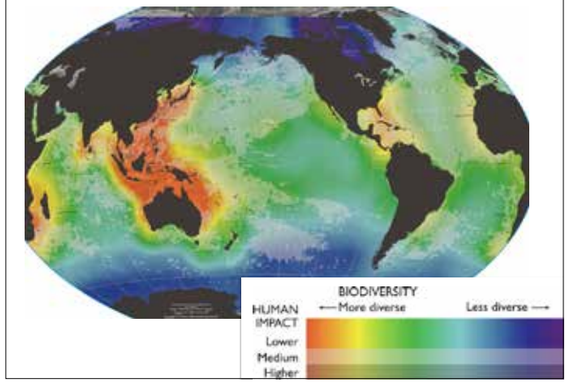
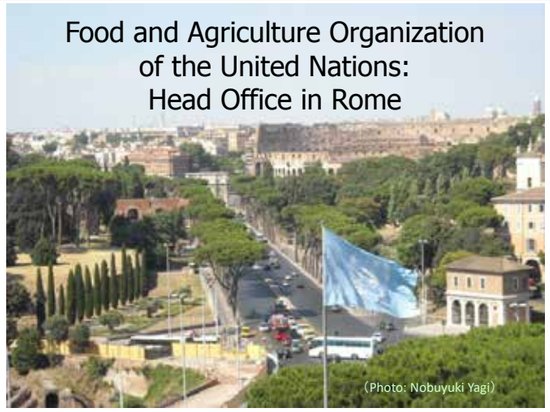
The triple bottom line of the sustainable development

- Environment
- Economics
- Socio-cultural

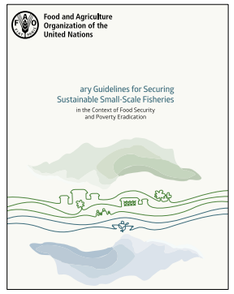
Source: Census of Marine Life（CoML）2001-2010



Food and Agriculture Organization of the United Nations: Head Office in Rome



Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (FAO, 2015)



- Human rights, gender equality and equity, participation and others are the guiding principles.
- States and all other parties should recognize, respect and protect all forms of legitimate tenure rights enjoyed by small-scale fishing communities.

Or human diet with “selection and concentration for economic efficiency”?

(Photo by Nobuyuki Yagi)

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The triple bottom line of the sustainable development

- Environment
- Economics
- Socio-cultural

GIAHS (Globally Important Agricultural Heritage System)

is characterized by remarkable agrobiodiversity, traditional knowledge, invaluable cultures and landscapes, sustainably managed by farmers, herders, fisherfolk, and forest people in ways that contribute to their livelihoods and food security.（https://www.fao.org/giahs/en/）

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- Substantial roles exist for artisanal fisheries and aquaculture in sustainable food systems.
- Keeping traditional knowledge has significant value for human to live in harmony with nature.
- “The more we think of ourselves as self-made and self-sufficient, the harder it is to learn gratitude and humility”. “Without these sentiments, it is hard to care for the common good”. Michael Sandel (2020).

Thank you

Human diet with “diversity and inclusion”

(Photo by Nobuyuki Yagi)

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Transforming Food Systems: Aquatic Foods for Nourishing People and Planet

Shakuntala Haraksingh Thilsted

Global Lead, Nutrition and Public Health, WorldFish, Malaysia

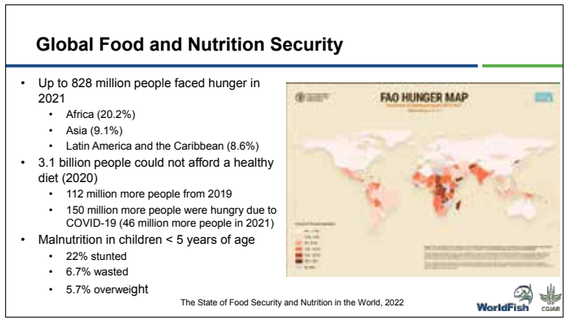
Dr. Shakuntala Haraksingh Thilsted is the Global Lead for Nutrition and Public Health at WorldFish, a One CGIAR entity. She was awarded the 2021 World Food Prize for her ground-breaking research, critical insights, and landmark innovations in developing holistic, nutrition-sensitive approaches to aquatic food systems. She was awarded the 2021 Arrell Global Food Innovation Award for research innovation. She is a member of the Steering Committee of the High Level Panel of Experts on Food Security and Nutrition (HLPE) of the United Nations Committee on World Food Security (CFS) and Vice Chair of the UN Food Systems Summit 2021: Action Track 4 – Advance Equitable Livelihoods, and also a Food Systems Champion. In 2022, Shakuntala was appointed co-chair of the EAT-Lancet 2.0 Commission. Shakuntala holds a PhD from the Royal Veterinary and Agricultural University, Denmark. She holds an Honorary Doctorate from the Swedish University of Agricultural Sciences.

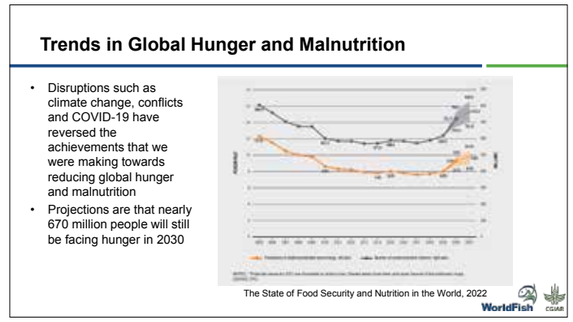
ABSTRACT

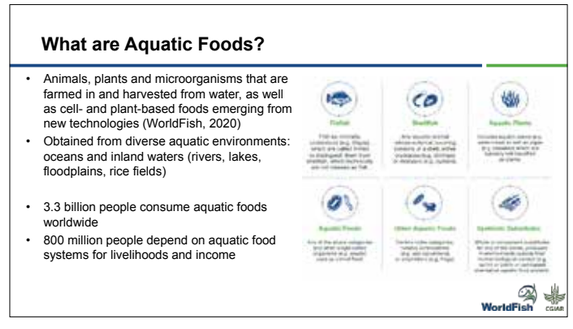
Global hunger and malnutrition rates have been increasing, exacerbated by disruptions, including climate change, conflicts and COVID-19. Over the past three years, these disruptions have reversed the progress we have made towards achieving Agenda 2030, especially meeting the targets of SDG 2: Zero Hunger.

There is growing recognition, backed by scientific data, on the potential and role of aquatic foods in transforming food systems to nourish people and planet. Aquatic food systems provide food and nutrition security and livelihood opportunities for over three billion people, globally, especially in low- and middle-income countries. Studies have shown that aquatic foods have lower economic and environmental costs, when compared to land-based foods.

A paradigm shift, to diversify and build resilience in aquatic food systems, is necessary to optimize the reach of aquatic foods in nourishing people and planet. This requires strong commitments by food systems enablers, including governments and policymakers, research institutions, the private sector, and local communities.

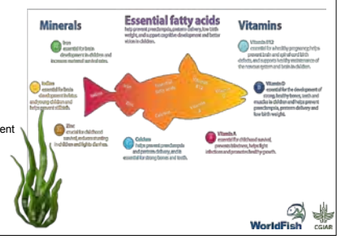




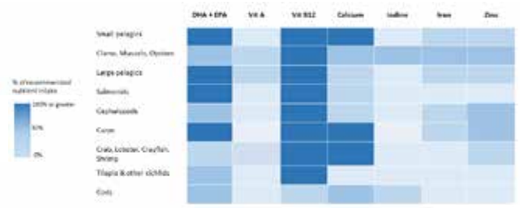


Aquatic Foods are Superfoods

- Recognize the diversity of aquatic foods as superfoods for:
  - Food and nutrition benefits
    - Multiple highly bioavailable micronutrients
    - Essential fatty acids
  - Socio-economic benefits
    - Livelihoods and income
    - Women and youth engagement
    - Capacity building
  - Environmental benefits
    - Ecology rehabilitation
    - Low environmental cost



Micronutrients and EFA in Diverse Aquatic Foods



Golden et al. 2021

UN Nutrition Discussion Paper on Aquatic Foods (2021)

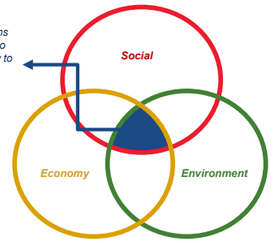
- First UN Nutrition Discussion Paper, in collaboration with FAO and WorldFish
- Addresses the need for a Global Narrative on Nutrition to promote diets that are socially, economically and environmentally sustainable
- Recognizes the importance of aquatic foods in sustainable healthy diets
  - Presents the breadth of existing evidence on the importance of aquatic foods to inform and steer policies, investments and research
  - Provides recommendations to use aquatic foods in improving global food and nutrition security

Nutrition-sensitive Aquatic Food Systems Approaches

- Put people at the center – meeting nutritional needs of people, especially poor and vulnerable, women and children – leaving no one behind
- Use multiple entry points in the food systems framework
- Improve diversity across aquatic food systems
- Approaches applied in aquatic food systems across Asia, Africa and the Pacific:
  - Diversify consumption with aquatic foods
  - Improve diversity in production and supply chains of aquatic foods
  - Include of aquatic foods in national and state policies
  - Engage women in aquatic food systems
  - Promote youth engagement in aquatic food systems

Aquatic Food Systems for Sustainable Development

Aquatic food systems have the potential to contribute holistically to all three pillars of Sustainable Development



Aquatic Foods Contribute towards the SDGs

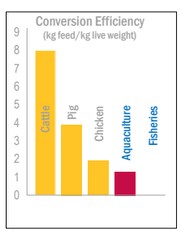
Diversify Consumption with Aquatic Foods

- Increase dietary diversity with fish and other aquatic foods – especially in women and young children
- Develop culturally acceptable, Africa (20.2%)
- nutrient-dense aquatic food-based products:
  - Dried small fish
  - Small fish powder
  - Fish chutney
  - Fish wafer
- Improve convenience, shelf life, accessibility and affordability

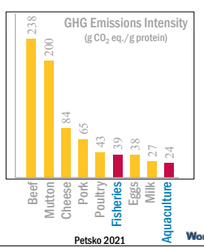
Pathways to Increase Consumption of Aquatic Foods

- Promote change in consumer behaviour and demand:
  - Social behaviour change communication
  - Nutrition messaging
- Increase awareness of benefits of diverse aquatic foods:
  - Public programs: School meals; mother and child health care; take-home rations
  - Cooking demonstrations
  - Recipe books – *Fish-based Recipes in Zambia; Cooking Fish and Seafood in Timor-Leste*

Environmental Footprint of Aquatic Foods



Fry et al. 2018



Petsko 2021

Aquatic Foods for Nourishing Nations

- Change the narrative from 'feeding a growing population' to 'nourishing people and planet'
- Shift the focus on quantity of few staple foods to also include quality (nutritional value, food safety) of diverse foods
- Transform food systems by engaging all actors in the framework – beginning with consumers
- Acknowledge and recognize the important role of aquatic foods in nourishing nations:
  - UN Nutrition Discussion Paper on Aquatic Foods
  - Blue Food Assessment

Improve Diversity in Production and Supply Chains of Aquatic Foods

- Diversified production systems
  - Polyculture of small and large fish
    - Homestead ponds, village water tanks, wetland water bodies
  - Integrated aquatic – terrestrial production systems
    - Aquatic foods – rice – vegetables
- Innovative solutions in supply chains
  - Solar drying tent
  - Solar-powered freezer

Include Aquatic Foods in Regional, National and State Policies

- Influence policymakers to include nutrition-sensitive aquatic food systems approaches in policies:
  - Bangladesh Second Country Investment Plan: Nutrition-sensitive Food Systems (2016-2020)
  - Strategy for Odisha's Pathway to Accelerated Nutrition (SOPAN)
- Build partnerships to strengthen policy changes and reforms:
  - South-South Cooperation
  - Universities / Research institutes
  - UN / International organizations
    - FAO
    - CGIAR

Engage Women in Aquatic Food Systems

- One in every two workers in primary and secondary sectors of aquatic food systems is a woman – more may be unaccounted for due to informal participation
- Evidence shows women's contributions are often undervalued, unpaid and overlooked
- Create space for women's inclusion through:
  - Policy interventions
  - Investments and research
  - Data and technology opportunities
  - Capacity building

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Promote Youth Engagement in Aquatic Food Systems

- Youth engagements are limited by significant risks including climate change, social and economic inequities, and political marginalization
- Policies and initiatives to promote youth engagements must be based on the pillars: **Rights, Equity, Agency and Recognition**
- Youth-centred innovation involves developing assemblages of old and new systems of knowledge and practice, with more democratic and inclusive governance and organization models

Read more: CFS HLPE Report 16 (2021): Promoting Youth Engagement and Employment in Agriculture and Food Systems

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Conclusion

- We must **recognize** the crucial role of aquatic foods in transformation towards sustainable, nutritious and equitable food systems
- We must **amplify** investments in research, innovations and scaling of aquatic food solutions at household, national, regional and global levels
- We must **empower** champions through capacity building, knowledge sharing and bridging digital divides to advance transformation in aquatic food systems

Holistic food, land and water systems transformation must build on the principles of sustainability and diversity to nourish all people and our planet.

WorldFish CGIAR

Thank You

WorldFish CGIAR

Session 1

The Challenges of Artisanal Fisheries and Aquaculture in the Sustainable Food Systems

Chairperson:

NAKASHIMA Kazuo

Program Director/Food, JIRCAS

The issues of artisanal fisheries and aquaculture in sustainable food systems in Southeast Asia

MIYATA Tsutom

Director, Fisheries Division

Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Dr. MIYATA Tsutom has been the Director of the Fisheries Division at JIRCAS since 2021. He received his Ph.D. at Tokyo University of Fisheries in 2006. He had been fisheries official and Chief Scientist of fisheries socioeconomics at Iwate Prefecture from 1994 to 2007, and head of research group on fisheries economics at the Fisheries Research Agency/Japan Fisheries Research and Education Agency from 2007 to 2021. His specialty is socioeconomics and management of fishery and marine product.

ABSTRACT

The expansion of intensive agriculture, livestock industry, and fisheries in pursuit of economic efficiency has further increased global greenhouse gas emissions, and has had a negative impact on the global food supply system, such as increased scale of natural disasters and erosion of coastal areas due to climate change. Therefore, we are conducting research and development of community-based artisanal aquaculture that maintains the ecosystem in collaboration with universities and research institutes in the Philippines, Myanmar, Thailand and Malaysia[1].

According to previous study in the Philippines, fishers in the research site were aware that their fishing grounds and fisheries resources had been deteriorating since the 1980s, therefore almost all fishers indicated the need for fishery management to be introduced in the site. However, most fishers indicated that they would not implement fisheries management until the main target fish stock was reduced to about half of its current level. Even though almost all of fishing households were getting poor and fishing was still their main source of income, they insisted on postponing the implementation of fisheries management[2].

A bottom-up fisheries management cannot be introduced without the agreement of almost all fishers. Therefore, implementation of fisheries management in the area was very difficult. This was due to the fact that the fishing regulations associated with fisheries management had avoided catch reduction, and the majority of fishermen believed that fishery resources would someday recover without the need to implement fisheries management by themselves[2].

These results led to the need for measures that will enable fisheries management with catch restriction to be implemented while generating alternative income. In addition, previous study showed that marine protected areas were effective in the Philippines[3]. Thus, it is highly recommended that measures should be taken to generate new income through oyster farming and to simultaneously make marine protected areas where ordinal fishing gears cannot be laid down by implementing oyster aquaculture facilities.

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[2] Miyata, T. et al. (2017) Consciousness of fishers for fisheries resources in poor fishing village: Case of Northern Panay Island, Philippines. *Journal of International Cooperation for Agricultural Development* **15**, 21-31 (in Japanese with English abstract).

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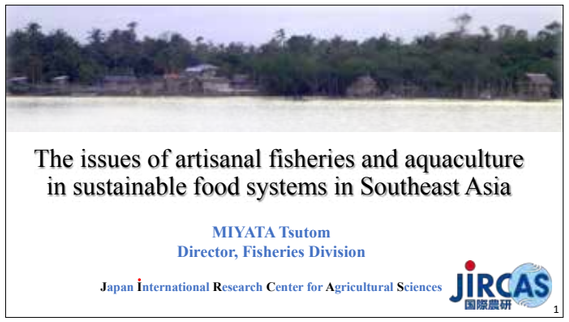

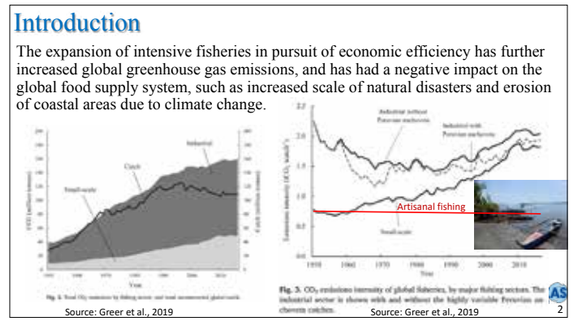

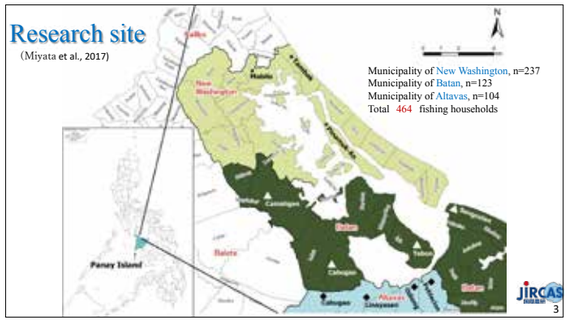

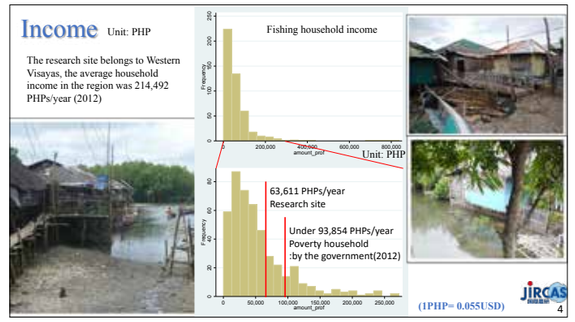

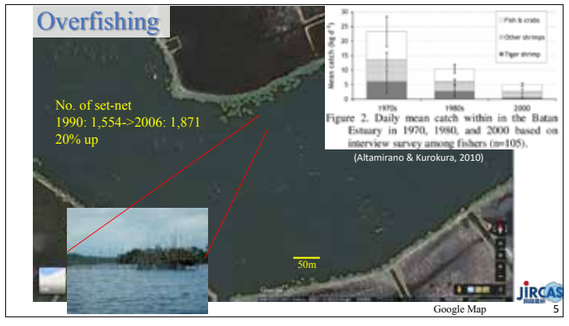

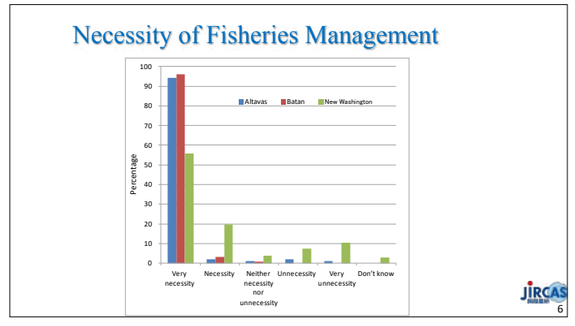

How many years/months can you tolerate the reduction in catch associated with the introduction of fisheries management?

Unit: Percentage

Year	0	1	2	3	4	5	10	don't	Amount
ALT	70	2	4	3	4	4	0	13	100
BATAN	87	1	1	1	1	1	2	7	100
NW	46	18	6	3	1	3	3	20	100
Amount	62	10	4	2	1	3	2	15	100

76%

ALT : Altavas,
NW: New Washington
Don't: Don't know

The result shows that it is too short to recover the resource, because it generally takes more than 3 years

7

Do you agree that there is no need to worry about the sea and the fish ?

Unit: Percentage

Degree	Strongly Disagree	Disagree	Somehow Disagree	No Opinion	Somehow Agree	Agree	Strongly Agree	Amount
ALT	10	36	6	0	8	24	17	100
BATAN	15	31	2	1	6	14	32	100
NW	15	41	4	1	5	20	15	100
Amount	14	37	4	1	6	19	20	100

Alt : Altavas
Nw : New Washington

55%

45%

They believed spontaneous recovery

8

Acknowledgments

This case study in the Philippines has been supported by the Research Institute for Human and Nature (Area capability project, No.14200061)

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13

Past >>>>>> Present

Believing spontaneous recovery

Measures for Improvement

Fisheries Management
- Input control
- Output control
- Technical control
- Marine Protect Area

Reducing catch amount

Poverty group

Too short fisheries management period

Alternative job and Income

Catch reduction

Income enhancement

9

Diners providing steamed oyster

Oyster road

Production area

←Oysters

Oysters →

10

Alternative income

Community-based MPA by oyster farm

Stock enhancement

(Miyata et al., 2017) 11

JIRCAS projects

Past project

12

Issues of sustainable aquacultural seedlings in Japan

SAKIYAMA Kazutaka

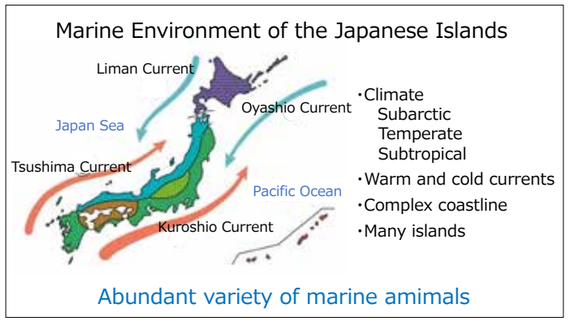
Director, Production Engineering Division, Aquaculture Research Department,
Fisheries Technology Institute, Japan Fisheries Research and Education Agency (FRA), Japan

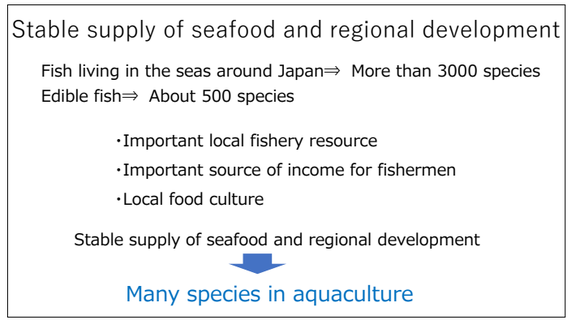
Dr. SAKIYAMA Kazutaka is the Director of the Production Engineering Division of the Fisheries Technology Institute, Fisheries Research and Education Agency. He was born in Nagasaki in 1965. He graduated from the Graduate School of Tokyo University of Fisheries and received a doctorate in fisheries from Nagasaki University. His research interests are seedling production for aquaculture and stock enhancement for fisheries. He is currently supervisor of technology development for bivalve aquaculture and breeding new fish species.

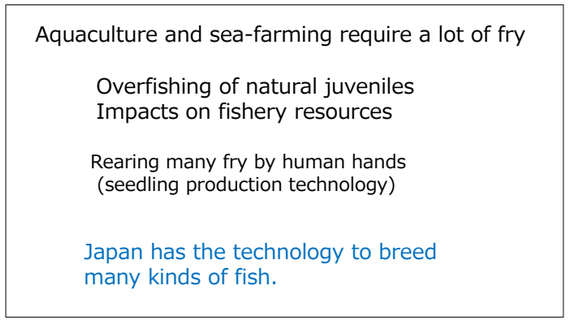
ABSTRACT

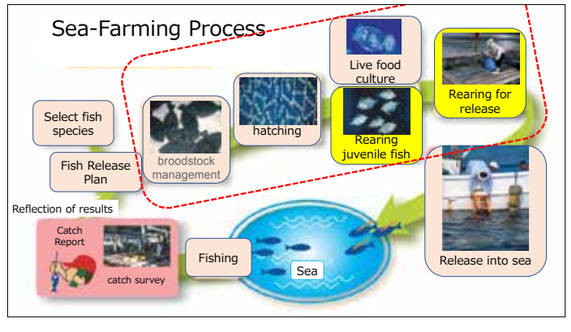
The Japanese archipelago, extending from north to south, is home to a variety of ocean regions ranging from subarctic to temperate to subtropical, with complex coastlines, and is interrupted by ocean currents such as the Kuroshio Current and Oyashio Current, making it one of the world's richest fishing ground and suitable habitat for a rich variety of fish and shellfish species. Since ancient times, the Japanese people have fished and used various types of fish and shellfish inhabiting each ocean region as food, and the current fishing industry and fish-eating culture have become well developed. In addition, in order to secure stable supplies of marine products and the sustainable development of the fishing industry, the release of young fish and the cultivation of fish, bivalves, crustaceans, and seaweeds are being conducted in many areas to maintain and increase resources. Currently, yellowtail, red seabream and scallop account for more than 50% of domestic production. Even the less abundant grouper species such as longtooth grouper and seven-band grouper, yellowtail amberjack, Japanese jack mackerel, chub mackerel, thread-sail filefish, filefish, Japanese sea perch, chicken grunt, striped beakfish, marbled rockfish etc. are also now available and highly valued in the Japanese markets. Although slightly different from aquaculture, capture-based aquaculture (short-term aquaculture) of Japanese spiny lobster, Japanese blue crab, common octopus, horned turban, Manila clam etc. has also been underway for quite some time.

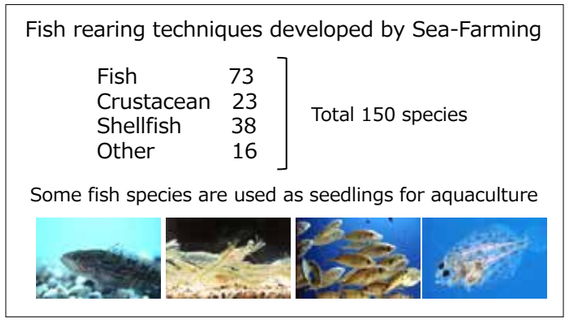
For sustainable development of aquaculture, it is important to secure a large and stable supply of artificial seeds rather than natural seeds. Currently, there are ongoing researches to achieve 100% artificial seedling production of yellowtail, eel and tuna, which are representative species for Japanese aquaculture. Similarly, technology to produce artificial seedlings is needed for new cultivated species. Fortunately, Japan has a number of seedling production technologies that have been developed through sea farming. Over the past 60 years, a total of 150 seedling production technologies for 73 species of fish, 23 species of crustaceans, 38 species of shellfish and 16 species of other marine seafoods have been developed so far. In recent years, new technologies such as closed recirculating aquaculture systems and LED lighting have been introduced, making it possible to produce seedlings of various fish species that were previously considered difficult to breed. In this symposium, we will introduce the technologies for producing seedlings of spotted halibut, common octopus, pen shell and hiziki, which are being researched and developed as new target species for release of seedlings and aquaculture.











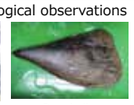
Important in the development of new fish seed production technology

Observation of larval ecology
Improve existing technologies to rearing techniques appropriate for each species

Introduction of new technologies
Important to appropriately improve on techniques developed for other fish species

Examples of ecological observations

Common octopus



Pen shell

Examples of introducing new techniques

Spotted halibut

Hiziki

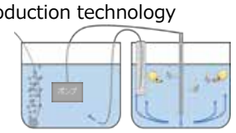
Common octopus seed production technology

hatching larvae

Octopus larvae (reaching the bottom)

Stable supply of food and rearing conditions unknown
One of the most difficult fish species to keep

Expected to be a future aquaculture species, but the major problem is cannibalism



Elucidation of water flow suitable for larval rearing

Swimming crab larvae "just after hatching" are effective as a food source

Survival rate of more than 90%

Vision for the future

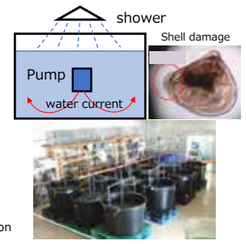
Increase and stabilize fishermen's income
Regional revitalization and creation of new industries
Stable supply of local fish
Food for tourism
Development of local aquaculture and sea-farming
Seed production technology for local specialty species

Pen shell seed production technology

Pen shell
Atrina pectinata

D-type larvae
100-150μm

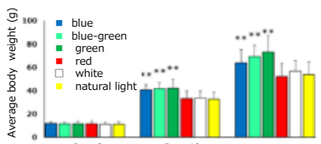
Mass mortality due to agglomeration and flotation



Rearing techniques using showers and water flow
Currently improving the technology to make it even better for stable production

Rearing techniques for spotted halibut juveniles

Spotted halibut (*Verasper variegatus*)



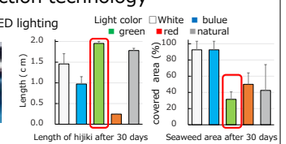
Breeding fry with various colors of light

- Green lighting is effective in promoting growth of spotted halibut
- Growth promotion effect by promoting feeding
- Conducted demonstration test of land-based aquaculture

"Hijiki" seed production technology

Hijiki *Hizikia fusiformis*

Breeding test with LED lighting



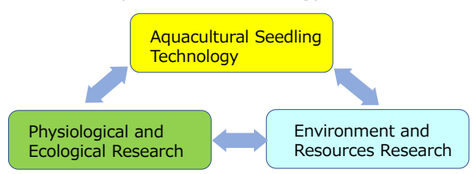
Suppression and removal of miscellaneous seaweeds

Removal of miscellaneous seaweed by fish

Reared with green LED lighting until the size of hijiki is 2 mm.

After 2mm, we devised a method to remove miscellaneous seaweeds with fish

Sustainable and appropriate development of seed production technology



Sustainable seed production technology requires collaboration with physiological ecology research and resource and environment research

Potential of seaweed utilization for greenhouse gas emissions reduction

Jeffrey T. Wright

Associate Professor, Institute for Marine and Antarctic Studies
University of Tasmania, Australia

Dr. Jeffrey T. Wright is an Associate Professor in seaweed biology, chemistry and ecology. His current research focusses on applied aspects of seaweed biology to support the sustainable production of seaweed for bio-products and to provide seedstock for restoration. His research also assesses the stability and resilience of seaweed and seagrass populations and their ecological roles as habitat-forming species.

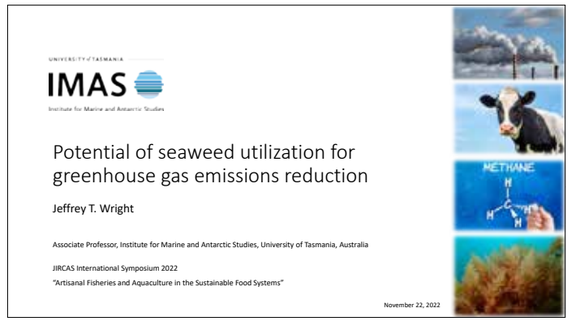
ABSTRACT

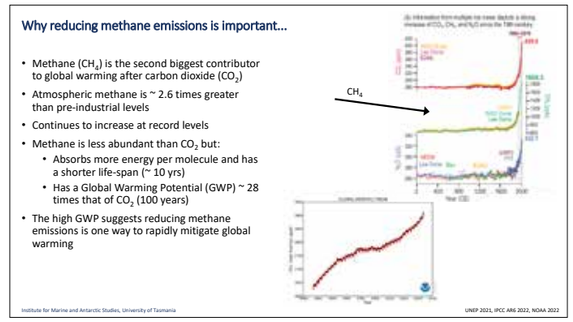
Methane is a powerful greenhouse gas that contributes significantly to global warming. Agriculture is the largest contributor to anthropogenic methane emissions (~ 40%) with emissions from livestock via enteric production the dominant process (~ 32% of anthropogenic methane emissions). Because methane has a short atmospheric lifetime of ~ 10 years compared to carbon dioxide, taking action to reduce atmospheric methane could result in rapid reductions in climate forcing. Consequently, a range of approaches to reduce methane emissions are being examined including a major focus on using feed supplements to inhibit enteric methane production in livestock.

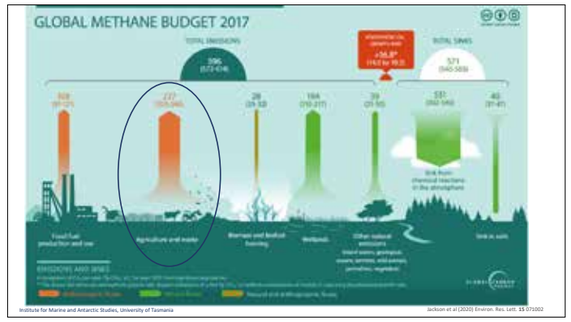
Of all the feed supplements tested, the red seaweed *Asparagopsis* demonstrates the highest potential to inhibit methane production in livestock. The two *Asparagopsis* species, temperate *A. armata* and tropical *A. taxiformis*, both produce bioactive compounds of which bromoform is the most abundant. Low doses (0.2-3% dry weight) of *Asparagopsis* incorporated into livestock feed reduces enteric methane production by up to 98%. Importantly, this reduction in methane by *Asparagopsis* is achieved with limited quantifiable effects on the animals or products bound for human consumption. However, in Australia alone, ~ 35,000 tonnes (dry weight) of *Asparagopsis* per year would be required to supply the ~ 1 million cattle feedlots. Until recently, cultivation methods for *Asparagopsis* were not well-established but in the last three years Australian seaweed companies have developed commercial-scale cultivation methods for *Asparagopsis*.

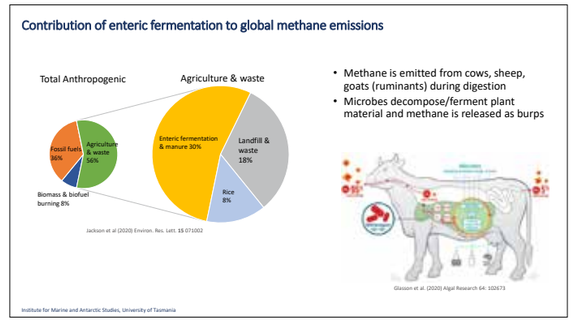
The life-cycle of *Asparagopsis* allows for both sea and land-based cultivation. The larger stage (gametophyte) can be cultivated at-sea attached to lines while the smaller stage (tetrasporophyte) can be grown in land-based tanks and ponds. Both stages can be cultivated via asexual propagation of fragments which grow rapidly and contain high concentrations of the bioactive bromoform. For the gametophytes, naturally occurring 'barbs' on fragments are used to hook the fragments onto lines which are placed at sea. For tetrasporophytes, free-floating fragments and placed in tanks at optimal densities. For both stages, identifying the best propagule type and size appears important to maximizing production. Both stages also reproduce sexually via spores which provides an alternative seeding method for cultivation.

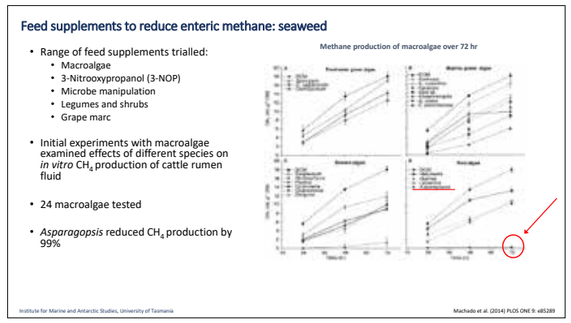
Although *Asparagopsis* represents a significant opportunity, and despite rapid progress, the *Asparagopsis* industry is in its early stages and optimisation of these methods is ongoing. Moreover, there are still many knowledge gaps surrounding its cultivation and future directions will be discussed.

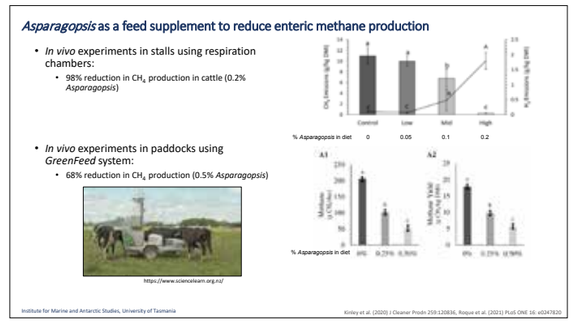












Asparagopsis: background biology

- Two *Asparagopsis* species being cultivated:
  - *A. taxiformis* (warm temperate-tropical)
  - *A. armata* (temperate)
- Life-cycle: two free-living stages
- Reproduction: sexual (spores) and asexual (fragmentation)
- Gametophytes of *A. armata* have barbs for fragment attachment


A. taxiformis - gametophyte

A. armata - gametophyte


A. armata - tetrasporophyte

Asparagopsis: background biology

- Two *Asparagopsis* species being cultivated:
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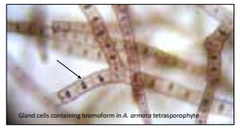
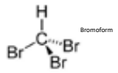
  - *A. armata* (temperate)
- Life-cycle: two free-living stages
- Reproduction: sexual (spores) and asexual (fragmentation)
- Gametophytes of *A. armata* have barbs for fragment attachment
- Produce bioactive compounds (bromoform) that inhibit enzymes that produce methane during digestion in ruminants


Gland cells containing bromoform in *A. armata* tetrasporophyte



Bromoform


A. taxiformis - gametophyte

A. armata - gametophyte


A. armata - tetrasporophyte

Asparagopsis aquaculture*:* challenges and opportunities

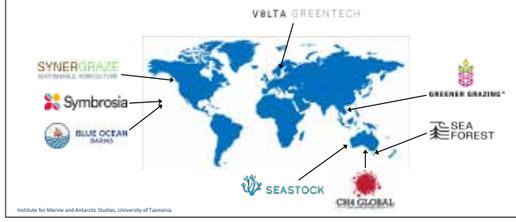
- Closing of life-cycle for production – commercial sensitivities, information not publicly available
- Improvements to seeding/hatchery/production methods – industry is in its infancy
- Strain selection and/or selective breeding for high-performing strains
- Limitations on access to the ocean (space restrictions for ocean farming of gametophytes)
- Scale of production required
  - Examples of estimated biomass needed (examples):
    - To supply 100% of Australian beef feedlot cattle (1.1 million cattle) ~ 29,000 tonnes dwt / yr (Agrifutures 2022)
    - To supply 20% New Zealand dairy herd (1.26 million cattle) ~ 25,000 tonnes dwt / yr (Glasson et al. 2022)

Asparagopsis aquaculture*:* summary

- Methane is a significant contributor to global warming
  - Enteric methane produced by ruminants contributes ~ 30% of anthropogenic methane emissions
- Feeding ruminants small amounts of *Asparagopsis* reduces methane emissions by ~ 65-98%
- Mass cultivation of *Asparagopsis* is feasible but is in its infancy
- Significant opportunities to optimise production of *Asparagopsis* to meet global demand

Asparagopsis: aquaculture

- All companies started since 2018
- A number of companies licensed to grow *Asparagopsis* for use as a feed supplement to reduce livestock methane emissions – and several are making good progress on cultivation and are selling it



Asparagopsis aquaculture: land and sea-based production

- Land-based for *A. armata* and *A. taxiformis* tetrasporophytes

- Sea-based for *A. armata* gametophytes


A. armata Sea Forest


A. armata Sea Forest

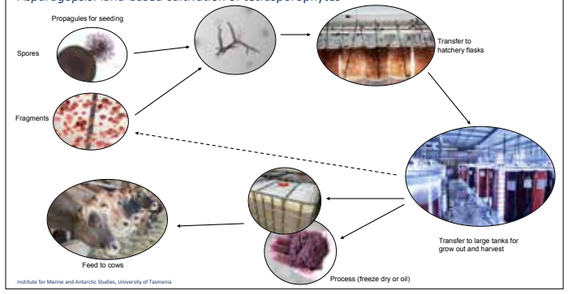

A. taxiformis Blue Ocean Barns


A. taxiformis Greener Grazing

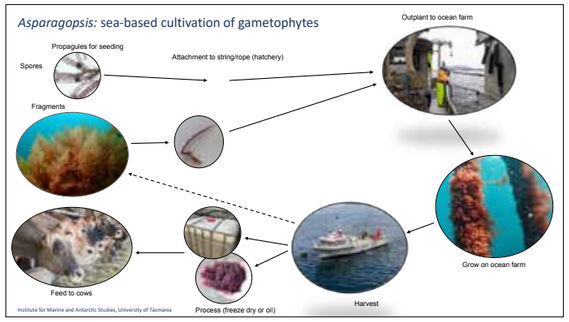
UNIVERSITY of TASMANIA

Thank you

Asparagopsis: land-based cultivation of tetrasporophytes



Asparagopsis: sea-based cultivation of gametophytes



Session 2

Research and Application to Enhance Sustainability and Productivity of Artisanal Fisheries and Aquaculture

Chairperson:

KANAMORI Norihito

Project Leader/Information Hub, JIRCAS

Development of sustainable bivalve aquaculture technology adapted to tropical monsoon region

YURIMOTO Tatsuya

Senior Researcher, Fisheries Division

Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Dr. YURIMOTO Tatsuya has been a Senior Researcher of the Fisheries Division at JIRCAS, from 2010 to 2016 and from 2020. He graduated with a master's degree from Kitasato University and a doctorate degree from Nagasaki University (Ph.D. in Fisheries Science). He had been a Researcher and a Senior Researcher at Seikai National Fisheries Research Institute, from 1999 to 2010 and from 2016 to 2020, respectively. His main research subject is coastal environment and bivalve biology.

ABSTRACT

Blood cockle (*Tegillarca granosa*) farming on the west coast of Peninsular Malaysia is carried out by collecting naturally occurring young spats in mud flats and sowing them to management farming plots owned by farmers. Since it is non-feeding extensive simple aquaculture, the farming materials and costs are less than those for hanging aquaculture, and small-scale farmers can easily start farming even with a small budget. However, this aquaculture has the drawback of being susceptible to changes in the natural environment[1,2]. First, the occurrence of planktonic larvae depends on the biomass of the adult cockles and natural conditions such as coastal topography, ocean currents, weather etc. In the case of this species, the full-grown larva does not settle to adhering substance during the transformation from planktonic to benthic stages, and starts benthic life directly on the surface sediment of the muddy bottom. For this reason, its distribution is easily affected by currents even in the benthic stage, and it is suggested that the early spats move and accumulate in the low current area with the fine mud. However, this spats collection site is not necessarily a suitable habitat environment (too soft bottom, high turbidity etc.) for the subsequent survival of the cockles. The early spats are raked up by farmers, transplanted to suitable bottom-condition plots, and cultivated with favorable growth and survival rates. In addition, as cultured cockles grow, organic matters are ingested in their bodies and CO_2 is fixed as calcium carbonate in shells, and these substances are also transported to land upon harvesting. Therefore, the activities of farmers play an important part in the substance cycle of coastal ecosystems.

Considering the above, it can be said that blood cockle farming can be an environmentally friendly sustainable aquaculture. However, there are still problems to be solved to realize its sustainability, and it is important to sustain the reproductive adult population of blood cockles and to maintain not only the coastal but also the terrestrial environments such as rivers. To realize this, it is important to have an organizational community for farmers to work together, and a system for environmental management from land to coastal areas based on mutual agreement and cooperation between fishermen, government, researchers and citizens. In recent years, the Malaysian Fishermen's Community (myKP) has been organized and has begun efforts to scientifically evaluate and redefine farming plots set up by the government. In addition, through joint research of JIRCAS and the Fisheries Research Institute Malaysia (FRI), a method has been developed that allows fishermen to rapidly evaluate the habitat conditions of the blood cockles during the aquaculture process using simple tools (calliper, scale)[3]. In addition, as part of coastal environmental management, activities for marine litter countermeasures have been started in cooperation with citizens. These activities are also in line with the "Sato-umi" concept that spread from Japan and are expected to lead to the realization of sustainable aquaculture in the tropical monsoon region[4].

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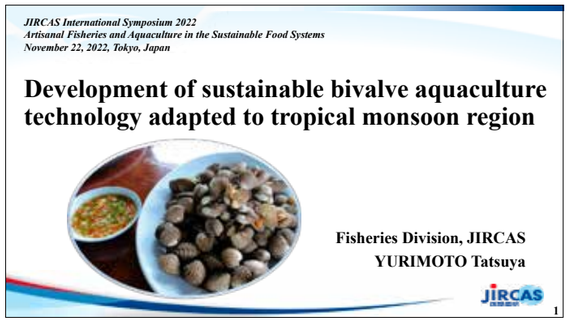
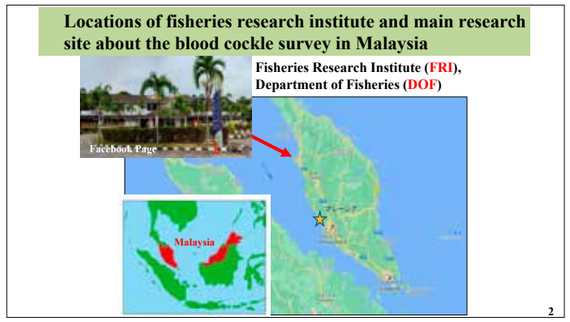
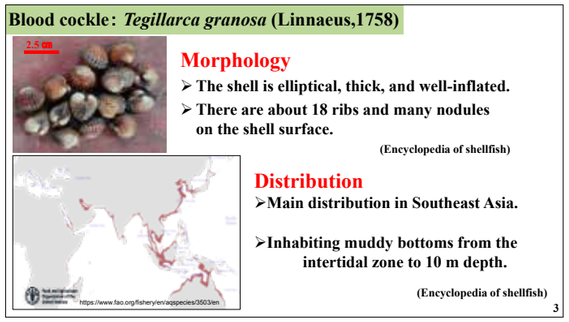
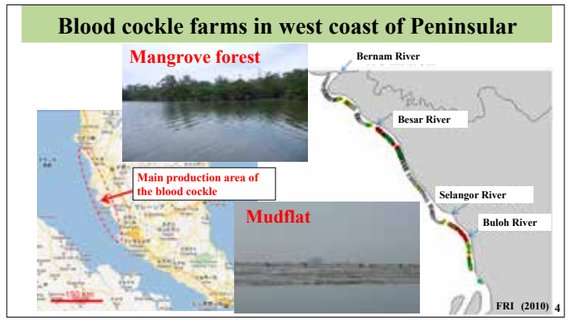
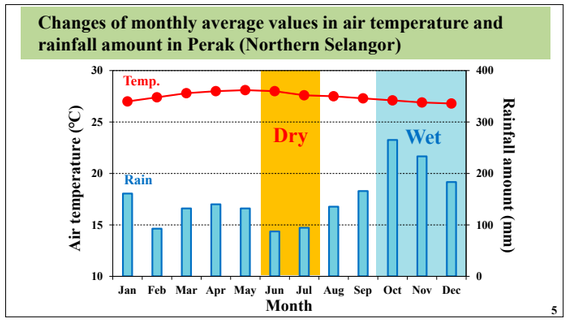
[2] Yurimoto, T. et al. (2021) *Fish. Aquat. Life* **29**, 230-238.
[3] Saito, H. & Wooi, T.H. (2020) *Malaysian Fish. J.* **19**, 21-46.
[4] Yurimoto, T. (2020) *Malaysian Fish. J.* **19**, 1-20.

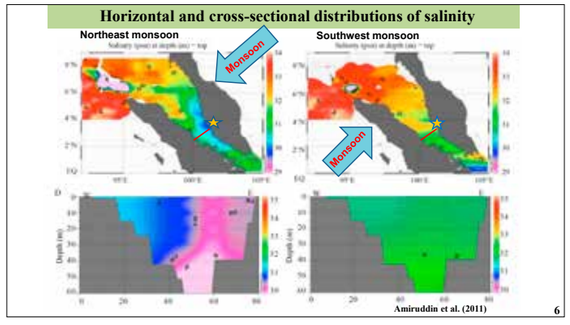






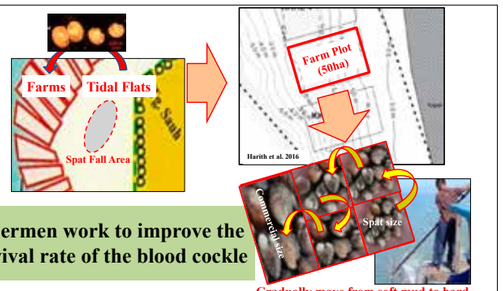






Sowing aquaculture of the blood cockle in Selangor

7

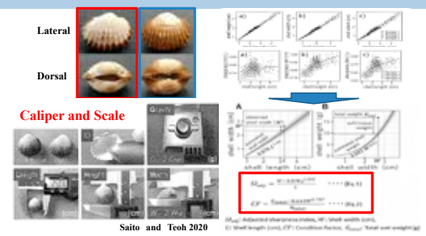


Fishermen work to improve the survival rate of the blood cockle

Gradually move from soft mud to hard mud depend on the growth size.

8

Simple evaluation index for the blood cockle physiological condition



➢An easy estimation method without destroying the shells to estimate the growth and physiological condition.

13

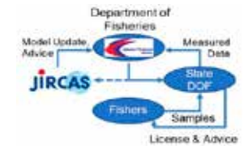
Additionally

➢Simple tools and methods which fishermen can use and evaluate.

➢This index is used for identifying a suitable farming area.

This method will lead to fishing ground management for stabilizing blood cockle farming.

Study meeting on blood cockle farming with local fishermen and FRI

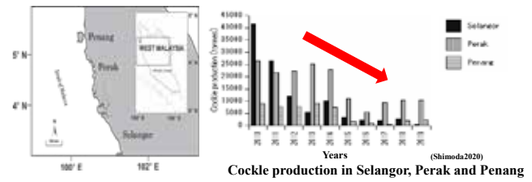


Collaboration system for the evaluation

Saito and Teoh 2020

14

Blood cockle production on the west coast, Peninsular Malaysia

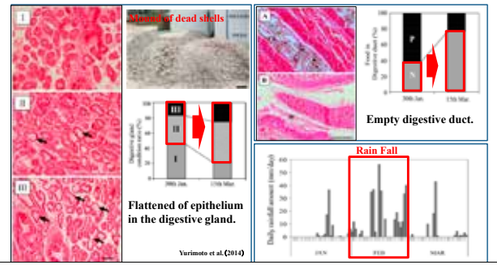


Cockle production in Selangor, Perak and Penang

- What is the reason for the decrease?
- What are the countermeasures?
- Environmental and biological surveys are important.

9

Occurrence of mass mortality event of the blood cockle in southern Selangor, 2012



10

Online News Paper (Mar.2020)

Revival plans

➢DOF plans to rearrange the farming plots to revive blood cockle farming.

➢Through the survey, DOF will identify the spat abundant areas and the suitable aquaculture sites.

➢To raise awareness of coastal litter, the DOF works with fishermen's associations (myKPs), primary school pupils, Forestry Department, and the Fisheries Development Authority to implement a nationwide program of action.

15

Thank you for your attention.

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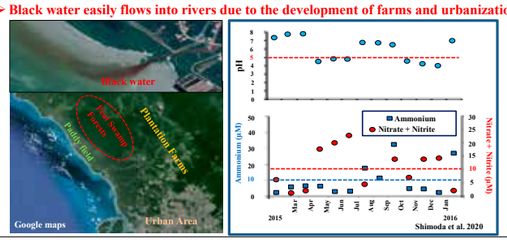
16

Water quality survey around Selangor coast

➢ Peat swamp forests exist on the west coast.

➢ It is called “black water” from its color, it is low pH, low dissolved oxygen, and rich in tannins.

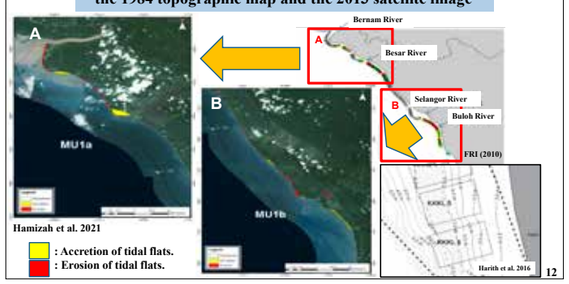
➢ Black water easily flows into rivers due to the development of farms and urbanization.



Shimoda et al. 2020

11

Difference in coastal topography from a comparison of the 1984 topographic map and the 2013 satellite image



Hamizah et al. 2021

: Accretion of tidal flats.

: Erosion of tidal flats.

Harith et al. 2016

12

Management, production and utilization of small indigenous species “Zako” for nutritional improvement in rural areas and biodiversity conservation in inland Southeast Asia

MORIOKA Shinsuke

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University of Human Environments, Japan

Dr. MORIOKA Shinsuke obtained his doctoral degree from the Graduate School of Tokyo University of Fisheries in 1993. From 1993 to 2006, he worked as a JICA Expert, mainly in Africa (Madagascar, Malawi). From 2006 to 2022, he was a Senior Researcher / Project Leader at JIRCAS, conducting research activities mainly in Southeast Asia (Laos, Thailand, Malaysia). He moved to his current post from 2022. His main areas of expertise are aquaculture and fish ecology.

ABSTRACT

Recent commercial aquaculture development in Southeast Asia has contributed to both economic growth and improvement of national food security. On the other hand, health problems, e.g., stunting in children younger than 5 years old and prevalence of anemia in women of reproductive age (15–49 years old), still remain unsolved particularly in rural inland areas[1]. These symptoms are considered to be attributable to deficiencies in micronutrients and vitamins[2]. In order to reduce the above health concerns, increase in intake of small fishes with high minerals and vitamins is strongly recommended[3].

In addition to the nutritional improvement, small indigenous fishes are important components from the point of view of biodiversity conservation. However, because of the impact of introduced alien species[4] and the aquacultural development of hybrid/alien fishes[5], there is increasing concern regarding the substantial risk of loss of regional biodiversity[6]. This situation has led to the necessity for aquacultural development, stock assessment and multiplication of indigenous fish species.

With the above background, management, production and utilization of small indigenous species "Zako" are important key issues for nutritional improvement and biodiversity conservation. In recent years, biological and aquaculture-related studies of several "Zako" species have progressed[7] and technical improvements in their efficient/value-added utilization are also ongoing[8]. However, considering the diversity of unexploited "Zako" species as well as a large number of residents under health risks due to micronutrient/vitamin deficiencies in Southeast Asia, further investigations of their biology, aquaculture and processing techniques contributory to management, production and utilization are required.

[1] Pahlisch, T.H., Parvathi, P. & Waibel, H. (2017) TVSEP Working Paper, No. WP-005, Leibniz Universitaet Hannover, Institute of Development and Agricultural Economics, Hannover, Germany.
[2] Ernawati, F. et al. (2021) *Nutrients* **13**, 1802 (https://doi.org/10.3390/nu13061802)
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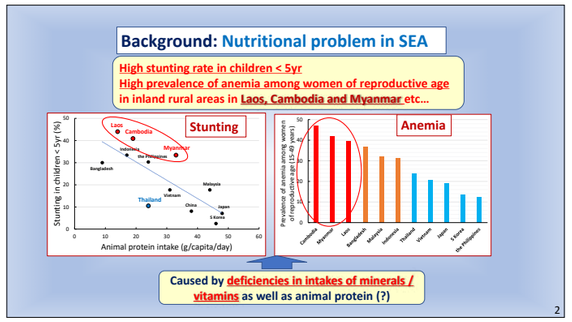
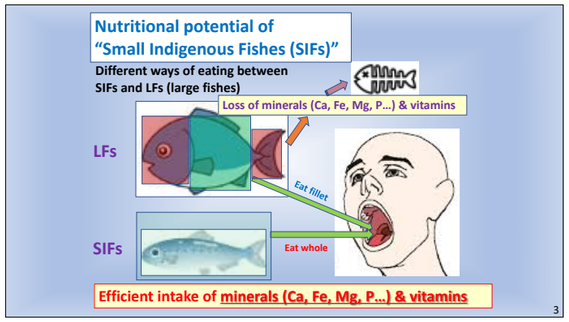
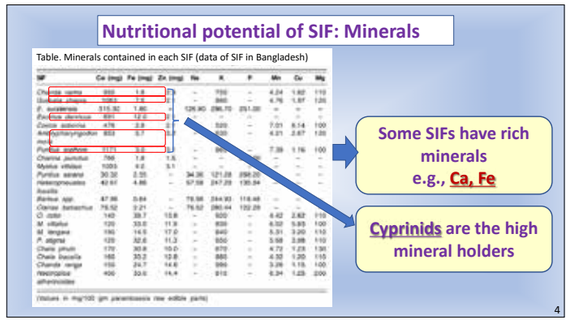
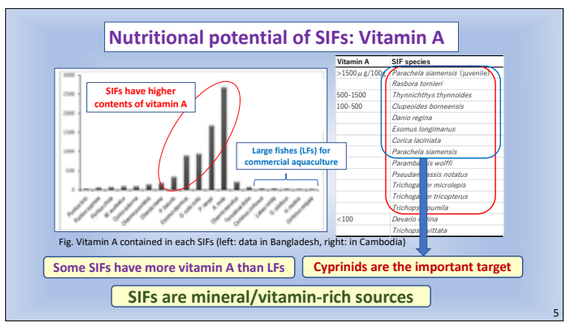
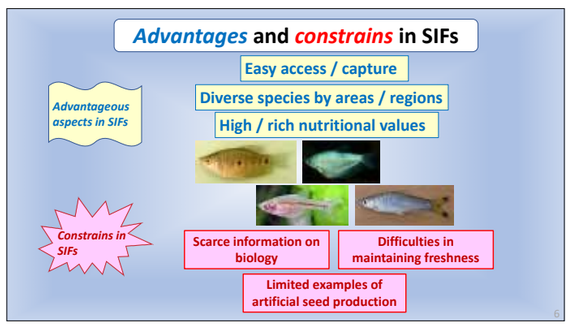
[4] Welcomme, R.L. & Vidthayanon, C. (2003) Technical Paper No. 9, Mekong River Commission, Phnom Penh, Vietnam.
[5] Na-Nakorn, U. et al. (2004) *Aquaculture* **240**,145–163.
[6] De Silva, S.S et al. (2009) *AMBIO A Journal of the Human Environment* **38**, 24–28.
[7] Ahamed, F. et al. (2017) *International Journal of Fisheries and Aquatic Studies* **5**, 336–339.
[8] Marui, J. et al. (2021) *Journal of Food Protection* **84**, 429–436.

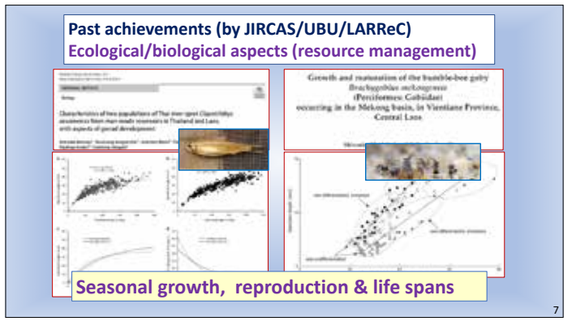


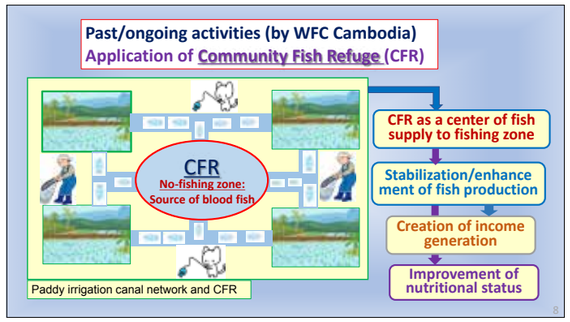


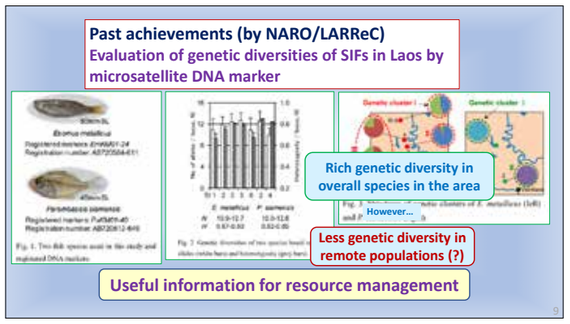


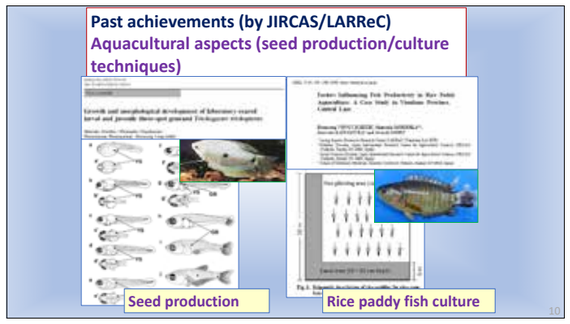


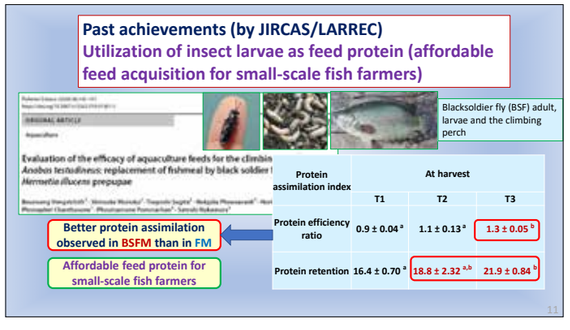


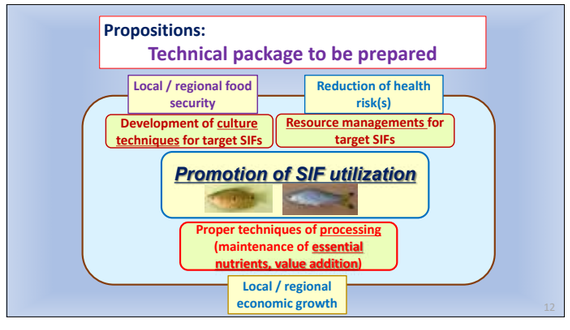












Improving artisanal fisheries through community-based prawn stock enhancement in a mangrove estuary

Jon P. Altamirano

Scientist and Head, Farming Systems and Ecology Section, Research Division
Southeast Asian Fisheries Development Center,
Aquaculture Department (SEAFDEC/AQD), Philippines

Dr. Jon P. Altamirano is a Scientist at the SEAFDEC Aquaculture Department in the Philippines. He leads the Program on "Maintaining Environmental Integrity through Responsible Aquaculture" and heads the Farming Systems and Ecology Section of the Research Division. He currently specializes on sea cucumber research for practical aquaculture applications. He also worked on the stock enhancement of shrimps that integrates environmental and social aspects. Along these fields, Dr. Altamirano is active in collaborative research with various national and international institutions and has, so far, led and co-authored more than twenty scientific journal articles, books and technical manuals. Aside from disseminating his research results in dozens of international conferences, Dr. Altamirano also lectures in technical training courses and academic symposia. He actively advises both graduate and post-graduate students in the fields of aquaculture and fisheries. Dr. Altamirano finished his bachelor's degree in Fisheries from the University of the Philippines Visayas in 1999, and has sequentially completed his master's and Ph.D. studies at the University of Tokyo, Japan from 2005 to 2010.

ABSTRACT

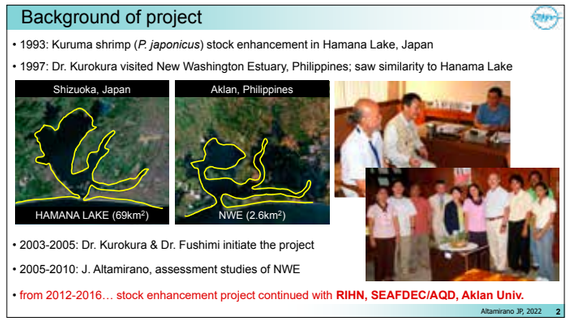
Tropical seafood, especially prawns, have always been in high demand with high market prices. Because of this, wild prawn resources are often overfished as indicated by the increasing number of fishers, but with overall declining catch volume and sizes through the years. Prawn aquaculture has, as of course, significantly contributed to the total yield in the past decades. However, the expansion of farms and ponds has often negatively affected the natural nursery grounds in the estuaries and mangroves. The economic gains from aquaculture are limited only to those who invested. However, local communities and artisanal fishers are often deprived of such gains. They are still reliant upon the dwindling natural stocks of fisheries resources. This is where the concept of stock enhancement comes in, wherein hatchery-produced juveniles are released into the water body in order to increase capture fisheries yield for local fishers[1].

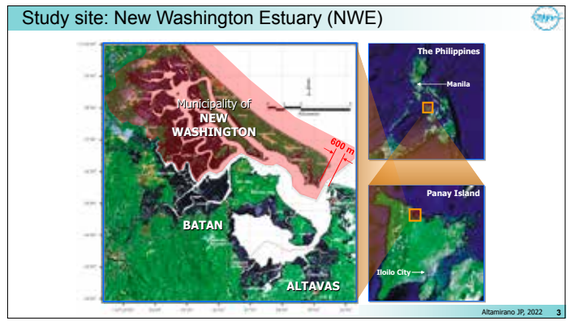
In this talk, I will present the case of the tiger prawn Penaeus monodon stock enhancement in the New Washington Estuary (NWE), in Aklan, central Philippines. The NWE was a productive fishing ground providing >24 kg/gear/day of catch in the 1970s but steadily declined to <0.7 kg/gear/day in 2010s. Prawn catches declined both in quality and quantity[2]. Meanwhile, mangrove cover was reduced from 4800 ha in 1950s to only <800 ha in 2010s. Site-specific studies were conducted in NWE on prawn nursery rearing, small-scale release and monitoring experiments, as well as social assessments. Our studies produced essential scientific data to guide future stock enhancement activities in NWE. Even at an experimental scale, our releases showed significant increases in catch by at least 8% but can potentially increase daily income by >400%[3]. However, in order to sustain the prawn fisheries and optimize the benefits, long-term management plans by all stakeholders are needed, especially between the communities and the local government.

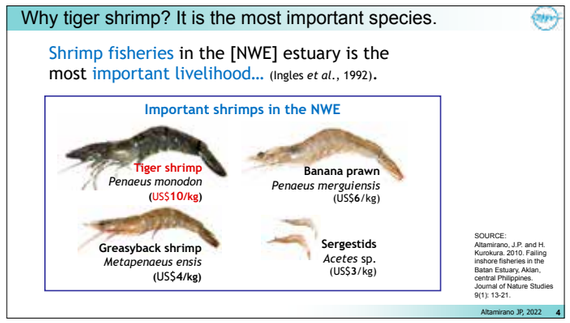
[1] Altamirano, J.P. & Meñez, M.A.J. (2021) Resource enhancement: Concepts, learnings, and future directions. In: Aya, F.A., de la Peña, L.D., Salayo, N.D., Tendencia, E.A. (Eds.) *Proceedings of the International Workshop on the Promotion of Sustainable Aquaculture, Aquatic Animal Health, and Resource Enhancement in Southeast Asia*. Iloilo, Philippines, 70-87.

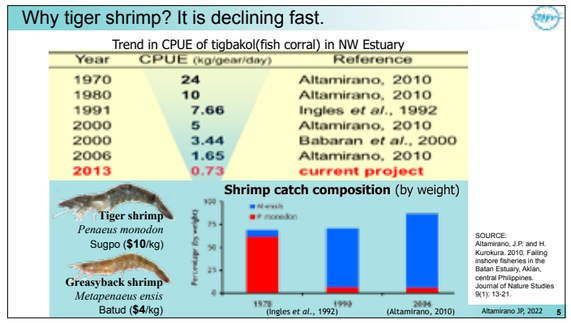
[2] Altamirano, J.P. & Kurokura, H. (2010) Failing inshore fisheries in the Batan Estuary, Aklan, central Philippines. *Journal of Nature Studies* 9(1): 13-21.

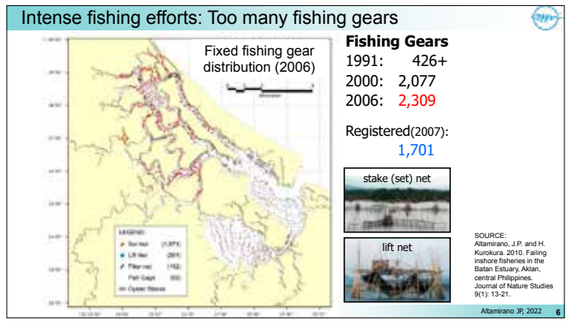
[3] Altamirano, J.P. et al. (2015) Stock enhancement for coastal socio-ecological restoration. In: Eguia, M.R., Salayo, N.D., Estepa, F., Ramos, M.J.H. (Eds.) *Proceedings of the International Workshop on Resource Enhancement and Sustainable Aquaculture Practices in Southeast Asia*. Bangkok, Thailand. 159-167.



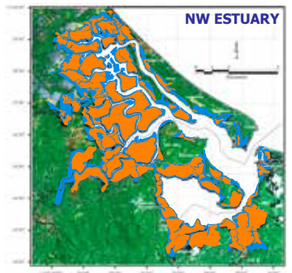








Nursery mangroves disappeared.



1953:
4,800 ha mngrv
0 ha ponds

1988:
4,200 ha mngrv
400 ha ponds

2008:
800 ha mngrv
4,000 ha ponds

SOURCE:
Altamirano, J.P., J.H. Primavera, M.R.N. Banaticla, and H. Kurokura. 2010. Practical techniques for mapping small patches of mangroves. Wetlands Ecology and Management 18(6): 707-715.

Project objectives

1. Increase fisher's income
- tiger shrimp is most important (expensive)

2. Reduce number of fishing gears
- even with less gears, sales can be improved by more expensive tiger shrimps

3. Promote mangrove rehabilitation
- awareness of nursery function of mangroves

Methods

PREPARATION — 2012-2013
Social Survey (Baseline)
Actual catch monitoring (baseline)
Site Selection & Preparation

PRODUCTION & CULTURE — 2013-2015
Broodstock sourcing/Larval rearing
Disease & quality check
Intermediate culture
Stock monitoring (survival & growth)

RELEASE & MONITORING — 2014-2015
Water quality & disease check
Tagging and release
Catch monitoring

FEEDBACK/ASSESSMENT — 2015-2016
Social survey & Community meeting
Fisheries impact assessment
Socio-economic impact assessment

Methods: Social Preparation (2005 – 2015)

Methods: Scientific evaluations

Site- & species-specific studies:
(New Washington Estuary (NWE) using *P. monodon*)

1. Source of stocks?
Field surveys → confirmed presence of local shrimp hatcheries

2. Location for intermediate culture?
Life stage and environmental profiling → upper mangrove estuary

3. Size/age at release?
Intermediate culture trials → 30 d to grow >0.5 g shrimps

4. Stocking density for initial rearing?
Multiple culture trials → 30-60 shrimps m^{-2} for 30 d

5. Schedule and timing for release?
Climate review → April-June (lesser chance of typhoon)

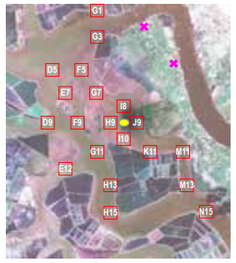
Methods: Participatory approach

Establishment and operation of intermediate culture area together with community

Methods: Participatory approach

Monitoring catch from 20 monitoring zones with local fishers (□)

Parallel monitoring:
1. Other fishing gears
2. Catch landings at 3 sites (✖)



= intermediate culture site

Results: Baseline shrimp catch per day

SOURCE:
Altamirano, et al., 2015. Community-based shrimp stock enhancement for coastal socio-ecological restoration in the Philippines. In: IWRESA 2014 Proceedings (159-167)

Results: How to increase income?

Present status:

Min. target income: PhP 235/d (Poverty Line, 2013)

Sales from shrimp: **PhP 34** /gear/d (ave.)

Ave. gears/family: **5** gears @ P34/gear
(PhP 170 total income)

Results: How to increase income?

Present status: P34/gear (total shrimp sales)

Hypothetical* catch of tiger shrimp after stock enhancement

Shrimp Size (CL, BW)	Price (PhP·kg⁻¹)	Scenario 1: 2 months after release (pieces) weight, price	Scenario 2: 3 months after release (pieces) weight, price
3-4cm, 15-35g	300		(15) 450g, PhP 135
2-3cm, 5-15g	150	(60) 900g, PhP 135	
1-2cm, 1-5g	60		
<1cm, <1g	20		
TOTAL:		900g, PhP 135	450g, PhP 135

At 4% recovery after 2 months

At 1% recovery after 3 months

Note: US$1 = PhP42.50 (2013 annual average) *Assumptions: 500,000 shrimps released; 330 potential fishers

Altamirano, et al., 2015. Community-based shrimp stock enhancement for coastal socio-ecological restoration in the Philippines. In: IWRESA 2014 Proceedings (159-167)

NOTE:
In Japan, recovery rates for shrimp releases was only about 5% (Hamasaki and Kitada, 2006).

Results: How to reduce number of gears?

Present status:

Min. target income: PhP 235/d (Poverty Line, 2013)

Sales from shrimp: **PhP 34** /gear/d (ave.)

Ave. gears/family: **5** gears @ P34/gear
(PhP 170 total income)

New scenario: (catch of tiger shrimps)

Sales from 1 gear: **PhP 135/d** (tiger shrimp only)

Reduced gears: **2 gears (PhP 270/d)**

Results: intermediate culture, tagging, release

2013 July: 1st rearing (129,000 stocked)
Aug: No release (high mortality)

2014 Feb: 2nd rearing (390,000 stocked)
April: **15,000** released (4%); 100 tagged

2014 June: 3rd rearing (270,000 stocked)
July: **120,000** released (44%); 240 tagged

2014 Nov: 4th rearing (400,000 stocked)
Dec: Series of typhoons caused mortality

2015 Apr: 5th rearing (483,000 stocked)
May: **250,000** released (51%); 250 tagged

Different color tags for different release batches

Results: Catch monitoring

Recapture info (5th batch)

Released: May 2015
Total released: 250,000
Shrimp tagged: **250 (0.1%)**

Total recovery: 20 pcs **(8%)***
Details: July (8 pcs), 5 g (3 %)
Aug (4 pcs), 15 g (1.6%)
Sep-Oct (8), 55 g (3%)

Estimated total potential harvest:
(4 months after release):
1,100 kg (PhP220,000)

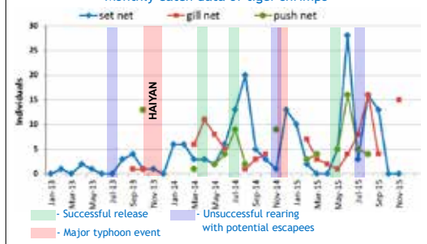
NOTE:
In Japan, recovery rates for shrimp releases was only about **5%** (Hamasaki and Kitada, 2006).

* Many more recaptured shrimps may not have been reported by other fishers

Altamirano, et al., 2016. Aquaculture-based Restoration and Stock Enhancement of Tiger Shrimps in the Philippines.
In: Proceedings of the Symp on Strat for Fish Res Enhance in the SEA Region. 166-170.

Results: Catch monitoring

Monthly catch data of tiger shrimps



- Baseline data, only <2 shrimps/per gear
- Typhoons reduced catch
- Successful releases increased catch (>20), but temporary
- Unintentional escapees increased catch (4-13)
- Haiyan (super typhoon) reduced number of gears; improved catch

Altamirano, et al., 2016. Aquaculture-based Restoration and Stock Enhancement of Tiger Shrimps in the Philippines.
In: Proceedings of the Symp on Strat for Fish Res Enhance in the SEA Region. 166-170.

Thank you

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Results: Catch monitoring

Overall improvement of shrimp catch after stock enhancement (experimental scale)
(pooled from 20 fixed set net/*tigbakol* stations)

* 2015 catch only from January-August 2015

Results: Community life conditions improved!

Perceived conditions (1<10 scale)*

	2013	2015
Average income (month)	~PhP 7,000	~10,000
Living condition	**4.9**	**5.1**
Catch (Shrimps)	**2.6**	**2.9**
Catch (Fish / Shells)	**3.1**	**3.7**

*Salayo et al., 2015 RIHN Project Update

Summary

- NWE was overfished and mis-regulated fishery
- Shrimp stock enhancement can (1) increase income; and (2) promote reduction of fishing gears
- Stock enhancement trials increased catch with higher recovery (8%++) than expected (1-4%)
- Community perceived an increase in life condition

Recommendation

- **Partnership** with a **local** community organization with strong leadership
- Sufficient **social preparation** and capacity building
- Active **community participation** (planning → implementation)
- **Reliable** scientific **baseline** information
- **Site-specific** and **species-specific** assessments and studies
- **Multi**-institutional/sectoral **collaboration** (e.g. community; government)
- **Long-term** management **plans** (fisheries management)
- **Long-term commitment** of partners (technical and financial support)
- **Government support** for **large-scale** sustained releases

Panel Discussion

Panel Chair:

Marcy N. Wilder

Project Leader, Research Application/Ventures, JIRCAS

Speakers:

YAGI Nobuyuki

The University of Tokyo

Shakuntala Haraksingh Thilsted

WorldFish

MIYATA Tsutom

JIRCAS

SAKIYAMA Kazutaka

FRA

Jeffrey T. Wright

University of Tasmania

YURIMOTO Tatsuya

JIRCAS

MORIOKA Shinsuke

University of Human Environments

Jon P. Altamirano

SEAFDEC/AQD

Marcy N. WILDER:
Thank you. Distinguished participants, thank you for your attendance today. We hope that you enjoyed today's presentations from our eight distinguished speakers. Briefly, to reiterate the goal of today's symposium, we at JIRCAS are determined to promote the further development of blue foods and contribute to the realization of the relevant SDGs. With this goal in mind, we have convened today's symposium to showcase how we can assist small scale artisanal fishers, fish farmers and agriculture workers to scientific research and exchange and thus contribute to poverty alleviation and economic development. I would like to take this opportunity once again to thank our speakers for sharing with us today their research findings and their views on how we can realize these goals. Without further ado, I would now like to initiate the panel discussion. Briefly, today's format will be: First, we will have one round of questions from the moderator to each panelist. Next, we have received several questions in advance. I will read these aloud and ask the comments, I'll ask the panelists to comment briefly. And finally, we will open up the floor to the audience. So please feel free to ask your question in either English or Japanese. And before stating your question or comment, please identify yourself, with name and affiliation and wait for the hall attendant to bring you a microphone.

So thank you. And the first question will go to keynote speaker Dr. Yagi. In your keynote speech you have discussed the FAO's voluntary guidelines for securing sustainable small-scale fisheries. You have also given some examples of small-scale activities in Japan, such as that of the Notsuke Fisheries Cooperative Association. Could you say a bit more about how we in Japan, drawing from such experiences, can work towards being successful in other parts of the world?

YAGI Nobuyuki:
Thank you very much. It's a very good question. I think the best use of the local resources such as the human organization or local knowledge or local environment, that is a key to be successful in the establishment of small-scale fisheries in other countries. In other countries, because of the diversity of the people's attitude towards nature or the natural conditions, we cannot just transfer the Japanese way of fisheries or aquaculture to other countries. Other countries, they have their own natural settings and human organizations. So, we need to respect that, the local situation. That is a quick answer from me. Thank you.

Marcy N. WILDER:
Thank you very much. The next speaker, to keynote speaker, Dr. Thilsted. You have enlightened us as to just how important aquatic foods are to achieving sustainable development and assuring that nutritional needs for all people are met. As you have stressed, it is important to engage everyone in these efforts. Could you elaborate a bit more on how important, how to inspire more women and youth to engage in careers or work opportunities relating to aquatic food systems?

Shakuntala Haraksingh THILSTED:
Thank you so much for that question. I think it's important and yes it's important within Food and Agriculture sectors but extremely important within the aquatic systems where we've seen the ages of those who are presently engaged in aquatic food systems is pretty high. And if we want it, interest youth and also young women to go into the different fields of studies, then it is important that they choose to study, for example, aquaculture and fisheries, food and agriculture. And we have seen in recent years that the number of young people who are attracted to these fields of studies, for example universities and colleges, is falling and therefore we must make these fields of study much more attractive for them to choose. One way I do think we can do that is looking at the types of from the

ways that we educate young people and in the field of aquatic food systems, I do think it would make it much more attractive if we would combine learning in the classroom and learning at universities with having young people spend time in communities to learn about aquatic food systems or to learn about traditional methods and traditional technologies. I think that's where one way not only to attract them, but also to make sure that the system gets to be very, you know, much more powerful and engaging. We also have to combine modern technologies such as data technologies, which are very attractive to young people, with that of traditional knowledge and there are many ways to do that and I do not think that we have truly tapped into the approaches that we should use, modern technologies, data technologies, it's a different scope of work. Traditional knowledge on which that's based with history, with storytelling, with the language that's used, that's a very different way of knowledge. But I do think that we that we are wise enough and can combine both so that it becomes attractive for the young people. And lastly, we should have targeted policies and instruments which render conditions for attracting young people within aquatic food systems. So that they for example include the conditions for loans, the conditions for access to outputs, for example, getting access to state lands on which they can practice aquatic food systems. Thank you.

Marcy N. WILDER:
OK. Thank you very much. The hands-on experience during the educational phase is very important, as I've understood. OK, thank you. The next question will go to Dr. Miyata. You have given us an overview of JIRCAS's research activities as part of your presentation and how they are related to promoting artisanal aquaculture in a number of countries. And you have emphasized that the fisheries themselves have to be on board, so for those of us who are about to embark on such work, what would be your further advice for designing projects that involve the exact people that we are trying to benefit?

MIYATA Tsutom:
Thank you, moderator Marcy. To make it more successful, participatory aquaculture by farmers is also required to the solution of bottle neck. So you know, the small size of seedling is a high mortality therefore, it is difficult to treat the small size seedling by aquaculture farmer so that's why we focused on the intermediate seedling to develop and create the new technology. So anyway, we focus on that, intermediate breeding techniques. Furthermore, we conducted the interdisciplinary approach research combining with natural scientific research and socioeconomic research, for dissemination of our technique to the local farmer and local officials. And furthermore, it is so very important to explain the scientific evidence to the local farmer and the local officials in some meeting, therefore it is needed, hold the meeting frequently. So that is very important to implementing a new technology in the village by farmers themselves. So this idea is from my success experiments in Japan. Thank you.

Marcy N. WILDER:
Thank you. So interdisciplinary work is very important and scientists being able, need to be able to articulate what their goals are. Thank you. The next question will go to Dr. Sakiyama. You have given us a very detailed explanation of Japan's progress made in seed production, technology and aquaculture for a number of important species. What would be your suggestions for adapting such technology to other countries? Would it be possible to involve artisanal fisheries?

SAKIYAMA Kazutaka:
I am Sakiyama. The question is whether the seed production technology we discussed earlier can be expanded to other countries, and what is needed to do so. To do so, we must first try to use standard technology. However, with regard to tools and equipment, there are some that can be used and some that cannot. First of all, I think it is important to try to create the same system using what is nearby and available. However, the fish breeding method presented earlier cannot be done with the parts to assemble the machine. I think it is very important to observe what kind of ecology the creatures show, how they behave, and whether or not they are able to eat food properly using such equipment. We are often misunderstood and evaluated as "this is no good because we couldn't do it with the same equipment." I think it is important to have an attitude of seeing with your own eyes to ensure improvement and refinement. The other point is whether we can involve the fishermen. Aquaculture originally began as a way to catch and rare wild fish. In Japan, such things were incorporated around 600 AD. I think it is important to first have fishermen grow the fish they catch, sell the grown fish, and then create a market to sell their produce. Once such a market is established, aquaculture using natural seedlings will be the first to emerge. However, wild fish for seedlings will not last forever, so artificial seedlings will become necessary once the scale of production expands to a certain extent. In order to produce artificial seedlings, the parents are necessary. The fishermen are the ones who breed the parents. In cooperation with fishermen, artificial seedlings will be created and brought to aquaculture. However, there will be competition between natural and farmed fish in a market. I think we need to think about how to combine the sale of wild fish with that of farmed fish so as not to invite too much competition between them. Therefore, in order to participate in mass production, I think it is important to first create a market and then breed parents for seed production.

Marcy N. WILDER:
Thank you very much. The next question goes to Dr. Wright. In your presentation today, you have enlightened us as to how seaweed culture will lead to the mitigation of greenhouse gas emissions by livestock and additionally have explained the science to us in detail. My question relates a little bit to a question that was asked in the session where you talked about what the profitability could be regarding this technology, but what do you have any specific plans for? How exactly do you plan to persuade livestock producers to use these seaweed-based feeds in their business operations?

Jeffrey T. WRIGHT:
Yes, thank you. Like I think the short answer for what will best persuade the livestock farmers because the, as I said earlier because the feed supplements are an additional cost to the farmers. The bit that I think they will need incentives to be persuaded to use those and I think the best incentives will come through government initiatives and in particular things like carbon credit schemes. So, in Australia we have what's called the Emissions Reduction Fund, the ERF, and that's a program set up by the Australian Government and the way it works is companies including farmers or other organizations can get projects set up within that fund. They need to be approved and they need to demonstrate that the activity that they're claiming they're going to do will actually reduce carbon emissions. And if they do that, then they can start to claim carbon credits. And once they get the carbon credits, they can potentially be sold either to the government or to other organizations or if they want to reduce their carbon footprint, they can hold on to those carbon credits as well. So there are different things that they can do with the carbon credits. Currently feed supplements such as seaweed are not approved within that scheme in Australia but there is an application that's currently now before the regulator and I guess I think we'll find out pretty soon whether that gets approved or not. Thank you.

Marcy N. WILDER:
Thank you very much for that. The next question goes to Dr. Yurimoto. You have given us a very detailed overview of your work in promoting sustainable blood cockle farming, both in the societal and scientific point of view. And you talked a little bit about your subsequent plans. Going forward, what do you expect to be the major challenges?

YURIMOTO Tatsuya:
Thank you for your questions. So in the case of Malaysia, in recent years the Fisherman's Association was organized in Selangor coast and new environmental monitoring program started with DOF and local fishermen and local people. So I hope the coastal management activities unite the fishermen, the citizens and the government so they will become a more active for a long time. These activities have led to the "Sato-Umi" concept. This is a Japanese word. "Sato" means in English home or village. "Umi" is sea in English and it is connected to environmental conservation and bioresource recovery. So I think it is important that experts from Japan and Malaysia work together with local fishermen and local people to regularly assess the coastal environment status for a long time for future support and also it is important to share the knowledge about successful active management cases in both countries in the future. I think that's all. Thank you.

Marcy N. WILDER:
Thank you very much. Next question is for Dr. Morioka. In your presentation you have made the case for the necessity of promoting improved management, production and utilization of small indigenous species. So in your opinion, what will be the best way to convince more local authorities and fishers to take up such endeavors?

MORIOKA Shinsuke:
Thank you, Dr. Wilder. Everybody said that well balanced combination of academia and administration and private sector including NGO and NPO are necessary to realize this kind of situation. So I am saying the same answer would be going to you, but actually what I have to say here is the people and residents there, for example, in Lao or Cambodia, have been already convinced of what they know, and what they need is that how to diversify the food material, including food material that has higher content of trace minerals and vitamins and other nutritional or functional contents. They know already. But the relatively new idea is how to use the indigenous small species, because indigenous small species were very low. Marketable value of these small spaces were very much low. That's why their motivation for producing these species was almost nothing. But if the, how to say, realistic technology or technique or processing for value addition like for example fermented fish, I think there's that kind of low market of low marketable value would be improved and also one of my friends at JIRCAS who is working on fermented fish in Lao, the so-called Pad-ek, then after fermentation of some kind of fish species. Some functional contents like for example vitamin B12 is synthesized by microbial activity in fermented fish. Such kind of functional features or processed fish or fishery product using the small indigenous fishes probably can be a one big tool to improve the marketable value. So anyway, I see again that well balanced academia and administration and the private sector is necessary to push this program for, to going forward. Thank you very much.

Marcy N. WILDER:
Thank you, Dr. Morioka. Finally, Dr. Altamirano, in your presentation you have explained to us how artisanal fisheries can be improved through community-based stock enhancement programs using the

example of the tiger shrimp. Could you elaborate a little bit more on this specific scientific whatever you're planning in the next phase of your project?

Jon P. ALTAMIRANO:
Thank you very much for that good question. So I think I have emphasized the term site specific and species specific. This can be imagined for example in comparing laboratory based and field based. So in the laboratory you can control the environment, but for stock enhancement which is essentially in the field, you have different factors interacting with each other. So it's not automatic that for example you read the paper about black tiger shrimp in this biology, you can just take that and use that in your experiment in the field. But the important thing is you need to verify whether that can match or that can be used in your site. So the important thing is you have to do all the detailed studies. I did not have time to really present that today. But the key thing there is that you'll be saving a lot of time in trying to do these scientific studies individually and answering specific questions. If you don't do that then you'll end up doing trial and error and spending maybe 10, 20 years of your life doing that. So we shortened that by doing these specific studies. And the key also for community based is not only environmental, it's not only biological and I think Dr. Yagi also mentioned the importance of the local setting. So you need to adjust in terms of species-specific site specificity, also in terms of the community that you're in. So respect the culture as well. So not only in terms of biology, environment, but also social and cultural; you need to be specific about in doing your projects. Thank you.

Marcy N. WILDER:
Thank you very much. I would just like to ask the panelists if anybody else has anything to add just very briefly? Does anybody wish to provide further comment? OK. Well, we're running out of time and we have four advanced questions, but I'd like to take some questions from the floor. So I'm only going to read two of them aloud for now and designate one of our keynote speakers to answer them. So the first question comes from Japan to Dr. Yagi. I would like to ask if you have any thoughts on the relationship between fishing and aquaculture. And how the balance of production will change in the future.

YAGI Nobuyuki:
Yeah, thank you. The question is to ask the proper balance between aquaculture and not capture fisheries for natural fish. I think on the aquaculture has two kinds, the one is to utilize the feed that is aquaculture for finfish, we need to input the feed for finfish, but other types, the type of aquaculture is not utilizing feed. The aquaculture for seaweed, for example the seaweed do not consume their feed, they are only, you know, growing using sunshine by phyto synthesis. And the other, the one is bivalve species. It's a shellfish and they are so-called plankton feeder. They only feed phyto zooplanktons and so the fishermen do not need to feed those bivalve species also, so those aquaculture that does not need, require feed, it has a huge potential. And also for example the seaweed aquaculture, the use of the product is not limited to the human consumption but also it's a consumption for animals and so those types of the aquaculture can be increased. But other types of aquaculture that require feeding activities, there is a natural limitation because feed are coming from the natural fish. So my conclusion is that aquaculture without using feed, it has a huge potential to be increased. Thank you.

Marcy N. WILDER:
Thank you very much. One more advanced question I would like to direct to Dr. Thilsted. This is also from Japan. If an abnormal rise in sea water temperature due to global warming continues for a long

time, what will be the impact on the flora and fauna of the sea in the future.

Shakuntala Haraksingh THILSTED:
Thank you. This is something that is an area of interest in many countries and if you look at the tropical countries and the area and the countries that are around the equator, this is some of this just in the Caribbean. This is something that many people are talking about, the other waters getting too warm and therefore that the fish would seek, would move away from the traffic, so move north and move south and therefore would be unavailable especially to local fishing communities. So this is one aspect that people are talking about and the other one is that if you go to colder waters like northern Europe. Already some fishermen in off the coast of England are talking about that there are other fish coming in and this is perhaps due to the warming again of the waters. We've done some work in Tonle Sap in the in the Mekong Delta and have seen that the temperatures are rising in the wetlands and in the rice fields and this seems to have because we have to look at it further, short period of that seems to have an effect on the diversity of this species, that there are lesser and lesser diversity of fish species. So I do think that we need to have some more data and to tease out the different movements that we're seeing in different parts of the world and the ways that is affecting different communities, for example if you have local communities that use boats with… that don't go far away, then of course that's going to have an effect on the amount of fish and the type of fish that they get. So it's not a one for all situation that goes in the same direction for all.

Marcy N. WILDER:
OK. Thank you very much. There's not that much time left. So I would like to take, I think we could take about two or three questions from the floor and anything please, if anybody would like to ask a question, please go ahead. Is there any, do we have any questions from the floor? There's one over there. OK, please identify yourself.

Questioner (JIRCAS):
I'm Hayashi from JIRCAS. My question goes to Dr. Wright, I thank so much for your presentation. And then about seaweed. So is there any side effect or benefit through applying this additive for month, for annual or for years for milking cow because when we're a child, our parents always ask to eat seaweed for shiny hair or good health, so I guess some benefit for the animal. Thank you.

Jeffrey T. WRIGHT:
Yeah. Thanks for your question. The amount of the Asparagopsis that the cows will be eating is very small. It's point five of a percent or 2% of the of the dry weight food that they're given. So they're not getting very much of it. There has been a couple of studies that I'm aware of that I've looked into what happens to the bromoform once it's been ingested. But unless it's at a very high concentration, much higher than would be applied in the feed supplements, it doesn't really seem to be an issue at all. It's not, it's just at really low levels. So hopefully that answers your question.

Marcy N. WILDER:
I think we can take one or two more questions. Are there any other questions from the floor? OK, we have a question over there.

Questioner (JICA):
Thank you, Mr. Chairperson. My name is Sugiyama. I'm from Japan International Cooperation Agency. My question goes to Dr. Shakuntala and Dr. Morioka. I'm very much impressed by your presentation, the potential role of fish and aquatic food for nutrition security. I think we should put more focus on this aspect of aquatic food. And when I think of how, you know, we can increase the contribution of aquatic food for nutrition security and when we think of the, you know, the production area of aquatic food, the fishing communities. You know, if we think of the nutritional status of fishing communities, since they are in the production area, they may not be deficient of the nutrition coming from fish. But those who need the nutrient from fish are the people not living in the fishing community coastal area, but the people living in the inland areas. So then if we think of the contribution of fish for nutrition security, we may have to think of the distribution issues, how we can supply fish from production area to non-production area. Then it comes to small fish which is very difficult to keep the quality and you know it's highly perishable that distribution may not be easy. It can be processed, but then there is another issue of acceptance of eating fish if the people are not used to eating the fish. So how do you think about, you know, to overcome these issues? I'm dealing with these issues. Thank you very much.

Marcy N. WILDER:
Thank you. Perhaps, Dr. Thilsted and then Dr. Morioka.

Shakuntala Haraksingh THILSTED:
Thank you for your views and what you said, there are many questions and also many answers, but let me start with one. So we've looked at consumption service in many countries and for many population groups and I would say all countries, but especially, but also for coastal communities, and especially for the poor and the vulnerable and countries in Africa and Asia. If you look at intrahousehold consumption patterns, you will see that in many communities, women and especially pregnant and lactating women and children from the age of six months to 18 months or even up to two years. That's the period where WHO has recommended complementary feeding, meaning continued breastfeeding, but where the breast milk is not sufficient for meeting the nutrient needs of the child and therefore must be complemented with additional foods complementary feeding. And in this period if you look at consumption and again from, as I mentioned before, pregnant and lactating women, consumption of aquatic foods is very low and you can increase the consumption and have a beneficial effect on the nutrition and health and the children's growth and development of children. So that's the first thing and that's nearly across the board even in rich countries. With respect to which population groups can benefit. So that's specific for which groups can benefit from a high intake of aquatic foods, that's pregnant and lactating women and children from the age of six months to two years because of all the effects it has in growth and development, all individual development and thereby national development. Think if you if we already know the research tells us that intake of aquatic foods improves school performance. And what if we can put a value on school performance and thereby the individual development and the effect that has on national development. There are other points you ask is about population groups that are close to waterbodies and those who are, for example, away from the waterbody. But we have looked at studies, for example in the urban poor, and they of course can benefit from an increased intake of aquatic foods and to do this as you say you rightly mentioned, you'd have to look at the supply chains and we know in many countries the supply chains, the cold storage transportation is poor. So this is why one of the ways is trying to develop convenient products that have a long shelf life and do not require refrigeration or freezing for example as we have in Africa with smoking and with drying and making the product for example into a powder that can easily be added to cooked foods. For example, if you would make a porridge for the child, then you can add a

fish powder, a teaspoon of fish powder, which would greatly increase the micronutrient content of the porridge.

MORIOKA Shinsuke:
Yeah, I think that Dr. Shakuntala said almost the same thing, nearly 100% I have to say. But if I add something, I think that Dr. Sugiyama asked one thing about eating culture, if the people like eating fish or not and I don't know about the very small tribal area in right for example in Lao northern edge of the country. I don't know. But in general almost all the people like eating fishes if there is beside or there is not, then. But another problem: the people like eating fish, but sometimes the people are eating fish in the form of, how to say, non-cooked fish and it is the cause of parasitic diseases so that we have to pay attention about this, but generally saying the people accept the, how to say, the culture of eating fishes and they rather like eating fresh fishes, but I think if they may, not less acceptable about the processed fishes, but what Dr. Shakuntala told that probably the way of processing can be a bit more modified for better acceptability by the residents, that's my answer, thank you very much.

Marcy N. WILDER:
Thank you very much. I'm afraid we're out of time. So I would like to thank our distinguished panelists once again for their enlightenment and thank you for everybody. Please join me in a round of applause for the panelists.

Closing Remarks

YAMAMOTO Yukiyo
Vice President, JIRCAS

Distinguished participants. On behalf of the organizers, I would like to give a few concluding remarks for this Symposium.

As a follow up of the 2021 UN Food Systems Summit, and on the occasion of the International Year of Artisanal Fisheries and Aquaculture 2022, today's symposium provided a valuable opportunity to discuss the role of artisanal fisheries and aquaculture in the provision of foods rich in diverse nutrients. Artisanal fisheries and aquaculture also create employment and contribute to maintaining knowledge systems and sociocultural values in rural communities.

In turn, in order to play a central role in the global food systems transformation, artisanal fisheries and aquaculture sector needs innovations to unlock the potentials of small-scale stakeholders. Given the extreme heterogeneity and diversity of their environment, however, developing and applying innovations without leaving no one behind is no easy task.

Today, we have greatly benefitted from the leading experts who shared their experiences of how best to address challenges of artisanal fisheries and aquaculture. While no single solution exists, multi-disciplinary approach can be a key to address not only the technical challenges small-scale operators face in locally specific contexts, but also identify support areas to overcome socio-economic constraints, including regulations and institutions. Therefore, accelerating innovations in artisanal fisheries and aquaculture requires not only local actions but also enabling commitment of all the stakeholders, from local communities, research institutions, private sectors, and policymakers.

I would like to take this moment to thank all our participants, especially the keynote speakers Prof. YAGI Nobuyuki and Dr. Shakuntala Haraksingh Thilsted. JIRCAS is also very grateful for having the opportunity to organize this symposium with supports from the Ministry of Agriculture, Forestry and Fisheries, and Japan Fisheries Research and Education Agency.

Finally, thank you to all the symposium participants, the on-site and online audience, as well as to everyone involved in planning and management of this hybrid event. We are truly grateful for your valuable contributions and attendance. Thank you very much.


JIRCAS International Symposium 2022
Artisanal Fisheries and Aquaculture in the Sustainable Food Systems
Organized by JIRCAS

Program

12:30–13:00	Registration

Opening

13:00–13:10	Opening Remarks:	
	KOYAMA Osamu	President, JIRCAS
	Welcome Remarks:	
	KOYA Takashi	Director General of Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries (MAFF), Japan

Keynote Speeches

13:10–13:30	The role of artisanal fisheries and aquaculture in sustainable food systems	
	YAGI Nobuyuki	Professor, Graduate School of Agricultural and Life Sciences The University of Tokyo, Japan
13:30–13:50	Transforming Food Systems: Aquatic Foods for Nourishing People and Planet	
	Shakuntala Haraksingh Thilsted	Global Lead, Nutrition and Public Health, WorldFish, Malaysia

Session 1 "The Challenges of Artisanal Fisheries and Aquaculture in the Sustainable Food Systems"

Chairperson: *NAKASHIMA Kazuo,* Program Director/Food, JIRCAS

13:55–14:30	The issues of artisanal fisheries and aquaculture in sustainable food systems in Southeast Asia	
	MIYATA Tsutom	Director, Fisheries Division Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
	Issues of sustainable aquacultural seedlings in Japan	
	SAKIYAMA Kazutaka	Director, Production Engineering Division, Aquaculture Research Department, Fisheries Technology Institute, Japan Fisheries Research and Education Agency (FRA), Japan
	Potential of seaweed utilization for greenhouse gas emissions reduction	
	Jeffrey T. Wright	Associate Professor, Institute for Marine and Antarctic Studies University of Tasmania, Australia

14:30–14:40	Q&A	

Session 2 "Research and Application to Enhance Sustainability and Productivity of Artisanal Fisheries and Aquaculture"

Chairperson: *KANAMORI Norihito,* Project Leader/Information Hub, JIRCAS

14:40–15:15	Development of sustainable bivalve aquaculture technology adapted to tropical monsoon region	
	YURIMOTO Tatsuya	Senior Researcher, Fisheries Division Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
	Management, production and utilization of small indigenous species "Zako" for nutritional improvement in rural areas and biodiversity conservation in inland Southeast Asia	
	MORIOKA Shinsuke	Professor, Department of Field Ecology, Faculty of Environmental Science University of Human Environments, Japan
	Improving artisanal fisheries through community-based prawn stock enhancement in a mangrove estuary	
	Jon P. Altamirano	Scientist and Head, Farming Systems and Ecology Section, Research Division Southeast Asian Fisheries Development Center, Aquaculture Department (SEAFDEC/AQD), Philippines
15:15–15:25	Q&A	

Panel Discussion

15:35–16:10	Panel Chair:	
	Marcy N. Wilder	Project Leader, Research Application/Ventures, JIRCAS

Closing

16:10–16:15	Closing Remarks:	
	YAMAMOTO Yukiyo	Vice-President, JIRCAS