ASEAN Fisheries and Aquaculture Conference and Exposition 2016

"ASEAN Seafood for the World"

and

11th Asian Fisheries and Aquaculture Forum

"Asian Food Security for the World"

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The Asian Fisheries Society (AFS) is a non-profit scientific society founded in 1984 by fishery professionals in Asia. The society aims at promoting networking and co-operation between scientists, technicians and all stakeholders involved in fisheries (including aquaculture) production, research and development in Asia. Its ultimate objective is to enhance food security and income generating opportunities for fisheries workers via sound management practices, environmentally sustainable development and efficient utilization of the aquatic resources.

Abstracts

Aquaculture trends and future perspective in Iran

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The Islamic Republic of Iran is located in the Middle East between latitudes of 2500°′ and 3947°′ N and longitude of 4402°′ and 6302°′ E. The total area of the country is 1,648,195 km^2 which includes 1,636 million km^2 land area and 12,000 km^2 of water surface. The coast line stretches for 2,700 km to the south in the Gulf and the Oman Sea and in the north along the Caspian Sea.

Weather conditions differ greatly across the country allowing a range of different types of aquaculture to be practiced. Fish farming in the Islamic Republic of Iran began with the enhancement of fish species selected from the Caspian Sea and then continued through the development of semi-intensive aquaculture utilizing various Chinese carp species, as well as the rainbow trout (***Oncorhynchus mykiss***). In recent years, shrimp culture (white shrimp - ***Penaeus vanamei***) has become the main focus for government investment in the Persian Gulf region where it has been developed in earth ponds.

The total area of fish ponds in the Islamic Republic of Iran is estimated at approximately 50,000 ha in 2014. The major warmwater species produced are the common carp (***Cyprinus carpio***) and the three main Chinese carps, namely, grass carp (***Ctenopharyngodon idellus***), silver carp (***Hypophthalmichthys molitrix***) and the bighead carp (***Hypophthalmichthys nobilis***). Of the total Iranian aquaculture production in 2015, carps represented 60 percent, rainbow trout 38 percent, cultured shrimp 2.47 percent, aquaculture-based fisheries production 13.26 percent and 0.32 percent for other aquaculture products such as sturgeon and lobster. About 88. percent of the total aquaculture production is utilized mainly for domestic markets with the main export commodity being shrimp (50 percent of export value in 2015) and caviar.

Aquaculture production increased rapidly from 3,219 tonnes in 1978 to 371,000 tonnes in 2014, representing approximately 41 percent of the total fish production. This proportion is expected to increase during the sixth five-year plan which began in 2015 to 50 percent.

The legal and institutional framework for aquaculture development in the Islamic Republic of Iran is relatively well established, and the law on conservation and harvesting of aquatic resources, approved by the Parliament in 1997, drives fisheries and aquaculture activities in the country.

As part of a stock enhancement programme along the southern Caspian Coast, the government had established eight hatcheries to produce bony fishes and sturgeon fingerlings. All aquaculture activities, including feed and larvae production, fish and shrimp culture, processing, marketing and trade are carried out exclusively by the private sector. The government supports the private sector by providing low rate interest loans and suitable land at competitive prices. The plan for aquaculture development is marine aquatic mainly cage culture in Caspian Sea in north, Oman Sea and Persian Gulf, shrimp and sturgeon with marine water. Iran has different climate and it is possible culture different species. There is native species in Iran that have potential for aquaculture such as Caspian trout, sea carp, kutum (***Rutilus frisii kutum***), ***Sander lucioperca, Sparidentex hasta***, ***Rachycentron canadum, Epinephelus*** coioides in south of Iran and ***Barbus sharpeyi*** for fresh water.

Alternative livelihood options for the coastal tribal people through brackishwater aquaculture technologies

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Brackishwater aquaculture offers good livelihood options for tribals, especially the tribal group known as ***Irular*** in the coastal areas of Tamil Nadu, India and offers scope for diversification of livelihoods. These coastal tribals take part in various capture as well as culture fisheries activities but the ongoing decrease in the catch from capture fisheries obtained through small scale fishing activities has prompted the people to take up an alternative or supplementary means of income generation through small scale brackishwater aquaculture. The brackishwater areas like lagoons, estuaries and creeks available in the coastal areas can be well utilized for brackishwater aquaculture by these marginal and poor tribal people. The coastal tribals can earn a significant supplementary income from these activities and increase their family income considerably.

This paper discusses the research and demonstrations conducted by ICAR-CIBA under the Tribal Sub Plan Programme on brackishwater aquaculture technologies, namely, crab farming in Fiberglass reinforced plastic cages, pens, tide-fed ponds, seabass nursery rearing in hapas, ornamental fish rearing, polyculture of mud crab and Asian seabass in community ponds, and ornamental fish farming integrated with mushroom culture and the collection and sale of polychaete worm ***Nereis*** and mollusks as feed material for shrimp hatcheries by the ***Irular*** tribal people. These case studies also portray the different brackishwater farming methods, farm management, marketing details and issues that are important to the successes and failures experienced by them and challenges faced by the beneficiaries and the researchers. The brackishwater aquaculture and allied farming technologies transferred to these coastal tribal people who were suffering in the post tsunami period, offered them new means of livelihood. These technologies and avocations adopted by tribals were observed to be viable means of enterprise for their livelihood and socio-economic improvement.

Inter-sectoral governance of ınland fısherıes: A case study of Badagry Creek, Lagos State, Nıgerıa

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The governance challenge in common pool resource (CPR) in which small-scale fishers operate is tremendous thus exposing them to additional risk outside the difficult terrain of fishing accentuated by conflicts. An effective social order, traditional institutions, cultural and religious beliefs over many centuries often ensure that fishing related conflicts are often resolved amicably and within the fishing governance structure. However, inter-sectoral governance of inland fisheries is often beyond the simple, sophisticated and traditional governance structure aided by long historical, cultural and traditional institutions that is well entrenched in the larger community of the society which the fishers are often considered as powerless. In this case study, the traditional systems worked effective to reduce the fishing conflicts but is not able to deal with other inter-sectoral governance issue between the fishers and non-fishers. Transportation and tourism activities in Badagry Creek are perceived by the fishers to generate positive externality and therefore, mutual cooperation exists between these sectors and the fishing community. However, the activities of small-scale sand mining are known to generate negative externality to the fishers as the sound generated from the miners' tools resulting in creek noise from their practice of wet pit mining is believed to produce huge sound effect which drives fishes away further offshore. Other negative effects of sand mining activities include river bank erosion, river bed degradation, river buffer zone encroachment and deterioration of river water quality. Recommendations made aimed at eliminating this conflict include prohibiting sand mining operation around areas the fishers identified as fishing ground and spawning floors for the fishes. In conclusion, the need to for the state government to deploy scientific knowledge in formulating policies and guidelines that will steer the mining activities towards amicable operations with the fishing community was emphasised among others.

Framing the perceptions of local officials and agency representatives towards Iloilo River, Philippines

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A natural resource like an urban river poses several management dilemmas to institutions in charge of managing it. While rivers provide livelihood and other uses to people living within the vicinity, most often some conflicting perceptions may arise between them and the institutions managing it and both may have differing relationships. This paper presents the perceptions of local officials whose villages situated along Iloilo River and of agency representatives that include government agencies, non-governmental organizations (NGOs) and the academe. Data were gathered largely through focus group discussions and forums. Using the framing theory as an analytical device, the analysis of findings reflected a better understanding of the perceptions of the stakeholders. Important findings show that both groups of stakeholders have varying perceptions on the management and importance of Iloilo River in their lives. At least four common frames are used by the participants: characterization frames which reveal how the stakeholders perceive their own behavior, characterize the behavior of others and assess these relationships; identity and values frames which refer to the stakeholders' purposes in life, their decision-making process and their fundamental values; substance frames, which refer to issues in the utilization and management of the Iloilo River and how the stakeholders relate to these issues; and aspiration frames which reflect their needs, interests, desires or concerns and on how they value options. These perceptions however did not result to any dispute between the stakeholders but instead smooth relationships have been maintained between them. Culture plays a significant role in the way people frame issues.

Playing by whose rules? Community norms, fisheries rules and corruption in Lake Victoria (Kenya) co-management

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Co-management of natural resources has developed within the premise that sustainable management is more likely achieved through decentralized and participatory governance. For Lake Victoria (Kenya), the introduction of co-management through the establishment of Beach Management Units (BMUs) coincided with apparent increases in unsustainable fishing practices associated with concurrent decline in fish stocks. In this article we identify what institutions at the community level influence practices and how these shape the interpretation and application of formal rules laid down by fisheries policies. Primary data collected from four beaches on the Kenyan side of Lake Victoria document local fishing practices. We found fishing practices are often contrary to government regulations, despite the creation of BMUs that were established to implement government regulations. Instead, fishing practices regulated by the BMUs are highly influenced by kinship ties and corruption. This analysis uses the concept of institutional bricolage to discuss how norms and rules interact to affect resource management. The findings build on existing evidence which challenges the view that devolution of Natural Resource Management (NRM) to local institutions, even those that follow national guidelines for participatory management, provides for more sustainable fishing. We suggest the need for a, perhaps, radical rethink of the design of participatory fisheries within Lake Victoria if sustainable management goals are to be realised.

Assessing governability of small-scale fisheries in Batan Bay, Philippines

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The paper identifies and describes the challenges in small-scale fisheries governance in the context of Batan Bay in Aklan Province, Philippines using the interactive governance approach. Results show that the natural and social systems in the bay are characterized by diversity (diverse species of flora and fauna; many fishers highly dependent on the fishery resources and other users; three local government units exercising power over parts of the bay), complexity (relationship between key fishery habitats and fish catch; low cooperation and compliance to laws and regulations and conflicts within and among stakeholder groups), dynamism (decline in the quality of the resources overtime; growing population; increasing number of fishers and their low mobility), and scale (relatively small-sized bay; different sizes of territorial waters of the three local government units; with stakeholders from the three local government units surrounding it up to the national government), which lend themselves to low governability. The independent management of portions of the bay by the three local government units that border it has not been responsive to governance challenges posed by small-scale fisheries in the bay. The lack of inter-local coordination and cooperation in the management of the bay have led to poor quality interaction between the systems. Based on these findings, the local government units should collaborate and coordinate with each other to achieve an integrated management of the bay as a single resource system.

Myanmar fishery and aquaculture development in action

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The Myanmar's strategic policy gives large importance on food security, rural and economic development. Fishery and aquaculture are the backbone of the Myanmar animal protein production, which serves both as an export commodity and, above all, for internal consumption.

The fish sector constitutes a relevant portion of the National GDP and provides employment to about 3 million people. However, further steps are necessary to improve the sustainable growth of the sector through increased productivity and the support to the whole value chain in compliance to safety and quality standards and international regulations.

In Myanmar there is currently the high need to consolidate new technologies adapted to local contexts. This implies investments on economic and human resources, whose know how must be dramatically improved, but also on the empowerment of public-private partnerships that can enforce the governance and the technical assistance to small-scale farmers and entrepreneurs.

In the framework of international cooperation an ongoing project funded by the Italian Ministry of Foreign Affairs, MyanMed - ***Small scale fishery and aquaculture in Myanmar: Institutional support for dissemination of European Regulations and Best Mediterranean Practices***, enabled the Department of Fisheries to advance in technologies, to develop extension programs and to open opportunities for public-private partnerships. Along with the program activities a series of meetings with key stakeholders throughout the whole value chain spotted strengths and weaknesses of the sector.

For the aquaculture sector it was arisen the need to raise in technology, develop efficient disease prevention and control systems as well as provide consistent supplies of quality seeds. Besides, some priorities were also seen in the access to the credit, still not industry-oriented, and in the empowerment of infrastructures, such as feed factories and cold plants.

For the fishery sector beyond the advances in technologies and infrastructures there is the high need to stabilize input prices, provide training to comply with domestic/international standards and to regulate and enforce the sector for the efficient control of illegal fishing.

For the processing sector the need of training and regulations/law enforcement is highly regarded to widen the opportunities for the export market. Nevertheless the sector could boost upon reliable supply of quality fishes from domestic suppliers.

Myanmar fish industry is largely targeting the export market, but its access would be granted only with the synergic action of different stakeholders within a common development plan. The public-private partnerships are in this seen an elective way to achieve a fast and sustainable growth.

Empirical analysis of patent documents related to fish biodiversity: Issues in governance, access and benefit sharing for innovation

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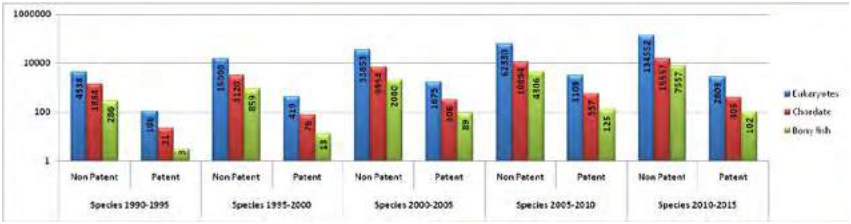
The International legal body that defines rules and regulations for trade through World Trade Organisation has Trade Related Intellectual Property Rights annexed, that defines territorial nature of a country with respect to jurisdiction. The adoption of CBD, ensures sovereign right of a nation on genetic resources. Though territorial flora and fauna have emerged from common heritage of mankind to Sovereign Right of a Nation, the aquaflora and aquafauna need clarity of regulation in connecting/ shared waters. Nucleotides were mined form Patent documents

related to fish genetic resources and categorised species wise. Semantic Utilization of International Patent Classification Codes were used to extract information for fish genetic resource for exploring fish biodiversity through patent analysis for novel sequences for usable information retrieval. Out of 377,799 Nucleotide sequences belonging to 10,020 fish species, 12,013 patented Nucleotide sequences were retrieved from 181 fish species The patents belonged to ***Gadiformes*** (26.45%), ***Cypriniformes*** (22.68%), ***Tetraodontiformes*** (11.74%), ***Anguilliformes*** (9.95%), ***Cichliformes*** (9.51%), Salmoniformes (6.44%), ***Beloniiforimes*** (4.01%), ***Cyprinodontiformes*** (2.76%), ***Pleuronectiformes*** (2.24%), ***Scombriformes*** (1.17%) and others(2.45%). Nucleotide sequences from Eukaryotes and Chordates were also retrieved for comparision. Year wise distribution of Nucleotide from NCBI Release 63 to 92 (1990-1995), Release 93-121 (1995-2000), Release 122 to 151 (2000-2005). Release 152-181 (2005-2010), Release 182-211 (2010-2015), were studied for patent and non patent Nucleotides of Eukaryotes, Chordates and Bony fish. The patent and non patent sequences were classified species wise and sequence wise. Graph 1 shows number of species with patents and non patents for Eukaryotes, Chordate and Bony fish. Though patents had come to existence to provide monopoly, but it also gives power to hinder innovation. The paper will discuss issues related to Patents, Disclosure of Origin and Access and Benefit Sharing with respect to indigenous fish germplasm nucleotides patented by countries without mentioning disclosure of origin.



Graph 1: Number of species with patents for Eukaryote, Chordate and Bony fish

Tuna fisheries in turkey: Monitoring and management for sustainability

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Tuna fishing in Turkey has a rich history. For centuries, tuna fish have provided an important source of food for Anatolian people. Besides the taxes paid by the sailing ships passing through the Istanbul Strait, bonito and bluefin tuna fishery was formerly another important financial source during the Byzantium era. During this period, these species have been selected as the symbols of the city. Reliefs of bonito and bluefin tuna had been imprinted on Byzantium coins, produced between the 1st and 3rd centuries A.D. Today, tuna fish are also an important source of income and export. The tuna fishery in Turkish waters, ranges from small-scale artisanal operations in the coastal waters to large-scale industrial purse-seine operations in both the exclusive economic zones of Turkey and on the high seas. The main species targeted by these fisheries are Atlantic bluefin tuna (***Thunnus thynnus***), albacore (***Thunnus alalunga***), Atlantic little tunny (***Euthynnus alletteratus***), bullet tuna (***Auxis rochei***), plain bonito (***Orcynopsis unicolor***), bonito (***Sarda sarda***), and narrow-barred spanish mackerel (***Scomberomorus commerson***). Among these species, Atlantic bluefin tuna is the most valuable fish in terms of economic benefit.

Advisory jurisdiction of the International Commission for the Conservation of Atlantic Tunas (ICCAT) has been implemented to support sustainable tuna fisheries in the Mediterranean and provides stock assessment and management advice on sustainable yields for tuna and tuna-like species. Turkey became a member of ICCAT in 2003. Tuna farming in the Mediterranean started in the second half of 1990s and increasing number of farms in a short time resulted in overfishing. Stock assessment and fishing regulations are carried out for bluefin tuna caught in Turkish waters, and its fishing, fattening and exporting activities we have been closely monitored. On the other hand, the stock assessment for the other tuna species cannot be carried out due to the lack of artisanal fishing data.

Internal strategies of microfinance institutions on disaster risk management: The case of MFI's in central Iloilo, Philippines

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There is a growing literature focused on strengthening internal structures and capabilities of Microfinance Institution (MFIs) rather than on the broader context of risk management in the industry. Studies show that risk management is effective when building institutional capacity is embedded in the organization. Achieving this goal is influenced by the institutional cultural issues and decision-making behaviours of the MFIs. This paper contributes to this strand of research by examining risk management practices of four MFIs offering credit, loan, and savings services to economically-disadvantaged individuals and groups in the coastal areas of Central Panay, Philippines. Churchill and Coster's Categories of Risk (2001) and Pantoja's (2002) model are used as analytical lens to describe MFIs measures on institutional and strategic risks, operational risks, and financial management risks. From key informant interviews and secondary sources, key results show that MFIs have embedded products in their clients' loan application. They have special interest rate for calamities and micro insurance has become compulsory to the loan. There is regular review & update of strategies, budget, and integrity of data. Institutional culture decision-making behaviour has influenced pre-disaster management measure of the MFIs.

Linking marine biodiversity conservation and poverty alleviation: A case study in selected rural communities of Sagay Marine Reserve, Negros Occidental

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Marine biodiversity has long been known to provide socio-economic benefits to the global economy. However, these benefits do not have market values and are thus often ignored in policy development. An increasing awareness on this matter led to several measures to safeguard biodiversity from imminent threats, an example of which is the establishment of the 32,000-ha Sagay Marine Reserve in Sagay City, Negros Occidental. Several articles state that biodiversity conservation limits the access of stakeholders to the resource thus worsening their situation in poverty. Hence, a linear relationship between biodiversity conservation and poverty alleviation cannot be established through literature only. The study seeks to (1) describe the socio-economic profile of various workers in the reserve; (2) determine if the steady stream of benefits contributed to poverty alleviation in the surrounding coastal communities through fishing, ecotourism and other reserve-related livelihood and; (3) ascertain the ways on how the reserve helped the poverty-stricken community. Being one of the direct beneficiaries of the reserve, Brgy. Bulanon was chosen as the study site with 245 randomly selected poor households.

Cost and benefit analysis of conserving marine protected areas (MPAs) in San Jose de Buenavista, Antique, Philippines

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This study was designed to determine the costs and benefits of conserving marine protected areas (MPAs) in San Jose dB, Antique. Both primary and secondary data

were used to analyze the different costs and benefits associated with establishing and managing MPAs. Data were anayzed from randomly selected participants from four selected barangays namely: Brgys. 3, 4, Madrangca and Funda-Dalipe.

The respondents were asked for their willingness to pay for the conservation of the MPAs. This study will also determine if San Jose dB MPA really provide benefits, and who are really benefitting from these MPAs. Thus, the results of this can study can further the conservation program of the local government of San Jose dB.

Do fishers benefit from marine conservation: A case in TINMAR fishing communities, Guimaras, Philippines

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The Philippines is situated at the center of highest marine biodiversity in the Coral Triangle (Convention on Biological Diversity). It has been widely recognized that coastal and marine ecosystems have provided livelihood such as fishing and eco-tourism to the nearby communities. Through the years various threats such as water pollution, eutrophication, habitat alteration, climate change and overfishing have threatened these natural resources and consequently affecting the communities that rely on it (Green Peace Philippines, 2012). Among the measures undertaken to address the aforementioned concerns is the establishment of marine protected areas (MPA). Taklong Island National Marine Reserve (TINMAR) is one of the many established marine protected areas in the country constructed generally for biodiversity conservation and for a long-term goal of restoration and replenishment of marine flora and fauna. Studies showed that the establishment of TINMAR actually contributed to the increase of fish stock in the area. This biological benefit however can only be realized by the people who are the main stakeholder in the success of the MPA if these are converted to economic benefits. This study assessed the direct economic benefits of TINMAR among fishers in the adjacent communities.

Shark conservation through community participation in Bangladesh

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Shark fisheries, including skates and rays, in Bangladesh are growing gradually due to the growing demands of shark commodities in the export market in Korea, Singapore, China, Hong Kong, Myanmar and Thailand. Traditionally produced crude shark liver oil, dried shark fins, dried top hide of skates and rays, dried shark skeleton, especially jaws and backbone are all exportable. Due to those growing demands of the shark commodities, once non-target shark fishery now becoming target fishery by different fishers' communities in the coastal region. Specialized shark gillnets (1,500-2,000 meter long with mesh sizes of 400-520 mm) and shark long lines are being introduced to catch sharks, skates and rays as target species. Hilsa gillnet, Lakkha net (large meshed gill nets used to catch Indian salmon), set-bag-nets, trawl nets and long lines are all common gears that catch sharks, skates and rays as by-catch. In some fishing communities in the southern region, about 50% fishers are involved in shark fishing. The prime shark fishing grounds are Patuakhali and Barguna district in the southwestern region and Sandwip, Kutubdia, Moheshkhali, Cox's Bazar and Teknaf coasts in the southeastern region. About 30 species of sharks have been recorded so far in Bangladesh. Annually, about 4,000-5,000 tonnes of sharks, skates and rays are harvested in Bangladesh. Shark fishing activities continue round the year with a peak in June. To restore sharks and other charismatic endangered mega-fauna, ECOFISHBD project has initiated marine mega-fauna biodiversity conservation activities. Efforts are being made to conduct scientific monitoring of the nature and extent of exploitation, methods of harvesting, community perceptions about harvesting and utilization of shark, skates and rays. Important shark fishing villages in the southwest region have been identified and fishers are being interviewed to collect various information. Shark fishers have been organized as SCG (Shark Conservation Group) involving both fishermen and fisherwomen and various alternative livelihood opportunities have been prescribed and implemented through community participation. ECOFISHBD project has started awareness building activities through, training, discussion, exhibition,

poster, booklet and leaflet for motivating fishers to release live mega-fauna accidentally caught by the gillnetters and to refrain from shark catching for restoration of the biodiversity.

Involving resource users in the evaluation of fisheries management options: the case of bivalve industry in central Philippines

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Bivalve mariculture has a significant history in the Philippines, being one of the oldest forms of aquaculture. Oysters and mussels dominates farmed production and this represents a marginal industry. Combined production of oysters and mussels represents only 1.7% of the total aquaculture production in the country. In value, the industry remains small and thus, regulating it is not really the primary concern in many coastal areas in the country. At present, oyster and mussel operators are complaining of decreased production. They attributed these to the siltation of the river, water pollution, and the lack of enforcement of the zoning policy. Most operators have stopped operating because of the unavailability of spats and the frequent occurrence of red tide in the area.

A study was conducted in Central Philippines to examine the bivalve mariculture industry (specifically oyster and mussel culture) with the aim of coming up with policy recommendations on improving the industry through regulatory reforms. Using workshop and focus group discussions, oyster and mussel farmers were consulted to identify best management options based on a set of criteria. The identified options were analyzed through a quantitative approach called Analytic Hierarchy Process (AHP) which is a method of scaling ratios using pairwise comparison. Results shows that the Biotic Diversity is ranked as the most prioritized criterion by the participants from the two study sites. Dredging of the river, regular water monitoring, and provision of financing and marketing support are the prioritized management options.

Conservation of marine fisheries resources: An economic valuation of seasonal fishing ban in India

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Fishery resources are renewable natural resources but exhaustible if harvested indiscriminately. For sustaining marine fishery resources, Seasonal Fishing Ban (SFB) for 45 to 60 days is followed every year for the last 15 to 25 years along the Indian coasts. However, the benefits from the SFB and continuation of ban are always questioned by the stakeholders. As there was no proper assessment of the SFB on fisheries, economic valuation of SFB was made in five selected maritime States of India. The study showed that there are improved ecological and economic benefits of the SFB in terms of fish catch, fisher income, biodiversity, respite to the sea floor and reduced carbon emissions. These benefits outweigh the costs of the ban.

The increase in incremental fish biomass ranged from five per cent to nine per cent. The estimated economic value (based on landing centre price) of the incremental growth of fish was INR 1.14 billion (US$17.28 million) in the five States. About 10.36 million fishing hours is reduced annually due to SFB, thus saving INR.8.3 billion (US$ 125million). The transaction cost, which includes information, enforcement and compensation to fishermen amounts to Rs.41.67 million (US $0.62 million) in the five States. The estimated net social benefit due to SFB in five States was INR 1.09 billion (US $ 16.45 million). The study recommends continuation of SFB. However, SFB should not be considered as a stand-alone practice and should be a part of a bundle of management measures such as ecosystem approach, marine protected areas, no-take zone, regulated entry, catch quotas, certification, protection of endangered species, mesh size regulation, and minimum legal size at capture.

Thailand's marine fisheries management plans.

National policy on the management of fisheries from 2015 to 2019

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Marine fisheries are important both socially and economically for Thailand. However, there are a number of challenges that, could have serious impact on the future of these fisheries. These include severe degradation of the fish resources through over capacity that has resulted in lower catch rates, large quantities of trash fish, including juveniles of larger commercial species, and Illegal, unreported and unregulated fishing (IUU). Critical fish habitats degradation has contributed to this decline. This situation has occurred mainly as a result of a lack of control of an ever increasing number of vessels and uptake of new technologies over the past 30 years, resulting in excessive fishing capacity and fishing effort. The new Royal Ordinance for Fisheries B.E. 2558 (2015) recognize the significance of managing the fisheries resources of Thailand sustainably and requires the development and implementation of a fisheries management plan. This Marine Fisheries Management Plan (FMP) 2015-2019 outlines the nature of the management challenges facing Thailand and details what actions and management measures are required to transform what is now essentially an open-access fishery into a limited-access fishery based on balancing the fishing effort with the productivity of the resources (maximum sustainable yield (MSY)). The FMP aims to reduce the fishing capacity and fishing effort to limit the catch at or near the MSY. The specific capacity reductions targets are (i) for demersal fish; 40% in the Gulf of Thailand and 10% in the Andaman Sea and (ii) for pelagic fish; 30% in the Gulf of Thailand and 20% in the Andaman Sea. The main measures to achieve these targets will be the removal of currently illegal commercial fishing vessels, plus a series of temporal closures to remove any excess fishing effort. Compensation incentives will be used, as well as buy-back scheme. The FMP is also designed to reduce the level of IUU fishing to reduce the level that can be controlled through regular MCS arrangements in the future. Specific management measures to achieve this include: strengthening Monitoring, Control and Surveillance measures through institutional changes and increased resources and capacity for MCS; and improving the licensing and registration system so that all vessels are registered and licensed. The other issues

are being managed through a number measures, through mesh size limitations and spatial and temporal closures. Conflicts between sub-sectors are being managed through declaration of exclusive fishing rights to different zones. Critical habitats will be restored through increased collaboration and cooperation with other agencies that is mandated to protect and conserve the marine environment. The FMP also recognizes the importance of better data and information to inform management decision making that can be used in the future marine fisheries management of Thailand. Lastly the FMP recognizes the need for institutional changes and strengthening the human capacity to improve future fisheries management. The Thai Government commits to allocate funding as well as increase significant number of personnel for various activities of FMP implementation.

China's policies and practices of distant water tuna fisheries

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Global tuna fishery resources started to decline since the 1980s. Most of the tuna stocks have been fully exploited, and some of them have already been overexploited or even become depleted. International organizations such as the FAO and Tuna Regional Fishery Management Organizations (T-RFMOs) have implemented conservation and management measures (CMMs) to control fishing methods and catch volumes, as a way to restore the tuna population. As a result, China's tuna distant water fisheries have become stagnated after more than 10 years' rapid growth. The current catch is unable to meet the increasing demand of the domestic population. With the background of T-RFMOs CMMs, this article looks into the regulations and policies enacted by the Chinese State Council and the Ministry of Agriculture, especially from vessel management, personnel management and enterprise management, to analyze the development and evolution of China's tuna fishery management. This article also discusses the necessity and possibility to develop China's tuna fisheries, and seeks for a feasible way to provide moderate and sustainable development for the purpose of meeting domestic demand and maintaining marine rights

and interests. Suggestions are given in the final part as a tentative proposal for China's tuna fisheries development.

Please note that this article does not intend to reflect Chinese government official views on tuna fisheries management.

The oceans and fisheries partnership: A regional cooperation to combat illegal, unreported and unregulated fishing and promote sustainable fisheries in the Asia – Pacific region

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Communities in the Asia – Pacific region are heavily dependent on marine and coastal fisheries for food and their livelihood. However, as a result of unsustainable fishing practices Asia's fish stocks and coral reefs are in danger, which threatens biodiversity, food security and livelihoods. Globally, illegal, unreported and unregulated (IUU) fishing is estimated to account for $10-23 billion annually, representing between 13-31% of the global catch. In Asia, over capacity of fisheries is common, and this overfishing, combined with IUU fishing, destructive fishing and seafood fraud are causing fisheries to collapse. The decline and failure of Asia's regional fisheries will ultimately have devastating consequences for regional food security and marine biodiversity.

The Oceans and Fisheries Partnership between the United States Agency for International Development, the "Southeast Asian Fisheries Development Center" and the "Coral Triangle Initiative for Coral Reefs, Fisheries and Food Security" aims to strengthen regional cooperation to combat IUU fishing, promote sustainable fisheries and conserve marine biodiversity in the region. The Partnership will develop, demonstrate and expand a catch documentation and traceability (CDT) system. The CDT system is a market based approach to promote sustainable fisheries and builds on the foundation of the ASEAN Catch Documentation Scheme, and will be complemented by other components, such as: 1) coordinate with and strengthen the capacity of regional stakeholders to combat IUU fishing, promote

sustainable fisheries and conserve biodiversity; 2) engage with the public and private sectors to ensure uptake and sustainability of the CDT system; and 3) integrate social welfare issues (gender, labor) into the CDT system. Fisheries through an ecosystem approach to fisheries management and CDT demonstrations will be harnessed and build on existing fisheries management systems, regional and national initiatives, and existing networks by engaging through participatory approaches, and implementing an adaptive management approach.

Engaging communities in Lao PDR in fisheries monitoring and co-management

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Small-scale, artisanal fisheries are an important source of food and income for many communities in Southeast Asia, but little information exists about these fisheries, and the localized nature of the fisheries requires localized management strategies. One solution to filling the information gap is to engage local communities in data collection and resource management activities through a participatory approach. Using participatory methods engages local people in monitoring their resources and enhances their capacity to enact conservation and sustainable fisheries co-management.

We present three projects from Lao PDR that approached community engagement in different ways. Between 2010 and 2012 we worked with local technicians to collect catch data from fishers in four villages along the Nam Kading River over 18 months. During a pilot project conducted in 2013, we trained fishers to record data on their own fish catch in two villages on the mainstream Mekong River. These two studies have documented a high fish diversity at the genus level, and have revealed localized differences in fishing methods among villages. In the second project, catch composition differed between the two adjacent villages, reflecting the selection of gear type and differences in the habitats fished. Both these studies also documented catches of endangered fishes, such as ***Probarbus***

jullieni and ***Probarbus labeamajor.*** In 2014, FISHBIO began an ongoing effort to collaborate with communities on the Mekong River in Northern Lao PDR to establish community co-management of fisheries, including the development of Fish Conservation Zones for ***Probarbus*** fishes. We conclude that co-management of community fisheries and community participation in fish catch monitoring is key for successful sustainable use, solidarity and ownership empowerment.

Transboundary fisheries management in the bordering provinces of Bokeo, Lao PDR and Chiang Rai, Thailand: Trans-boundary issues and needs identified from joint assessment of fisheries resources and management practices

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The Mekong fisheries are interlinked, from local to regional levels and crossing national boundaries of Mekong riparian countries. It has been recognized that the development activities implemented in one country can affect also the other riparian countries. A series of development activities currently undertaken do have the cross-border or trans-boundary dimension between the riparian countries as have inappropriate fishing and fisheries management practices; both impact on abundance and diversity of the Mekong fisheries resources in various ways. Therefore, the fisheries management in the Mekong river basin is needed to plan and implement by using a geographically integrated and trans-boundary approach among or between riparian countries.

The Mekong River Commission (MRC) funded Thailand and Lao PDR to implement the project on Transboundary Fisheries Management on the

Mekong River Basin in Bordering Provinces of Bokeo in Lao PDR and Chiang Rai in Thailand from 2014-2015 to enable key fisheries stakeholders of two countries jointly manage the Mekong fisheries resources in a sustainable way based on trans-boundary cooperation and commonly agreed principles, tools and targets". The project was implemented under three main objectives; 1) jointly establish a trans-boundary fisheries management body, 2) jointly explore fishery resources management and conservation issues through joint assessment of fisheries resources and management practices, and 3) jointly cross-/trans-border institutions operating for jointly improve regulations and promote their enforcement through awareness raising campaigns.

This paper presents the initial achievements of this project implementation in Thailand. It focuses on transboundary fisheries management issues and needs that identified from a joint assessment of fisheries resources and management practices as the basic information for the development or review of community fisheries management plans and it contribution to the Mekong Basin-wide Fisheries Management and Development Strategy (BFMS). Based on this project implementation, the transboundary fisheries management in this particular border area is essentially a multi-level "Institution Building" and fisheries co-management in both border provinces, and integrating those institutions to higher level, district and provincial stakeholders in national fisheries management into a mechanism that is able to harmonize fisheries management between the two provinces of two countries.

Improving fisheries management in Southeast Asia through fishery improvement projects

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Generally, the term, ***Fishery Improvement Project*** (FIPs) is used to describe a framework designed to incrementally improve practices and conditions in a specific fishery to help it in reaching sustainability certification. A key principle underpinning

these FIPs has been ongoing market recognition and access to those fisheries demonstrating stepwise, incremental improvements. This market incentive can help both accelerate early improvements in fishing practices and encourage continual improvement toward achieving sustainability.

The FIP framework has recently been recognized as a mechanism for improving fisheries management performance and facilitating cooperation among government, industry, scientists, and NGOs (Banks and McFadyen, 2011). While certification is traditionally associated with the FIP approach, effective and clear processes contained with FIPs can help fisheries move towards more sustainable practices, and importantly lead to the implementation of an operational Fisheries Management Plan.

FIPs advocate a stepwise approach which begins with pre-assessment of the fishery to identify its current status in terms of fish stocks, ecosystem impacts and governance. The pre-assessment provides the basis for actions needed to achieve improvements and recommendations on timeframes for their implementation; agreed to by stakeholders via a transparent consultation process. Detailed action plans adapted to local conditions can include social and economic development aspirations aligned with sustainability.

This presentation draws from the experiences and lessons learned in the implementation of FIPs across the Southeast Asia region to demonstrate how this framework can be designed to i) incorporate risk-based strategies suitable for data-deficient fisheries, ii) deliver ecosystem (EAFM) outcomes iii) provide flexibility to incorporate socio-cultural, livelihood and economic aspirations and iv) encourage private and public sector cooperation. We use positive examples of FIPs being implemented in the Philippines, Vietnam and Indonesia to explore opportunities and challenges associated with establishing a FIP in a multi-species trawl fishery in Thailand along with steps for further consideration.

The Philippine fisheries education in the midst of recent developments in Philippine educational system

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The Philippine educational system has been undergoing dramatic changes in the recent years. With the introduction of new schemes in the basic education curricular programs, the programs at the tertiary level have to make necessary shifts. Philippine fisheries tertiary education programs are no exception. Since the development of the entire Philippine fisheries industry is dependent on the changes and development in the fisheries educational system, it becomes imperative among fisheries educators to face the recent challenges and decide on appropriate pivotal changes in fisheries educational programs.

This paper discusses the developments in the Philippine fisheries educational system ***vis-a-vis*** the recent development in the country's educational system, coupled with the recent changes in the Comprehensive National Fisheries Industry Development Plan of the country. Specifically, the paper focuses on the direct impact of the recent developments in the country's educational system on fisheries education and some recommendations on how to mitigate such impact. Likewise, a critical assessment of the performance of the country's fisheries educational institutions, their curricular programs, international collaborations and partnerships, accreditation status and quality assurance efforts, and its role in supplying the needed manpower to sustain the industry and to achieve a better Philippine fisheries industry, is included. Strategic recommendations for an integrated system of fisheries education are also incorporated in the discussion.

Fisheries education in University of the Punjab, Lahore, Pakistan

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The University of the Punjab University, Lahore has been placed at 15th position out of 2107 institutions in South Asia. In Pakistan, out of 291 institutions, Punjab University is ranked number one. This is the oldest multi-disciplinary university and was established in 1882. There are 13 teaching faculties and 63 departments. During last five year (2010-2014) 2550 research papers were published in Impact factor Journals by university teaching faculty. In last eight years (2008-2015) 1153 scholars were awarded PhD degrees by the University.

The Zoology Department was established in 1921 and is now ranked among top departments, on the basis of its academic achievements in research publications and PhD produced. Earlier significant contributions have been made by some past faculty and alumni of Zoology department in development of Fisheries sector in the country. Teaching and research in Freshwater Fisheries is one of the oldest and dominant areas of study in the Zoology Department. At present the basic and specialized fisheries courses are offered at BS/MS, M.Sc. / M. Phil. and PhD levels. The research on culturable and ornamental fishes and freshwater muscle is carried in well-equipped laboratories in the department. Recently eight PhD research scholars completed their projects on different topics in Fisheries and were awarded PhD degrees.

Fish Disease and health Management laboratory (FDHM) was established in 2004 in Zoology Department. This laboratory provides state of the art research facilities in Parasitology, Mycology and Bacteriology to researchers. Identification of parasites, isolation and characterization of pathogenic fungi and bacteria and their treatment are the main areas of our research. Over 40 students have completed their research projects and their papers are published in national and International Journals. The current and future aspects of "Fisheries Education" needed in aquaculture industry in Pakistan and Asian Pacific Region is discussed.

Developing a responsive curriculum for sustainable fisheries and aquaculture at the Faculty of Fisheries, Kasetsart University, Thailand

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The Faculty of Fisheries at Kasetsart University was established under the Kasetsart University Act of 1943. It has been the main degree granting institution for fisheries and aquaculture in Thailand, for both undergraduate and graduate programs. Its departments include Aquaculture, Fisheries Management, Fishery Biology, Fishery Product and Marine Science. Through the years, the Faculty of Fisheries has been producing graduates to work in various government and private agencies, academic and research institutions, and civil society organizations. The Faculty has also trained a number of people from various levels of the fisheries and aquaculture workforce, both local and foreign, as well as new entrants to the field of fisheries. Stakeholder consultations as well as employer and alumni feedback revealed a need for a more responsive fisheries education curriculum. This means a curriculum not only covering the basics of fisheries and general education, but also recent trends, global issues and relevant interdisciplinary topics. Fisheries students are encouraged not only to focus on a specific field of fisheries, but to encompass other interconnected areas within fisheries and aquaculture. This will enable them to be more prepared when they graduate and enter the workforce, which covers various fields and disciplines in job responsibilities. Thus the Faculty of Fisheries curriculum has been evolving to adapt to recent developments. With Thailand as a leader in aquaculture and fisheries in the region, and even globally for some species, the Faculty of Fisheries of Kasetsart University's has a comparative advantage in enriching its curriculum to make it more responsive to the sector's needs, especially in equipping the young generation with skills and capabilities to implement sustainable fisheries and aquaculture development.

Aqua-centre assists aquaculture development through technology transfer and leadership development

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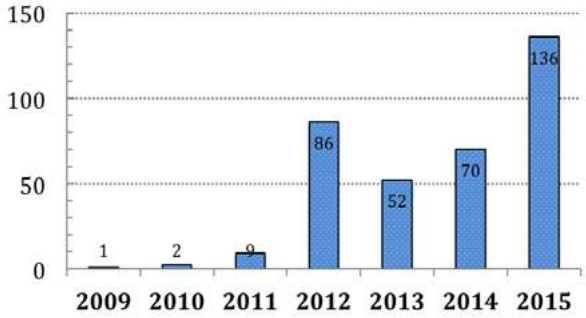
Aquaculture has attracted a lot of public attention as well as private investment because various sub-sectors within aquaculture have emerged as very competitive and profitable businesses. Highlighting many success stories and providing latest information, Aqua-Centre offers training on innovative aquaculture technologies to professionals and investors/entrepreneurs. Since 2010, Aqua-Centre has trained over 370 professionals from all over the world including from Africa, America Australia and Europe (Fig 1).

Fig. 1 No. of participants trained by Aqua-Centre



Our approach is to improve system's productivity and profitability and transforming subsistence farming for the benefits of wider communities. More people are consuming seafood due its health benefits and other reasons. Additional 160 million tons of seafood will be needed by 2050 which is possible only when thousands of new generation leaders are produced. The Centre develops these leaders who ultimately will train millions of other people.

Extensions officers of each country need to update their knowledge and skills to be able provide services to the farmers and entrepreneurs in the context of rapid pace of technological development, climate change and market economy. Only then other countries can take advantages of the sector.

Our training courses (http://aarm-asialink.info/activities.html) include over 50% time for practical and field observations. World-renowned experts deliver lectures. Our technical staff and partner organizations provide on-the-job training. More importantly, we cooperate with private farms/companies to arrange practical work for participants. "How to produce millions of monosex tilapia fry and table fish" is the most attractive course. Other topics include catfish/Pangasius, seabass and shrimp, feed making, etc. Salient features of training courses will be presented and underlying reasons of success will be discussed.

Capacity building using agricultural quality system certifications to produce safe and healthy foods to support the global population

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Since the revolutions of global food quality and safety before 2000, all countries have to prepare their relevant infrastructures to combat to these issues, both importing and exporting countries. The impact of traceability '**from farm to table'** has also pushed countries to upgrade the concerned elements from producer to the market place and then to consumers. Voluntary standards have been announced to be implemented at the beginning as well as the mandatory regulations. Up to now more mandatory standards have been announced and regulation enforced in many developed countries. Furthermore, new safety parameters have been elucidated and then laid down into the regulated safety limits for seafood products, which are trending to become more conservative. The consequences of these issues are the need for development of quality systems, testing laboratories and related facilities and very essentially, sophisticated equipment.

In Thailand, the Central Laboratory (Thailand) Company Limited (CLT) had been established and fully equipped by the the Ministry of Agriculture and Cooperatives (MoAC) and aims to support novel regulation and standards for primary production quality and safety for both local and global consumption. The accomplishments of these systems in Thailand are the implementation of **Quality Infrastructure** (**MSTQ**) to issue health certificates in fisheries, plant and livestock produce with the regulated government competent authorities, issuance of quality systems for fishery farm certificates in several schemes such as GAPs, GMP/HACCP, and Organics base on ISO/IEC 17065, ISO/IEC 17020, ISO/EC 17021 and coverage will be extended over time to more plant and livestock products and activities.

Testing, calibration and proficiency testing are based on ISO/IEC 17025 and ISO/IEC 17043 together with professional training by ISO 29990 (learning service provider, LSP) to support laboratory and scientist competency have also been established as a one stop and fast services for customers as a toolkit for their businesses. The details of the successes story will be discussed during the seminar.

Role of inland fishery and aquaculture for food and nutrition security in Nepal

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The aim of this paper is to elucidate the role and potential of inland-fisheries based food and nutrition security in a Himalayan land-locked country. Capture fisheries in Nepal is an ancient tradition, and fish have been symbolized for fertility and prosperity probably due to its high nutritive food quality. Fish as a food is generally acceptable to all people regardless of region, religion, race, gender and age. Thus, demand is substantially increasing due to the health benefits reports of Omega-3 or N-3 fatty acids in fish food. Predominantly seven carp species are cultivated with additional scope of ***Tilapia*** and ***Pangasius*** aquaculture in warmer plains. Recently, rainbow trout (***Oncorhynchus mykiss***) has emerged as most suitable and potential fish for commercial cultivation in Himalayan pristine cold waters. Currently, the contribution of fisheries in agriculture has reached only about 2%, but production trends suggest more promising future. The per capita fish consumption based on internal production has increased from 125 g in 1975 to 2060 g in year 2013; which is far below comparing to average global consumption. Since the current per capita fish consumption is based on amount of inland fin fish production, however, the value would be increase if native shellfish (gastropod, crab, shrimp, and turtle), frogs; aquatic plants such as foxnut (***Euryale ferox***), water chest nut (***Trapa*** spp) could be added. The present fish production data showed that Central Development Region of Nepal ranks the top among five with least in Far Western Development Region. However, on altitudinal basis southern plains contributes

highest production, the potentiality of cold water aquaculture in mountains is high due to rich cold water availability. These imply that support services and innovation should be extended in the far western and mountainous regions addition to the plains for improving fisheries based food and nutrition security.

Strategies to attract private sector investment in aquaculture for self-sufficiency in Nepal

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Aquaculture in Nepal is rapidly growing. The contribution of aquaculture to total fish has reached 69%. The growth rate of aquaculture has increased from 6.95% to 8.5% after initiation of "Fish Mission" program seven years back. However, the demand for fish in the country is increasing so rapidly that import has increased to a volume of around 12000 metric tons worth 15 million USD. The per capita availability of fish is very low and there is a plan to increase per capita from 2.5 kg to 10 kg in next fifteen years which can be achieved with a growth rate of 16%. There is a potential to accelerate the growth through increased government investment, policy interventions, improved technical back stopping and financial assistance. Furthermore, Nepal has just declared the "Agriculture development strategy" for next 20 years. The strategy aims to increase land and labor productivity along with competitive and commercial production. The recent strategy is to attract more private sector investment and make agriculture production competitive. Aquaculture is found to be very competitive with high productivity. Therefore, Government has taken few initiatives to further attract private sector investment like: Soft loan, subsidized insurance, support for construction of new aquaculture facilities, subsidy on machineries and customs and tax relaxations on aquaculture tools and equipment. These strategies are working efficiently and has attracted new entrepreneurs from various walks of life. A support of 5 million has added 60 million to national account with private sector investment of 30 million USD. Therefore, the current strategies and support program needs to be continued to achieve address the issues of nutritional security, trade deficit, regional dis-balance,

increased land and labor productivity and increased income and better livelihood to farmers in addition to meet national target and sustainable aquaculture development in Nepal.

Economic feasibility of producing fish and vegetables through aquaponics

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Aquaponics, producing fish and vegetables in a closed-loop water system, reduces fertilizer use and effluent discharge, and is promoted as a sustainable venture. Yet, its economics has been poorly studied. Using grey literature and a post-hoc cost-benefit analysis, this paper discusses the feasibility of investing in aquaponics in the Philippines considering the local market demand.

The quantity of nutrients in the effluent of the fish component imposes a ratio volume of fish tank : area vegetables ranging from 1:30 to 1:100, depending on used species of both. Thus the farm size is set by the quantity of marketable fresh vegetables. The latter, as well as other data were collected by e-mail and phone from four Philippine aquaponics farms, and online searches by a team of MSc students. Following Kaikanen et al. (2012) and assuming survival rates and feeding norms, they calculated fish growth and soluble N-output of the fish component. This N-output was balanced against the production of lettuce and tomato. Tomato's N-demand considered the vegetative and fruit growth (Mori ***et al***., 2008), and that of lettuce, the plant growth and a fixed N concentration in the leaf tissue (De Pinheiro Henriques & Marcelis, 2000). The discounted benefit-cost ratio was calculated using: $DBCR = [\sum_{t=0}^{n} B_t/(1+r)^t]/[\sum_{t=0}^{n} C_t/(1+r)^t]$, in which B_t = benefit in yr t; C_t = cost in yr t; n = project length (yr); r = discount rate (%).

Producing 50 fish of 0.5 kg wk^{-1} can support the N-demand of 160 kg wk^{-1} lettuce and close to 40 kg wk^{-1} tomato. Though vegetables are well priced in the Philippines, for the current r (8%) the ***DBCR*** was below 1.3 when producing catfish (see Table).

When producing seabass, this ratio improves to above 1.3. The latter is needed considering the risks against which a farmer shouldn't be insured. Insurance gives incentive towards non-sustainable investments and free rider behaviour. In the Philippines, small farms do not pay value added tax (VAT) when selling directly to consumers; we assumed wholesale prices, which implies taxation. The latter affects feasibility. Farmers can start with catfish and shift to seabass as soon as they master the aquaponics system. Aquaponics should aim at high value vegetables and fish species for a niche market to reach an appropriate level of discounted returns.

Table: The ***DBCR*** (discounted benefit-cost ratio) for a 20 yr project period, yes/no VAT payment and three discount rates (***r***), for two systems: catfish or switch from catfish to seabass after 5 year.

	Catfish						Catfish/seabass					
	0% VAT			10 % VAT			0 % VAT			10% VAT		
r	4	8	12	4	8	12	4	8	12	4	8	12
	1.31	1.23	1.15	1.15	1.04	0.94	1.66	1.51	1.39	1.47	1.38	1.28

Analysis of influence of industrial organization form on farming performance of large yellow croaker farmers

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Large yellow croaker, one of the "four traditional marine fish" in China, is the commercially important fish in China's southeast coastal area, and is also one of the largest breeding marine fish in China. The main management mode of the aquaculture production is household contract management. Although the model is conducive to improving the enthusiasm of the production and operation of fishermen, it is difficult to adapt to changes in market supply and demand and the existence of other constraints on the development of industrial problems. In fact, how to organize the scattered farmers and the large market to form an effective link, improve the efficiency of agricultural management organization system has become a common view of scholars.

Based on the survey of 430 large yellow croaker farmers from three cities in 9 sea areas in Fujian and Zhejiang, this paper analyses the large yellow croaker farmers' costs and benefits level and the production technical efficiency of the large yellow croaker of different industrial organization forms in the basic unit of household by means of the trans-log production stochastic frontier production function model. The results show that the influences of the industrial organization form and the technical training on the performance of the farmers have passed the significant test of 5%, and the coefficients are positive.

The value chain of blue swimming crab (*Portunus pelagicus*) in Losari, Brebes, Indonesia

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Blue swimming crab (BSC) is a fisheries product having high economic value, good taste and attractive colors. BSCs are targeted by commercial and recreational fisheries throughout the Indo-Pacific region. Especially in Indonesia, these crabs are sourced from the wild, but increasing demand and changing marine environment might threaten their sustainability. This review aims at analyzing the situation before starting BSC culture to reduce overexploitation.

Brebes district is one of the highest producers of captured BSC and has more than 1400 fisherman specialized in fishing BSC by using three types of gears (see Table). They can catch the BSC almost every month but the peak season is from January to March. In 2015 the value of the total catch was close to 120,000 tons which was more than USD 250,000. However, the catches show a decreasing trend. Besides, farmers catch them with traps in ponds where ***Gracillaria*** is cultured off-bottom.

BSC can easily enter the abraded ponds with broken dikes. Most coastal lands in Brebes are abraded or exposed to abrasion because of loss of mangrove, subsidence and sea-level rise. Losari sub-district has the largest submerged area, where farmers may also culture milkfish in netted pond or fish with fixed gears.

Total registered catch of blue swimming crab (*Portunus pelagicus*) by different fishing gear (kg) for three villages of Losari sub-district, Brebes regency, in 2014 and 2015.

	2014			2015		
Fishing Gear	Trip/Unit	Total trips	Catch (kg)	Trip/Unit	Total trips	Catch (kg)
Bottom mini trawler	130	130,520	65,260	120	120,480	60,240
Trammel net	88	33,560	48,840	90	33,300	49,950
Trap net	124	5,580	8,370	120	5,400	8,100

Source: Local government statistic reports

While the nursery grounds in the estuaries have dramatically decreased, field observations and interviews with local stakeholders showed that they use mesh sizes that allow them to catch juveniles and that they also market carrying females. The latter fetch a slightly higher price than mature males, while the undersized are sold at low price, either as trash or for grow-out using (trash) fish. In a neighboring district the authorities are looking for investors in a crab canning factory. In Thailand and Australia projects to culture BSC are promising. The BSC culture in Brebes can start with the grow-out of the discarded juveniles. Mechanisms to increase the availability of (natural) seed have to be studied, as well as the options to replace (part of) the trash fish with pelleted feeds using e.g. residues from poultry processing.

Socio-economics of aquaculture communities in central Philippines

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Aquaculture industry has grown globally to fill in the shortage of fish supply from the sea. A study of aquaculture communities in Integrated Coastal Resource Management Project (ICRMP) sites in Central Visayas was conducted to determine the socio-cultural and economic aspects of aquaculture. Results revealed that 79% of aquaculture systems are in freshwater and brackish ponds with 50% ***Oreochromis niloticus and*** 43% ***Chanos chanos*** as common cultured species. Ponds are operated by private individuals and conform to the standard culture systems of cultured species.

Employed individuals in aquaculture are mostly caretakers and helpers and basically non-permanent and on-call basis. In spite of employment in aquaculture, communities near aquaculture sites are considered poor since majority of households are living below the poverty thresholds. Periodic consumption of aquaculture products creates demand in the community.

Lactic acid enhanced prawn growth and resistance to bacterial infection when added in the feeds of the giant freshwater prawn (*Macrobrachium rosenbergii*)

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A current global trend in sustainable aquaculture is to reduce the reliance on antibiotics. Although antibiotics have been shown to be an effective prophylactic against disease, the long term consequences can be harmful to the host animal, environment and the human consumer. A promising alternative to antibiotics are short-chain fatty acids (SCFA), also known as organic acids, such as lactic, formic, citric and propionic acids. Information on the use of SCFA in the diets of crustaceans is lacking.

Five practical diets supplemented with graded levels of lactic acid, LA (0, 2, 4, 8, or 16 g kg^{-1}) were fed to four replicate groups of freshwater prawns, ***Macrobrachium rosenbergii***, for seven weeks. At the end of feeding trial, the prawns were challenged with pathogenic ***Vibrio harveyi***. Prawns fed diets with added LA at all levels showed significantly better growth, FCR and protein utilization efficiency ($P<0.05$) compared to the control diet. The total viable bacterial, ***Vibrio*** spp. and lactic acid bacteria counts in the hepatopancreas of prawns fed the LA added diets were significantly decreased. Microbiota population composition in the hepatopancreas and gut of prawns were altered with dietary lactic acid. After two weeks of ***V. harveyi*** challenge, prawns fed LA added diets showed significantly lower mortalities (26.7% - 33.3%) compared to the control diet (90%). In conclusion, the supplementation of LA in prawn feeds is able to impart beneficial effects to the growth, nutrient utilization, immunity and disease resistance of cultured prawns. This will contribute to the development of a more sustainable shrimp farming industry.

Oyster processing byproduct as replacement for fishmeal or mineral mix in the diet of the Nile tilapia *Oreochromis niloticus*

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There has been a continuous search for fishmeal replacement as a protein source for aquafeeds. A good candidate is a byproduct from processing oysters (*Crassostreairidalei*) for human consumption. The process involves homogenization of oyster meat with water, mild heat treatment of the slurry and the product of interest is the filtrate. Due to the high protein content of the byproduct (i.e. the residue, 74.9% crude protein), it was evaluated as a possible protein source that could replace fishmeal in the diet of the Nile tilapia. An 8 week-feeding trial was conducted in which 7 experimental diets containing various inclusion levels of the oyster byproduct (OBP) replacing fish meal were prepared and fed to fish. Namely, Diet 1 (contained 0% OBP) while Diets 2-6 contained 5%, 10%, 15%, 20%, 25% OBP; Diet 7 was a fishmeal-based diet with OBP as the only source of dietary minerals. Estimates of the optimum amount of OBP inclusion levels that gave maximal responses (i.e. FABW, WG, SGR, FCR and PER) were done using the Broken Line Model of analysis. The average optimum level was 17.0% of dietary OBP (fishmeal replacement of 63.8%). Feeding Diet 4 (15% OBP= 56.4% fishmeal replacement) resulted in statistically similar growth and feed efficiency parameters with those fed Diets 1 to 3 and was the closest to the estimated optimum inclusion level. Total mineral replacement by OBP (Diet 7) resulted in mixed results; it resulted in statistically similar SGR values with those of the other dietary treatments; however, it resulted in either inferior (FABW) or intermediate values (WG, FCR and PER). In conclusion, OBP could replace as much as 63.8% by weight of dietary fishmeal and probably a large proportion of the mineral mix in the diet of the Nile tilapia.

Nutritive value of *Rhizoclonium pariumas* feed ingredient in the diet of sex-reversed Nile tilapia fry

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A study was conducted to evaluate the potential of the crinkle grass ***Rhizoclonium riparium*** meal (RM) in the diet of sex-reversed Nile tilapia ***Oreochromis niloticus*** fry. Four experimental diets were prepared containing various inclusion rates of RM at 0% (Diet 1), 4.2% (Diet 2), 8.4% RM (Diet 3) and 12.6% (Diet 4); RM replaced the soybean component of the diet. Results showed that feeding the diet containing 12.6% RM resulted in significantly higher final average body weight (FABW, $p<0.05$) and higher weight gain (WG, $p<0.05$) than feeding the control diet. However, both were not significantly different from fish fed Diets 2 (4.2% RM) and 3 (8.4% RM). Specific growth rate (SGR) of fish in all dietary treatments were not significantly different ($p>0.05$). Data on food conversion efficiency (FCE) showed that fish fed Diet 4 resulted in significantly the highest food conversion efficiency (FCE, $p<0.05$) and the rest of the fish fed other diets were significantly lower but were statistically similar with each other. The present study showed that ***Rhizoclonium riparium*** meal could be included as an ingredient in aquafeeds for Nile tilapia fry with the inclusion rate of 12.6% RM resulting in better final weight, weight gain, feed and protein efficiency rates than without. This inclusion rate was equivalent to replacing 45% of soybean meal, which is an imported ingredient in the Philippines. This could be an important cost-effective measure in intensive culture of tilapia.

Practical diet for the grow-out culture of the snub nosed silver pompano, *Trachinotus blochii*

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The snubbed nosed silver pompano, ***Trachinotus blochii*** is a nice tasting fish that grows well in seawater. Improved hatchery techniques for this species made the juveniles readily available for the grow-out culture. A sustainable grow-out culture for this species would require an adequate feed. Nutrient studies are few for this species and, thus, the aim of this study was to determine optimum levels of crude protein (CP) and crude fat (CF) in pompano diet.

Series of feeding experiments were conducted. Pompano fingerlings (avg. wet wt.=1.6g) were stocked at 15 fish per 250 L circular tank and fed practical diets (CP levels 38%, 46% & 54% and CF levels 8%, 11% & 14%) in a 3 x 3 factorial experimental design in triplicates for 14 weeks. Survival rates were 96 to 100%, and regardless of lipid level, fish weight gain (WG), specific growth rate (SGR), and feed conversion ratio (FCR) were significantly best at 54% CP. No sparing of CP by CF was noted in all levels of protein. In another experiment, bigger pompano (avg. wet wt.= 70g) were fed four diets (CP levels 46%, 49%, 52% and 55%) with CF levels ranging from 8-11% and the estimated dietary P/E ratios were 117.22 to 143.3 mg protein/kcal. Fish were reared in 12 net cages (2m X 2m X 2m) installed in 500 ton cement tank with flowing filtered seawater for 14 weeks. Survival rate ranged from 96 – 100% and fish fed the 55 % protein diet has significantly highest WG, SGR, FCR and viscera- and liver- somatic indices. Diets may lack essential amino acids since growth did not reach a plateau even when fish were fed high protein diets. Succeeding experiments showed that at dietary CP level lower than 50% growth of pompano was enhanced when supplemented with taurine.

Processed knife fish *Chitala Ornata* (*Gray, 1831*) meal as fishmeal replacement in diets improves performance of juvenile Nile tilapia *Oreochromis niloticus* (*Linnaeus, 1758*)

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A 60-day feeding trial was conducted to assess the effects of Knife fish ***(Chitala ornata)*** meal (KFM) as fishmeal replacement in diets of Nile tilapia (***Oreochromis niloticus***) juveniles. Iso-nitrogenous and isolipidic diets were used which is composed of a control diet and four basal diets with 25, 50, 75 and 100% KFM inclusions. With a stocking density of 15 fish per tank, ***O. niloticus*** juveniles were distributed randomly in fifteen 30-L rectangular tanks for the evaluation of growth performance, feed utilization, blood chemistry, fish body and carcass composition.

KFM diets generally enhanced the growth performance and feed utilization while having no adverse effects on the body composition and blood chemistry of Nile tilapia juveniles. Statistical treatment of the data affirmed the significant improvement on the weight gain, growth rate, Feed Conversion Ratio (FCR), Protein Efficiency Ratio (PER) and major blood serum parameters for KFM fed fish. Cost analysis was also conducted to determine the economic efficiency of KFM diets. Cost analysis exhibited increasing feed cost up to 75% KFM fed fish due to increasing feed intake and higher production costs of KFM diets. The incidence cost of 75% KFM fed fish was also the highest among the treatments as well as on its profit index. Higher costs for the production of the 75% KFM diets can be compensated by higher profit index and fish weight gain.

With all these findings, it can be suggested that 75% KFM diet is the optimal level of fishmeal replacement to achieve better growth performance in Nile tilapia juveniles.

Diet supplementation of *Pediococcus pentosaceus* in cobia (*Rachycentron canadum*) and orange-spotted grouper (*Epinephelus coiodes*) enhances growth rate, resistance against pathogens

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The objective of this study was to investigate the effect of feeding ***Pediococcus pentosaceus*** strain 4012 (PP4012) to cobia (***Rachycentron canadum***) and orange-spotted grouper (***Epinephelus coiodes***) on growth rate, innate immunity, and resistance against pathogens. ***Pediococcus pentosaceus*** strain 4012 (PP4012) was isolated from the intestine of adult cobia, and its culture supernatant can effectively inhibit the growth of ***Photobacterium damselae*** subsp. ***piscicida*** (Pdp) and ***Vibrio anguillarum in vitro***. In ***in vivo*** test on cobia, after a 2-week feeding of PP4012, the growth rate of the fed cobia was 12% higher than that of the non-fed group, and the relative percentage of survival (RPS) of the fed cobia was found to be 74.4% in Pdp immersion challenge. In addition, the respiratory burst (RB) of peripheral blood leukocytes (PBL) in the PP4012-fed group was significantly higher than that of the non-fed group. Although feeding PP4012 did not improve specific antibody response in cobia after immunization with Pdp vaccine, it still significantly raised the survival rate by 22% over that of the non-fed group after Pdp challenge. In the study on grouper, the challenge test showed that the cumulative mortality of the PP4012-fed groupers was significantly lower than that of the control fish after ***V. anguillarum*** infection. Supplementation of PP4012 in commercial diet not only enhanced the growth rate and erythrocyte numbers of the groupers, but also regulated the gene expression of the pro-/anti-inflammatory cytokines. One day post-infection of ***V. anguillarum***, the PBL and the phagocytic activity of the head-kidney phagocytes in the PP4012-fed groupers were significantly increased, when compared with those without PP4012-feeding. These results suggested that PP4012 can be a dietary probiotic for cobia and groupers in modulating the immunity and protecting the groupers from pathogen infection.

Utilization of different carbohydrate sources in hybrid grouper, tiger grouper *(Epinephelus fuscoguttatus)* X giant grouper *(Epinephelus lanceolatus),* TGGG juvenile

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Hybrid grouper (***Epinephelus fuscoguttatus X Epinephelus lanceolatus***), TGGG is a carnivorous fish that naturally has high requirement for dietary protein for their growth. Approaches to spare the protein to maximize growth by incorporating cheaper energy source such as carbohydrate have been evaluated in several fish species. In the present study, four isoproteic (50% CP) and isolipidic (10% CL) diets containing four various local starch as the carbohydrate sources (tapioca starch, corn starch, sago starch and dextrin) at the same inclusion level (20 %) were fed to triplicate groups of TGGG (13.78 ± 0.08 g mean initial weight) for 67 days. After 67 days of feeding trial, the highest percentage weight gain, WG% ($P<0.05$) was obtained in TGGG fed sago starch whereas the lowest ($P<0.05$) PWG was observed in TGGG fed with dextrin diet. The finding was correlated with feed intake as significant reduction was observed in dextrin diet. The survival of TGGG grouper was 100% in all treatments and no difference ($P>0.05$) was found. For the body indices, the highest HSI, VSI, IPF and CF were found in dextrin diet and the lowest was with sago diet. The total cholestrol, triglyceride, and total protein were highest in dextrin diet, and the lowest in sago diet. Contradictory, glucose content was highest in sago and lowest in dextrin. Whole-body protein and moisture contents were highest in sago diet, lowest in dextrin diet and the result was inversely correlated with whole-body lipid content. Currently, on going experiment are conducted on digestibility coefficients (ADCs) of the diets, glycogen content of the liver and enzyme activity of the digestive system. The present findings from this study suggest that sago starch is a good source of dietary carbohydrate to be included in the diets for hybrid grouper.

Ingestion rate and feeding schedule of selected microalgae by zoeal stages of blue swimming crab *Portunus pelagicus*

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The objective of the study is to determine the ingestion rate of the various microalgae and to develop a feeding regime of this various microalgae in each larval stage of blue swimming crab, ***Portunus pelagicus***. In experiment 1 (E1), one l crab larvae was taken from master tank culture and gently pipetted into container with ***Chaetoceros*** sp. only (E1:T1), ***Chlorella*** sp. only (E1:T2), ***Isochrysis*** sp. only (E1:T3), and ***Nannochloropsis*** sp. only (E1:T4). Every treatment was equipped with 20 pieces of centrifuge tubes. Each control tube was prepared without crab larvae. ***P. pelagicus*** ingested most ***Chlorella*** sp. (E1:T2), during Zoea 1 (1,169.72 cells ml^{-1}) and during Zoea 2, the larvae consumed highest species microalgae of ***Nannochloropsis*** sp. (E1:T4) (2,722.38 cells ml^{-1}). For Zoea 3 and Zoea 4, the highest ingestion rate of the microalgae by ***P. pelagicus*** larvae is ***Isochrysis*** sp. (E1:T3) for both larvae stages which are 2,561.53 cells ml^{-1} and 2,530.80 cells ml^{-1}.

In experiment 2, the larvae were fed with rotifer and ***Artemia*** only (E2:T1) for control; larvae fed rotifer, ***Artemia*** and ***Chaetoceros*** sp. (E2:T2); larvae fed rotifer, ***Artemia*** and ***Chlorella*** sp. (E2:T3); larvae fed rotifer, ***Artemia*** and ***Isochrysis*** sp. (E2:T4); and larvae fed rotifer, ***Artemia*** and ***Nannochloropsis*** sp. (E2:T5). For Zoea 1, larvae fed rotifer, ***Artemia*** and ***Chlorella*** sp. (E2:T3) were the highest survival rate, which is 79.96%±0.11. In Zoea 2, larvae fed rotifer, ***Artemia*** and ***Nannchloropsis*** sp. (E2:T5) was the highest of survival rate with 57.35%±0.01, SGR with 25.35% ±0.01 and LSI with 2.9±0.18. For both Zoea 3 and Zoea 4, larvae fed rotifer, ***Artemia*** and ***Isochrysis*** sp. (E2:T4) was highest of survival rate with 33.21%±0.07 and 10.21%±0.45. As a conclusion, ingestion rate of microalgae are different depending on larvae stage and also influenced by the larval development.

Effects of antioxidant supplements on growth, survival, antioxidant capacity, immune response, metabolic response and oxidative stress status of pacific white shrimp (*Litopenaeus vannamei*)

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This study aimed to determine the dietary effects of antioxidant supplements on growth, survival, antioxidant capacity, immune response and oxidative stress resistance of ***Litopenaeus vannamei***. Seven supplements were astaxanthin (AX), vitamin A (VA), ***Quillajasaponaria*** (QS), ***Yucca schidigera*** (YS), Nutrafito plus (NP, mix of QS and YS), leaves or seeds of ***Moringaoliefera*** (ML, MS). Each supplement was incorporated into a basal diet with the same diphenylpicrylhydrazyl (DPPH) antioxidant capacity. Treated diets and control diet (C) were fed to the shrimp in triplicates for 12 weeks. Shrimp's growth, survival, antioxidant capacity, immune response and hypoxia stress resistance were evaluated. The treatments had no effect on survival. Shrimps fed with supplements had better growth performance than C fed shrimps. Compared to control, treatment diets resulted in higher antioxidant capacity, namely, superoxide dismutase (SOD), glutathione peroxidase (GPx), glutathione reductase (GR), alanine aminotransferase (ALT) and aspartate aminotransferase (AST) and immune response in respiratory burst (RB). AX shrimp had the highest and C shrimp the lowest antioxidant capacity in SOD, GPx and GR and resistance against hypoxia stress. Hypoxia stress increased shrimp's GPx and AST, but had no effects on SOD and ALT. The treatments exhibited their effect on RB when under no stress, however, hypoxia stress overrode the treatment effect, causing no difference in RB and total haemocyte count (THC). Hypoxia stress increased glucose (Gluc) and lactate (Lac) and decreased triglycerides (Trigs). Under stress, treatments with supplements resulted in lower Gluc, Trigs and Lac and lethal dissolved oxygen level and longer lethal time than control. However, no differences in metabolic responses among treatments of the supplement. In conclusion, antioxidant extracts enhanced shrimp's growth, antioxidant capacity and hypoxiastress resistance and stabilized metabolic responses when under stress, and slightly affected immune responses.

Effects of dietary cholesterol supplementation on growth, cholesterol metabolism and related gene expression of giant grouper, *Epinephelus lanceolatus*, fed high soybean meal diet

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The aim of the present study was to investigate the effects of dietary cholesterol supplementation on growth, cholesterol metabolism and related gene expression of giant grouper, ***Epinephelus lanceolatus***, fed with high soybean meal diet. Hepatic HMG-CoA (3-hydroxy-3-methylglutaryl-coenzyme A) reductase and CYP7A1 (cholesterol 7α- hydroxylase), the key enzymes involved in cholesterol biosynthesis and elimination, respectively, gene expression were evaluated. Basal diet containing high soybean meal (replaced 50% fish meal protein) was supplemented with 1% cholesterol. Basal diet without cholesterol supplementation and all fish meal diet were also involved for comparison. Total of three experimental diets were each fed to triplicate groups of juvenile giant grouper (initial wt: 12.39 ± 0.36) in a recirculating rearing system for 8 weeks. Grouper fed the all fish meal diet showed higher ($P<0.05$) weight gain than the other two dietary treatments. Plasma cholesterol and low density lipoprotein (LDL) concentration was the highest in fish fed the diet with 1% cholesterol, followed by fish fed the all fish meal diet, and lowest in fish fed the control diet. Plasma high density lipoprotein (HDL) concentration was higher in fish fed the 1% cholesterol-diet than other dietary groups. Hepatic cholesterol concentration and HMG-CoA reductase gene expression were higher in fish fed the control diet than fish fed the all fish meal diet and 1% cholesterol-diet. Hepatic CYP7A1 gene expression was not significantly different among all treatments. The results indicated that grouper fed with high soybean meal diet can synthesize cholesterol ***de novo*** to meet the cholesterol requirement for the species. It is not necessary to supplement cholesterol in giant grouper diet when the fish fed high soybean meal diet.

Effects of coconut oil supplementation in diet on growth, lipid metabolism and relative gene expression in grouper, *Epinephelus coioides*

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The study was to estimate the effects of coconut oil (rich in lauric acid, C12) supplementation in diet on growth, lipid metabolism and relative gene expression in orange-spotted grouper, ***Epinephelus coioides***. The key enzymes involved in lipid metabolism, including peroxisome proliferator-activated receptor γ (PPARγ), carnitine palmitoyl transferase-1 (CPT-1), fatty acid synthase (FAS), fatty acid desaturase (FAD), fatty acid elongase (FAE) and neuropeptide Y (NPY) and gene expression were determined. Experimental diets were kept as isonitrogenous and isoenergetic. Fish oil was replaced by coconut oil at 0, 1, 3, and 5% in the basal diet (15% lipid). A low lipid (10%) diet was also included for comparison. Total of five experimental diets were each fed to triplicate groups of juvenile grouper (initial weight: 8.53 ± 0.13 g) in a recirculating rearing system for 8 weeks. Weight gain was higher in fish fed the diet with 3% coconut oil than that in fish fed the diet with 5% coconut oil and the 10% lipid-diet. Fish fed the diet with 1% coconut oil had higher hepatic malic enzyme activity than fish fed the 10% lipid-diet. Hepatic CPT-1, FAS, FAD and PPAR gene expression were all the highest in fish fed the diet with 1% coconut oil. Fish fed the control diet was observed up-regulated NPY and FAE gene expression compared with other dietary treatments. The results suggest that 1-3% coconut oil supplemented in diet can enhance growth and lipid utilization of grouper.

Nutrient digestibility of conventionally processed canola meal in Nile tilapia

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Three conventional processing methods, namely water extraction with pH of 7.5, yeast fermentation with ***Saccharomyces cerevisaie*** and their integration method (water extraction followed by yeast fermentation) were used to improve nutritional values and some anti-nutritional factors (ANFs) of canola meal. The results showed that all the three methods completely removed glucosinolates (GLs). Reductions of phytic acid, tannins and non-tannins were shown as 5-18, 36-49 and 70-89%, respectively. These processing methods increased meal crude protein (CP), crude fiber (CF) and minerals consisted of P, Ca, Mg, Fe, Zn, Cu and Mn by 4-9, 7-9 and 4-35 %, respectively. In contrast, crude lipid (CL) and essential amino acids (EAAs) were reduced by 13-34 and 1-31 %, respectively. Yeast fermentation mostly maximized reductions of ANFs and EAAs, and increases of CP, CF and minerals,

followed by integration method and water extraction. All canola meals including untreated meal were subjected to digestibility test in Nile Tilapia. The test diets consisted of 30% of each meal type and 70% reference diet. Three groups of fish with an initial weight of 10 g were fed each diet twice a day to an apparent satiation. The results showed that digestibility coefficients of dry matter (DM), CP, CL and energy of canola meals in Nile tilapia were 66-75, 73-77, 76-92, and 73-81 % for respectively. Yeast fermented meal maximized digestibility coefficients of DM and CP, while integration method responsible for digestibility coefficients of CL and energy.

Effect of nutritional status on growth response in Indian snow trout *Schizothorax richardsonii*

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Schizothorax richardsonii, a Himalayan cyprinid fish inhabiting fluvial coldwater streams, has been considered as a potential candidate for hill aquaculture in Indian uplands. However, nutritional studies in captivity are scant. Therefore, to elucidate the effect of nutritional status on growth and the underlying biochemistry of snow trout, a 6 week feeding trial was conducted in juvenile fish of 5 g average body weight. 180 fish were randomly assigned to two treatment groups, namely fed (F) and starved (S) with six replicates each (i.e., 15 fish per tank). Purified diet containing 35% crude protein and 6% crude lipid was fed to the fish according to the treatment. In the first phase of the feeding trial, the S group was feed deprived for 3 weeks, whereas the F group was routinely fed to assess the effect of starvation. In the second phase consisting 3 experimental replicates, feeding was resumed in the S group and continued in F group for another 3 weeks to assess the effect of refeeding. Growth measurement and sampling was carried out at three different time points to determine the effect of starvation (after three weeks), acute re-feeding (2 days after re-feeding) and chronic re-feeding (three weeks after re-feeding). Throughout the experiment, there was no mortality irrespective of the nutritional condition. The average weight gain in the F group was 16.8% in the first phase and 9.6% in the second phase. On the other hand, the 3 week starvation resulted in significant loss of body weight (-5.4%) in the S group, but the resumption of feeding was found to result in a compensatory growth response (24.8%). At the end of the starvation period, the viscerosomatic index (VSI) of the S group was significantly lower than the F group, indicating the utilization of visceral fat for energy supply during starvation in snow trout. Nevertheless, the gain in VSI was remarkable in the S group just after 2 days of re-feeding, almost at par with the continuously fed group and reaching even significantly higher values at the end of the 3 week re-feeding period. This phenotype strongly indicates the possibility of distinct metabolic changes in snow trout with respect to its nutritional condition, which will be analysed further.

Improving feed quality, availability and cost with alternative feeds and feeding regimes for smallholder aquaculture operations

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Aquaculture growth for smallholder farms is often limited by a lack of access to affordable, high-quality feed sources. Furthermore, feed costs constitute the majority of production costs between 60-80% for tilapia, one of the most widely cultured species in the world. Research supported by the AquaFish Innovation Lab in Africa and Asia is focusing on reducing operational costs by developing alternative feed types and feeding regimes, while maintaining high yields. More specifically, research involves investigating affordable and locally sourced feeds and examining how pulsed feeding strategies affect fish gut biomes to improve nutrient uptake efficiency from feeds. In doing so, AquaFish researchers are improving feed quality and availability and reducing reliance on expensive feeds, which will increase productivity and sustainability of small-scale aquaculture operations in communities across the globe.

Single nucleotide polymorphism (SNP) in a crustacean hyperglycemic hormone gene and its association with growth performance in pacific white shrimp *Litopenaeus vannamei*

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Thailand is one of the main producers of cultured shrimp. The introduction of the

Pacific white shrimp, ***Litopenaeus vannamei*** to Thailand in 2002 reverses the production trend from ***Penaeus monodon*** to ***L. vanmanei***. Marker-assisted selection (MAS) is a major potential application used for expanding research on the genomics of farmed species. Genetic markers that allow selection of juveniles and broodstock with high potentials for growth rates would be useful for the shrimp industry. In this study, single nucleotide polymorphism (SNP) of crustacean hyperglycemic hormone of ***L. vannamei*** from seven different sources were examined by PCR-cloning and sequencing. Seventeen positions of SNP were found across examined specimens. The methods for detection C>T121 and C>T196 SNP were developed using real-time PCR-based PCR amplification of specific allele (real-time PCR-based PASA) and PCR-restriction fragment length polymorphism (PCR-RFLP). Genotypes of these SNP in 2-month-old of cultured ***L. vannamei*** (LV2TA and LV1TA samples) were further examined. At position 121, LV2TA juveniles with a T/T genotypes (***N*** = 24) exhibited a greater average body weight and total length than those with a C/T genotype (***N*** = 124). Similar results were also observed in the LV1TA samples (***N*** = 15 and 65). At position 196, LV2TA juveniles with a C/C genotype (***N*** = 5) exhibited a greater average body weight and total length than those with T/T (***N*** = 79) and C/T (***N*** = 52) genotypes in order. Similar results were also observed in the LV1TA samples (***N*** = 4, 67 and 10, respectively). The identified SNP markers will be applied to assist genetic selection of farmed ***L. vannamei*** in Thailand.

ß-glucan binding protein purified from the haemolymph of Indian white shrimp, *Fenneropenaeus indicus* and evaluation of its functional and antimicrobial activity

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Despite having relatively short life and assumed lesser complexity, crustaceans possess mechanisms to spot unknown intruders. In particular, they appear to recognize common characteristics present in bacteria and fungi, such as

lipopolysaccharides and ß-glucans. ß-glucan binding protein (ß-GBP) is one of the members of pattern recognition protein (PRP) which involves the activation of prophenoloxidase system by reacting with ß-1, 3 glucan available on fungal surface. The present study was aimed to purify ß-GBP from the haemolymph of Indian white shrimp, ***Fenneropenaeus indicus*** by laminarin coupled Sephadex G-100 affinity column chromatography. The purified ß-GBP appeared as a single band in SDS-PAGE and has the molecular mass of 100 kDa and purity was further confirmed by HPLC. Functional studies of purified ß-GBP showed evidence for the agglutination reactions against yeast, bacterial and mammalian RBCs. This explain, ß-GBP have the mechanism to identify the foreign invaders by their surface marker, ß-1, 3 glucan. Immune specificity of ß-GBP was explained by activating the prophenoloxidase system by the couple action of ß-GBP and laminarin complex. Inhibition of bacterial growth was scrutinized by antibacterial and antibiofilm activity against Gram positive ***Bacillus subtilis*** and Gram negative ***Vibrio parahaemolyticus***. The findings of antimicrobial studies proved that the complex of ß-GBP and laminarin (ß-GBP-ß-G) could effectively inhibit the biofilm formation when compared to ß-GBP and laminarin unaccompanied. ß-GBP was found to hold inherent serine protease activity but lacked ß-1, 3 glucanase activity and all these results suggest that ß-GBP from the haemolymph of ***F. indicus*** function as a recognition molecule for ß-1, 3 glucan on the surface of microbial cell wall. This study emphasizes the potential activity of ß-GBP as an interesting candidate for the activation of innate immune system against pathogenic microorganisms present in crustacean environment.

Neuroendocrine regulation of ovaran maturation in giant freshwater prawn, *Macrobrachium rosenbergii* (De Man)

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The neurosecretory system plays vital roles in reproductive physiology of crustaceans by transducing the environmental stimuli into physiological processes. An attempt has been made to understand the neuroendocrine mechanisms involved in ovarian maturation in giant freshwater prawn, ***Macrobrachium rosenbergii***. Neurosecretory cells (NSCs) of ***M. rosenbergii*** related to reproduction are congregated in eyestalk, brain and thoracic ganglia. There were five types of NSCs in eyestalk having size in range of 5-35 mm with or without axons and round to oval shape. They were distributed in medulla externa, medulla interna and medulla terminalis. Sinus gland measuring 30-35 mm was also observed in the medulla interna region. Axonal terminals of these neurosecretory cells were found to terminate in this structure. Brain and thoracic ganglia possessed five types of neurosecretory cells such as giant neuron (>80 mm), A (60-80 mm), B (40-60 mm), C (20-40 mm) and D (<20 mm). They were seen arranged in several groups in different parts of brain. In anterior region B, C and D cells were located whereas in posterior region giant neurons and A cells predominated. In lateral regions A, B, C and D cells were recorded. The thoracic ganglionic mass was divided into anterior, middle and posterior regions. The NSCs were distributed in anterior and posterior portions but were lacking in middle portion. A and B cells were present in anterior-most region followed by C and D cells. In posterior-most region, giant neurons and A cells were present. Histochemical tests demonstrated that the neurosecretory cells of the giant freshwater prawn were strongly positive to acid fuchsin, paraldehyde fuchsin but exhibited feeble reaction to Sudan black B and periodic acid-Schiff's reagent (PAS) too.

Unilateral eyestalk ablation for 15 days induced ovarian maturation by increasing GSI and ova diameter as well as enhancing the secretory activities of the giant neurons (GN) and A cells of the brain and thoracic ganglia of ***M. rosenbergii***. Neurotransmitters like 5-HT administration to the intermolt prawns induced ovarian development while dopamine injection resulted in negative response. Ovary of 5-HT treated prawns exhibited development from primary vitellogenic to vitellogenic stage on day 28 of the treatment, whereas in dopamine treated group ovaries remained in pre-vitellogenic stage but a few oocytes depicted the signs of degenerative changes too.

Construction of genetic linkage map and detection of growth-related quantitative trait loci (QTL) in inter-specific F_1 hybrids of groupers (*Epinephelus fuscoguttatus* × *E. lanceolatus*)

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One of the main targets of genetic breeding programs in aquaculture is growth-related trait. In order to identify the genomic regions responsible for growth-related traits for marker assisted selection (MAS), quantitative trait locus (QTL) analysis is a useful method. Herein, we have constructed genetic linkage maps for tiger grouper (***Epinephelus fuscoguttatus***) and giant grouper (***E. lanceolatus***) using 400 simple sequence repeat markers in F_1 hybrids (***E. fuscoguttatus*** × ***E. lanceolatus***) and performed QTL analysis of growth-related traits. The ***E. fuscoguttatus*** (female) linkage map contained 331 markers assigned to 24 linkage groups (LGs) and spanned a total of 1202.0 cM. Meanwhile, the ***E. lanceolatus*** (male) linkage map contained 232 markers distributed in 24 LGs and spanned a total of 954.2 cM. These maps covered 82.6% and 73.5% of genome with the average interval of 4.8 cM and 5.6 cM, respectively. QTLs associated with growth-related traits with 5% genome-wide significance were detected on five LGs. In tiger grouper, four QTLs were identified for total length and body weight on LG 8, 10, 13 and 19 which

explained 5.7-12.4% of the phenotypic variance. In giant grouper, two QTLs were identified for body weight on LG 3 and 10 which explained 6.9% of the phenotypic variance. Growth-related QTLs found in this study can be useful for genetic breeding programs of grouper species.

Ovarian maturation stages of captive mud spiny lobster, *Panulirus polyphagus*

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Aim of the present study was to indicate the ovarian maturation of captive mud spiny lobster, ***Panulirus polyphagus*** fed with different diets (squid and fish). The samples maturation were determined via morphology, histology and biochemistry (fatty acids). ***P. polyphagus*** samples were sampled from Kuala Sedilli, Johor Bahru, Malaysia. Various stages of ovarian maturation were found during experimental period namely; on morphological aspect showed different color and distribution of gonad. While in histological and biochemical aspects showed different oocyte size and distribution, saturated fatty acid (SAFA), monosaturated fatty acid (MUFA) and polyunsaturated fatty acid (PUFA) content. The size and gonadal somatic index (GSI) were also discussed in this study. Conclusion, the diets play an important role on ovarian maturation of mud spiny lobsters, ***P. polyphagus***.

Preliminary study on early larval stage of blue swimming crab, *Portunus pelagicus* fed with free-living nematode

Panagrellus redivivus

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Free-living nematode, ***Panagrellus redivivus***, was tested as live food for blue swimming crab, ***Portunus pelagicus*** larvae during the first feeding stage. A series of experiments were conducted to determine the acceptability of the free-living nematodes in blue swimming crab larvae at first feeding, the optimum nematode density and the response of the larvae to nutritionally enriched nematode. The experiments were conducted in 15 plastic containers filled with 500 ml filtered seawater and each of the containers was stocked with 30 nos of newly hatched blue swimming crab larvae.. Moderate aeration was provided in the larval rearing containers to increases oxygen level in reared medium culture. Dead crab and uneaten food were siphoned out from the containers daily. Microworms were given four times in a day at around 0800 hrs, 1100 hrs, 1400 hrs and 1600 hrs after the water exchange. Duration of feeding experiments was up to day 10-15 and the results showed survival rate of 56%, 74%, 84% and 66% for zoea 1, zoea 2, zoea 3 and zoea 4, respectively. Observations indicated that the blue swimming crab larvae readily fed on free-living nematodes as early as 2 days post hatching, i.e. the start of exogenous feeding.

Feeding, digestion and protein efficiency of white shrimp (*Litopenaeus vannamei*) fed with different natural food sources

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A study of feeding, digestion and efficiency of protein use in white shrimp fed with different natural food sources was conducted in 35-liter glass tanks each containing 20 shrimps. Shrimps (0.12 ± 0.00 g/individual) were fed for 3 weeks with gutweed (T1), chironomid larvae (T2) or mosquito larvae (T3). Shrimps fed with pellet (T4) or without feeding (T5) were used as controls. Individual shrimps were fed with natural foods and their stomach contents were checked at 0.5, 1, 2, 3, 4, 5 and 6 hr. The digestion was measured and growth rate, protein efficiency ratio (PER), net protein utilization (NPU) and survival rate were calculated weekly. The results showed that weight gain and PER of shrimp in T2 (442 ± 98.6% and 2.37 ± 0.22) and T4 (410 ± 45.7% and 2.31 ± 0.13) were not significantly different but they were significantly higher ($P<0.05$) than for the other treatments. NPU of shrimps in T2 (1.69 ± 0.16) and T4 (1.62 ± 0.09) was significantly higher than for shrimps in T1 (0.93 ± 0.09) and T3 (0.82 ± 0.09). The survival rates of shrimp were not significantly different between T1, T2, T3 and T4 but they were significantly higher than that for T5. These results indicate that chironomid larvae can promote growth as well as does pellet feed. The digestion of gutweed, chironomid larva and mosquito larvae was completed within 3, 4 and more than 6 hr. respectively. Chironomid larvae provide a natural food which is useful for shrimp growth and easy to digest by white shrimp. These studies show that preparation of a shrimp pond to contain a high abundance of chironomid larvae is an efficient alternative way to reduce the use of pellet feed especially in the 1st month.

Fermented banana (*Musa spp.*) peel improves growth and red blood cells of Nile tilapia (*Oreochromis niloticus*)

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Banana peel (BP) has a high nutritional value which could be considered to be a potential fish feed ingredient. BP is a rich source of a starch (3%) crude protein (6-9%), crude fat (3.8-11%) total dietary fibre (43.2-49.7%) and vitamins. Additionally, it contains flavonoids, tannins, phlobatannins, alkaloids, glycosides and terpenoids.

This study evaluated the dietary effect of fermented banana (***Musa spp.***) peel on growth, hematological parameters and survival of Nile tilapia (***Oreochromis niloticus***) following ammonia stress. The fermented banana peel (FBP) was sprayed into one kg of commercial tilapia feed; 50 ml FBP + 250 ml distilled water (DW) (FBP50), 100 ml FBP + 200 ml DW kg-1 (FBP100) or 200 ml FBP + 100 ml DW kg-1 (FBP200) while 300 ml DW for the control diet (C). Significant effects of treatments on growth were observed from 2nd to 6th week of rearing. For Wf, WG and SGR, FBP200>FBP100>FBP50=C while for FCR, FBP200=FBP100>FBP50=C. WG of FBP200, FBP100 and FBP50 was increased by 62%, 35% and 8% as compared to the C, respectively. Among hematological parameters, only RBC of FBP200 showed higher value than the control at seven days after ammonia stress test. Overall, these results indicated that FBP, especially FBP200 enhanced growth performance and RBC of tilapia.

Effect on growth by replacing various levels of fishmeal in Asian sea bass (*Lates calcarifer*) diets with fermented natto-yeast protein

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This study was focused on growth of Asian sea bass (***Lates calcarifer***) by replacing 0%, 10%, 20%, 30% fishmeal-based dietary protein with fermented Natto-yeast protein. Experimental diets were designed at similar crude protein, fat and energy level. After 151 days experimental period, the researcher observed significant improvement on growth Rate (GR) of 30% replacement treatment. This treatment also maintain no mortality that slightly better than control treatment (0% replacement). No amino acid profile and proximate content difference in carcass was found between treatments. However, only crude fat content in carcass of control treatments (1.54%) showed significant higher than 30% replacement treatments (0.39%). 30% replacement treatment also appear low fat appearance on liver.

The result of this experiment suggested fermented Natto-yeast protein was able to replace 30% of fish meal in commercial diet that can maintain similar meat quality but better growth.

Alternative microalgae paste to replace fresh microalgae for caranoid copepod

(*Pseudodiaptomus annandalei* Sewell)

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The tropical calanoid copepod, ***Pseudodiaptomus annandalei***, has good potential as a live food for tropical marine finfish and shrimp larvae. The present study comprised two experiments. First experiment was carried out to investigate the intake of ***P. annandalei*** nauplii copepodites and adults when fed alternative algae paste and fresh algae of ***Chaetoceros*** sp. (Chae), ***Isochrysis*** sp. (Iso), ***Tetraselmis*** sp. (Tet), ***Skeletonema*** sp. (Ske) and ***Nannochloropsis*** sp. (Nan) at temperature 28-29°C and salinity 30-31‰ for 72 hours. Three replicates, with an initial 10,000 ***P. annandalei*** per replicate, were set up for each treatment. The results showed that algaepaste and fresh algae significantly affected feed intake of ***P. annandalei***. Chae, Iso, Tet and Nan algae paste gave the same feed intake of fresh algae ($P>0.05$), while Ske algae paste had lower feed intake than fresh algae ($P<0.05$). Thus, Chae, Iso, Tet and Nan algae paste were usefully as alternative algae paste for ***P. annandalei*** in the next experiment. The second experiment was carried out to investigate the population growth of ***P. annandalei*** when fed mono-and combination algae pastes. For the population growth experiment, the final ***P. annandalei*** population (including nauplii, copepodites and adults) was determined after feeding 14 alternative algae pastes (Chae, Iso, Tet, Nan, Chae+Iso, Chae+Tet, Chae+Nan, Iso+Tet, Iso+Nan, Tet+Nan, Chae+Iso+Tet, Chae+Iso+Nan, Iso+Tet+Nan and Chae+Iso+Tet+Nan) for 10 days at the same temperature and salinity of previous experiment. Three replicates, with an initial 1,000 adult ***P. annandalei*** per replicate, were set up for each treatment. The results showed that algae paste significantly affected population growth of ***P. annandalei***. The combination algae pastes were more successful than monoalgae paste. The highest population growth was recorded on ***P. annandalei*** fed Chae+Iso+Nan (final population: 90,910±92), which was significantly higher ($P<0.05$) than all other mono- and combination algae

pastes except for Chae+Iso (final population: 90,550±180).The results of this study suggest that the alternative algae paste could replace fresh algae and a combination of ***Chaetoceros*** sp. ***Isochrysis*** sp. and ***Nannochloropsis*** sp. paste was the best for the culture of ***P. annandalei***.

Nutritional value of sea lettuce (*Ulvarigida*) and application as feed ingredients in Pacific white shrimp (*Litopenaeus vannamei* Boone, 1931) diets

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The nutritional value and application of sea lettuce (***Ulvarigida***) as feed ingredients was investigated in Pacific white shrimp (***Litopenaeus vannamei***). Two feeding trials were conducted. The first trial was aimed to investigate growth and survival rate of ***L. vannamei*** feeding with 6 experimental diets which diets 1, 2, 3, 4 contained ***U. rigida*** at 0, 6, 9 and 12%, respectively, while diets 5 and 6 contained soybean meal at 17 and 20%, respectively. Shrimp were reared in 24 of 1x1x1 metre cages at density of 30 shrimps per cage and fed with experimental diets 4 times a day for 12 weeks. Growth and survival rate were recorded at 2-week intervals. The second feeding trial was study the digestion efficiency of diets contained sea lettuce compared with soybean meal. Shrimps were reared in 24 of 200 litres aquarium at 20 shrimps per aquarium and fed with the same formulated diets as in the first trial for 3 weeks. The results of the first trial revealed that growth and survival rate of ***L. vannamei*** fed with 0, 6, 9 and 12 % of ***U. rigida*** in diets were not significantly different ($p>0.05$) from shrimp fed with 17 and 20% soybean meal in diets ($p>0.05$). The result of the second trial found that there were not significant difference of digestibility efficiency of ***L. vannamei*** fed with 6 formulated diets and the digestibility was in the range of 84.00-84.32%. The results of present study

showed that ***U. rigida*** has nutritional value as feed ingredient to ***L. vannamei,*** which can replace fishmeal as high as 6-12% and not differ from 17-12% of soybean meal.

Response of haemocytes receiving sodium alginate in white shrimp *Litopenaeus vannamei*

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In this study, we examined the binding activity of r***Lv***LGBP to sodium alginate derived from brown seaweed using ELISA and the effect on the haemocyte size change of white shrimp, ***Litopenaus vannamei***. Shrimp haemocytes treated with four different concentrations of sodium alginate at 0, 0.1, 0.5 and 1 mg ml^{-1} for five different incubation times were examined for haemocyte change using flow cytometry. Shrimp haemocytes treated with sodium alginate caused reduction in the percentage of large cell and increase in the percentage of small cell. In shrimp haemocytes treated with 0.1 mg ml^{-1}, the percentage of large cell among circulating haemocytes was 85.6% at time 0 min, and decreased to 66.1% after 120 min, whereas the percentage of small cell was 14.4% at time 0 min, and increased to 33.9% after 120 min. In shrimp haemocytes treated with 0.5 mg ml^{-1}, the percentage of large cell among circulating haemocytes was 85.4% at time 0 min, and decreased to 56.5% after 120 min, whereas the percentage of small cell was 14.6 % at time 0 min, and increased to 43.5% after 120 min. The apparent dissociation constant (Kd) of r***Lv***LGBP to sodium alginate, calculated from saturation curve fitting according to the one-site binds was 0.1146 μM. We conclude that ***Lv***LGBP functions as a PRP, recognizes and bindssodium alginate and subsequently leads to activating innate immunity in shrimp, and activates the prophenoloxidase system as evidenced by changes in haemocyte size.

Immumostimulatory effect of fucoidan on white shrimp *Litopenaeus vannamei* in vitro and in vivo study

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Fucoidan is a sulfated polysaccharide extracted from the brown seaweed, can be used as a natural product against pathogen threats and as an immunostimulant in aquaculture. In this study, we examined the immune response of fucoidan ***in vitro*** and the survival rate of shrimp following administration of diets containing fucoidan. Results indicated that fucoidan caused changes in the cell morphology and cell size. Proliferation and mitotic index of haematopoietic tissue (HPT) were higher in shrimp that immersed in seawater containing fucoidan at 100, 200, and 400 mg l^{-1}. Survival rate of shrimp fed the 1.0 and 2.0 g kg^{-1} diets were significantly higher than those of shrimp fed the control and 0.5 g kg^{-1} diets and then challenged with ***V. alginolyticus***. Phagocytic activity and the clearance efficiency against ***V. alginolyticus*** were significantly higher in shrimp that fed the 1.0 g kg^{-1} diet than to those of control shrimp. It was concluded that fucoidan can be used as immunostimulant that may warrant further development as a marine drug and promotes growth and resistance against ***Vibrio*** in shrimp.

Immunological role of ß-glucan binding protein (ß-GBP) purified from the haemocytes of mud crab, *Scylla serrata* and its antibiofilm property

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The ß-glucan binding protein (ß-GBP) otherwise known as pattern recognition

protein/receptor (PRP) contribute to the defensive response against microbial illness in invertebrates. The defense mechanism of crustaceans is less developed than that of finfish and other vertebrates. In crustaceans, ß-GBPs are plentiful plasmatic proteins produced by the hepatopancreas attested manifold biological task. The haemocytes of mud crab ***Scylla serrata***, contains a protein which is able to bind to laminarin (a soluble ß-1, 3 glucan) has been isolated by two methods, laminarin precipitation and affinity chromatography on Sepharose CL 6B column. The resolution of SDS-PAGE showed that the molecular weight of purified ß-GBP was 100 kDa. The purity, homogeneity and crystalline nature of the protein were investigated by HPLC, CD and XRD studies respectively. The interaction of ß-GBP with ß-1, 3 glucan and polysaccharides which are present on the membrane of yeast and bacterial cells was assessed through yeast agglutination and bacterial agglutination activities. In addition, the antioxidant property of ß-GBP was evidenced by DPPH radical scavenging activity. The competence of purified ß-GBP to bacterial environment was screened by antibacterial and antibiofilm activity against Gram positive ***Bacillus licheniformis*** and Gram negative ***Proteus vulgaris***. The purified ß-GBP did not show any glucanase activity but was able to enhance the activation of haemocyte derived peptidase and prophenoloxidase only in the presence of ß-1, 3 glucan. It showed the enhanced PO activity by the complex of ß-GBP and laminarin (ß-GBP- ß-G complex) and there was no stimulation by ß-GBP and laminarin alone. Consequently, the present study records the multifunctional role of ß-GBP in crustacean immune system and also proves their efficiency to provoke the prophenoloxidase activating system.

Application of bacteriophage for combating acute hepatopancreatic necrosis disease (AHPND) in shrimp

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Acute hepatopancreatic necrosis disease (AHPND, also known as early mortality syndrome, EMS) caused by ***Vibrio parahaemolyticus*** has resulted in severe marine shrimp mortality and significant economic losses in related aquaculture throughout Southeast Asia and Central America. As no viable remedy has yet been reported, the main objective of this study was to develop an effective bacteriophage (phage)-based method of controlling AHPND/EMS. To determine the bacteriolytic activity of phage pVp-1 against ***V. parahaemolyticus*** strains causing AHPND/EMS, its infectivity was tested on 22 strains isolated from geographically diverse regions (5 of the Asian type and 17 of the Mexican type). This phage was able to infect 90.9% (20 strains among 22 strains) of the AHPND/EMS-related ***V. parahaemolyticus*** strains used in this study, and demonstrated substantial bacteriolytic activity against three strains known to be highly pathogenic. In our previous study conducted using two models of oyster infection, we demonstrated that pVp-1 is effective in controlling ***V. parahaemolyticus*** infection by bath immersion, and inhibits bacterial growth when applied to the oyster-surface. Also, this phage did not cause any harm to oysters. To the best of our knowledge, this is the first report of a virulent phage infecting ***V. parahaemolyticus*** strains responsible for AHPND/EMS, and indicates the potential utility of pVp-1 in phage therapy.

Essential oils of *Nigella sativa* protects *Artemia* from the pathogenic effect of *Vibrio parahaemolyticus* Dahv2

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The anti-***Vibrio*** activity of essential oils (EOs) of nine medicinal plants such as ***Azadirachta indica*** (seeds), ***Alternanthera sessilis*** (leaves), ***Eclipta prostrata*** (leaves), ***Hydnocarpus pentandra*** (seeds), ***Madhuca longifolia*** (seeds), ***Nigella sativa*** (seeds), ***Ricinus communis*** (seeds) ***Sesamum indicum*** (seeds) and ***Cocos nucifera*** (seeds) was tested against 28 ***Vibrio*** spp. isolated from infected ***Fenneropenaeus indicus***. Among the nine EOs, ***Nigella sativa*** EO exhibited antivibrio activity against all ***Vibrio*** sp. and greater inhibition was noted for the isolate V_2 which was identified as ***Vibrio parahaemolyticus*** Dahv2 by 16S rDNA gene sequencs with accession number HQ693276. Further, EO of ***N. sativa*** effectively inhibited ***Vibrio parahaemolyticus*** Dahv2 with an inhibition zone of 23.9 mm at 101.2 µg ml^{-1}. Moreover, EO of ***N. sativa*** revealed antibiofilm activity at 101.2 µg ml^{-1} against ***Vibrio parahaemolyticus*** Dahv2. ***In vitro*** experiments showed that ***N. sativa*** EO inhibited the growth of ***V. parahaemolyticus*** Dahv2 (10^3 cfu ml^{-1}) at 100 µg ml^{-1}. ***In vivo*** experimental infection studies showed that the survival of ***Artemia*** spp. infected with ***V. parahaemolyticus*** Dahv2 at $1x10^3$ cfu ml^{-1} was only 40%. The ***Artemia*** infected with ***V. parahaemolyticus*** Dahv2 showed structural deformities, i.e., loss of antennae and carapace. However, the survival of ***Artemia*** was significantly increased (78%) with the addition of 100µg ml^{-1} of ***N. sativa*** EO. EO of ***N. sativa*** showed higher antioxidant potential and total phenol content than other EOs tested. The antioxidant activity of EO of ***N. sativa*** was highly correlated to their total phenolic contents ($r= 0.836$, $P<0.05$). This observation suggest that ***N. sativa*** EO may act as protective agent and will enhance the survival of ***Artemia*** spp. by preventing the pathogenicity of ***V. parahaemolyticus*** Dahv2. Through the present findings, it is possible that ***Artemia*** spp. treated with ***N. sativa*** EO would result in less oxidative stress and maintain their anti-oxidant defences active against pathogenic microbes.

Characterization of Vp_PirA-like and Vp_PirB-like in *Vibrio parahaemolyticus* causing-acute hepatopancreatic necrosis disease

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Acute hepatopancreatic necrosis disease, AHPND is a shrimp disease cause by a unique strain of ***Vibrio parahaemolyticus*** carrying plasmid that harboring Vp_PirA-like and Vp_PirB-like toxin genes. Vp_PirA-like and Vp_PirB-like toxins have been identified as virulence factors of AHPND. They are considered to function as binary toxin, however, their functions remain unclarified.

In this study, protein expression of Vp_PirA-like and Vp_PirB-like were observed from five ***V. parahaemolyticus*** AHPND-causing strains; D2, D4, D6 E1 and E2. Total proteins from whole cell lysate and culture supernatant were electrophoresed using SDS-PAGE, proteins were blotted into membrane and used specific antibodies against Vp_PirA-like and Vp_PirB-like to determine protein expression of each strain. Western blot analysis revealed the difference expression levels among five strains in both whole cell lysate and culture supernatant samples. The highest expression of Vp_PirA-like and Vp_PirB-like proteins in whole cell lysate and culture supernatant were observed in strain D6 and E1, respectively. We also examined virulence of five AHPND strains to juvenile shrimp, ***Litopenaeus vannamei***. Shrimps were immersed with two bacterial concentrations of five AHPND strains, $5x10^4$ CFU/ml and $5x10^5$ CFU/ml. Immersion tests showed that strain E1 caused the highest mortality to juvenile shrimp which is consistent with protein expression of Vp_PirA-like and Vp_PirB-like from culture supernatant. These results suggest that secreted proteins of Vp_PirA-like and Vp_PirB-like are the key factors of AHPND virulence. For better understanding, further study on mechanism of action of these toxins is necessary to investigate.

A member of the immunoglobulin superfamily, orange-spotted grouper immune gene EcVig, is induced by immune stimulants and DNA virus

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A novel grouper immune gene, EcVig was identified in orange-spotted grouper (***Epinephelus coioides***). Our recent study has shown that EcVig expression can be induced after an infection by an RNA virus (nervous necrosis virus, NNV) infection while the NNV replication can be suppressed when EcVig was overexpressed. Even though EcVig appear to be involved in grouper antiviral activity, however, its immune effect has not been well understood and further investigation will be required.

In the present study, the pathogen-associated molecular pattern, lipopolysaccharides (LPS), synthetic double-stranded RNA polyriboinosinic-polyribocytidylic acid [poly (I:C)], as well as fish DNA viruses (red sea bream iridovirus, RSIV; grouper iridovirus, GIV) were used to study EcVig response in orange-spotted grouper. In addition, we treated groupers with recombinant type I interferon to observe if EcVig expression is able to be induced. We found that EcVig expression was significantly induced after poly (I:C) stimulation. In contrast, the LPS stimulation did not appear to have any effect in grouper intestine. Following injection with RSIV and GIV, expression levels of total EcVig, EcMx and other immune-related gene were all increased slightly after RSIV and GIV infection. Furthermore, endogenous type I IFN was induced by recombinant type I IFN, whereas EcVig was expressed following expression of endogenous type I IFN. These data provide more evidence of the immune function and possible regulation of EcVig.

Reproductive performance of wild and captive *Penaeus indicus* and growth of offspring

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Penaeus indicus is classified as an important shrimp species of the world and is indigenous to the Philippines. The Aquaculture Department/Southeast Asian Fisheries Development Center has produced multiple generations of hatchery-bred ***P. indicus***. However, data on reproductive performance of the captive broodstock (C) compared to its wild (W) counterpart together with the information on the growth performance of the post larvae it produced are yet to be reported.

For the reproductive performance experiment, 16 adult shrimp were stocked in one-ton tanks (n=3) at 1:1 male to female ratio. After ablation of females, stocks were monitored for maturation and spawning for 60 days. For the growth performance, 30 post-larvae from C and W were stocked in one- ton tanks (n=3) and reared for 60 days. Results show that percentage of spawning of W (70.8±5.3%) was significantly higher compared to C (33.3±8.3%). Further, there was no significant difference in the fecundity of W (1652±972 eggs/g) and C (1924±1171 eggs/g). No significant difference was also recorded in hatching rate of eggs produced from W (62.1±30.0%) and C (63.3±12.9%). For the growth performance, analysis showed that PL produced from C (24.6±0.9%) had significantly higher survival compared to PL from W. Average body weight of PL from C (0.4±0.1 g) was also higher compared to PL from W (0.3±0.0 g), but significant difference was not detected. Similarly, feed conversion ratio of PL from C (1.9±0.5) were lower compared to PL from W (2.1±0.5), but significant difference was not detected. Reproductive performance of C and W in terms of fecundity and hatching rate were comparable. However, additional experiments should be conducted to determine the factors causing the reduced percentage of spawning of the C. This study recommends the use of PL from captive broodstock.

Genetic parameters and selection responses for growth and body color in genetic improvement program of red tilapia in Egypt: implications for high quality seeds

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Red tilapia (***Oreochromis*** spp) has become popular in Egypt due to its greater economic value relative to Nile tilapia, especially due to shortage of freshwater. As there is a growing demand for quality seed of this species, the Fish Research Center, Suez Canal University, Egypt has initiated a genetic improvement program for red tilapia. The ultimate aim of the project is to develop a genetically improved strain of red tilapia with uniform red coloration, high survival and good adaptation to local environment. A successful development of genetically improved strains of red tilapia is expected to have a direct beneficial impact on fish farmers in Egypt. Genetic parameters and selection responses were obtained for growth, survival and external color traits of Florida red tilapia (***Oreochromis*** spp.) in Egypt after three generations of multi-trait selection. Red tilapia from five hatchery stocks in Egypt was used to compose a synthetic breeding population. About 15,000 tagged fingerlings representing 500 full-sib families in three generations were tested in freshwater and brackishwater concrete ponds. About 10,000 fish were recorded at the expected time of sexual maturation (150 days) and at harvest (240 days) to estimate genetic parameters. Heritability (h^2) estimate for body weight was 0.40±0.02 when analyzing all harvest data, while h^2 of survival was 0.06±0.01 and 0.08±0.11, respectively, when estimated on the observed and underlying scales. The h^2 of external color traits at harvest was 0.26±0.03, 0.63±0.02 and 0.15±0.01, respectively, for black spots, pigmented area and skin/scale color. Including all data, effects common to full-sibs other than additive genetic effects (c^2) accounted for 4–6%, 3–4% and 6–14%, respectively, of the total phenotypic variance for body weight, survival and external color traits. Genetic correlations between observations at expected time of sexual maturation and at harvest were generally high in magnitude (0.8–1.0) for all recorded traits except black spots (0.79±0.07). It is concluded that the ongoing selective breeding of red tilapia in Egypt has resulted in considerable genetic improvements of growth (60% larger body weight at harvest), survival and external color traits after three generations of multi-trait selection.

Spatial distribution of benthic diatom communities of Bundelkhand Rivers, India with reference to the proposed Ken-Betwa Link

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Freshwater habitats are relatively discontinuous, and species do not disperse easily across the land barriers that separate river drainages into discrete units. In the tropical developing countries like India, species extinction or genetic loss may become severe in future due to loss of habitat, blockage of waterways, inter-basin transfers and water withdrawal from rivers. The rivers Chambal, Betwa and Ken form the lifeline of the Bundelkhand region. Ambitious plans are afoot to link these rivers. Execution of the Ken-Betwa link has already begun. A preliminary pre-linkage survey was done with respect to diatom communities in these two Rivers. Only 39% of the flora was common to these locations, while many species were specific to both the Ken and the Betwa. ***Achnanthidium minutissima*** var ***gracillima, Gomphonema parvulum*** and ***Planothidium lanceolatum*** were dominant diatom taxa in river Ken, while ***Navicula virudula, A. minutissima v. minutissima, Cymbella exicisa, C. turgidula*** and ***Melosira granulata*** diatom taxa in river Betwa. All these point towards diverse nature of these Vindhayan River and linkages could destroy the biodiversity paving way for bioinvasion, which are common in disturbed habitats as waters will be regulated as per needs of the populace.

Effect of squid (*Loligo sp.*) ink raw extract to survival rate of white shrimp (*Litopenaeus vanname*) post larvae infected with *Vibrio harveyi*

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Vibrio harveyi, a pathogenic bacteria, usually attacks the white shrimp larvae and caused the mortality that effected to the shrimp hatchery business. People use antibiotics to avoid the vibriosis. However, this method caused bacterial resistance and accumulation of antibiotics in shrimp and the environment. There for it is necessary to control the vibriosis with other substances in order to achieve a sustainable aquaculture condition.

Squid, ***Loligo*** sp., ink are known to have the ability to increase the number of leukocytes, antioxidants, anti-radiation, anti-viral and anti-bacterial; so it can be used as an anti-vibriosis alternative material.

The aim of this study was to know the effect of using the squid ink as anti-vibriosis, ***V. harveyi***, on the white shrimp post larvae culture which infected with ***V. harveyi***. The research was an experimental research using Fully Randomised Design. The methods used were: 1) extracting squid ink with methanol, 2) Minimum Inhibitory Concentration (MIC) test and disc test, 3) in-vivo test using ink squid extract in a dose of, 6. 8, 10, and 12 ppm, in tiger shrimp post larvae culture infected with ***V. harveyi*** at density of 10^7 cfu/mL, 4) Counting the bacteria density before and after treatment with squid ink raw extract. Water quality measurement, temperature, DO, pH, and salinity was done every day. Data was analysed statistically using SPSS16 program.

The results showed that the best dose of squid ink raw extract with methanol eluent to inhibit the growth of ***V. harveyi*** was 12 ppm, with survival rate of 85.56 %., and decreasing bacteria density from 10^7 cfu/ml to 36.67 X 10^5 cfu/ml.

WSSV envelope protein VP51B links structural protein comolexes and may mediate virus infection

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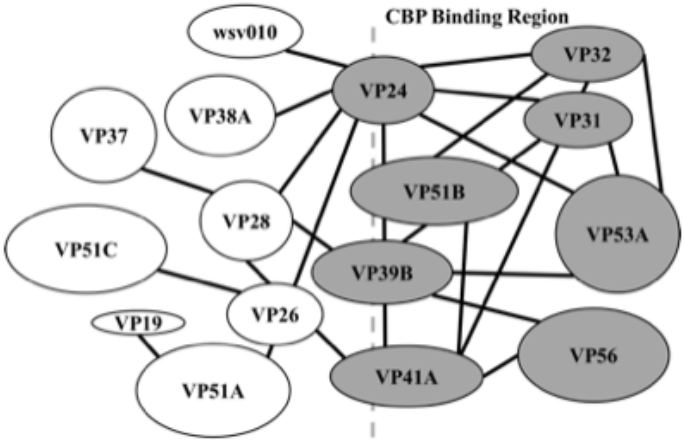
White spot syndrome virus (WSSV), an enveloped double-stranded DNA virus, is the causative agent of a disease that has led to severe mortalities of cultured shrimps in Taiwan and many other states. In the previous study, ***Penaeus monodon*** chitin-binding protein (CBP) and glucose transporter 1 (Glut1), two cell membrane proteins, were found to at least interact with other 10 WSSV envelope proteins including VP51B. These envelope proteins might form a protein complex. According to the known information, VP51B was used to identify its role in the protein complex. Western blotting of the intact viral particles and fractionation of the viral components confirmed that VP51B is one of WSSV envelope proteins. In this study, the protein-protein interaction between VP51B and other WSSV envelope proteins was identified by far-western blot experiment and VP51B was found to interact with VP24, VP31, VP32, VP39B, and VP41A. Furthermore, the ***in vivo*** neutralization experiment using recombinant VP51B plus with VP39B showed the best inhibition. These data indicate that VP51B participates in the WSSV protein complex and plays an important role in WSSV infection.



Pir-like toxins from *Vibrio parahaemolyticus* is the cause of acute hepatopancreatic necrosis disease (AHPND) in shrimp

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Unique isolates of ***Vibrio parahaemolyticus*** (VP_{AHPND}) have previously been identified as the causative agent of acute hepatopancreatic necrosis disease (AHPND) in shrimp. AHPND is characterized by massive sloughing of tubule epithelial cells of the hepatopancreas (HP), proposed to be induced by soluble toxins released from VP_{AHPND} that colonize the shrimp stomach. Since these toxins (produced in broth culture) have been reported to cause AHPND pathology in reverse gavage bioassays with shrimp, we used ammonium sulfate precipitation to prepare protein fractions from broth cultures of VP_{AHPND} isolates for screening by reverse gavage assays. The dialyzed 60% ammonium sulfate fraction caused high mortality within 24–48 hours post-administration, and histological analysis of the moribund shrimp showed typical massive sloughing of hepatopancreatic tubule epithelial cells characteristic of AHPND. Analysis of the active fraction by SDS-PAGE revealed two major bands at marker levels of approximately 15 kDa (ToxA) and 50 kDa (ToxB). Mass spectrometry analysis followed by MASCOT analysis revealed that both proteins had similarity to hypothetical proteins of ***V. parahaemolyticus*** M0605 (contig034 GenBank accession no. JALL01000066.1) and similarity to known binary insecticidal toxins called 'Photorhabdus insect related' proteins A and B (Pir-A and Pir-B), respectively, produced by the symbiotic, nematode bacterium ***Photorhabdus luminescens***. In ***in vivo*** tests, it was shown that recombinant ToxA and ToxB were both required in a dose dependent manner to cause AHPND pathology, indicating

further similarity to Pir-A and -B. A single-step PCR method was designed for detection of the ***ToxA*** gene and was validated using 104 bacterial isolates consisting of 51 VP_{AHPND} isolates, 34 non-AHPND VP isolates and 19 other isolates of bacteria commonly found in shrimp ponds (including other species of ***Vibrio*** and ***Photobacterium***). The results showed 100% specificity and sensitivity for detection of VP_{AHPND} isolates in the test set.

Effects of natural diets on gonad maturation of captive male orange mud crab, *Scylla olivacea*

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The aim of this study was to investigate the effects of different diets on testes maturation stages of mud crab, ***Scylla olivacea*** broodstock through morphological and histological assessments. Two dietary groups each comprising 10 male crabs per triplicate, were fed with two different diets viz., squid, ***Loligo*** sp. and fish, ***Decapterus*** sp. at 5-10% of body weight daily. In addition, the proximate analysis of diets was also described by using the Association of Analytical Communities (AOAC) methods. Results showed that there is no significant difference ($p>.0.05$) inbody weight, carapace width, and gonadosomatic index (GSI) in crabs fed with different experimental diets except of crabs fed with squid ($p<0.05$) in terms of GSI compared to the control (wild). The results indicated that at the end of the experiment, 6 individuals of crabs fed with fish reached stage 3 and 23 crabs fed with squid reached stage 3. The results also showed that the differences in crude protein and fat levels in the mud crab natural diets were reflected in the composition of the male gonadal development. In conclusion, the diet of squid was enough to induce the stage 3 testes maturation of ***S. olivacea*** within 60 days of culture period. The information from this study could prove useful in developing feeding regimes for ***S. olivacea*** broodstock and enhancing the testes maturation in captivity through diet manipulation.

Effects of various microalgae on fatty acid composition and survival rate of blue swimming crab *Portunus pelagicus* larvae

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A study was conducted to examine effect of various microalgae on Fatty Acid (FA) of blue swimming crab, ***Portunus pelagicus*** larvae. Larvae were subjected to five different treatments; T1: rotifer and ***Artemia*** only; T2: rotifer, ***Artemia*** and ***Chaetoceros*** sp.; T3: rotifer, ***Artemia*** and ***Chlorella*** sp.; T4: rotifer, ***Artemia*** and ***Isochrysis*** sp. and T5: rotifer, ***Artemia*** and ***Nannochloropsis*** sp. The result showed highest saturated FA component in Zoea 3 of T2 with concentration 26.06±26.23mg/g. For monounsaturated FA group, highest FA component in Zoea 1 was T5 with concentration 9.88±0.34mg/g. FA component in polyunsaturated FA group in Zoea 4, T4 with concentration 9.33±0.45mg/g was highest. For survival rate, highest survival rate obtained from T4 with 10.21%±0.45. In this study, essential FA requirement in each stage of ***P. pelagicus*** larvae can be reveal. Species of microalgae suitable for larvae can be characterized and selected for hatchery purpose.

Use of alternative ingredients as replacement for fish meal in feeds for commercially important aquaculture species in the Philippines

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Commercially important aquaculture species in the Philippines includes low and high value species of fish and crustaceans. Replacing fish meal with alternative ingredient sources in the feed formulated for these species is profitable and has been practiced. The use of these alternative sources are

influenced by the following factors such as cost, commercial availability, processing cost, anti-nutrient contents, seasonal availability, and human consumption among others. Soybean is the most common plant feed ingredient used to substitute fish meal in commercial feed formulations but importation cost is fluctuating and hence local sources of plant and animal origin are utilized whenever available. This presentation will discuss the R&D efforts on the use of alternative ingredients as replacement for fish meal in aquaculture feed formulations in the Philippines and possible applications in the Southeast Asian region.

Dietary effects of saponin mix and cholesterol on rearing performance and immunoreactions of white shrimp, *Litopenaeus vannamei*

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An experiment was conducted to determine the combined dietary effects of cholesterol (CHL) and NUTRAFITO Plus (NP), a mix of plant extracts containing mainly saponin, on Pacific white shrimp ***Litopenaeus vannamei***. A two-factor factorial design was used consisting of four cholesterol levels (0.00%, 0.05%, 0.10% and 0.15% of diet) and three NP levels (0.00%, 0.05% and 0.1% of diet), the experiment was carried out for 3 months. The results indicated that diets supplemented with either CHL and/or NP significantly improved shrimp survival (SUR), weight gain (WG), specific growth rate (SGR), average body weight (ABW), and food conversion ratio (FCR). There was a highly significant interaction between CHL and NP on SUR, WG, SGR, ABW and FCR. The dietary cholesterol level to achieve significant shrimp growth was 0.10%, while that for NP was 0.10%.

Shrimp fed diets supplemented with CHL had no significant effects on immune capacity of total haemocyte count (THC), superoxide dismutase (SOD), total antioxidant (TAS), glutathione peroxidase (GPx), glutathione reductase (GR), alanine aminotransferase (ALT) and, aspartate aminotransferase (AST). However, supplement of 0.10% NP has significantly improved shrimp's THC, SOD and TAS, but not other parameters.

NP was beneficial as a feed supplement in the white shrimp, which could replace cholesterol partially or totally in diet as well as reduce the cost of feed.

Development of microsatellite analysis platform for determination of genetic diversity of domesticated giant tiger shrimp, *Penaeus monodon*

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The basic information on genetic diversity of propagated stocks is important for the construction of appropriate breeding programs of the giant tiger shrimp ***Penaeus monodon***. To possible implement genetic improvement of ***P. monodon*** based on the family selection scheme, rapid genotyping and family assignment of examined shrimp are required. Ten pairs of primers for amplification of different microsatellites were individually screened against genomic DNA of cultured ***P. monodon***. The amplification products were analyzed using agarose gels or denaturing polyacrylamide gel electrophoresis. The amplified microsatellites were divided to those provided small-, medium- or large amplification products. Reverse primers of seven microsatellite loci (Pm02, PmMS6, PmMS8A2, CuPmo13, PmMS11AH, PmMS 9 and PmMS9GG) were fluorescently labelled by fluorescent dyes (FAM, TAMRA, HEX or ROX). Microsatellites showing different sizes were grouped together and labelled with the same fluorescent dye and singleplex PCR amplification was modified to a multiplex amplification platform. Conditions of fluorescent multiplex PCR for amplification of these microsatellites were optimized and successfully developed. The genotyping method of 7 microsatellite loci was preliminary applied to examine genetic diversity of the 5th generation sample of domesticated ***P. monodon*** (***n***= 60). The amplification success for each locus was 93.33 – 100%. In addition, the developed fluorescent multiplex microsatellites was used for genotyping of parents (18 pairs, 6th generation) and 23 full-sib families of

the progeny cultured in 6 concrete pond (4 families for 1S7 - 5S7 samples and 3 families for the 6S7 samples, ***N*** = 17 for each pond). Genetic distances between different groups of samples were calculated. A bootstrapped neighbour-joining tree was constructed and correctly allocated each progeny group with its parent. Results demonstrated the rapid genotyping of microsatellites and the ability to perform family group assignment of domesticated ***P. monodon***.

Presence of endogenous viral elements of white spot syndrome virus (WSSV) in shrimp genome

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Recent research results from several shrimp EST databases have revealed that endogenous viral elements (EVEs) of major shrimp viruses, including white spot syndrome virus (WSSV) occur in the shrimp genome. Studies in the honeybee and the fruit-fly ***Drosophila melanogaster*** revealed the beneficial role of EVEs against RNA virus infections via the host RNAi machinery that resulted in reduced viral multiplication in both cell cultures and whole organisms. It has been hypothesized that EVEs may allow shrimp to tolerate viral infections without signs of disease (viral accommodation). EVE366 of WSSV has been demonstrated in the shrimp genome and was chosen to work with in this study. Three pairs of the black tiger shrimp (***Penaeus monodon***) brood stocks were selected from the Shrimp Genetic Improvement Center (SGIC) and were checked to be free of WSSV infection

using nested PCR (IQ2000 detection system) before mating to produce the off springs. The off springs from these three families were collected and the EVE366-positive offspring are found in each family suggesting that EVEs are inheritable elements. The digital droplet PCR (ddPCR) was used to determine the copy number of EVE366 in these EVE366-positive offspring and the results demonstrates that the inheritance of EVE366 in the three families do not follow Mendelian's distribution. EVE366-positive offspring with known EVEs copy number in one family were challenged with WSSV. The time to death of each offspring was recorded. Preliminary results reveal no significant correlation between the copy numbers that each EVE366-positive offspring posses and the time to death. More studies are required to better understanding the function of EVEs in shrimp genome.

Development of vaccination regimens against viral diseases in marine fish and crustaceans

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Aquaculture of marine fishes and crustaceans in SE Asia has significantly intensified over the past years. However, problems concomitant with disease occurrence and husbandry problems that compromise the health of fish and crustaceans have persistently remained as major deterrent to sustainable and high production in aquaculture.

This presentation will highlight the importance of vaccination regimens against viral diseases of marine fishes and crustaceans. Specifically, laboratory and field data elucidating the practicality and efficiency of vaccination in controlling major viral diseases of marine fishes and crustaceans such as viral nervous necrosis and white spot syndrome virus disease, respectively, at the hatchery and grow-out stages will be discussed. In addition, challenges and concomitant solutions aimed at optimizing the use of vaccination coupled with best management and good aquaculture practices to increase yield from various production systems with least impact on the environment will be presented.

Marine cage culture in I. R. Iran

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Iran has some 50 years experience on aquaculture, mainly on pond culture of freshwater fishes including major Chinese carps and trout. The first cage farm in inland and fresh water bodies established 40 years ago in reservoir of Karoon River in Khozestan province, south west of Iran. The cages were made of metal and imported ones. In 80' use of handmade cages by using traditional material expanded in inland water bodies for rearing of trout. The expansion of cage farming is limited because of disagreement of water supply authority. So in recent years annual production in cage in lake of dames is limited to some 517 mt in 12 farms in 7 provinces at 2015.

Marine cage culture has a short history in Iran. Early research activities on marine cage culture back to 90' when Iranian Research Institute (IFRO) established some experimental small cages for rearing of collected juveniles of fish. Marin cage culture in Iran was started at 2001. Trip of Agriculture Minister and Iranian fisheries managers to Norway and visit of marine cage culture development in Norway, was initial point for marine cage culture in Iran In 2001 a contract signed between Iran Fisheries Organization (IFO) and a Norwegian company (Refa) for general survey of coastal areas in south and north of Iran. This survey gave IFO a general and reliable view for development of marine fish cage farming. This study also elucidated possible cage farming placement in the country. (Table 1).

Table 1. Estimated capacity for cage farming in Iran

province	Length of Coastline(KM)	Production Capacity(Tons)
MAZANDARAN	350	200000
GILLAN	300	200000
GOLESTAN	300	40000
HOMOZGAN	1050	120000
BOSHEHR	500	30000
SISTAN& BALOCHESTAN	300	300000
KHOZESTAN	250	5000
TOTAL	3050	910000

Following to the survey, IFO selected a cage site in the Persian Gulf near by the Qeshm Island to establish his pilot cage farm. The pilot farm established in 2005 with the assistance of Scottish and Nordic companies. Local fishes like sea bream and Sobaity bream are farmed experimentally to achieve local standards for marine fish farming and finally 24.4 tons was produced. The second pilot farm will be established in Busher province in 2009 and finally 4.8 tons was produced.

At 2002- 2009 IFO invited private companies to investment in marine cage farming. As local hatcheries can't supply reliable amount of fish juvenile the private companies have not established their farm yet.At 2010 marine cage culture in Iran was emphasized again by Agriculture Minister and several pilot cage culture farms in the Gillan, Mazandaran,Boshehr, Hormozgan and Khozestan province to cooperation of private sector(Table 2).

Table 2: Total of production marine cage culture (2007-2015)

province	MAZANDARAN	GILLAN	HOMOZGAN	BOSHEHR	KHOZESTAN
species	Trout	Trout	Sobaity Sea bream Asian sea bass	Asian sea bass	Sobaity Sea bream Asian sea bass
Total of production(MT)	190	5	527	5	4
Total of Country(MT)	731				

New intensive methods for seaweeds cultivation and management in Indonesia

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Currently, cultivation of seaweed using floating cages was limited reported before. This study aims to reveal growth of ***K. alvarezii*** reared in new cultivation methods as floating cages and compared with traditional methods as longline. The study was conducted in cultivation areas in Southeast Sulawesi, Indonesia. Total growth rates in average of ***K. alvarezii*** in floating cages and long line are 22.5 ± 1.40 kg, 5 kg and 38.8 ± 1.6 kg, from 5 kg in first weigh (Wo) in 40 days of cultivation, respectively. The growth rate of thallus of ***K alvarezii*** also performs in this experiment. During August, the increasing of growth rate from 50 g was 132,0 ± 8.0 g and 218.8 ± 8,6 g at longlines and floating cage, respectively. SGR of ***K. alvarezii*** was high during August, 3.69 $\%.d^{-1}$ and 2.43 $\%.d^{-1}$ cultivated on floating cage and longline, respectively. During August, thallus look more dense and healthy in floating cage and looks chipped and cut off due in longline. Floating cages was also useful to cultivate various seaweed aside ***K. alvarezii***. This new methods performs as suitable instrument in seaweeds cultivation and management in Indonesia.

TetraBeads for improving water quality, survival and growth of *Penaeus monodon* postlarvae in hatchery system

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Water quality has been considered to be an important factor that influences the growth and survival of postlarvae (PLs) in a hatchery system. In shrimp rearing system, ammonia and nitrite accumulate in the water column due to high stocking density, artificial feed containing high protein and faeces which is a constraint in the larval rearing system. Chemical and biological filtration system for small-scale shrimp hatchery system is expensive. In this study, an efficient, simple and eco-friendly biological method of using ***Tetraselmis chuii*** (TetraBeads) beads were tested for its efficacy in reducing total ammonia nitrogen (TAN) and nitrite nitrogen (NO_2-N) to improve the survival and growth of ***Penaeus monodon*** postlarvae (PL) in hatchery system. TetraBeads beads were prepared using ***Tetraselmis chuii*** cells in alginate for rapid and efficient removal of nitrogenous compounds such as ammonia and nitrite from shrimp PL culture water. There were three treatments, i.e., 1) tanks containing TetraBeads, 2) tanks with beads only but without ***Tetraselmis chuii*** cells, 3) tanks with 50% water exchange on alternate days, and 4) control tanks (without water exchange and TetraBeads). Results showed that tanks treated with TetraBeads were able to significantly ($P<0.05$) sustain TAN and NO_2-N concentration below 0.1 mgL^{-1}. Shrimp PLs in tanks treated with TetraBeads beads had significantly higher ($P<0.05$) survival rate (74%) and specific growth rate (13%) compared to other treatments. In addition, shrimp PLs reared in tanks containing TetraBeads had a significantly higher survival when subjected to stress test as compared to the control but was not significantly different ($P>0.05$) when compared to tanks with 50% water exchange. Further studies are needed to investigate the economic feasibility of using the TetraBeads on a commercial scale for improving water quality, survival and growth of shrimp PLs in hatcheries.

Adaptive learning models in sustainable aquaculture best practices for small-scale shrimp farmers in Thailand

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Thailand has been a leading world shrimp producer and exporter for decades. At its peak, annual production for farm-raised ***Litopenaeus vannamei,*** white shrimp, reached 500,000 to 600,000 metric tons with nearly all (reportedly 99% in 2008) sent to overseas markets. After the EMS crisis in 2013, however, the country's output plunged to less than a third of previous volumes. As a result, many farms, especially small-scale ones, which comprise at least 73% of the total number of registered farms (according to Thai Department of Fisheries statistics in 2013), stopped or scaled down operations or sold out to bigger farms or turned to other species. Consequently, global markets also felt the impact.

Recognizing the value and resilience of the Thai aquaculture shrimp industry, Sustainable Fisheries Partnership Foundation, through funding from Walmart Foundation and IDH The Sustainable Trade Initiative, developed, together with local Thai partners, unique field level improvement models to assist the most vulnerable groups in the global shrimp supply chain. Framed within the perspectives of a holistic supply chain affected by food safety, environmental and socio-economic concerns, the study uses an adaptive learning approach at demonstration farms in selected coastal provinces. This Small-Scale Shrimp Farmer (SSSF) Thailand Project aims to: a) increase small-scale farmers' confidence in culturing white shrimp again using innovative best practices that could prevent disease; b) engage more women and raise awareness of their roles and contribution to farming and/or processing; c) create a multiplier effect in farmer-to-farmer learning-by-doing and sharing within their local networks.

Effects of diet and stocking density on the growth and survival of sandfish (*Holothuria scabra*) larvae

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Holothuria scabra, commonly known as sandfish has a high market demand, especially in South East Asian countries such as Malaysia and Philippines. It is consumed for health food due to the high bioactive substances that exhibit the antibacterial, antifungal and anticancer properties. Currently, sandfish aquaculture has been developed worldwide as hatchery production enables continuous seed supply throughout the year. The most crucial aspects in larviculture of sandfish are the hatching, metamorphosis and settlement stage. In this study, 4 feeding types and 3 stocking densities were tested on the two days old (2 days-after-hatch) larvae in a factorial experiment. Two species of microalgae were used for feeding test at 1, 1.5 and 2 larvae per ml. The experiment was carried out in plastic containers randomly arranged in a 2 tonnes water bath that was maintained at temperature 29-30°C. There was an interaction between diet types and stocking density on the growth of the sandfish larvae (***p***=0.00). Single species feeding of ***Nannochloropsis*** sp. at 1.5 larvae ml^{-1} stocking density demonstrated the highest growth (109.69± 8.21). However, metamorphosis of the larvae into doliolaria was delayed. On the other hand, single species feeding of ***C. calcitrans*** (stocking density: 1.5 larvae ml^{-1}) enhanced the metamorphic rate. At the 6th days of rearing, doliolaria was appeared earlier compared to other treatment. The survival rate was not significantly affected by the diet types and stocking density (***p***=0.974). However, the highest survival rate was recorded in larvae fed with ***Nannochloropsis*** sp. at stocking density of 2 larvae ml^{-1} (1.2±1.05). Based on the finding, it is recommended to feed the larvae with ***Nannochloropsis*** sp. (stocking density: 1.5 larvae ml^{-1}) for highest growth. However, for faster metamorphosis rate it is recommended to use ***C. calcitrans*** as the feed (stocking density: 1.5 larvae ml-^{1}).

Climate robust aquaculture as an adaptation strategy

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This study assesses the robustness of alternative, longer-term, adaptation strategies for inland aquaculture under a set of qualitative future scenarios of climate, water and fish demand in northern Thailand. Strengthening climate risk management practices in inland aquaculture requires attention be given to short-term reactions, mid-term tactics, and long-term strategies at household, community, and national scales. Self-assessment by fish farmers suggests that many farm-level reactions and tactics are useful today and are likely to be also useful under a range of possible future climate patterns – with the key issue being whether the costs of such actions are worthwhile or not in a particular site. It is the long-term strategies however, which distinguish climate risk management for current climate from what is needed for adaptation to a changing climate. The benefits of pursuing specific long-term strategies like investing in new technologies or infrastructure, establishing insurance or improving early warning systems, were found to be worthwhile in many scenarios, and thus represent robust strategies. Many other proposed strategies, such as zoning or trade facilitation, were assessed as very useful in only a few futures and not useful at all in others. In terms of assessment methodology, this study had innovative elements in the engagement with stakeholders to evaluate adaptation options while acknowledging some sources of uncertainty, in particular, climate variability. Analysis of the worthiness of proposed adaptation strategies under many alternative qualitative scenarios of climate and other key drivers, may be one way to pragmatically approach the ideals of more participatory robust decision support. In conclusion, to make aquaculture more robust to climate change requires adaptation pathways in the aquaculture sector that maintain significant flexibility so that, over time, strategies can be abandoned, switched, combined, or new ones introduced, as conditions and knowledge change.

Climate smart stocking combination for freshwater aquaculture in the Indian Sundarban Delta

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The Indian Sundarban Delta covers 9,630 km^2 area and comprises of 102 low-lying islands, of which 48 islands are inhabited. Agriculture and aquaculture play a vital role in the socioeconomic development of the communities. The occurrence of cyclonic storms, sea-level rise and salinity has significantly increased over the Bay of Bengal region and traditional freshwater aquaculture has been adversely by climate change. There is a need to develop climate resilient aquaculture strategies to safeguard the fish farmers from the losses. Based on species specific salinity tolerance, natural adaptive capacity of freshwater fishes to salinity, effect of saline water flooding on freshwater species and post-flooding growth performances, and culture potentialities of brackishwater fishes in freshwater, four species combination were formulated to combat varying degree of salinity intrusion. After grow-out trail in earthen ponds (0.02 ha) with ideal farm management for five months duration, the Combination-III (***Labeo rohita, Catla catla, Cyprinus carpio, Barbonymus gonionotus, Etroplus suratensis, Mystus gulio***) and Combination-IV (***L. rohita, C. catla, B. gonionotus, Paeneus monodon, Macrobrachium rosenbergii, Liza parsia, Scatophagus argus***) showed better growth performances in terms of biomass gain (30% and 27% biomass increment respectively). After further refinements, three species combinations are proposed for different saline water flooding prone zones of the Sundarban. However, farmers are advised to take a maximum of six species from the following recommended list depending upon seed availability and market value. (i) Species suitable for areas vulnerable to low saline water flooding (up to 5 ppt) : ***L. rohita, C. catla, C. carpio, Ctenopharyngodon idella, Hypophthalmichthys molitrix, M. rosenbergii, B. gonionotus, P. monodon,***

Terapon jarbua, S. argus, L. parsia. (ii) Species suitable for areas vulnerable to medium saline water flooding (up to 10 ppt) : ***L. rohita, B. gonionotus, C. carpio, M. rosenbergii, Systomus sarana, C. idella, Cirrhinus mrigala, P. monodon, T. jarbua, S. argus, Mystus gulio.*** (iii) Species suitable for areas vulnerable to high saline water flooding (above 10 ppt) : ***C. carpio, B. gonionotus, P. monodon, T. jarbua, S. argus, M. rosenbergii, Etroplus suratensis, L. parsia, Mugil cephalus, M. gulio.***

Climate change impacts on freshwater aquaculture and adaptation strategies for sustainable production in the Indian Sundarban Delta

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The Indian Sundarban Delta is an UNESCO declared world heritage site covering 9,630 km^2 and comprises of 102 low-lying islands, of which 48 islands are inhabited. Sea-level rise coupled with frequent extreme weather events have led to saline water intrusion into freshwater areas, putting an enormous risk to freshwater aquaculture and causing huge losses to the farmers. To address these problems, climate-resilient aquaculture strategies were developed. These included the following : salinity tolerance screening of cultivable freshwater species, effect of saline water flooding on freshwater species and post-flooding growth performances, culture potentialities of brackishwater fishes in freshwater, species combinations trial with best performing species under different salinity regimes, feed manipulation and climate adaptive integrated farming. Among the different strategies, the following are more resilient: (i) selection of right kind of species combinations with proper stocking density, (ii) changes in the existing feeding management strategies, (iii) climate adaptive integrated fish-livestock-crop farming, and (iv) change in pond design. However, developing policies and programmes to improve

the resilience of natural resources through assessments of risk and vulnerability, increasing awareness of climate change impacts and strengthening key institutions, may help the communities adapt to climate change. Strong technical, financial and extension services from government organisations and research institutions are urgently needed for sustainable development of aquaculture in the Indian Sundarban Delta.

Seaweed aquaculture as sustainable climate resilient strategy in Nusa Penida Island, Bali, Indonesia

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In the context of climate change and its impacts we investigated how to develop sustainable climate resilient seaweed aquaculture in the coastal water of Nusa Penida Island, Bali. Indonesia's rapidly developing seaweed aquaculture sector essentially consists of small-scale farmers located mainly in rural coastal villages. Seaweed aquaculture can be considered as a sustainable climate change resilient strategy with multiple benefits. Seaweeds are a feedstock for biofuels production, thus reducing dependency on fossil fuels. The carbon sequestration ability of seaweed makes its farming an option to combat ocean acidification. While climate change has negatively affected the rural livestock of fishermen in several coastal villages, seaweed aquaculture requires manpower and hence presents an opportunity to enhance the rural livelihoods. This study thus calls for more attention towards developing seaweed aquaculture as a sustainable climate change strategy which has multiple benefits as an alternative of energy stock, an option to combat ocean acidification, a mitigation method for agriculture and a means to improve coastal livelihoods.

Farmers' perceptions of climate change impacts on freshwater aquaculture: insights from the Indian Sundarban Delta

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The Sundarbans is the world's largest single deltaic mangrove zone spreading 9,630 km^2 in India and 16,370 km^2 in Bangladesh. The Indian Sundarban Delta is an UNESCO declared world heritage site and a well-known Biosphere Reserve of India. Freshwater aquaculture (termed as "semi-improved low-input carp polyculture") provides employment and offers reliable income to the communities in the delta, has been threatened by recent environmental and climatic changes. Though coastal aquaculture is more vulnerable than inland aquaculture, future climate change will severely affect inland fish production. The household survey conducted in the Indian Sundarban Delta shows (i) how local farmers perceive climate change, (ii) prevailing freshwater aquaculture scenarios and potential impacts of the climate change on aquaculture, and (iii) what strategies employed by farmers to cope perceived risks. The study reveals that farmers are aware about climatic variability and expressed their experiences of changes in temperature, rainfall, tropical cyclones, and sea-level rise. Cyclones and storm surges are the most significant climatic phenomena that severely affect freshwater aquaculture. The next signicant is coastal flooding and sea-level rise that cumulatively lead to salinity intrusion. This is followed by rising temperature and drought. In relation to perceived risks, farmers are addressing the problems through short-term coping measures which need scientific improvements to give long-term relief to the farmers. The study proposes some preliminary policy recommendations to cope with the challenges of the impacts of climate change on freshwater pond aquaculture in the delta.

Risk decisions of fish farmers in a role-playing simulation game

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River-based cage aquaculture in Northern Thailand involves dealing with a number of climate- and weather-related risks. The most important decision is when and how much to stock. The purpose of this study was to improve understanding of how farmers make investment decisions in their fish farms when faced with risks from floods that are imperfectly known, and which may be changing. A role-playing simulation game was created to capture some of the key features of the decision-making context and explored with farmers in the field. In-depth interviews were conducted post-game to reflect on strategies used in the game as compared to in practice. As hypothesized, more frequent or larger impact floods reduced cumulative profits. Farmers reduced their stocking densities when playing in games with high likelihood of floods, but did not do so in games with large impacts when a flood occurred. Contrary to initial expectations, farmers were less likely to learn from experience – choose the optimal density, and thus improve score within a game – when floods were common or had large impacts. Farmers learnt most when risks were decreasing and least when they were increasing. Providing information about likelihoods prior to a game had no impact on performance or decisions. These findings suggest there may be an emotional component to risk decisions. Post-game interviews suggest most farmers found the simulation game represented key features of their decision context; the main discrepancy being inability to take short-term measures to reduce losses when a flood was imminent. The novel combination of experimental, role-playing and qualitative methods revealed limitations in common assumptions about the ease of learning about risks from previous experiences. The findings also suggest that decision-support systems for aquaculture need to take into account how recent experiences, understanding of information and other factors influencing risk perceptions and decisions.

Fishing uncertainties: A case from island fishers community in Concepcion, Iloilo, Central Philippines

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Based on focus group discussions, key informant interviews and surveys, this study describes the socio-economic conditions and fishing operations of fishers from an island community in Concepcion, Iloilo, Central Philippines. It presents the account of these fishers' experience with typhoon Haiyan (Yolanda) that ravaged their community in November 2013. As the worst typhoon they experienced so far, typhoon Haiyan destroyed their houses, fishing boats and fishing gears. To date most of these fishers continue to recover from the typhoon. Despite efforts made, the fishers faced various difficulties and uncertainties that include decrease in fish catch, lack of other means of livelihood, illegal fishing activities, and lack of capital as a start-up on alternative livelihoods. Potential socio-economic impacts of climate change are also assessed. Corresponding mitigation measures and coping strategies are outlined.

Recovery of small-scale fisheries from impacts of an extreme weather event in Batan Bay, Philippines

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This study examines the recovery of small-scale fisheries from the impacts of Typhoon Haiyan. With Batan Bay as a study site, we determined the impact of Typhoon Haiyan on capture fisheries through fisheries data (e.g., GIS maps, fish catch, and fishing mandays) that were collected before and after the typhoon. To determine other impacts on the fishery and recovery, key interviews and focus group discussions were conducted. Fishers in Batan Bay mostly employ fixed fishing gears such as shrimp traps, filter nets, fish corral, and lift nets. In addition, fish cages and oyster stakes are present throughout the fishing ground. The immediate impact of the typhoon was disruption of fishing due to fishing gear damage. Among the fixed or stationary fishing gears, about 95% were completely or partially damaged. Resumption of fishing operations varied largely among fishers. Some were able to resume fishing 10-30 days after the typhoon. Others took a longer time to resume fishing because of delayed reconstruction. In some gears such as fish corral and shrimp traps, a short-term increase in catch rates was observed. Reconstruction of damaged stationary gears was hampered mainly by the financial capacity of fishers. In particular, bamboo, which is a main component in the construction of these fishing gears was scarce and cost doubled after the typhoon. We also discuss the impacts on other fishing gears such as line fishing, gillnets and pots. This information is valuable in understanding the impacts of extreme weather events on tropical small-scale fisheries so that managers may be able to devise measures to reduce vulnerabilities among coastal resource users.

The role of social capital in disaster mitigation and recovery: the case of fishing households in Batan Bay, Philippines

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Literature on disaster mitigation and recovery has acknowledged the contribution of social capital in the resilience of affected households and communities. The high poverty incidence in the fishing sector makes those affected more vulnerable to natural disasters. This study examines the role of social capital in the disaster preparedness and recovery of fishers and their households in three municipalities surrounding the Batan Bay in Aklan, Philippines, that were affected by Typhoon Haiyan in November 2013. The dimensions of social capital examined include community groups, norms, reciprocity and trust. Analyses were carried out on differences in the dimensions of the fishers' social capital by their individual and economic characteristics, and how these differences affected their responses to the disaster. The data used in the analyses were collected through focus group discussions and two surveys (in 2012 and 2014) of the same randomly selected fishing households in the municipalities surrounding Batan Bay that include Altavas, Batan and New Washington. The results showed that neighborhood and community-based groups (***barangay***) play important roles in the disaster preparedness and recovery of fishers and their households. The dimensions of social capital were also related to the economic resources of the fishers, the levels of trust varied by individual characteristics in pre- and post-Haiyan, and reciprocal relations were more common among close ties. The findings of this study are useful in providing the context in understanding community collective action and disaster management and recovery in small fishing communities.

Are environmental variables or habitat structure more influential to larval fish assemblage in Johor Strait, Malaysia?

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Larvae fishes were collected by subsurface horizontal towing using a bongo net equipped with a flow meter. In total, 24 fish larval families were identified from the investigated area. Among them, 14 occurred in S1 (upper mangrove area), 17 in S2 (mangrove estuary), 16 in S3 (Strait estuary), 20 in S4 (seagrass beds), and 16 in S5 (open sea). A canonical correspondence analysis test indicated a weak overall correlation (36.4%) between larval assemblage and physico-chemical parameters in the seagrass-mangrove ecosystem of Johor Strait, Malaysia. This likely indicates that the habitat structure was more important in determining larval abundance, in which the highest density of larval fishes was recorded at S4, dominated by seagrass, which was significantly higher ($p < 0.05$) than the other sampling sites. Furthermore family richness was significantly ($p < 0.05$) higher in seagrass beds than mangrove ecosystems. The results indicate that seagrass may be more important as a nursery ground than mangroves and is therefore necessary to protect this habitat to ensure adequate larval fish recruitment and ultimately sustainable fisheries management.

FAO-SEAFDEC/TD energy audits project for Thai trawlers

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Since early 2000s, Thai fishing vessels have suffered a three-fold increase in the real global price of crude oil. In trawl fisheries fuel consumption in each fishing operation trip may account for 50 to 80% of total costs. Also, with high fuel consumption of trawlers, a large amount of greenhouse gas was released into the surrounding. A collaborative energy audits project for Thai trawlers was set up to mitigate these matters using the Australian energy audits process as a main reference method. Six investigated trawler samples, classified by size - small (less than 14 m), medium (14-18 m), and large (over 18 m) - from the Gulf of Thailand and Andaman Sea were measured at the set up or during the towing operation period without interfering with fishing activities to extract their fuel consumption profiles, costs, and revenues. The results indicate that each trawler has individual profiles and optimum condition regarding dissimilarity of dimension and capacity of ship, engine, propulsion, and fishing gear. These data were applied for maintaining an adequate level of energy efficiency along the energy profile and identification of potential fuel saving tactics to handle at an optimum stage. The results on a long-term fishing vessel energy audit and consideration of fleet-wide fuel consumption were distributed to vessel owners or fishing operators for estimating the current consumption and planning for reducing fuel using both operational and mechanical changes. The information also serves as a reminder on greenhouse gas reduction awareness.

Adaptation to temperature in commercial breeding of Nile tilapia (*Oreochromis niloticus*)

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Temperature of small tropical water bodies such as fishponds often rises excessively high during summer, which has been aggravated further by global warming. Nile tilapia (***Oreochromis niloticus***) is stressed when the surface water temperature of its brooding ponds reaches above 35°C. Secondary infection by bacteria and viruses often occurs which results in reduced growth and reproduction. Commercial tilapia hatcheries in Thailand have often suffered from high mortality of their broodfish (>50%) during summer. To address the challenges of frequent high temperature rises, a trial was conducted for 120 days (May-September 2015) to investigate the effects of shading on the commercial seed production of Nile tilapia. Twelve hapas (12 m x 5 m x 1 m) were installed in a green water pond of AIT consisting of three treatments : (i) Hapa covered with black colour shade net, (ii) Hapa covered with blue shade net, and (iii) Hapa without cover. Control was replicated four times. Each hapa were initially stocked with 150 females (mean weight ± SE, 118.8 ± 5.7 g) and 75 males (mean weight ± SE, 120.3 ± 4.6 g).

During the trial period, water temperature ranged from 26.7°C to 37.8°C. Both black and blue shading reduced the mean water temperature (14:00 h) by about 0.8°C. Average egg production was 15,622±842 hapa^{-1} wk^{-1} from the hapas shaded with black net, which was 9% and 18% higher than that from the control and blue shade, respectively. Percent clutch hapa^{-1} wk^{-1} from the black shade increased by 9% and 10%, as compared to the blue shade and control treatment respectively. Therefore, the trial suggests that black shade helps reduce temperature and improves seed production of Nile tilapia, whereas blue shade does not. Further research should be done to test the shading by the nets of other colors such as green including the use of various degree of transparency of the nets to determine the optimum level of light intensity and heat combination for tilapia reproduction. The study also indicates that early morning temperature and afternoon dissolved

oxygen had a direct relationship with the reproductive performance and the seed outputs of Nile tilapia.

Upper incipient lethal temperature of two species of mud crab, genus *Scylla* juvenile

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The impact of water temperature on portunid crabs, an important species in fisheries and aquaculture, is scant. The mud crab, genus ***Scylla,*** is fished and cultured in various Asian countries and is considered as an alternative culture crustacean to the shrimp. Rapid and considerable changes in ambient temperature inevitably cause stress in animals and modify many physiological conditions. In order to design experiments to study the effects of elevated temperature on developing the growth and maturation, it is necessary to establish the upper incipient lethal temperature ($UILT_{50}$) at juvenile stages. To address these questions, the $UILT_{50}$ was estimated for two mud crabs, genus ***Scylla*** (***Scylla olivacea*** and ***S. paramomosain***) juvenile after 48 h of exposure. The results showed that at 29°C acclimation temperature, the 48 h UILT of ***S. paramomosain*** had more tolerance to the temperature compared to the ***S. olivacea***. The results from this study will assist the mud crab aquaculture industry to overcome the impacts of climate change particularly on the sustainability of the aquaculture of genus ***Scylla***.

Stress responses in the adrenal tissues of Indian freshwater fishes - *C. auratus*, *C. carpio* and *H. fossilis* exposed to hypoxia

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In the present investigation we describe and compare morphometric changes to hypoxia stress in the adrenal tissues of some tropical freshwater fishes. Adult specimens of ***Carassius auratus*** (gold fish)**,** ***Cyprinus carpio*** (common carp) and ***Heteropneustes fossilis*** (catfish) were exposed to short term (5 h) and long term (12 h) durations of moderate hypoxia (30-50% O_2 saturation) and acute hypoxia (< 30% O_2 saturation) in the laboratory under natural photoperiods (14L:10D) and temperature (20-25°C). The interrenal cells show hypertrophy and changes in the nuclear staining characteristics. These responses are the first indications of cellular stress involving the HPI (hypothalamic-pituitary-interrenal) axis. While a significant ($p<0.05$) increase in the interrenal cell size was observed in ***C. auratus*** after exposure to 12 h of moderate hypoxia with 81.72% increase in cell size, significant increases in ***C. carpio*** and ***H. fossillis*** were observed only after exposure to 5 h of acute hypoxia with 104.56% increase in the interrenal cells of ***C. carpio*** and 79.41% increase in that of ***H. fossillis***; the latter appears to exhibit comparatively the slowest and least response among the three fishes. Comparing the rates of changes in the interrenal cell size, ***H. fossilis*** characteristically shows initially an increasing trend like the other two fishes but during the 12 h acute hypoxic exposure it exhibits a decreasing trend not seen in ***C. auratus*** and ***C. carpio***. These fishes adapted to tropical waters of fluctuating oxygen saturation levels appear to cope with hypoxia stress differently. In ***C. auratus*** and ***C. carpio***, an adaptive mechanism of cellular responses involving progressively increasing interrrenal activation is suggested. ***H. fossilis,*** an air breather, appears to cope with hypoxia stress by slower and more resistant nature of responses. The presence of stress coping measures such as tolerance and resistance have been suggested in these fishes.

Elucidating the impacts of temperature alteration to the initial stage of life development in hybrid *Puntius* spp. for cultivation

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Environmental stress caused by global warming adds pressure to various species. Although adaptation is an important key to survival success there are limits on how much a species can adapt to certain stress conditions. Thermal adaptation of the embryos and larvae is very important to ensure survival as the environmental condition varies during the development stages. An experiment was designed to observe the effect of temperature changes on the early stages of freshwater cyprinid, known locally as lampam kerai, hybrid ***Puntius*** spp. It was conducted in our wet laboratory and the broodstock were induced with artificial hormone Ovatide at 0.4ml/kg both male and female. The fertilized eggs and larvae from lampam kerai hybrids (***Puntius gonionotus*** x ***Puntius daruphani***) were exposed to three different temperature regimes at 22°C, 27°C (room temperature), and 32°C. Water temperatures were reduced to 22.0°C, by using a Resun CL500 chiller and raised to 32°C using an Eheim Jager heater. The glass aquaria were conducted in triplicate and insulated with styrofoam to maintain the required temperature. The eggs and larvae development were periodically monitored for 4 weeks during the experiment. Results showed that the hatching rate was significantly higher in 32°C at 90.3% ($p<0.05$) while the hatching rate was found to be lowest at 20.2% in 22°C. Other significant findings were the similarity in size and the decrease in hatching time at 32°C with low deformity rate as well. Our finding shows that the hybrids lampam kerai during the early development stages have better performance towards high water temperature as compared to the lower water temperature. The finding could be attributed to the adaptation capability possessed by lampam kerai eggs and larvae towards high water temperature.

Difference in response between male and female calanoid copepod (*Eurytemora affinis*, Seine) to cadmium toxicity

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This study aimed to determine gender-specific sensitivity of copepod (***Eurytemora affinis***) exposed to different levels of cadmium (Cd). Twenty-five adult males and females were sorted separately into 100 ml beaker containing cadmium contaminated seawater (20 ppt, 18°C) of 0, 40, 80, 150, 220 and 360 µg/L concentrations in 3 replicates, a non-renewable static culture and were kept in a biological incubator. Dead copepods were recorded at 24, 48, 72 and 96 hours. The results showed an increase in mortality based on increasing cadmium concentration and time of exposure. After 24 h mortality was less than 50% for both males and females. After 48 h LC50 was estimated at 497 μgL^{-1} of Cd for females. After 72 h LC50 was estimated at 282 μgL^{-1} and 159 μgL^{-1} of Cd and after 96 h LC50 was estimated at 128 μgL^{-1} and 90 μgL^{-1} of Cd for males and females respectively. LC50 of cadmium for males and females were significantly different ($p<0.05$) after 72 h and 96 h.

A second experiment was carried out to understand the reason for higher mortality in females than in males. Different ratios of adult males (M) and females (F) (12M/12F, 16M/8F) were mixture together with or without cadmium and/or food. Also ovigerous and non-ovigerous females with or with cadmium were tested separately. After 96 h, the observed survival of 12M/12F copepod mixture was lower than those fed and lower than the adult males, but higher than 16M/8F copepod mixture. Also, after 96 h, survival of ovigerous females was observed to be higher than non-ovigerous with or without cadmium. In addition, observed survival of ovigerous females were greater than adult males and females alone at 0µg/L Cd and less than adult males and females alone at 40µg/L Cd. However, non-ovigerous females were less than adult males and females alone at 0µg/L Cd and less than

adult males and females alone at 40µg/L Cd.

In this study, female copepods of ***Eurytemora affinis*** were more sensitive to cadmium toxicity than the adult males. However, it could be observed that their physiological state was a major factor determining their level of sensitivity to cadmium. As sensitivity to toxicant varies with species, environment or culture conditions, stages and gender the standardization for cadmium level or other toxic pollutant in the aquatic environment should take into consideration the differences in gender sensitivity to contaminants.

Principal socio-economic characteristics of West Aceh small-scale fisheries, Aceh Province, Indonesia

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The ability of fishermen to carry out fish harvesting in the sea affects livelihoods, including socio-economic condition. West Aceh Fishermen use shrimp net, seine net, purse seine, gill net and hook and lines as fishing gear. They are dominantly small-scale fisheries with unique characteristics that includes compliance to customary law and a system of profit sharing of the fishing activity. Customary law is implemented by the sea commander (local name is "Panglima Laot") that regulates fishing gear type, fishing session and location of fishing ground. The system of profit sharing has a specific pattern adjusted for the type of fishing gear. For seine net fishermen, net profit is distributed to ship owner (40%), wholesaler (10%) and fishermen (50%). For hook and line fishermen, ship owner receives 5%, wholesaler 42.5% and fishermen 42.5%. For shrimp net and gill net 5% is for the ship owner, 80% for wholesaler and 15% for fishermen. These socio-economic characteristics are considered suitable for small-scale fisheries and to support sustainable fisheries.

Keeping poverty at bay: an analysis of small scale fishers' livelihood strategies in Batan Bay, Aklan, Philippines

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The fishing industry is an important sector to the Philippine economy for its contribution to GDP and employment. The fishery, however, is characterized by a high incidence of poverty; one of the highest among the basic sectors in the country. Poverty is found mostly among small-scale fisheries, which comprise about 85% of the total employment in the whole sector. Despite this destitution and the many challenges that affect this sector, we find that small-scale fishers remain resilient. This paper looks into the reasons for this resiliency by analyzing strategies that fishers employ to maintain a sustainable standard of living. Using the livelihood diversification framework, this paper argues that fishers do not rely solely on fishing but takes on multiple livelihoods to smooth income and consumption. This analysis was applied to the data obtained from focus group discussions, key informant interviews and a survey of randomly selected fishing households in the three municipalities surrounding Batan Bay, Aklan, Philippines. The results of the study show that households indeed have various livelihoods to augment or replace fishing income. The data further show that the ability to maintain a portfolio of livelihoods depend on the household's access to the different assets. The findings of this research have important implications on the design of interventions to enhance small-scale fishers income.

Investment and profitability in marine fishing in the south west coast of India

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The maritime states in the south west coast of India, comprising Kerala, Karnataka and Goa, contribute more than 30% of the total marine fish landings in India. Mechanized trawlers are the prominent fishing gear in Kerala, whereas purse seiners dominate in Karnataka and Goa. The marine fish production has shown a consistent increase in Karnataka and Goa but a decline in Kerala in recent years. The states of Karnataka and Goa provide value added tax (VAT) exemption for the diesel supplied to fishing sector whereas there is no tax exemption for fuel in the state of Kerala. A comparative analysis of the investment and profitability in marine fishing sector in the south west coast states was carried out.

The compound annual growth in marine fish landings during 2000-2014 for the three states, Kerala, Karnataka and Goa, was 1.35%, 8%, and 4%, respectively, whereas the growth in gross revenue realized at first sales was 8%, 13% and 14%, respectively. The comparative economic efficiency analysis of various fishing units in the states showed that in the mechanized sector, trawlers operating for 2-5 days (operating ratio- 0.18) in Goa, trawlers of >6 days of operation (operating ratio- 0.48) in Kerala and purse seiners operating for single day in Karnataka(operating ratio- 0.40) had the highest economic efficiency. The catch per unit effort and fuel efficiency were highest for the mechanized purse seiners in all the states. The fuel cost accounted nearly 40% of the total operational cost in fishing in all the states. The capital turnover ratio was 2.92, 2.29 and 1.67 in Kerala, Karnataka and Goa respectively.

Using a social representations approach to understanding coastal resource management: the case of San Joaquin, Iloilo, Philippines

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This study employs Social Representations Theory to unpack how residents of a coastal community in Iloilo, Philippines collectively comprehend coastal resource management. Data were gathered through in-depth interviews among community members, local officials, and personnel implementing the community's Coastal Resource Management (CRM) Program as well as through collection of documents concerning the community's CRM endeavours that are available in the public sphere. Meanings constructed concerning management of coastal resources center on four themes: environmental, economic, social, and political storylines. The environmental discourse revolves around the community's rich coastal resources as well as protection of these resources, while the economic narrative brings attention to the financial implications of coastal resource (mis)management. The social storyline talks about the community's collective (un)involvement in safeguarding their natural resources; while the political account points to the local government and its CRM program implementation along with the issues besieging the operation. Results lend support to the usefulness of Social Representations Theory in understanding how members of a group create their shared reality together; as well as point toward the theory's practical relevance in addressing current environmental issues.

Fairness at the end of the line: fair trade certification of Indonesian small-scale handline tuna fisheries

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Fair Trade is an internationally recognised labelling scheme, informing consumers of the high ethical and environmentally sustainable standards with which the product complies. Historically the scheme has focused on land-produced commodities, such as bananas and coffee. In 2014, Fair Trade USA developed the first Capture Fisheries Standard with certification verified through third-party auditing. An Indonesian small-scale handline tuna fishery in Molucca was the first to implement this standard, and in 2014 became the first fishery in the world to be certified Fair Trade. In 2014 this included four Fisher Associations comprised of ~120 fishermen, under one unit of certification. For the second audit in 2015, the numbers expanded to 27 Fisher Associations, over 500 fishermen and six units of certification, located in Molucca and North Sulawesi.

To be certified Fair Trade, the fishermen must comply with various social, environmental and ethical standards, covering aspects such as no child labour and avoiding catches of endangered, threatened and protected species. A certified fishery receives ~10% of the ex-vessel price per kilo of fish in a fund termed the Premium Fund. This fund can be spent on community development and improvement projects, with a stipulation that 30% of the fund must be spent on environmentally-focussed projects. To date, over USD52,000 has been returned to the community via the Premium Fund. The Fair Trade Committees jointly and democratically determine what the money will be spent on, with previous projects including building waste disposal units, setting up a fund for widowed individuals and installing a water system for the local mosque.

The achievement of the Fair Trade certificate is having a noticeable effect on both the communities and the fishermen. This presentation will discuss the process of achieving certification in terms of opportunities and challenges, and the outlook for expansion to additional sites.

Structural changes and impacts on economic efficiency of mechanized trawling in Kerala

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The state of Kerala contributes 16% of the total marine fish landings in India. The total marine fish catch in the state has reduced from 6.02 lakh tonnes in 2000 to 5.75 lakh tonnes in 2014. Trawlers are the prominent fishing units in the mechanized sector contributing 40% of the landings. The increase in fishing power of trawlers in the state over the years with expansion in engine, gear capacities and overall length has resulted in extending the fishing trips from single-day to multi-day trips up to 12 days duration. With the initiation of pelagic trawling using imported high speed engines there was diversification in the species caught by the trawlers from shrimps, cephalopods and demersal finfishes to pelagic fishes. The paper discusses the structural changes and its impacts on economic efficiency of trawl operations in Kerala for the period 2000-14.

The catch per unit effort of single-day trawlers declined from 0.4 to 0.2 tonnes, whereas that of multi-day trawlers increased from 1.07 to 2.3 tonnes during 2000-14. The capacity of engines increased from 106 hp to 550 hp during 2000- 2014, resulting in increased use of fuel in the fishing sector. In absolute terms, there was fivefold increase in diesel cost during 2000-14 compared to the two-fold increase in average fish price. The economic efficiency of multi-day trawlers which undertook fishing trips of 2-5 days duration declined during 2000-14 with low capital productivity. The resource use efficiency analysis revealed that there is over use of diesel and the return from the additional quantity of diesel consumed was lower than its cost.

Contribution of reef gleaning to food security and nutrition of poor coastal communities in selected sites in the Philippines

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Gleaning for edible invertebrates on reef flats and seagrass beds is a common form of subsistence fisheries in the Philippines. These are mainly for local consumption, but occasionally for supplemental family income. Despite the highly active nature of gleaning, there is very little documentation on the role of reef gleaning in food security and nutrition of coastal communities. A case study was carried out in five gleaning sites in the Visayas and Mindanao islands in order to evaluate the contribution of gleaning to food security and nutrient sufficiency of coastal households. Artisanal fisherfolk of the Philippines are considered the "poorest of the poor", and with a large proportion (38-76%) living in extreme poverty, and dependence of coastal populations on gleaning as a source of subsistence and vital nutrients is very high (up to 92%). More than half of their catch is retained for household consumption and most gleaners earn very little income from this subsistence activity. Analysis of daily nutrient intake (DNI) of the typical gleaner's diet as compared to the daily reference intake (DRI) shows that women have higher sufficiency in energy and protein than men. Seafood represents 32-36% of the gleaners' daily protein intake of which 22-27% comes from gleaned invertebrates. Energy and protein intake from gleaned invertebrates by gleaning households are only slightly higher than those of non-gleaning HH (t-test, $p > 0.05$, $n = 222$) indicating the importance of gleaning to family nutrition. Increase in gleaning effort, indiscriminate gathering of invertebrates and the virtual lack of regulation in most areas threaten the sustainability of subsistence fisheries and the resilience of reef flat ecosystems. Formulation of sound management policies is crucial to sustaining the economic and nutritional benefits from gleaning.

Mitochondrial DNA analysis discloses panmictic structure of narrow barred Spanish mackerel, *Scomberomorus commerson* in Indian waters

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Narrow barred Spanish mackerel***, Scomberomorus commerson,*** is a commercially important marine pelagic finfish resources of the Indian Ocean. The species is widely distributed across the Red Sea, the Indo-West Pacific, and the Mediterranean Sea. The apparent fidelity of this species to a particular region is a matter of concern, as overfishing in these areas can lead to localized depletion. This scenario warrants knowledge on genetic stock structure of the species for fishery management. This species is categorized under near threatened category in IUCN conservation assessment (Collette et al., 2011). Genetic variation at mitochondrial ATPase 6/8 genes and D-loop region were used to reveal the evidence of population structure, levels of connectivity, and influence of historical processes in fish species. Samples collected through commercial catches from six different geographical locations from east and west coast of India were analyzed for mitochondrial ATPase 6/8 genes (842 bp) and D-loop region (427 bp). The sequences of both the mitochondrial regions revealed high haplotype diversity (0.809 - 0.992) and low nucleotide diversity (0.0020 - 0.0026). The unimodal mismatch distribution for the pooled samples of ***S. commerson*** inferred from both the genes suggests the historical expansion of this species. Mean pairwise F_{ST} value for the populations was 0.02 ($P>0.05$). The results suggest that adopting a single-stock model and regional

shared management are appropriate for sustainable long term use of this important resource. More rigorous genetic analysis using additional nuclear markers and mark-recapture experiments are suggested to detect spatial movement patterns, to further elucidate any stock substructure.

Identification of species composition of deep-sea fishes in the deep-sea shrimp fishery along the southern coast of India - a molecular approach

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Deep-sea fishes are known to be highly diverse with a high level of morphological and ecological diversity. These fishes are difficult to identify by traditional approaches due to the morphological complexity, sexual dimorphism and because they are easily damaged during collection. Samples were collected from commercial deep-sea shrimp trawlers operated off Cochin, Kollam and Tuticorin, southern coast of India. The deep-sea fish diversity was analysed using DNA barcoding technique. A total of 119 species of deep-sea fishes covering 89 genera of 64 families were barcoded for the first time using mitochondrial COI gene. Genetic diversity within, and between, species were calculated. A total of 178 sequences of COI (640-672 bp) gene were generated from deep-sea chondrichthyan species and 426 sequences of COI (588-675 bp) gene for deep-sea teleost fishes. The overall mean distance of individuals among the deep-sea teleost fishes under this study was 23.3%. The maximum interspecific K2P distance was 32.6% between ***Samaris*** sp and ***Priacanthus blochii*** and minimum was 4.9% divergence between ***Notacanthus indicus*** and

Notacanthus sp. A. The minimum intra-species distance observed was 0.2% in ***Obliquogobius cometes*** while maximum intra-species distance observed was 1.1% in ***Priacanthus prolixus.*** The overall mean distance of individuals among chondrichthyans was estimated as 25.7%. The maximum interspecific K2P distance was 35% between ***Centrophorus atromarginatus*** and ***Dipturus*** sp. A and the minimum was 2.8% divergence between ***Centrophorus atromarginatus*** and ***C. zeehaani***. The minimum intra-species distance observed was 0.1% in ***Deania profundroum*** and maximum intra-species distance observed 0.6% in ***Dipturus*** sp. A. The present study shows that COI gene have been useful in resolving taxonomic ambiguities, resurrecting species, and identifying new species from other congeners. Further research focused on deep water species collections cataloguing and taxonomic identity, coupled with molecular markers will be essential for Indian deep-sea fisheries management and conservation.

Genetic divergence in natural populations of *Silonia silondia* on the basis of molecular markers

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Silonia silondia, a commercially important large catfish, has become vulnerable due to overfishing, pollution and other anthropogenic activities. This study was

undertaken to gain insight regarding the population structure of this fish species.

Our study characterized the genetic stocks of ***S. silondia*** using two types of molecular genetic markers, viz., mitochondrial markers (Cytochrome ***b*** and ATP***ase***6/8 genes) and nuclear markers (11 microsatellite loci), using samples from the rivers Tons, Son, Chambal and Mahanadi of India. Genetic variation was slightly higher for mitochondrial DNA (mtDNA) haplotypes (average haplotype diversity of 0.839 in cyt ***b*** and 0.807 in ATP***ase***6/8) as compared to microsatellite loci (average, expected heterozygosity, H_e=0.7948 and observed heterozygosity, H_o=0.5159). Microsatellites markers showed higher (92.5%) within population variations, as compared to that of mitochondrial markers (76.51% in cyt***b*** and 76.93% in ATPase6&8). With microsatellite markers, among groups variation that attributed to the total genetic differentiation, was 7.5%, whereas the two mitochondrial markers showed among groups variation of 23.49% and 23.07%, respectively.

The extent of genetic differentiation values illustrated that the samples were not drawn from a single genepool. The pair-wise F_{ST} obtained from mitochondrial markers as well as 11 microsatellite are suggestive of four distinct genetic stocks of the samples studied. In addition, results from the analysis of cytochrome ***b*** sequences showed significant divergence between samples from two locations of River Tons, i.e., Rewa and Chakghat. This study conclusively indicates that wild populations of ***S. silondia*** are genetically structured and hence, conservation/ management/rehabilitation plans need to be population/location specific.

Genetic diversity and species-diagnostic markers of freshwater mussels in north Konkan region of Maharashtra determined by RAPD analysis

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The freshwater mussel, ***Lamellidens corrianus,*** is a commonly occurring mollusc with wide distribution in freshwater reservoirs, lakes, rivers, tanks and ponds. This species is also considered as a potential candidate species for freshwater pearl culture in India. At present there is no literature available regarding population structure of the freshwater mussels from north Konkan region of Maharashtra. Therefore, attempts were made to estimate genetic diversity of ***L. corrianus*** in this region. Samples were collected from four locations of the Thane district and three locations of the Raigad district. A total of 216 RAPD bands in the size range of 200 to 1500 bp were generated by five primers with 135 polymorphic bands and 81 monomorphic bands. Four primers generated species-specific bands. The degree of polymorphism was higher in the samples from the Thane district than in the samples from the Raigad district. The results indicated higher genetic variability between the two populations. The average genetic similarity for the Thane district population was 0.6621 and for the Raigad district population was 0.6886. When the Thane population was compared against the Raigad population the genetic similarity was 0.8862. Variation in genetic similarity values may indicate geographical isolation in the breeding populations of ***L. corrianus*** from different rivers. Phylogenetic analysis revealed that samples collected from two different locations of the same river were genetically closer, than the samples from two different rivers. Results of the present study revealed high genetic variability and low genetic differentiation among populations, thus suggesting a great potential for genetic homogenization within populations over large geographical distances.

Age, growth, and mortality of brown stripe snapper, *Lutjanus vitta* (Quoy and Gaimard, 1824) in west Sulu Sea, Philippines

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Brown stripe snapper, ***Lutjanus vitta***, is a commercially important species that has been heavily fished for decades in west Sulu Sea. Hence a detailed and accurate investigation relating to its life history is necessary in order to formulate sound management strategies. Information on life history of many marine fishes is poorly known in the country and studies relating to age, growth and mortality of ***L. vitta*** using sectioned otolith have not previously been reported. This study presents the first detailed life history information on L***. vitta*** such as age, growth and mortality in west Sulu Sea. ***Lutjanus vitta*** was sampled from landings of small-scale bottom set longline from east coast of Palawan. Fish were weighed (g) and measured (total length, TL, in cm), and sagittal otoliths were removed for age analysis. Examination of sectioned otolith margins (n= 490) using proportion of opaque against translucent bands indicated annulus formation in December and January, related to the period of lowest temperature. The oldest fish examined were a 12 year-old male and 11-year old female and measured 33.5 and 26.5 cm TL, respectively. Length-weight relationships were significantly different by sex (ANCOVA $F= 9.71$, $P< 0.05$). The von Bertalanffy growth equations curve differ significantly between sexes (male $L_{\infty} = 33.15$ cm, $K= 0.29$ yr^{-1}, $t_0 = -1.8$ year and female $L_{\infty}= 27.38$ cm, $K = 0.46$ yr^{-1}, $t_0 = -1.45$ year) (ARSS, $F= 3.76$, $P > 0.05$). Estimate of total mortality rate revealed slightly lower than previously reported in the area.

Study of migratory route of hilsa (*Tenualosa ilisha*) revealed from electron probe microanalysis and isotopic study of otolith

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Hilsa (*Tenualosa ilisha*) has long been considered as a fluvial anadromous fish with feeding grounds in the sea and spawning grounds along considerable stretches of the lower and middle reaches of big, as well as small, rivers of India. When juvenile hilsa reach a certain size related to developmental stage in freshwater, they leave their rearing tributaries in spring and begin a journey that will take them downriver through estuaries to ocean feeding areas. Present study depicts the migratory behavior based on otolith extracts of several hilsa shad captured along the course of Hooghly River of West Bengal, India. Sr/Ca ratios across the growth bands were mapped to understand the salinity condition during their development. Further, bulk samples are analysed for 18O and 13C to understand the overall water conditions during the life cycle of each fish. The region experiences tidal effect which allows differential mixing of sea water with fresh water throughout the year causing variability in the isotopic composition of river water at varying distances from the coast. The migratory behavior of the fish is traced by comparing the d18O signature in otolith's carbonate and the salinity of the river water along its course at different season. This observation is further supported by the 13C signature in carbonate and corresponding d13C signature recorded in the DIC of water. Present study reveals a lowering of d18O and 13C values in the otolith's recovered from the juveniles, which is consistent with the proposal of inland migration of hilsa to a distance of ~100km from the coast for spawning during the dry season.

Community characteristics of the phytal fauna of *Undaria pinnatifida* in the coastal artificial reef area of Zhangzi Island

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Marine ranching can improve and optimize the marine ecological environment through the use of artificial reefs that provide a good substrate for algae. Data obtained from seasonal surveys in January, June and September 2015 of ***Undaria pinnatifida*** and the associated phytal fauna showed that ***Undaria pinnatifida*** was the dominant population in benthic macro-algal communities of coastal artificial reef area in Zhangzi Island and attracted swimming animals, plankton, benthic fauna, as well as attached phytal organisms that constituted a species-rich biological community that was an important part of coastal ecosystem. The phytal organism community of ***Undaria pinnatifida*** played an important role in substance-recycling and energy-flow processes in the coastal ecosystem and was one of the key carrier primary producers of energy transfer to the higher trophic levels. In order to further understand the substance-recycling and energy-flow of coastal algal fields, the study analyzed the species composition, density, biomass and dominant species of the phytal organism community of ***Undaria pinnatifida*** in the area. The diversity of the phytal organism community was determined by using Margalef's species richness index, Shannon-Wiener diversity index and Pielou's evenness index. Phytal organisms community of ***Undaria pinnatifida*** in different seasons and artificial reef areas were comparatively analyzed using multivariate statistics analysis.

Adaptive modifications in the skin of certain fresh water teleosts in relation to different ecological niches

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The range of environments inhabited by fish is vast, and the successful maintenance of fish populations in challenging environments requires responsive adjustments in physiology. Skin is an ever-changing organ and alterations in its morphology vividly reflect an animal's ecological niche and its behavioural habit. All vertebrates' epidermis has a stratified epithelium that generally contains two developmental potentials; one related to keratinization and the other to mucogenesis. Fish epidermis, in general, is mucogenic and remains covered mainly with a mosaic pavement of irregularly polygonal epithelial cells. Their free surfaces show specialised structures - the microridges, which characteristically form different patterns in varied fish species. Interspersed between epithelial cells are a variable number of specialised secretory cells e.g. mucous cells, club cells and sacciform cells. In addition, intrusive cells, chromatophores and sensory structures e.g. taste buds and superficial neuromasts are present. The histological organization of epidermis shows considerable variation, despite some common factors. The secretory cells elaborate mucus and release it on the surface**.** Its composition varies with species. Lying at the interface between fish and the aqueous environment, skin mucus provides a medium in which antibacterial mechanism may act and thus serve a repository of several innate immune components playing a frontier role in protecting fish from infections. In some fish, epidermis on the general surface of the body is keratinized. In addition, specialised keratinized structures are observed in some species on their adhesive apparatus, lips and structures associated with them - the rostral cap and the horny jaw sheaths. Keratinization in teleosts is a unique phenomenon. It is associated to provide epithelial cells, strength and stiffness to protect the fish against abrasion.

Distribution and accumulation of heavy metal in the water and sediment of Poovar estuary, Kerala, south west coast of India with special reference to sustainable development

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The present study was carried out in the Poovar estuary adjacent to the beach resorts of Poovar – Vizhinjam area in Thiruvananthpuram District, Kerala State to examine the distribution of heavy metals associated with water and sediments. Poovar estuary is a bar built estuary of area 30.93 hectare and length 15 km and it is situated between N. Lat. 8° 18′ 32″ to° 18′ 6″ and E. Long. 77° 4′ 32″ to 77° 5′ 14″, and is formed by the confluence of river Neyyar. For the present study, three stations were selected in the Poovar estuary.

The heavy metal analysis of samples collected from three different stations in Poovar estuary during the period 2014-2015 indicated that the estuarine ecosystem are highly disturbed by waste water discharge through sewage disposal, beach resort effluents and retting activity. Of the different study stations monitored for the assessment of pollution load in water and sediments, it was found that the pollution load was highest in the Station III.

At times, the effluent discharges from tourist resorts and other anthropogenic activities caused mass mortality of fishes and other aquatic organisms in the estuary when the bar mouth is closed during the post-monsoon period. Thus, steps should be taken to protect this environment by recycling the effluents before discharging and also take necessary steps to keep the bar mouth always open.

Six years of observations on seasonality of planktonic copepod assemblages driven by the interplay waters of Kuroshio and South China Sea in a mixed semi-enclosed embayment in the western Pacific Ocean

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The copepod community structure and succession patterns at spatial and temporal scales in Nan-Wan Bay were studied over six years, comprising 24 research cruises. Zooplankton samples were collected from surface stratum of 2-0 m during November 2001 to January 2007. A total of 178 species of copepod belonging to 6 orders, 30 families and 58 genera were identified from 256 samples. We evaluated the copepod diversity, the association of copepod species, the association of stations and inter-annual and seasonal patterns. The average copepod abundance ranged from 91.67 ± 50.17 (individuals m^{-3}) (Nov/2001) to 1039.77 ± 860.86 (individuals (ind.) m^{-3}) (Nov/2004) whereas average species richness varied between 18.75 ± 5.01 (number $station^{-1}$) (Apr/2003) and 35.50 ± 4.54 (number $station^{-1}$) (Aug/2004). A clear temporal succession of top 10 most abundant species was identified at seasonal as well as inter-annual scale. In all, the top three most abundant copepod species were ***Oncaea media***, ***Clausocalanus furcatus*** and ***Paracalanus parvus***. Seasonally, the species richness and total copepod abundance was significantly lower in spring (March-May) than either during summer (June-August) or during winter (December-February). The present results show that the copepod community structure and succession in the Nan-Wan Bay are influenced by the interplay waters of the Kuroshio Current and the South China Sea.

Fecundity and egg quality of the white-spotted rabbitfish *Siganus canaliculatus* (Park, 1797) in Palompon, Leyte, Eastern Visayas, Philippines

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The fecundity and egg quality of ***Siganus canaliculatus*** were studied for 64 spawning female individuals ranging from 7.1 – 15.5cm SL from catches of drive-in gillnet and spearfishing from Palompon, Leyte. Samples were collected monthly from June 2011 – July 2012 and only mature and spawning females based on histological examination were used. Fecundity estimates were done following the protocol of the volumetric method. Egg quality was determined by measuring the egg size and mature oocyte size from histological slides. Yolk granules were also measured and the relationship with oocyte size was used in predicting possible increase of the yolk volume with oocyte size. Fecundity estimates ranged from 18,350 – 306,850 eggs/individual, and increased significantly with fish length, back-calculated age, body weight and gonad weight. Oocyte size increased slightly but significantly with standard length, showing a 15 – 20% increase in oocyte volume over a size range of 7.1 – 15.5cm standard length (SL). This translates to a 19.7% to 22% increase in yolk volume over the same size range. Based on the results, high fecundity and egg quality will be realized if these population will be allowed to grow >16cm SL.

Paraneuronal NE cells in the gills of fishes: probable extra-branchial system

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Various kinds of paraneuronal cells are the sources of neurologically active substances, typical of the endocrine cells belonging to the diffuse NE cell system scattered throughout the animal body (Zaccone ***et. al.***, 1996). Paraneuronal cells have been identified in the skin and gills of certain fishes. These cells are found to control the complex epithelial functioning of these domains by a paracrine mode of action. The gill is a multifunctional structure having a role in many important functions besides its basic function of respiration. Paraneuronal cells had been identified in the epithelium of gill filaments involved in chemoreception in these fishes. Presence of similar cells in the gill region, but away from the gill filament, has been a later discovery for fish. The cells belonging to a new system of neurosecretion the pseudo branchial neuro secretary system has been found to be present in catfishes and a few other groups of teleosts, from fresh and marine environments in India. These cells are found to be present in close association with pseudobranch/carotid labyrinth and first two efferent branchial vessels in all the species studied The system has been thoroughly studied histologically and immunologically. The system has the extra branchial NE system known as the Hypothalamo-hypophysial system of brain and caudal neurosecretory system of the tail. The immunocytochemical and confocal immunoflorescence investigations have revealed presence of multiple neuroactive substances in the cells indicating involvement of the system in multiple functions in the biology of these fishes, especially in conditions of hypoxia.

Although very little is understood about their functional role in the biology of fish, their paraneuron like appearance, secretion of more than one neuroactive substances and the resemblances with other paraneuronal cells are suggestive of a regulatory function in the gill region. The system is described in detail and the probable roles are discussed in the light of the experimental investigations undertaken, so far and are compared with the other types of gill NE cells reported earlier.

Reproductive biology of the diamondback squid *Thysanoteuthis rhombus* in Camotes Sea Central Philippines

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The diamondback squid, ***Thysanoteuthis rhombus***, (locally known as Dalupapa), is an epipelagic species found in tropical and warm temperature waters throughout the world's oceans. The squid is exported to Japan, Korea and other neighboring countries from the Philippines. Because of its high demand, the resources are harvested regardless of size. This study was conducted in order to provide information of its reproductive cycle so that management can protect its spawning. The study was conducted in Camotes Sea, Central Philippines. The biological characteristic of the squid in terms of length-mantle weight, sex ratio and gonado-somatic index were measured. Results showed that the total length and weight correlates proportionally with the mantle weight ($r=0.99$; $P<0.05$). In terms of sex ratio, the size indicates its sexual maturity- most of the catches from the month of June to February were predominantly male and only in the months of July to September females were present. The results of gonado-somatic index revealed that it was only in June that a gonad was observed in both male and female squid and increased in number until August as its peak and decreased in September.

Seasonality of water quality and fishery resources in wild environment of the river Satluj in Punjab (India)

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The river Satluj is a major source of water and capture fisheries for the Punjab, Himachal Pradesh, Haryana and Rajasthan states in India. The river sustains a diverse flora and fauna that provides sustenance to local fishermen and riparian populations. The Satluj originates southwest of the Tibetan lakes of Rakasthal and Mansarover, and enters the plain of Punjab at District Ropar and flows up to Fazilka via the industrial city of Ludhiana and the meeting point of river Beas at Harike Pattan, covering an area of 280.02 km in Punjab.

Water samples of the River Satluj were collected from 15 different sites. The full range of water quality indices viz; water temperature, transparency, salinity, pH, conductivity, TDS, turbidity, free CO_2, alkalinity, chloride, hardness, DO, BOD, Na, K, Ca, Mg were analysed seasonally. The commercial/subsistence fishing activities practiced by local, as well as migrant fishermen, were also examined. The variety of fish species were also monitored at landing sites and local markets at Ropar, Ludhiana, Harike Pattan and Tarn Taran. The percent catch composition of commercially important and miscellaneous fish species were recorded at different locations.

The intensity of fishing and fish diversity was low near district Ropar where a maximum of 56 species were encountered. With the convergence of a few small tributaries, the river Satluj water gets augmented at Ludhiana resulting in the increase in both diversity (93 species) and abundance of fish. Further increase in both diversity (104 speices) and catch was observed at Harike Pattan. The fish catch was the most representative at Harike Pattan where important catch components of the Satluj fishery were encountered. The high value of some water quality parameters at certain sampling points in Satluj is probably due to the pollution and anthropogenic factors such as discharge of industrial wastes, municipal/domestic sewage, use of organochlorine pesticides/chemical fertilizers,

throwing solid/liquid wastes by people as rituals including Budha Nala wastes. The shifting course of the river, discharge of untreated effluents, land encroachment, declining water level/fish productivity, changing catch complexion, lack of incentives/co-operation/awareness, and enactment of eco-regulation are affecting the delicate balance of Satluj ecosystem. There is need to restore the purity of water and health of Satluj ecosystem by adopting various scientific management and technical norms.

Preliminary report on the 2015 oceanographic survey in Sulu-Sulawesi by the M.V. SEAFDEC 2

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Oceanographic data were collected through a survey using the M.V. SEAFDEC 2 in the Sulu and Sulawesi Seas from 28 March to 1 May 2015, during the Northeast monsoon period. The study was aimed at investigating relationship between water quality parameters and abundance of tuna resources in the area. Water quality parameters that were collected included temperature, salinity, dissolved oxygen (DO) and fluorescence using CTD (Model: Seabird 911 ***plus***). Subsequently, data analysis for vertical and horizontal distribution of such parameters was made by using Ocean Data View software.

The analysis showed the differences in water quality properties between the Sulu Sea and the Sulawesi Sea, particularly for DO and fluorescence at sub-chlorophyll mix layer. In the Sulu Sea, long resident time of deep water mass in the sea led to low DO in the sub-surface layer. While for the Sulawesi Sea, intrusion of the North Pacific subtropical water mass resulted in noticeable high DO, salinity and fluorescence. On examining the correlation between the oceanographic parameters and distribution of tuna resources, the results showed a tendency for a relationship between DO at sub-chlorophyll mix layer and tuna distribution.

A comparison of aquatic animal community structure and catch between complex reef and group reef in Phang Nga Province

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The community structures and catch rates in concrete cubic blocks artificial reefs at Thaimuang and Takhuapa Districts, PhangNga Province was examined using bottom gill nets. Three treatments were compared (i) complex reefs (6 set reefs, 3,307 concrete modules and 11,161 m^3), (ii) group reefs (2 set reefs, 1,006 concrete modules and 3,395 m^3) and (iii) control area (natural fishing ground). Samples were collected during November 2013-April 2014 with a total of 95 hauls. The total catch comprised 86 species.

The catches from complex reef, group reef and control area included 68, 52 and 48 species, respectively. Their average individual number pers 100 meters of gill net were 7.285, 6.067and 4.224, respectively, and the average catch per 100 meters of gill net were 1,498.45, 1,484.30 and 1,366.60 grams, respectively. Although the catch in the control area was the highest, there were no significant statistical differences. The complex reef had the highest species richness of 33.74. The group reef had the highest Shannon-Weiner diversity index (H') and Pielou's eveness index - 3.06 and 0.77, respectively. The lowest H' of 2.88 was found in the control area.

Bray-Curtis similarity index of aquatic animal community structure between complex reef and group reef was 67.81 percent, between complex reef and group reef was 55.02 and between complex reef and control was 50.57 percent. These results indicate that the construction of artificial reefs will attract of aquatic animals more than enlarging group reefs, as a result of increasing the number complex reefs with the more space and volume.

Harmful algal blooms in the Gulf of Thailand

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Algal blooms are a common occurrence in aquatic environments. A subset of these blooms poses environmental or public-health threats, and it is therefore referred to as "harmful algal blooms," or HABs. Some HABs are harmful by virtue of their sheer biomass, whereas others are associated with algal blooms capable of producing toxins. During a HAB event, algal toxins can accumulate in predators and organisms higher up the food web. Toxins may also be present in ambient waters, Animals, including humans, can thus be exposed to HAB-related toxins when they eat contaminated seafood, have contact with contaminated water. Illnesses associated with marine HABs have been known for decades as well as the fact that the toxins causing these illnesses are very stable molecules and are not destroyed by any method of food preservation or preparation.

This paper reports on HABs in the Gulf of Thailand, which is a semi-enclosed sea and supports a major fishery. It is fed from water from four rivers including the Mae Klong River, the Tha Chin River, the Chao Praya River and the Bangpakong River. The circulation of water is a result of the interactions among tides, winds, the northeast monsoon and the southwest monsoon. In the past, there has been an apparent increase in the frequency, intensity and geographical distribution of HABs in the Gulf. The first occurrence of HABs in Thailand was been reported in May 1983 and involved 63 victims from that were affected by eating mussels that were harvest from the red tides. However, the source of the toxin has not yet been investigated.

The Thailand Department of Fisheries has established a monitoring program with the objectives to ensure that bivalve molluscs do not contain toxic substance in quantity that are considered to be harmful to human health.

Age and growth determination of Indo-Pacific mackerel using otolith microstructure technique

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Age and growth determination, using otolith microstructure technique, were conducted for two stocks of Indo-Pacific mackerel (***Rastrelliger brachysoma***) from the Andaman Sea and the Gulf of Thailand. Total length of of fish from the samples ranged from 68.21 to 197.27 mm. The relationship between total length and number of daily increments were examined through exponential equations that revealed that Indo-Pacific mackerel from the Gulf of Thailand were older than those from the Andaman Sea at the same length. The degree of difference was higher with increasing in length. The average growth index of males and females from the Andaman Sea was 0.996 and 0.851 mm/day, respectively which significantly higher than males and females (0.688 and 0.610 mm/day) from the Gulf of Thailand.

The Gulf of Thailand stock reach an asymptotic length (L_∞) at 22.229 cm with a growth parameter (K) of 2.432 per year and theoretical age at which length of the fish would have been zero (t_0) of -0.00426 year. The Andaman Sea stock reach a L_∞ at 20.290 cm, K was 3.260 per year and t_0 was -0.00348 year. The length based growth parameter estimates calculated from length frequency data of the Gulf of Thailand stock was L_∞ of 28.782 cm, K of 1.175 per year and t_0 was -0.00680 year. The comparison between otolith growth and morphometric growth revealed lower growth rate of otolith than total length. We conclude that the productivity of the Andaman Sea stock was higher than that Gulf of Thailand stock.

Evaluation of the fishing regulations on minimum landing size for some commercial species in Turkey

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As humans have continued to exploit fishery resources, considerable changes in harvest have been observed. As exploited fish stocks decline, the need for the information on reproduction biology and recruitment dynamics increases. In this respect, it is obvious that this information is indispensable for the fisheries research such as stock assessment and management. Especially for exploited stocks, size at maturity (Lm), the length at which 50 % of population becomes sexually mature for the first time, is a key parameter in fisheries management. As indicated by Beverton and Holt (1957), in order for the stock biomass to be maintained, fish should be allowed to spawn at least once over their lifespan before being caught. Therefore, size at maturity is the basis in setting the minimum landing size (MLS) of exploited stocks.

In this study, we have tried to analyze the findings obtained from the studies carried out in Turkish waters in order to determine Lm as well as MLS values of the 14 species, which are commercially caught in Turkey. These species are: Atlantic bluefin tuna (***Thunnus thynnus***), Atlantic bonito (***Sarda sarda***), bluefish (***Pomatomus saltatrix***), chub mackerel (***Scomber japonicas***), common pandora (***Pagellus erythrinus***), common two-banded seabream (***Diplodus vulgaris***), European hake (***Merluccius merluccius***), European pilchard (***Sardina pilchardus***), gilthead seabream (***Sparus aurata***), goldband goatfish (***Upeneus mollucensis***), little tunny (***Euthynnus alletteratus***), red mullet (***Mullus barbatus***), tub gurnard (***Chelidonichthys lucerna***), whiting (***Merlangius merlangus***). In addition, the Lm for females and MLS values for these species are 135.0 cm/30.0 kg; 42.5 cm/25.0 cm; 25.4 cm/20.0 cm; 18.0 cm/18.0 cm; 11.3 cm/15.0 cm; 12.9 cm/18.0 cm; 21.5 cm/25.0 cm; 12.1 cm/11.0 cm ; 28.5 cm/20.0 cm; 11.0 cm/10.0 cm; 60.0 cm/45.0 cm; 12.3 cm/13.0 cm; 20.0 cm/18.0 cm; 14.6 cm/13.0 cm, respectively. In conclusion, it is obvious that the Lm values are greater than the MLS, indicating growth overfishing.

Study and integration of modern marine ranching technology: A case of Zhangzi Island marine ranching, North Yellow Sea, China

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Modern marine ranching is an advanced fishery production system that uses modern science and technology and involves a progressive management concept with the ultimate object of sustainable development of the fishery that includes a healthy ecosystem, plentiful resources and a safe product. Marine ranching covers artificial habitat construction, seed production, breeding and releasing, behavior of domestication and control, environmental monitoring and early warning, ecological regulation, monitoring of catch recovery and other aspects. From the beginning of 2008 in Zhangzi Island waters we developed ecological neutral concrete artificial reefs in the Zhangzidao demonstration area that included the development of a new type of reef and deployment method, studies on the relationship between artificial reefs and marine organism, enhancement and releasing technology and invented releasing and ecological harvesting equipment of ***Patinopecten yessoensis***. We also obtained parameters of typical behavior of reef fishes in the North Yellow Sea area, developed the first domestic application instrument to realize remote acoustic taming and control in marine ranching, and achieved real-time online monitoring on marine environmental factors by environmental monitoring and management system. In the demonstration area, the number of living organisms has significantly increased, which has good ecological, economic and social benefits, and provides a scientific support and demonstration for the construction of marine ranching and the production of marine fishery.

Protection and restoration of salmon chum of the Sino Russian border basin of Heilongjiang River

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In order to protect the biodiversity of rare and endangered cold water fish, and restore the population and habitat of the cold water ecological indicator fish migratory salmon chum (***Oncorhynchus keta***)in the waters of River Heilongjiang, the salmon chum fish scientific and technical research group of River Heilongjiang Fisheries Research Institute under the auspices of the Ministry of Agriculture Finance special species resource protection project, undertakes the investigation and monitoring of River Heilongjiang fishery resources and ecological environment. The aim is to achieve the recovery and scientific management of the target restoration resources, and jointly promote the Heilongjiang Basin biodiversity conservation and ecological civilization construction to support the local government and Department of Fisheries management and all sectors of society, Heilongjiang River and its adjacent waters will be developed as one of the salmon chum resources protection and ecological restoration demonstration area. The identification and evaluation of spawning functionality, evaluation of artificial reproduction and releasing, water quality, water regime bottom material suitability, and analysis of the key influencing factors of river habitat, habitat ecological environment were carried out. Also, the research on rehabilitation and functional recovery application technology were conducted that included advanced techniques, such as bionic field incubation, habitat restoration, and population labelling. Releasing in the upper reaches of River Heilongjiang in its original spawning area in Huma River in winter and spring, as well as the implementation of the protective action of salmon chum in the whole basin were conducted. The size of the resources, enhancement quantity, spawning field position, and social and economic factors, fishing and operation sites were monitored.

Moving the Kaimana mud crab fishery (*Scylla serrata*) towards sustainability and market access

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Mud crab, ***Scylla serrata***, is an important species for food security and livelihood provision in Kaimana, West Papua. The fishery is considered 'small-scale' and is conducted by female fishers located in a remote part of Indonesia with difficult market access. It also occurs in a biodiverse and fragile ecosystem - mangrove forests. Underdevelopment and adult illiteracy are identified issues in the area. In 2015, Masyarakat dan Perikanan Indonesia, in collaboration with Conservation International, established a Fisheries Improvement Program in northern Arguni Bay, Kaimana, West Papua. The project aims to improve the sustainability of the fishery by establishing data collection activities, exploring management measures, developing understanding of stock stability, supporting capacity building and developing market links. A co-management group, termed a Data Management Committee, is in operation, requiring participation from the various stakeholders, with the aim of empowering local actors to contribute to management discussions and decisions. The stakeholders include fishers, suppliers, academia and district and provincial government officials. Data Management Committees convene twice a year to discuss fishery-related issues, implications of new regulations and potential management measures. Another development in the region is the establishment of 'POKMASWAS', a community-led initiative for patrolling the fishery to identify illegal activities and protect the fishery.

The majority of the crabs are sent to Jakarta, with a proportion continuing to Singapore. Consequently, it is a challenge to use market forces to generate change as seafood sustainability is currently not a high priority food attribute in Indonesia. Effort is also directed towards developing and improving the supply chain by

establishing a Bali Sustainable Seafood Sourcing group. It is anticipated this will improve market links with Bali, a destination with a high number of affluent consumers, who are increasingly willing to pay for sustainable, locally-sourced products.

Willingness to shift on pelagic fishery as a model of integrated coral reef fish management and policy

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Under a common and open access regime, development focuses on progressively intense and varied use by a quantity of actors in coastal waters, and the accomplishments will normally assume the interests of one or more of the users. The Government of Indonesia has set a goal of economic development of Indonesia as a future orientation as a maritime State recognizing Marine and coastal regions as one of the pillars of the national economy. Its natural resources have significance strategic benefits for the economic development of Indonesia. To realize one of Indonesia's economic development goals Indonesia requires experts who truly understand the management of coastal resources and territory.

Interface procedures characterized by significant interchange of "externalities" are likely to initiate proposals for some kind of coordination and attempts to reach some joint decisions regarding the management of interdependent activities. This has been the situation also with regard to ocean uses including the 'tragedy of the commons' and multiple use disagreements. Ideas for integrated ocean management or some similar concept, are now recurrently encountered. However, it is not clear what exactly integrated ocean policy means, why a specific activity such as ocean uses requires an organized policy zone, and how the integration is to be accomplished? The current article is an introductory attempt to discovering model of coral reef fishery management integrated with marine policy.

The sea cucumber fishery in Palawan, Philippines: challenges and opportunities

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Sea cucumbers are among the most heavily exploited marine resources in Palawan, Philippines. The study aims to provide information and propose measures for managing the sea cucumber fishery. More specifically, it determined and compared the sea cucumber population in terms of species richness, diversity and densities between exploited and unexploited sites. The exploited sites were the Green and Johnson Islands and the unexploited is in the Arreceffi Island. The survey was done last April 20 to June 10, 2015 covering the shallow coral reefs, reef flats and seagrass beds with a total area of 38,250 m^2. Information on catch composition and catch per unit effort (CPUE) of gatherers were also determined in Green and Johnson Islands.

Results showed that sea cucumber densities were very low in areas where harvesting is unregulated. In exploited sites, total mean densities range from 48 individuals (ind.) ha^{-1} to 64 ind. ha^{-1}, while in unexploited area, densities were up to 595 ind. ha^{-1}. Similarly, diversity and species richness is lower in exploited sites (2.63, 11) compared to the unexploited (4.88, 16). Between the two exploited sites, more species were gathered in Johnson Island (23) than in Green Island (19). The CPUE was also higher in Johnson Island wherein gleaners get up to 29 pieces per person $^{-1}$ hr^{-1}. On average, sea cucumbers contribute Philippins peso (PhP) 1,500.00 $mo.^{-1}$ to the income of gatherers. However, the resource's wild population is at risk of being depleted as evidenced by low density estimates, and so is the livelihood of gatherers. Thus, management measures must be taken immediately so as not to exhaust the sea cucumber's wild population, and sustain the economic benefit from its fishery.

The stocking strategies of giant freshwater prawn *Macrobrachium rosenbergii* for culture-based fisheries

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A stocking program of giant freshwater prawn (***Macrobrachium rosenbergii***) has been conducted in Thailand since the 1980s. ***M. rosenbergii*** post larvae (PL) are released into the designated water bodies during the wet season. Because the recapture rate is very poor (i.e. less than 5%) experiments were conducted to investigate the appropriate stocking strategies that could yield a higher recapture rate and production. Predator-prey relationships, between 5 PL stages ***M. rosenbergii*** and a predator, Hampla barb, (***Hampla macrolepidota***), under different habitat complexity treatments, were examined. The result showed that the highest survival of the larvae, after 15 days of releasing, was at 20 days old.

Releasing PLs at the mud bottom during night time yielded a higher survival rate of the ***M. rosenbergii*** seeds. However, there was no significant difference in survival rate when different types of predators were used, i.e. ***H. macrolepidota*** and ***Oxyeleotris marmorata***. Impact by the difference in temperatures between the seed-container and water body was examined by the before-after & control-impact study. The results showed that significant mortality started at ± 2°C and the higher the difference in temperature, the lower the survival. Results from experiments were then transferred to field trials. Sixteen community ponds size ranged from 0.5 to 7.5 ha with a production cycle of 7 months were used. In each pond, the stocking consisted of ***M. rosenbergii*** and fishes, mostly tilapia, silver barb, Chinese major carps. The stocking densities were 800, 1,200, 1,600 and 2,000 seeds per ha, with 4 replicates at each stocking density. The recaptured rate of ***M. rosenbergii*** improved noticeably and ranged from 12% to more than 40%. The weight of large size individual male ***M. rosenbergii***, in each pond, was over 100 g.

Population dynamics and fishery of roughear scad *Decapterus tabl* Berry 1968 (Perciformes: Carangidae) in Camotes Sea, central Philippines

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Population dynamics and fishery status of the roughear scad, ***Decapterus tabl*** Berry 1968 caught from Camotes Sea, Central Philippines were investigated. Asymptotic length ($L\infty$) was 32.55 cm while growth coefficient (K) was 0.97 year^{-1}. Total mortality (Z) was 5.57 year^{-1} while natural mortality (M) and fishing mortality (F) were 1.71 year^{-1} and 3.86 year^{-1} respectively. Exploitation level (E) was 0.69. The length at which 50% of the fish were retained by the gear (L_{50}) was 17.48 cm. The recruitment pattern was continuous with one major peak in the months of February-March. The coefficient "b" of the length-weight relationship (LWR) was 2.986 (±0.178) indicating isometric growth while results of the length-length relationships (LLRs) of females and males were highly correlated (r^2 =0.99, $p<0.01$).

The fishery of roughear scad revealed mean monthly catch per unit effort (CPUE) and income per unit effort (IPUE) ranging from 0.83-11.48 kg·man^{-1}·hr^{-1} and 73.10-1247.80 peso·man·hr^{-1} (1.72-29.39 USD) while total catch was estimated at 144,856 metric tonnes during the study period. High Z, F and E values indicate that the roughear scad is facing high level of exploitation in the Camotes Sea. It is recommended that the reproductive biology should be studied to properly address the fishing pressure confronting this species.

Assessment of commercially important groupers (Epinephelinae) in Tawi-Tawi, Philippines

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Groupers of the subfamily Epinephelinae, family Serranidae, are high valued coral reef fishes and are commonly exploited for live reef fish trade (LRFT). As high trophic species, groupers are vulnerable to overexploitation. In this study, we conducted both fishery-dependent (e.g. market surveys and landings) and fishery-independent (e.g. fish visual census) surveys of groupers (Epinephelinae) in Tawi-Tawi, Philippines conducted from November 2015 – May 2016. Tawi-Tawi is the southernmost province of the Philippines with more than 300 islands. It has a huge coral reef area which serves as the major source of livelihood for the majority of the population. Coral reef deterioration and the decline of the fishery impacts on poverty and food security in the province. Hookah fishing, often with the use of poison, is the most common fishing method, particularly of high-valued grouper species. Initial results showed that there are more than 40 grouper species and our study showed that Tawi-Tawi coral reefs harbor high grouper diversity but have been continually deteriorating due to the prevalence of destructive fishing practices and irresponsible coastal development. Historical trends of grouper fishery, enforcement against illegal fishing activities and insights from conservation initiatives in the area will be discussed.

Status of fish biodiversity in Surha Tal: a back water natural lake in the floodplain of the river Ganga in Ballia district, Uttar Pradesh, India

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Surha Tal is a perennial oval shaped natural backwater oxbow lake fed by the river Ganga. The lake was studied from 2011 to 2013 in the pre- and post- monsoon seasons to assess the fish biodiversity and water quality with respect to different pollutant parameters. A total of 4,852 individuals were collected, which represented 66 fish species belonging to 21 families. Water quality of the lake was found to be within the prescribed standard for drinking water (BIS 10500:1991). Among fish families, Cyprinids reported highest species diversity (22) followed by Bagaridae (8). Considerable variations in the species abundance and richness were noticed between pre- and post- monsoon seasons (F> Fcritical) while the species diversity reflected no significant difference ($t = 2.1902$, $p = 0.02$. According to the IUCN Red List 2014 7 species were in the Near threatened (NT), 50 Least concern (LC) and one species Vulnerable (VU) categories. Eight species were listed as Not Evaluated (NE). Apart from Indian major carp, other catfishes like ***Chitala chitala, Labeo pangusia, Ompok bimaculatu, Ompok pabda, Wallago attu, Ailia coila and Bagarius bagarius*** that were reported as near threatened were also recorded. The present study provides the baseline information on the fish biodiversity, which could be used for conserving and managing the fish biodiversity in the future.

Trophic flows in the marine ecosystem of an artificial reef zone in the Yellow Sea China

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This study is the first attempt to evaluate the ecosystem structure and function of the nearshore reefs in the Lidao coastal ecosystem of northern China. This region is one of intensive aquaculture, particularly kelp culture, and fisheries enhancements through the deployment of artificial reefs and stock enhancement programs, which are practiced intensively. An Ecopath model, with 20 functional groups representing 81 species, was developed for a small area in the region and Ecosim was used to explore two scenarios for alternative fishing practices and surrounding aquaculture activities: 1). closing all fisheries after three years for 20 years; and 2). removing kelp farms, and the detrital material from kelp into the region, over 10 years and projecting forward for 10 years. The Ecosim simulation of closing all fisheries for 20 years (keeping the original state for the first 3 years) resulted in an increase of about 100% in the relative biomass of the main exploited species; sea cucumber ***A. japonicas*** and abalone ***H. discus hannai***. The simulated removal of all kelp farms over 10 years resulted in an increase by about two times in the relative biomass of type III fish and 1.2 times in their main prey (i.e. small pelagic fish), while the relative biomass of the detritivore ***A. japonicas*** and heterotrophic bacteria decreased by 31.4% and 12.7%, respectively. These predictions indicate that nearshore kelp cultivation might restrict the trophic flow of the grazing food chain in the water column, and favour benthic production, resulting in a significant change of trophic flows in nearshore waters. It is likely that extensive kelp cultivation is providing energy subsidies for the stock enhancement of benthic species and functional groups in this region.

Tuna Longline Fishery in the East Indian Ocean

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A study on the tuna from longline fishery in the East Indian Ocean was carried out during January to December, 2011. Data were collected from landing vessels from Taiwan, Belize, Malaysia, India and Indonesia in by interview and port sampling in the Phuket Province of Thailand. The vessels ranged from 19-40 m in length and used 1,300-1,500 hooks per vessel, using round scads and/or live milkfish as bait. Their fishing ground was in the latitude of 2°S to 12°N and longtitude of 77° to 95° 40´E. The high fishing period was during November to March and the low fishing period was during June to October. The total catch was 5,543,244 kg with the value of 766.8 million baht. The catch included 4,318,743 kg of tuna (77.92 %), 92,351 kg billfishes (1.67%) and other 1,132,150 kg miscellaneous bycatch (22.08%). Tunas mainly comprised yellowfin (***Thunnus albacares***) (68.77%) and bigeye (***T. obesus***) (9.14%), and a small quantity of albacore (***T. alalunga***) (<0.01%). The average total catch rate was 14,781.98 kg per trip or 847 kg per 1,000 hooks. Average catch rate of tunas, billfishes and other other miscellaneous bycatch were 660, 14 and 173 kg per 1,000 hooks, respectively. The individual dressed weights of tunas were also collected and analyzed. The individual weight of yellowfin tuna ranged from 6-100 kg, the average weight was 38.47±14.01 kg and the modal weight was 30 kg. The individual weight of bigeye tuna ranged from 9-118 kg,the average weight was 38.46±17.78 kg and the modal weights were 25 and 27 kg. The individual weight of albacore ranged from 8-39 kg,the average weight was 14.25± 3.09 kg and the modal weights were 12 and 13 kg. The distributions of fishing effort, catch rate and fish size are shown in geographical map of the fishing ground.

In-situ and ex-situ conservation of sahar (*Tor putitora*) in Nepal

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Sahar (*Tor putitora*) is one of the economically important indigenous fish species of Nepal. It is most popular freshwater sport fish throughout the trans-Himalayan waters. Biological diversity of this species is being threatened by various anthropogenic activities and its population is declining. Two species of sahar exist in Nepal of which *Tor putitora* is more common than *Tor tor.* Major river system and lakes of the Pokhara valley are a notable source of sahar and the lakes of the Pokhara valley are the major accessible natural resources for in-situ conservation. The main activities for in-situ conservation are the community awareness and mobilization, training on aquatic resource management, ranching of sahar, conservation campaign, patrolling to protect the spawning ground through the active participation of fisher including women groups from a fishing community of Jalari. Fish catch statistics reveals that catch of sahar has increased by 50% in last five years.

With respect to the ex-situ conservation and aquaculture potential of sahar, significant developments in artificial propagation of this species have been achieved. Brood fish of sahar reared in ponds have reproduced and fry have been restocked every year for maintaining the population of lakes. These activities have had a significant impact on in-situ and ex-situ conservation of sahar in the lakes of Pokhara valley. Likewise research activities on sahar in tropical climate resulted better survival and growth of fry. Enhanced growth in tropical and subtropical climate as well as the recent breeding success in the subtropical region has raised new hopes on the prospects of in-situ and ex-situ conservation of sahar in Nepal.

Role of fish reserves and swamp forests in Sumatra and West Kalimantan floodplain fisheries

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Global climate and anthropogenic changes alter the hydrological pattern and forest density of upland catchments and floodplains. In terms ecosystem services, floodplains are ranked the second most valuable ecosystem type behind estuaries. Rivers with extensive floodplains support the largest freshwater fisheries. Reduction in floodplain forest density, expansion of plantation drainage canals, and unpredictable flood pulse could reduce floodplain productivity and floodplain fisheries.

Ecosystem based management through maintaining floodplain forests and their existing natural assets or constructing fish reserves through involving local people with their local wisdom are alternative management options to conserve and sustain fish resources and their habitat, and floodplain fisheries. In Indonesia, at least 92 natural and artificial fisheries reserves have been recorded and 86% of them are located in Kalimantan and Sumatra floodplain areas. However, whereas some of fisheries reserves function well and contribute to local fish production, others are dysfunctional.

This paper discuss the factors influencing fisheries reserves function and their contribution to fish production in Sumatra and Kalimantan floodplain. Materials presented in this paper are based on a study conducted in floodplain area of Sumatra in 2010-2015 and a literature review. It can be summarized that limited fish pathways, less floodplain forests, drting out during the dry season, and fish resources management focused more on the ecosystem without applying local wisdom in the floodplain management are factors for dysfunctional fish reserves. Successful fish reserves contribute 150 kg/ha/year or 22 times higher fish production than that of floodplain area without fish reserves.

Establishment of a critical habitat in Hinobaan and Sipalay City, Negros Occidental, Philippines

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The study was conducted to assess the biophysical environments of Hinobaan and Sipalay City, Negros Occidental for the establishment of a critical habitat for the protection of marine turtles. Study sites were determined based on preliminary interviews conducted by the research team with key informants and community residents and with assistance from the Department of Environment and Natural Resources (DENR) to determine the barangays where marine turtles are seen and known to nest. Primary data were collected using Focused Group Discussions (FGDs) and interviews with community representatives in the chosen barangays. Participants were asked about marine turtle sightings, fishing activities, key issues, and government interventions as well as possible sightings of other marine wildlife in their areas. Likewise, mangrove and seagrass habitats were identified, assessed and mapped. Density and diversity indices were assessed using standard procedures. Results showed that the waters in the study sites were frequented by marine turtles and that the beach areas served as nesting grounds. Identified turtles include Olive Ridley (***Chelonia olivacea***), Green Turtle (***Chelonia mydas***) and Hawksbill (***Eretmochelys imbricata***). Further, results indicate that it is essential that these habitats be declared as critical habitat for the protection and conservation of marine turtles in the country.

The sustainability of shark finning: assessing eastern Indonesia's data-poor fisheries

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For over two decades, Indonesia has reported higher average shark landings than any other nation, but very little information exists on the fishery and life histories of the targeted species. This poses severe challenges to shark sustainability and conservation in this vast archipelago. We draw on diverse sources of data to evaluate the sustainability of the shark fishery in eastern Indonesia, a particularly data-poor region where sharks are primarily targeted for their fins. Shark fishers from three coastal communities were interviewed on their perceptions of catch trends over the past twenty years and asked to collect fishing data during fishing trips in the Seram, Arafura and Timor Seas. For the most frequently harvested species, we estimated maximum intrinsic rates of increase to predict their resilience to fishing pressure. Current catches of hammerhead, sandbar, tiger, and some reef sharks largely comprised of immature individuals and most fishers perceived sharks to be declining in numbers, size and species diversity, attributing this to overfishing. Hammerhead sharks have higher intrinsic resilience but are nevertheless at risk of local extinction due to their availability to the fishery and the value of their fins. Sandbar, dusky and grey reef sharks have lower resilience and are frequently caught, but are neither protected in Indonesia nor by international agreements such as CITES. A composite management approach, including consistent implementation of existing trade restrictions, fisheries research and opportunities for fishers' livelihood diversification, is needed to stem the predominantly unsustainable harvest of sharks in eastern Indonesia.

FAO/SEAFDEC Project on energy audits for Thai trawlers

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Since early 2000s, Thai fishing vessel's operators, who rely mainly on diesel combustion engine, have been suffering from the increase in global crude oil price of approximately three times over the decade. For trawl fisheries, the main cost for fishing operation is the fuel cost, which contributes up to 50-80% of the total operation costs. Such high fuel consumption also creates huge amount of exhaust gas, resulting in greenhouse gas emission that impact climate change. Therefore, a collaborative project on energy audits for Thai trawlers was initiated with the aim of mitigating this situation, making use of Australian energy audits process as the main reference method. Six trawlers that operate in the Gulf of Thailand and the Andaman Sea were selected, classified as small vessels (less than 14 meter), medium vessels (14-18 meter), and large vessels (over 14 meter). Data were collected by comparing with towing operation period with and without fishing activities, to obtain information on fuel consumption profiles, cost and revenues from fishing activities.

Results from this experiment indicated that different trawlers have different energy profiles and respective optimum condition, which result from the differences in dimension and capacity of ship, engine, propulsion, and fishing gear. Nevertheless, information on such energy profiles could be analyzed to come up with appropriate procedure for maintaining adequate level of energy efficiency along the energy profile and identification of potential fuel saving techniques to optimize the vessel's operation. The results from this project, were distributed to vessel owners and fishing operators to enable them to estimate the current fuel consumption and explore possible ways to reduce fuel usage through changes in either operational and mechanical configurations, while also raise their awareness on reduction of greenhouse gas to mitigate global warming in the future.

Comparison on the efficiency of conventional trap and vented trap in ghost fishing experiments in Si Racha Bay, the Gulf of Thailand

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This study was undertaken with the aim of investigating ghost fishing efficiency caused collapsible crab traps in the study site in Si Racha Bay in the Gulf of Thailand. Two types of traps, ***i.e.*** "conventional trap" and "vented trap," were simulated as lost gear, and data were collected on entrapped individuals during the period from 6 January 2013 to 5 April 2014.

Fish baits in the traps were either consumed or decomposed rapidly; within 3 days in the vented traps and 4 days in the conventional traps. For the conventional traps, at least 548 individuals from 23 species were recorded in the trap, of which 69% could be classified as commercial species, while 31% were non-target or low-value species. For the vented traps, at least 243 individuals of 23 species were recorded, 64% of which were commercial species, while 36% were non-target or low-value species. It was also found that both types of trap could continue ghost fishing for more than one year, with the CPUE of the conventional trap significant higher than those of vented trap. Although the target species of these traps is blue swimming crab, it was found that the traps had entrapped other species much more than the target species. Specifically, the entrapped number of blue swimming crabs was recorded to be only 1.58±0.63 and 1.42±0.82 crabs/trap/454 days in the conventional trap and vented trap, respectively

Also in this study, the number of mortalities has been confirmed by diving observation to monitor the number of dead bodies of entrapped individuals remaining in the trap. The number of mortalities in conventional traps was recorded to be 137 bodies (25% of entrapped individuals), while in the vented traps the number was 31 bodies (12.76% of entrapped individuals). From the study, it could be concluded that the vented trap has lower entrapping efficiency and mortality than the conventional trap, and demonstrates a positive function of the escape

vent in reducing negative impacts from ghost fishing caused by the lost traps, either in entrapping or causing mortality to aquatic animals.

Assessing impacts of fishing gears on marine ecosystems: expert judgement

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Scientific data on the ecological impacts of fishing are needed for developing policies to support the ecosystem approach to fisheries management. However, such data are not always available. Conducting field experiments can consume considerable resources and time. Expert knowledge is an alternative option that can be used for decision making in sparse data situations. In this study, we assess severity of fishing gear impacts on marine ecosystems in Thailand through expert judgement using 13 selected large- and small-scale selected fishing gears. The assessment focused on bycatch and habitat damage. An expert consultation workshop was convened in January 2016 in Bangkok, in which twenty one experts who are knowledgeable in fishing gears and operations, stock assessment, fisheries management, marine habitats participated. The results from an analysis of existing knowledge concerning ecological impacts of fishing in Thailand, conducted prior to the workshop, were mobilized for the participants to discuss during the workshop. According to the expert opinions, impacts of otter board trawls and pair trawls on marine ecosystems are of high concern. Forage fish, epifauna and infauna, marine mammals and sea turtles are at risk to be incidentally caught as bycatch while coral reefs, seagrass beds and soft bottom are highly rated as habitat that sustain damage caused from the trawls. Shrimp trammel nets and crab gillnets

are also of concern as they cause bycatch problems. They strongly agreed that the severity of fishing impacts are varied with different fishing operations, locations, periods, and duration. The rating and additional information regarding ecological impacts of fishing gears serve as a basis for establishing policies in order to minimize ecosystem impacts that could be valuable to the ecosystem approach to fisheries management in Thailand.

Population structure of marine pelagic fish species in waters of -Philippines, -Indo-Pacific and -Western and Central Pacific as inferred through genetic markers

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Understanding the population structure of fish species is fundamental in drawing important fisheries management strategies for sustainability. Unfortunately, in countries such as the Philippines situated in the Indo-Pacific basins and the wider Western and Central Pacific Ocean, such studies are very limited. Here, we present our results showing population structures of commercially important marine pelagic fish species in Philippine waters and adjacent oceans with the use of genetic markers. We show stocks of blue-stripe herring (***Herklotsichthys quadrimaculatus***) being shared across the coastal municipalities in the Verde Island Passage, Batangas using mitochondrial 16S marker. We also show that stocks of big-eyed scad (***Selar crumenophthalmus***) Bali sardine (***Sardinella lemuru***), Indian

mackerel (***Rastrelliger kanagurta***) and frigate tuna (***Auxis thazard***) in the Sulu-Sulawesi seas are shared by Indonesia, Malaysia and Philippines using mitochondrial D-loop marker. In contrast, we found structuring in the population of long-tail tuna (***Thunnus tonggol***) across the basins of the Indo-Pacific using mitochondrial D-loop marker as well as in the populations of yellowfin tuna (***Thunnus albacores***) in the Western and Central Pacific Oceans using DNA microsatellites. Our results were used to generate policies and management interventions such as seasonal closures, regional and national management plans that contribute directly to addressing food security and marine biodiversity conservation in the country and in the region.

How DNA barcoding is used to support fisheries regulation and traceability to combat illegal, unreported and unregulated (IUU) fishing in the Philippines

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The Philippine fishery is one of the largest in the world and harbours the highest number of marine species per square area in the planet. Unfortunately, it is also beset with illegal, unreported and unregulated (IUU) fishing practices making it also one of the hotspots in terms of the need for sustainable fisheries and biodiversity conservation. Here we present our work on using DNA barcoding (mitochondrial CO1 gene) to support monitoring the trade of protected and regulated aquatic species, and also in identifying processed fishery products for labelling and

traceability purposes. We identified the species of juvenile eels (elvers) confiscated at the Ninoy Aquino International Airport, Manila as well as the species of sharks and rays in dried form (skin, bones and muscles) confiscated at the North Harbour, Manila. We likewise present evidence of mislabelling in various fish fillets products sold in major supermarkets in Manila. Further, we were able to optimize DNA extraction and identify fish species in processed food such as fermented fish paste. To store and manage generated DNA sequence data for reference and future use, we present our Genetic Fingerprinting Laboratory (GFL) DNA Sequence Database developed and housed at National Fisheries Research and Development Institute (NFRDI). Our results provide evidence that IUU in terms of illegal trade of aquatic species and mislabelling is occurring in the country and that DNA barcoding is an accurate tool in identifying aquatic species along the value chains that can enhance anti-IUU regulatory and traceability measures in the country.

Stock identification of short mackerel in the Gulf of Thailand: an otolith microchemistry approach

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The short mackerel ***Rastrelliger brachysoma*** is the major commercial important marine fish for Thai people. However, this fish has been overfished since 1977 and its annual catch has also fluctuated over time, particularly in the Gulf of Thailand (GoT). The management of this species fish is based on the assumption of a single stock of ***R. brachysoma*** in the whole GoT, which may not be appropriate. This study aimed to identify the stock-structures of ***R. brachysoma*** in the GoT using otolith microchemistry.

A total of 55 ***R. brachysoma*** were collected and otolith sections were prepared.

Elemental analysis was performed using a New Wave UP193FX laser ablation system coupled to a Thermo X-Series II ICP-MS. Multivariate Analysis of Variance (MANOVA) and Principal Component Analysis (PCA) were to detect differentiations between sampling sites and examine the relative importance of each variable. Linear Discriminant Function Analysis (LDFA) was used to classify individual fish to their collection locations using micro-chemical values.

The edge otoliths micro-chemical structures from the four sample sites (i.e. Eastern, Upper, Central, and Lower of GoT) were clearly separated for both sexes (MANOVA, $p<0.01$). Three variables fluctuated among sites for both sexes. The LDFA using 8 micro-chemical structures in the edge zone showed a high classification accuracy of ***R.brachysoma*** to their collection locations (89% for males and %79 for females). The LDFA results also showed a high classification accuracy in both fish sex (%85 for males and %86 for female). The results highlighted that ***R. brachysoma*** in each stock (i.e. Eastern, Upper, Central and Lower stocks) comprised of fish from different origin of the larvae. The study should lead to better understanding of the biological characteristics and population dynamics of each stock, and consequently to more efficient and effective management of ***R. brachysoma*** in the GoT.

DNA barcoding of *Setipinna* ecotypes from Indian water reveals single species *Setipinna phasa* (Hamilton-Buchanan, 1822)

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Species of the genus ***Setipinna*** (Family: Engraulidae) contributes major share in the total landings of anchovies in India and four species have been reported from Indian waters. Among these species, ***Setipinna phasa*** is a dominant species and has a restricted distribution along the West Bengal coast of India. Knowledge of the taxonomy of the genus and ability to delineate species is essential to assess the stocks and to formulate effective resource management measures. However,

the taxonomy of species of ***Setipinna*** is ambiguous and needs to be validated by using morphological and molecular markers. In the present study, species belonging to ***Setipinna*** were collected from Diamond Harbour, West Bengal, India and were differentiated based on morphological and meristic characters. Twenty four morphometric traits and fourteen meristic characters were measured. Factor and discriminate analyses revealed the presence of different ecotypes with significant statistical differences. However, DNA barcoding using mitochondrial cytochrome ***c*** oxidase subunit I and 16S ribosomal RNA gene showed less divergence values (0.00-0.008) among the ***Setipinna*** ecotypes. Further phylogenetic analysis using combined DNA sequences (COI and 16S rRNA) displayed clustering of these ecotypes with ***Setipinna phasa*** with significant bootstrap values. This study concludes that even though ecotypes of ***Setipinna*** displayed considerable morphological variation they are genetically not distinct from ***Setipinna phasa*** species. Thus the species seems to be base in the evolution of others ***Setipinna*** species.

Genetic variation of wild populations of snow trout (*Schizothorax richardsonii,* Grey 1832) from rivers of Nepal revealed by microsatellite DNA

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Schizothorax rischardsonii, locally called "asala" and also known as snow trout is a popular coldwater food fish of the temperate zone of trans-Himalayan region. The natural population of ***S. richardsonii*** has dwindled considerably due to several anthropogenic activities in the region. Genetic variation is a key component for identifying distinct natural stocks to conserve and to establish foundation stocks for aquaculture potential. Microsatellite DNA markers were used to assess genetic variation in six wild population of the ***S. richardsonii*** in the Sabha, Indrawati,

Melamchi, Tadi, Palakhu and Khudi rivers in Nepal. Twelve primers were used to amplify microsatellite markers from 30 fish from each population. Thirty two of the 40 score able bands were polymorphic, indicating some degree of genetic variation in all the populations. The mean number (±standard deviation) of alleles per locus ranged between 2.50±1.0 in the Sabha population to 2.91±1.37 in the Tadi population, and the percentage polymorphic loci was 81.9%. The proportion of polymorphic loci and gene diversity values reflected relatively higher level of genetic variation in the Tadi population. Seventeen of the 32 polymorphic loci showed a significant ($p < 0.01$, $p < 0.001$) departure from homogeneity. Average F_{ST} value (0.1675) indicated significant ($P<0.002$) population differentiation among the natural populations of ***S. richardsonii***. Estimated genetic distances between populations were directly correlated with geographical distances. The unweighted pair group method with averages (UPGMA) dendrogram showed two distinct clusters, the Indrawati and Khudi populations forming one cluster and the second cluster from the other three subgroups. Therefore, each of the population of ***S. richardsonii*** should be regarded as a group comprising significant genetic differences in species conservation and acquiring foundation stocks for aquaculture development.

Genetic and morphological evidence reconciles *Systomus sarana subnasutus* (Valenciennes, 1842) as a distinct valid species

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Systomus sarana sarana commonly known as Olive barb is widely distributed throughout the natural freshwaters in South Asian countries. In India, this species is common in almost all rivers except in the peninsular region. The natural population has reduced in abundance over the years due to anthropogenic pressure and, therefore, categorized as vulnerable species. Another congener, ***S. sarana subnasutus*** is endemic to the Western Ghats and inhabits in the rivers in south of the River Krishna. ***S. sarana subnasutus*** has been considered as a subspecies of ***S. sarana sarana***, although concerns have been raised on its taxonomic validity. The present investigation aims to resolve this taxonomic conflict through combined use of molecular and morphological tools.

Specimens of ***S. sarana sarana*** (n=29) were collected from the River Mahanadi, Daya, Luna, Godavari and Krishna while ***S. sarana subnasutus*** (27) from Manimala and Periyar River. A number of morphomeristic characters and truss-based morphometric characters were found to be diagnostically useful. Lateral line scales and corresponding vertebrae counts had significant contribution in validating that ***S. sarana subnasutus*** as a distinct taxon. Molecular evidence corroborated the morphological conclusions.

Based on the COI gene, the intraspecific genetic distance among the three populations of ***S. sarana sarana*** and the two populations of ***S. sarana subnasutus*** was low (0.1%). However, the average genetic distance between these two ***Systomus***

species was found to be 2.5%. Kimura-2-Parameters values and NJ tree distinctly separated ***S. sarana sarana*** from ***S. sarana subnasutus*** with 100% bootstrap support. Conclusively, the study provides evidence that ***S. sarana subnasutus*** is a valid species and distinct from the ***S. sarana sarana***. The present data recommends the consideration of the species name, ***S. sabnasutus,*** originally described by Valenciennes (1842).

Species specific molecular signatures of fishes of genus *Sillago* from Indian waters for fishery management purposes

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The fishes of the genus ***Sillago*** are commercially important and widely distributed along the coast of India and the Andaman & Nicobar Islands. ***Sillago*** is one of the three genera in the family Sillaginidae, which contains 31 species. Species of ***Sillago*** are usually identified with lateral line count, vertebral count and structure of swim bladder. A total of 8 species of ***Sillago*** have been reported from India (FAO, 1992). However, morphological identification becomes very difficult since many species looks similar in appearance and colour. We have collected specimens from all over India, including Andaman & Nicobar Islands for examing the diversity of Sillaginids in India using molecular markers. Species-specific molecular signatures for species belonging to the genus ***Sillago*** were generated by amplifying mitochondrial COI sequences (628bp) and the phylogenetic relationship among the species was determined using software MEGA 6.0. The phylogenetic analysis showed 8 clades, confirming 8 species, out of which 5 species were reported earlier and 3 species

requires further taxonomic investigation. Nucleotide composition observed were A=23.71%, T=28.52%, C=29.70% and G=18.07%. The analysis revealed a total of 399 conserved sites and 229 variable sites. Out of variable sites, parsimony informative sites of 214 and 15 singleton sites were observed. The genetic divergence values of intra-species ranged from 0.000 to 0.014, while it varied from 0.021 to 0.278 for interspecies for eight species under study. The phylogenetic trees were also in concordance with the genetic divergence values of the study. The species specific molecular signatures developed in the present study will be useful in demarcation of most confusing members of genus ***Sillago*** for sustainable management in Indian waters.

Processing and marketing of donkey's ear abalone *(Haliotis asinina)*: the case of Iloilo, Philippines

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Abalone is a high-value export fishery product. The highest recorded Philippine export earnings of processed abalone was in 2004 with more than 600,000 kgs valued at 3 million USD; export volume, however, has continuously declined since then. The Province of Iloilo has been identified as one of the areas in the Philippines where abalones are abundant. This paper examined the processing and marketing of abalone in Iloilo to identify constraints to industry's growth and opportunities for upgrading. Primary data was gathered through face-to-face interviews with 28 abalone collectors who were purposely selected from two abalone-producing municipalities, and 23 marketing intermediaries who were identified using tracer methodology. Results revealed that collectors sold the abalones immediately after harvest, such that value addition at this level was primarily the labor exerted in collecting abalones from the wild. The assemblers-processors not only provided the crucial link between the collectors and exporters, they contributed substantial value addition along the market chain; and subsequently reaped the largest benefits. There were no standard protocols for the measurement, classification, processing and storing of abalones which tended to result in high variability in the quality of processed abalones. Likewise, industry players had difficulty accessing information about processing technology, prices, food safety, and market requirements. Additional constraints included insufficient supply of electricity and absence of cold storage facility in far-flung islands where processing was undertaken. Recommendations offered include capacitating industry players by providing them with trainings on proper collection, processing, packaging, handling and

storage of abalones; developing common standard protocols for measurements, classification, and value adding processes; promoting adoption of Philippine National Standard for live, chilled/frozen abalone; strengthening linkages among industry players through periodic industry consultations and use of information, communications technology (ICT); and establishing common post-harvest service facilities.

Meeting customer expectations what does quality look like? A seafood wholesaling context from Sydney Fish Market

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This paper will look at quality from a number of different perspectives and will outline what steps Sydney Fish Market (SFM) takes to ensure that the products it sells and the services it delivers meet or exceed customer expectations. This paper will delve behind the scenes of SFM's quality management system to determine what factors are required to ensure it remains an iconic business with a strong reputation for the finest seafood and also increasingly seen as a desirable tourist destination.

The paper will look at what makes up the Integrated Management Framework that SFM operates under and what supporting services (and their accreditations) are required to ensure this continuing success.

Iloilo fish port complex: analysis of capacity and utilization, the fish auction system and future prospects

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Across the years various fish post have been constructed in major fish landing sites which are located in major cities across the Philippines. The fishports have provided the needed infrastructure and support facilities like freezing plants necessary for sustained delivery of fish to the downstream market channels up to the consumer level.

This paper reviews the marketing channels for fish in the context of the second largest fishport in the country, the Iloilo Commercial Fishport. Subsequently, it describes and analyzes the fish auction in Iloilo Commercial Fishport, where the Dutch auction model locally known as "bulungan system" is employed.

Key informant interviews, focus group discussions and review of previous studies provides insights on the present level of the fishport's utilization and prospects for future management towards sustained fish supply particularly for Iloilo City and Iloilo province.

Nutritional status and associated factors among fishers in Batan Bay, Aklan, Philippines

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Fishers catch fish for food that promote nutrition and food security of the people. Not much attention, however, is given to their own nutrition. This paper presents an assessment of the nutritional status of 342 fishers in three municipalities (Batan, Altavas, and New Washington) surrounding Batan Bay in Aklan Province, Philippines. Data were collected in July to September 2014. The study used body mass index (BMI) as a measure of the fishers' nutritional status. Results showed that 75 percent of the fishers had normal weight, while 8 percents were underweight, 16 percent were overweight, and 1% were obese. The normal weights of the fishers were positively and significantly affected (at 5% level of significance) by being male, able to fish daily, having a normal blood pressure, and having a government health insurance. In contrast, the factors that negatively and significantly affecting their weights were age, and being an elementary graduate. The results underscore the importance for the fisher to be able to fish daily because this could also mean having a fish for food daily.

Value chain analysis of sergestid shrimp (*Acetes spp.*) Oton and Tigbauan, Iloilo Province, Philippines

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The sergestid shrimp industry in the municipalities of Oton and Tigbauan in Iloilo Province has contributed to local income and employment. This study described and analyzed the value chain of sergestid shrimp in these municipalities. Specifically, the study described the marketing channels, market participants, and marketing practices; determined the revenues received, costs incurred and gross margins received by the market participants; and, identified the problems facing the market participants. Data were collected from personal interviews of 14 shrimp catchers, 9 raw shrimp traders, 11 shrimp processors, and one shrimp product trader in January to March 2014. The annual volume of shrimp caught was estimated at 132,758 kilograms. Most of the shrimp caught were sold (129,182 kg, 97.31%). Only three commission houses handled an estimated volume of 128,702 kilograms (96.94%). The major outlets of the commission houses included the raw shrimp retailers and different types of shrimp processors. The highest average selling price (P372.73/kg), gross margin (P168.65/kg) and net returns (P161.39/kg) was received by one shrimp product retailer. Generally, the shrimp catchers were price takers, with the commission people as quantity leaders and seemingly price leaders. The net added value of shrimp increased with their transformation into new forms such as the shrimp paste, dried shrimp, and shrimp mill. Adding value to the raw shrimp through processing can increase returns. Creative ways to create demand for raw and processed shrimp should be introduced. New processing technology, new market outlets for processed shrimps, and better packaging can likely increase the demand for processed shrimp.

Studies on factors influencing carnosine content in eel *Anguilla spp.*

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Freshwater eels contained a very high level of histidine-containing dipeptide, carnosine (β-alanyl-L-histidine), which is a special nutraceutical compound and plays an important role on biological functions. The purpose of this study was to investigate the factors influcing carnosine content in eel ***Anguilla spp.*** Carnosine was found rich in Japanese eel (***Anguilla japonica***), European eel (***A. anguilla***), American eel (***A. rostrate***), giant mottled eel (***A. marmorata***) and short-finned eel (***A. bicolor pacifica***). Muscle is the dominant tissue with a high amount of carnosine in eel, but other tissues such as liver, gill, vertebrate and other viscera contain a very low level or only in trace. Japanese eel muscle possessed the highest level of carnosine than other four species of eel.

Japanese eel increased their body weight from 23 to 242 g over the 36-week growth period. The carnosine content showed no significant change during growth. After 5-month period of starvation, carnosine level showed no significant difference between starved and control group eel. A very high amount of carnosine present in eels throughout growth and starvation indicated carnosine may play an important role of physiological function for this fish.

There was no significant change in carnosine of Japanese eel muscle during storage. However, carnosine in European eel, giant mottled eel and short-finned eel was subject to degradation to L-histidine and β-alanine. After elongated storage, histidine may be further degraded to histamine by decarboxylation or to urocanic acid by deamination. After bleeding treatment, the rate of carnosine degradation was lower than that without bleeding. This study provided the useful ways to retard the degradation of carnosine during storage and processing of eel products.

Changes in biochemical compositions of Japanese eel (*Anguilla japonica*) during growth and starvation

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Japanese eel (*Anguilla japonica*) does not assimilate nutrition during the long distance of oceanic spawning migration. No study has been done on biochemical compounds of eel in relation to starvation. The objective of this study was to monitor the changes of chemical compositions in eels during growth and starvation. Japanese eel increased their body weight from 29.5 to 266 g and condition factor from 1.2 to 1.8 during the 36-week growth period. Moisture decreased from 68.1 to 61.4% while fat increased from 13.6 to 22% with growth. The predominant free amino acids (FAAs) were taurine, glycine, lysine and proline. The latter three FAAs and total FAAs decreased gradually with rearing time. Japanese eel contained a very high level of carnosine, and the level showed no significant change during growth.

No mortality occurred in any of test groups over the 5.5-month period of starvation. Body weight decreased from 120 to 81 g during starvation. Starvation also resulted in the reduction of muscle lipid, condition factor and hepatosomatic index. As compared to control group fish, the starved fish possessed lower amounts of glycine, lysine, proline and total FAA, but taurine remained approximately the same. Carnosine level showed no significant difference between starved and control group eel. Results showed fat may serve as energy source for Japanese eel during prolonged starvation. In addition, a very high amount of carnosine present in Japanese eel throughout growth and starvation indicated carnosine may play an important role of physiological function for this fish.

Studies on biochemical compositions of cultured freshwater prawn (*Macrobrachium rosenbergii*) and quality changes during storage

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Aquaculture of freshwater prawn (***Macrobrachium rosenbergii***) is an important fishery sector in Asian countries. The biochemical characteristics of cultured freshwater prawn including proximate compositions and taste components were analyzed in different size and gender. Storage stability, freshness indicators, and sensory rating during storage at 4°C and 25°C were also investigated. Freshwater prawn contained moisture ranged from 76.7 to 78.4%, protein 19.0 to 20.2%, and a very low level of lipid. The moisture of big female samples was slightly lower than that of small ones. However, protein in big prawns was higher. Freshwater prawn was rich in free amino acids (FAA) ranged from 1726 to 1960 mg/100 g with arginine, proline, glycine, glutamic acid, alanine and taurine being the predominant compounds. The FAA amounts of small prawns were higher than those of big samples.

FAA increased in the initial stages of storage at 4°C and 25°C for the period of 14 days and 1 day, and decreased at the end stages of storage. Ornithine in prawn is trace, but after storage its level becomes large. The ATP-related compounds in freshwater prawn ranged from 7.06 to 7.68 µmole/g, and adenosine diphosphate (ADP), adenosine triphosphate (ATP) and adenosine monophosphate (AMP) were the major ones. ATP, ADP and AMP remarkably decreased during storage, while inosine (Hx), hypoxanthine (HxR), and K-value increased with time. The total volatile basic nitrogen (TVB-N), ammonia (NH_3), and total plate count (TPC) also gradually increased during storage. The sensory evaluation associated with TVB-N and TPC was in acceptable quality after 6 hours of storage at 25°C and 3 days at 4°C. Ornithine, Hx, HxR, K-value, TVB-N, NH_3, and TPC could be considered as quality indicators for freshwater prawn during storage.

Nutritional composition and antioxidant properties of dried powder residue, a by-product from oyster (*Crassostrea iredalei*) extract processing

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Oyster powder residue, as a by-product of oyster extract processing, can be used as an ingredient for a variety of food preparations. The extraction process involves homogenization with water, mild heat treatment and filtration steps that resulted to the oyster extract and its by-product (residue). The residue was then dried and pulverized into powder form. The study aimed to characterize the nutritional components (protein, lipid, ash, moisture and amino acid profile) and physical (pH, Aw) properties of the residue as well as its antioxidant capabilities.

Analyses reveal that the product has a protein content of 73.89 + 0.40%, 8.92 + 0.12 % lipid, 8.65 + 0.02% ash, and 3.98 + 0.05 % moisture, while pH and water activity were 6.54 and 0.24, respectively. Amino acid profile shows that the product contains the nine essential amino acids that cannot usually be synthesized by human and must be supplied in the diet. The 85% ethanol oyster residue extract exhibited increasing antioxidant activities (2, 2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity, reducing power, and gallic acid equivalent assays) with increasing concentrations. A sample extract concentration at 50 mg /ml exhibited a 46% DPPH free radical scavenging activity and a 0.60 reducing power absorbance at 700 nm suggesting that the residue may contain compounds that can act as primary or secondary antioxidants. The phenolic content, as estimated by the Folin-Ciocalteu assay, has gallic acid equivalent (GAE) value of 39% at 50mg/ml sample concentration, implying the presence of compounds that act as scavengers of singlet oxygen and free radicals. This suggests that the oyster residue could contain bioactive compounds responsible for its potential antioxidant activity.

The study shows that oyster residue product can be a potential functional ingredient, being a good and natural source of high protein, essential amino

acids and antioxidants, and a shelf stable product attributed to its low moisture content and water activity.

Development of extruded product from seaweed (*Sargassum tenerrimum)* and its process optimization

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Seaweed refers to any large marine benthic algae that are multicellular, macrothallic and thus differentiated from most algae that are of microscopic size. It forms one of the most commercially important marine living renewable resources. It has been used as a staple diet from the immemorial time as they are nutritionally rich materials. Edible seaweeds are rich in bioactive antioxidants, soluble dietary fibers, proteins, minerals, vitamins, phytochemicals and polyunsaturated fatty acids. Extrusion is a method of continuous food processing in which raw food materials are thermo-mechanically cooked in a screw barrel assembly by a combination of moisture, pressure and temperature in order to be mechanically sheared and shaped. Starch is the main constituent of the extruded products and responsible for most of their structural attributes. These products are rich in energy but are nutritionally poor and give a possibility to add some beneficial nutrients to them.

Therefore the present study developed an extruded product fortified with seaweed (***Sargassum tenerrimum)*** using a co-rotating twin screw extruder. The process parameters were optimized using response surface methodology. The Box-Behnken design was employed with three independent variables i.e. feed moisture (X_1), ***Sargassum*** concentration (X_2) and barrel temperature (X_3) with three levels for designing the experiment. Feed moisture had the most significant ($p<0.05$) linear

effect on both the response variables whereas ***Sargassum*** concentration and barrel temperature shown significant ($p<0.05$) quadratic effect. The optimum level of independent variables i.e. feed moisture, ***Sargassum*** concentration and barrel temperature for maximum expansion ratio were 16.45%, 4.33% and 123.08 ˚C respectively whereas for maximum porosity were 16.06%, 4.51 and 124.04 ˚C respectively. The present investigation can be used to develop extruded products fortified with seaweeds using an optimized process which can help to fulfill the high nutritional demand of fast growing world population.

Development of crackers using different levels of gonads of sea urchin (*Tripneustes gratilla*)

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Sea Urchin is a ball of spines, more like a hedgehog, it is tasty and highly beneficial food, with its health benefits such as a good supplier of fiber, rich in protein, vitamin C, vitamin A, rich in calories that will fuel the body, improve and promote circulation of blood and enhances virility. Sea Urchin is rich with some vitamins and minerals such as glycogen, carotenoids, alamine, methionine, glutamic acid and inosinic acid. Sea urchin roe is a popular aphrodisiac food.

Sea urchin is valuable food resource most especially their gonads which are eaten raw or pickled. That is why gonads of sea urchin was tried out as one of the ingredients of a cracker as finger food in gatherings and leisure time.

With the noted benefits and nutritional value of sea urchin, a product was developed. The study was conducted using five(5) treatments where P_1 is the control, P_2 ingredients were added with 25 percent of gonads, P_3—added with fifty percent gonads, P_4—added with 75 percent gonads and P_5 added with 100 percent gonads.

Results show that all treatments added with different levels of gonads mixed with the cracker ingredients were acceptable by the sensory panelists. However, some

of the treatments were moderately liked, and others were liked very much. Common suggestion is to increase the spiciness of the product; likewise packing should be done immediately after frying to preserve its crispiness.

In vitro antiplasmodial activity of *tambelo* (*Bactronophorus* sp.) extracts

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Malaria is a mosquito-borne infectious disease derived from parasitic protozoans belonging to ***Plasmodium*** type. It is one of the most common endemic diseases and becomes one of the major health issues in Indonesia. Based on the empirical experiences of the coastal people in Torobulu, Southeast Sulawesi, ***tambelo*** (***Bactronophorus*** sp.) is commonly used for medical purposes as traditional medicine, notably in combating malaria disease. ***Tambelo*** is one type of wood eating worm belongs to family of ***Teredinidae***, phylum of mollusc which lives in decayed mangroves, especially ***Rhizophora*** sp. It is usually consumed freshly or cooked as regular food.

The objective of this research is to evaluate the ***in vitro*** antiplasmodial activity of methanol, chloroform, and n-hexan extracts of ***tambelo*** against ***Plasmodium falciparum***. ***Tambelo*** was extracted by ***macerate*** method using methanol, chloroform, and n-hexan. Antiplasmodial activity assay was carried out by microscopically observing culture of chloroquine-resistant P. ***falciparum*** 3D7 strain.

Based on the research, the antiplasmodial activity of methanol, chloroform, and n-hexane extract shows satisfying result. The IC_{50} values obtained indicate that the methanol extract is higher than chloroform and n-hexane, which are 1,33 µg/ml, 5,87 µg/ml, and 8,04 µg/ml respectively.

Parasite infestation on *Oreochromis niloticus* (linnaeus, 1758) from selected fish farms in Cebu, Philippines

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This study was conducted to determine parasite infestation on ***Oreochromis niloticus*** Linnaeus (1758) cultured in the selected fish farms in the province of Cebu, Philippines. A total of 20 fish samples were collected from the selected fresh and brackish water fish farms and dissected on the day of collection. Microscopic examination was conducted on 100 specimens comprising of liver, muscle, intestines, gills, skin and scales dissected from the fish samples. A total of 806 organisms were collected from these organs of the fish host. All organisms identified were classified under 14 genera. The 12 genera belong to parasitic groups dominated by protozoans of ciliates and flagellates such as ***Piscinoodinium***, ***Trichodina***, ***Cryptobia, Icthyophthirius, Chilodonella,*** and ***Ambiphrya.*** Organisms belonging to other genera of parasitic groups were ***Dactylogyrus, Ergasilus,Myxozoa***, ***Coccidia,*** Microsporidiaandalarval fluke**.** There were two other organisms classified as ***Navicula*** and ***Pleurosigma***, but were not in the parasitic group.

Higher diversity of parasites occurred in fish samples from freshwater farms than in brackish water environment. The species diversity of parasites could have been influenced by some environmental factors.

Biosynthesis of Ag/ZnO nanocomposite using chitosan from shell waste of mud crab, *Scylla serrata* and its antibiofilm screening

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In the present study, chitosan was biologically synthesized from the shell waste of mud crab, ***Scylla serrata***. Then, chitosan based silver/zinc oxide (CS/Ag/ZnO) nanocomposite was synthesized by direct precipitation method. The structural characterization of CS/Ag/ZnO nanocomposite was analyzed by UV-vis spectroscopy (UV-Vis), X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR) and Scanning electron Microscopy (SEM). The UV-vis spectra recorded the absorbance of three distinct peaks at 320, 360 and 425 nm due to surface plasmon resonance of CS/Ag/ZnO nanocomposite. The XRD pattern of CS/Ag/ZnO nanocomposite showed the crystalline nature of particle with various Bragg's reflection peaks corresponding to crystal planes of (100), (002), (101), (111) and (200). The FTIR spectra showed sharp bands at 3465, 2843, 1650, 1613, 1445 and 452 cm^{-1}. The SEM micrograph confirmed the spherical shape of nanocomposite and the particle size ranges between 100 -150 nm. The CS/Ag/ZnO nanocomposite exhibited relatively a higher zone of inhibition against Gram-positive bacteria ***B. licheniformis*** than Gram-negative bacteria ***V. parahaemolyticus*** at 8 µg ml^{-1}. CS/Ag/ZnO nanocomposite effectively inhibited the biofilm growth of ***Bacillus licheniformis*** and ***Vibrio parahaemolyticus*** by decreasing the hydrophobicity index and EPS production at 30 µg ml^{-1}. CS/Ag/ZnO nanocomposite caused the disruption of fungal biofilm formed by ***Candida albicans*** at 50 µg ml^{-1}. The cytotoxicity of CS/Ag/ZnO nanocomposite on RAW 264.7 murine macrophages is currently under preliminary investigation. The study concludes that CS/Ag/ZnO composite will act as a safe, eco-friendly and promising alternative for controlling bacterial and fungal infections.

The effect of plasticizer on the functional properties of biodegradable protein base film from surimiwash water

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Films made from surimi wash water with addition of thirteen plasticizerswere used for castingprocess, i.e.glycerol (G50), oleic acid (O50), polyethylene glycol (PE50), glycerol+oleic acid (G25O25), glycerol+polyethylene glycol (G25PE25), glycerol+steric acid (G25S25), glycerol+palmitic acid (G25PA25); oleic acid+steric acid (O25S25); oleic acid+palmitic acid (O25PA25); oleic acid+polyethylene glycol (O25PE25); polyethylene glycol+steric acid (PE25S25) polyethylene glycol+palmitic acid (PE25PA25) steric acid+palmitic acid (S25PA25) in order to improve mechanical properties, water and oxygen permeability. Additionally, antibacterial properties (***Escherichia coli*** and ***Staphylococcus aureus***) of all films were tested. The resultsof mechanical properties demonstrated that the film adding 50% oleic acid provided the highest tensile strength of 34.30±3.68 MPa while the film adding 50% glycerol was the lowest as 2.15±0.41 MPa. For the elongation at break, the film with mixture plasticizer, glycerol-oleic acid and polyethylene glycol-oleic acidshowed the highest value as 42.57±8.96% and 37.07±2.66%, respectively.For the permeability properties, the film adding 50% oleic acid and 50% oleic acid-palmitic acid showed the worst water permeability as $0.35\pm0.05\times10^{-12}$and $0.61\pm0.09\times10^{-12}$g.m/$m^2$.s.Pa.,respectively. Moreover,the film adding 50% oleic acid presented the poor oxygen permeability as 138.84±10.87 gm/m^2.day.kPa.In case of antimicrobial properties; all films cannot resist***E. Coli*** while the film with polyethylene glycol-oleic acid can inhibit ***S. aureus*** growth. All films are suitable coating on food surface such as eggs, fruits and sun dried fish due totheir low tensile strength and elongation at break. With low water and oxygen permeability, the films are good for prolonging shelf life as well.

Comparison of transportation, handling and preservation methods of sea lettuce (*Ulva rigida*) and gutweed (*Enteromorpha sp.*) for prolonged shelf-life of chlorophylls

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Sea lettuce (***Ulva rigida***) and gutweed (***Enteromorpha*** sp.) are green algae in phylum Chlorophyta containing abundant chlorophyll. This study aimed to determine transportation, handling and preservation methods for sea lettuce and gutweed as raw materials for chlorophyll processing. The transportation of seaweed with seawater and without seawater was compared. Three drying methods were tested ie. drying, blanching before sun drying and blanching before drying in hot air oven at 50±2˚C. Dried seaweed produced via each method was packed in polyethylene bags (50 grams per bag) and stored at room temperature (33±5˚C) and 5±0.5˚C. Sensory evaluation, color measurement and chlorophyll were examined after 0, 1, 2 and 3 months of storage. The results showed that the transportation without seawater then blanching before drying in hot air ovens at 50±2˚C and storage at 5±0.5˚C was the best method for sea lettuce. This method could preserve good quality of seaweed for 3 months. The sensory score was at the highest level from the beginning (0) until 3 months of storage (8.55±0.07 to 8.44±0.62). For color measurement, L*, a*, b* values were 24.91±1.16, -11.17±1.22, +17.09±1.87 in the 0 month and 25.820.18±16.76+ ,-10.72±0.12 ,4.33± in the 3rd month. Moreover, the total chlorophyll, chlorophyll a and b content were ,0.11±7.59 0.09±4.58 and 0.07±3.00 g/100g at the 0 month and 5.70±0.43, 3.49±0.27 and 0.17±2.22 g/100g at the 3rd months. In case of, gutweed, the best method was transportation with seawater and then blanching before drying in hot air oven at 50±2˚C and storage at 50.5±˚C. The obtained sensory score was a very good level (0.14±8.56) from 0 month and decreased to a good level (0.15±7.99) at the 3rd months. For color measurement, L*, a*, b* values were ,0.91±8.86- ,2.61±24.81 1.24±16.66+ at the 0 month and 0.94±17.56+ ,0.63±9.26- ,2.53±24.10 at the 3rd months, respectively. During 3 months of storage, total chlorophyll, chlorophyll a and b content were 0.19±9.17-0.41±9.27 ,0.08±15.28-0.55±15.58 and -0.31±6.18 0.05±6.11 g/100g, respectively and not significantly different (***p***>0.05).

Effects of relaying on the quality and safety of green mussels (*Perna viridis*)

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Ensuring the safety of food has to be the primary concern in any product intended for human consumption. Pre-processing steps necessitate inclusion of a process that eliminates or reduces contamination in the raw materials. This is more important in shellfish where growing areas are very susceptible to all contaminants that are biological and chemical in nature. Bivalves like mussels are filter feeders and accumulate food particles from their habitat. Reducing or eliminating bacterial load becomes a challenge in making this product safe for human consumption, more particularly when these are consumed raw or lightly cooked. Relaying is one of the techniques to reduce if not eliminate bacterial contamination in mussels. This technique means harvesting of shellfish from polluted growing water to a clean seawater area to allow shellfish to cleanse and purge themselves while continuing their filter feeding and digestive processes. In this study, green mussels were harvested from and relayed for 2 months in the mussel culture areas in Panay, Capiz, Philippines. Mussel relaying was done in February to April 2015 and samples were collected every 2 weeks for microbiological, physic-chemical and sensorial analyses. The tide levels during sampling as well as water quality of the relaying areas were noted and evaluated.

It was evident in the microbiological results that relaying technique in mussel had significantly reduced the levels of ***E. coli*** and ***V. parahaemolyticus*** within the standards and had eliminated Salmonella and ***V. cholerae*** in mussel meat within the 2- month relaying period. Relaying allows mussel to cleanse from bacterial contamination while weight of its meat increased over time. The acceptability of mussel was not significantly affected by the relaying method. Relaying as a purification technique in mussel may be recommended to reduce or eliminate pathogenic bacteria in mussel meat to ensure safety of the consumers.

Quality and shelf life upscaling on chilled storage of Japanese threadfin bream *(Nemipterus japonicus*) incorporating green tea (*Camellia sinensis*) extract in icing medium

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'Green consumerism' is the trend which is seen among the consumers, worldwide. 'Going back to nature' will minimize the risks associated with synthetic preservatives and the market value of such products gets enhanced due to growing health conscious consumers. Frozen green tea extract at varied concentration were used for extending shelf life of frozen fish which proved to be a promising food safety approach. Extracts of leaves from the tea plant ***Camellia sinensis*** contain polyphenolic components, which can inhibit the growth of a wide range of Gram-positive and Gram-negative bacterial species with moderate potency. Bio preservation using natural compounds can extend the shelf life and enhance the safety and quality of fish. The present study was aimed to investigate the changes caused by the inclusion of green tea leaf extracts of varying concentrations (3%, 6%) in the icing medium employed during the chilled storage (2 ± 1^{0}C) of Japanese thread fin bream (Pink perch). Fish stored in Normal ice (NI) was treated as the control sample. Changes in microbiological parameters, biochemical characteristics and sensory quality outlines were monitored during the period of storage. Samples stored in normal ice (NI) gave only 8 days shelf life where as both 3% GTE stored samples and 6% GTE stored samples gave a shelf life of 16 days

PCA was performed on the mean values of 18 variables of microbiological, chemical and sensory parameters of the samples of Japanese threadfin bream. The first three principal components explained 93.02% of the variance in the data. The correlation loadings of the PCs showed high correlations of all the parameters studied. PCA plot has clearly separated the investigated samples according to storage time and treatments. In this study 6% frozen GTE exhibited more activity than 3% frozen GTE, but the results obtained were comparable. So from an economic point of view 3% frozen GTE can be adopted for preservation of fish.

The application of GTE in ice is a promising technique to increase the shelf life of *Nemipterus japonicus* in chilled condition and hence the technique has to be commercially exploited.

A shrimp virus, WSSV, changes the balance of host metabolism during infection to complete its replication

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Shrimp aquaculture is a global industry that suffers severe economic losses from a number of serious shrimp diseases. One of the most damaging diseases is WSD (white spot disease), which originally swept through the cultured shrimp industry with devastating effect in 1995. The shrimp industry continues to seek an effective strategy against this disease, which is caused by the shrimp virus WSSV (white spot syndrome virus), but because of the virus's uniqueness and complexity, WSSV pathogenesis is still far from being completely understood.

In our current research, we have used an approach based on human cancer systems biology to determine the global metabolic changes induced by WSSV at different stages of viral replication. In this talk, we review some studies about the metabolic changes in WSSV-infected shrimp, including aerobic glycolysis, lipid synthesis and glutaminolysis. Most interestingly, at the genome replication stage (12 hpi), WSSV induces a metabolic rerouting known as the invertebrate Warburg effect. This effect, which is also commonly found in cancer cells, acts to boost the availability of energy and biosynthetic building blocks in the host cell. WSSV has thus become the first invertebrate virus known to cause special metabolic rerouting in its host. This groundbreaking discovery in the overlapping fields of invertebrate metabolism and viral pathogenesis potentially provides a range of new ways that can be used to design and/or select for virus-resistant shrimp.

Monitoring of mercury, lead and cadmium contamination in imported fishery products for laying down control measures

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This study aims to evaluate heavy metal contaminations and provide recommendations for improving food safety control measures in imported fisheries products to ensure heavy metals contamination does not exceed safety standards under the authority of the Department of Fisheries. Accordingly, the study involved the identifying existing laws and regulations on related matters and the examination of mercury, lead and cadmium concentrations in fisheries products imported through the Fish Inspection Offices during January 2011 to May 2014.

The study identified that there were 2 acts of ***Parliament,*** 17 notifications and 2 cabinet resolutions relevant to heavy metal contamination control in imported fisheries products under the authority of the Department of Fisheries. Moreover, the Department of Fisheries had a heavy metal contamination monitoring program which had developed some of its own criterion on maximum concentration of heavy metals in fisheries products, especially for unregulated heavy metals in particular products. However, Department of Fisheries had reported to the Food and Drug Administration as the responsible agency when the permitted concentrations of permissible limits in imported fisheries products was found to have been exceeded. Based on the legislation, the study found that a total of 102, 2 and 87 cases from 3,940, 2,152 and 2,683 samples respectively had contained mercury, lead and cadmium concentration exceeding food safety standards. In addition to those samples, there were 7 seafood samples and 95 other food samples that had contained mercury concentrations exceeding standard levels under the Notification of Ministry of Public Health No. 98, B.E.2529 (1986). There were 2 samples where lead concentration had exceeded standard levels under the same Ministerial Notification. There were 52 cephalopod samples that had contained cadmium concentrations exceeding standard levels under the notification of the National Committee on Agricultural Commodity and Food Standards, subject:

Thai Agricultural Commodity and Food Standard in Cephalopods B.E. 2548 (2005). There were 2 gastropod samples that had contained cadmium concentrations exceeding standard levels under Codex Standard 2012 ,1995-193. There were 31 bivalve mollusc samples and a fish sample that had contained cadmium concentrations exceeding standard levels under determination of quality chemical analysis in raw fish materials and their processed products by Department of Fisheries. However, there was not any penalty provision for those who imported the fishery products contained cadmium concentrations exceeding standard levels.

Regarding authority, the Department of Fisheries has authority for food safety control of imported shrimp and tuna products via Cabinet Resolution of March 4, 2003. In this regard, the efficiency of facilities and manpower for heavy metal monitoring programs were identified as an important strength. Furthermore, the fishery staff are assigned to be authority officers under the acts for conducting the programs. However, adequate practical skills and knowledge base were ***necessary for improving officer performance***, especially perceiving the current situation of heavy metal contamination. Moreover, legal gaps such as the maximum contamination level on particular species should be clearly ***concerned as threat. Consequently, the relevant government sectors should improve upstream to downstream operations that are involved in reformation of the relevant laws and regulations and supporting monitoring programs.***

Histamine level and microbiological quality of dried fish products sold at retail markets in Iloilo, Philippines

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Dried fish products are important food item for consumption in the Philippines and the safety quality of these products is a major concern. Twenty-one dried fish products sold at major retail markets in Iloilo, Philippines were purchased and

tested to determine the occurrence of histamine and histamine-forming bacteria. The levels of pH, salt content, water content, water activity (Aw), total volatile basic nitrogen (TVBN), aerobic plate count (APC), Escherichia coli, Salmonella and Staphylococcus aureus in all samples ranged from 6.36 to 6.71, 2.55% to 15.84%, 21.12% to 49.99%, 0.67 to 0.87, 19.25 to 69.05 mg/100g, 3.0 to 7.39 log CFU/g, <3 to 28 MPN/g, absent in 25 g and 3.58 to 6.89 log CFU/g, respectively. Ten (47.6 %) dried fish samples had histamine levels greater than the United States Food and Drug Administration guideline of 5 mg/100g for scombroid fish and/or scombroid products, whereas seven (33.3 %) samples contained histamine levels greater than 20 mg/100g which is sufficient to cause the symptoms of scombroid poisoning according to the Centers for Disease Control and Prevention. Seven histamine-forming bacterial strains were isolated and identified biochemically and morphologically as belonging to genus Vibrio, Salmonella, Staphylococcus, Bacillus and Pseudomonas. The presence of these bacteria in dried fish is indicative of poor standards of process hygiene and sanitation as well as mishandling during storage.

Quality degradation of milkfish *(Chanos Chanos)* along the food value chain: An assessment in municipalities with high incidence of malnutrition in the province of Iloilo

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Food security is one of the most stressing global concerns. It categorically emphasizes that food security has to be supported by an environment of adequate sanitation, health services and care allowing for healthy and active life.

The paper quantifies degradation in quality and safety of milkfish along the different stages of food value chain. Milkfish was chosen as a commodity to be studied because the Province of Iloilo is one of the major producers and that per capita consumption of milkfish in Iloilo is high. Municipalities were chosen based on incidence of underweight, stunting and wasting among children.

Deterioration in quality and safety was quantified using the value chain framework. Milkfish samples were collected at each stage of the value chain. Changes in the level of quality and safety were analyzed at the laboratories of UPV-Institute of Fish Processing Technology and Bureau of Fisheries and Aquatic Resources. Samples were transported in Styrofoam boxes packed in ice following the recommended procedures. Quality Index Method was used to quantify quality degradation.

Results show that quality has significantly deteriorated at the retail level. Significant changes were observed in muscle stiffness, conditions of the belly and scales, eye clarity and shape, and gill color and smell. Noted also was variability within each node of the supply chain. No significant change was noted at the histamine level.

Important policy implications for future policies and industry practices are targeting of player-specific interventions, redefining role of public markets not just as local economic enterprises but as key agents in promoting food and nutrition security, and finally, enactment of existing food handling and sanitation laws and its proper monitoring.

Verification of ELISA kit for monitoring of leucomalachite green residues in farmed marine fish

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Chemical residue of aquaculture product is a concern to consumers, farmers and companies that produce process and prepare aquaculture products. There is always a potential for aquaculture products to be contaminated by chemical contaminants either from direct and indirect sources. One way to ensure safety products for consumers is to generate data on the contaminants that may enter aquaculture products during production and processing.

Leucomalachite green (LMG) is the main chemical found in aquatic animal treated with malachite green (MG) due to its longer retention time inside animal tissues. MG is a synthetic dye used to fabric coloring and has traditionally used to treat fungal infections on fish eggs. A health risk assessment determined that the potential carcinogenic properties of MG rendered it unsuitable for use on fish for consumption. An effective control of MG can be achieved by measuring tissue concentration of metabolite form; LMG. Analytical method reports for the detection of LMG have been used HPLC, LC-MS and LC-MS/MS with high cost for operation and time consume for sample preparation. Meanwhile, the rapid and high capacity screening method is required to support the frequent monitoring of the preventive action of the food safety management system. ELISA kit, coupled with minor modification of sample preparation was verified for using in the monitoring program of marine fish and shrimp farms.

ELISA testing was verified according to the sensitivity of 1 ppb for fish and adult shrimp meat and 2 ppb for shrimp larvae. The accuracy and precision of ELISA method are consistence with the criteria requirements of method. Therefore, ELISA is sufficient for LMG residues screening in marine fish and shrimp. The frequency of LMG can be increase in the food safety management program instead of confirmatory method; LC-MS/MS.

A feminist analysis of the voluntary small-scale fisheries guidelines

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Gender equity and equality is the fourth guiding principle of the Voluntary Guidelines for Securing Sustainable Small scale Fisheries (henceforth SSF Guidelines). This focus on gender is within the larger framework of a human rights based approach that forms the basis of the SSF Guidelines. Language on gender and gender equity is found in many different areas of the text including monitoring, policy, development, and protection against violence, although is not treated as a crosscutting issue and is missing from areas such as climate change and disasters. Throughout the guidelines there is acknowledgement of the roles of women in small-scale fisheries, and much of the language is gender inclusive (i.e. "Women and Men" and "fishers"). The SSF guidelines also emphasize the need for equal participation in the decision making for small-scale fisheries policies, and ask states to take measures to ensure the participation of women in fisheries organizations. While this languages encouraging, it is necessary to explore the possibilities and challenges of implementation of gender equality in small scale fisheries in different countries. The presentation seeks to highlight the potential barriers to implementation as the first step toward understanding how to manage them. For these reasons we suggest a gender transformative approach, which specifically focuses on illuminating several root causes of gender injustice and inequality. This would require engaging with power relationship, as well as capacity building for women and marginalized groups, which could include the creation of autonomous organizations where appropriate.

Caribbean views on gender equality: Fisherfolk consider the small-scale fisheries guidelines

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Fisherfolk in the seventeen Member States of the Caribbean Regional Fisheries Mechanism (CRFM) took great interest in the development of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (the SSF Guidelines). The Caribbean Network of Fisherfolk Organisations (CNFO) has actively encouraged Caribbean national fisheries authorities and the inter-governmental CRFM to incorporate the SSF Guidelines into policy. The regional CNFO has also been very active in promoting awareness of the SSF Guidelines among the leaders of national fisherfolk organisations. The Barbados National Union of Fisherfolk Organisations (BARNUFO), under female leadership, has organised events and undertaken projects to communicate the practical benefits of the SSF Guidelines to fisherfolk in Barbados. Many of the participants and spokespersons involved have been women whose livelihoods are in the postharvest sector, particularly in fish marketing and distribution. In a country where men have been said to be "in crisis" due to low educational attainment and high levels of unemployment, mainly among young men, perspectives on gender equality may run counter to expectations. This presentation shares the results of an investigation into Caribbean fisherfolk perspectives on gender equality with emphasis on the postharvest sector in Barbados, but including other countries and components of the fisheries value chain. Special attention is paid to how perspectives relate to the guidance on gender equality in the SSF Guidelines. This information is useful for designing a CNFO programme of action to implement the SSF Guidelines.

Understanding adaptive capacity and capacity to innovate in small-scale fisheries and agricultural systems; applying a gender lens

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Small-scale fisheries and agriculture provide foundations that support human well-being in communities within developing countries - but they are inherently changeable and unstable systems. The Food and Agriculture Organization (FAO) Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries emphasise the importance of developing strategies to build the adaptive capacities of communities dependent on small-scale fisheries to avoid negative implications of economic, environmental and social shocks. Simultaneously, these guidelines promote the mainstreaming of gender within small-scale fisheries development strategies in order to design gender-sensitive interventions that strengthen women's rights and opportunities within the sector. However, few attempts have been made to understand how people's capacities to adapt to changes in fisheries systems are differentiated by gender. Tackling this knowledge gap is imperative to aid the design of gender-sensitive development processes, promote equitable development opportunities and ensure sustained improvements to well-being for women, men, vulnerable and marginalised groups. The ultimate objective of our study is to recognize, protect and build capacities of people to respond to inevitable change (adaptation), and to drive change (innovation) in a manner that sustains and improves their well-being. We apply a gender lens over our analysis. We present a qualitative study that examines how social and gender differentiation shape capacities to adapt and innovate within three communities in Solomon Islands;

a developing country, where rural livelihoods and well-being are tightly tied to small-scale fisheries and agriculture. We look beyond economic, physical and environmental assets, and address how socio-institutional factors shape capacity to adapt and to innovate. We examine our findings through a framework that defines five dimensions; assets, flexibility, learning, social organisation, and agency, and find that within each dimension social and gender differentiation impact upon people's capacities to adapt and innovate. Our findings offer insights for development interventions that focus on building these capacities to realise improvements to well-being within dynamic and diverse small-scale fisheries and agricultural systems.

Applying a gender lens to the interactive governance framework for small-scale fisheries: Kiribati as a case study

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Since mid-2014, a number of communities in Kiribati have been moving towards establishing co-management arrangements for their small-scale subsistence fisheries. The emergence of this new mode of governance has governability implications for the fisheries and the resource users who depend on its contributions to food security, livelihoods and well-being.

The interactive governance framework on small-scale fisheries emphasises the need to contextualise the systems-to-be-governed (both natural and social), the governing system and the governing interactions to assess the governability of a particular small-scale fisheries system. In the emerging co-governing mode of small-scale subsistence fisheries in Kiribati, managers are striving towards ensuring broad participation of resource user groups and equitable sharing of costs, benefits, rights and responsibilities. Co-governance approaches should in theory pay particular attention to promoting women's participation at all stages of a program to reduce gender inequality. However, in practice the new co-governance

approaches are finding it challenging to effectively address "gender equality and equity" in the face of cultural norms, traditional governance structures and the gender-blindness of fisheries authorities.

This project seeks to understand these gender related sensitivities to better contextualize the systems-to-be-governed and improve the chances of this co-governance approach's success. Based on empirical data collected from communities on two islands in Kiribati, we evaluated how the existing gender norms as perceived by men and women influence the engagement and participation of different resource user groups. By applying a gender lens, we believe these findings provide deeper insights into the interactive governance framework for small-scale fisheries.

Gender-sensitive small-scale fishery management and the VG-SSF guidelines in Thailand

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Small-scale fishers account for 80% of the total population of fishers in Thailand and half of them are women. Women small-scale fishers are primarily involved in pre- and post-harvest fishery activities, their presence in and contribution to national fisheries is almost entirely overlooked by national statistics. This lack is representing a big problem because these statistics are used by the government to inform the design of national policies, measures and programs. If women small-scale fishers are not accounted their needs and concerns will not be addressed at the grassroots level.

The VG-SSF represents an important tool for Sustainable Development Foundation (NGO - SDF) in working to promote and support the fundamental rights of marginalized small-scale fishers in Thailand. The fact that the guidelines enshrine gender equity and gender sensitive approaches have allowed non-governmental organizations and civil society organizations to work to promote and support the active involvement of women small-scale fishers in both national policy development and concrete local initiatives.

SDF, together with the Thailand Federation of Small-scale Fisher-folk Association, was able to use the VG-SSF guidelines as the foundation for conducting a national consultation forum together with the Department of Fisheries and representatives of provincial-level small-scale fishery communities from all over the country. The guidelines provided a concrete and internationally recognized framework for discussing the rights and entitlements of small-scale fishers, and as part of the consultation forum the specific needs and concerns of women small-scale fishers were also debated – a discussion that had never formally taken place before at the national level in Thailand. This national consultation forum led to the drafting of a national implementation plan for securing sustainable small-scale fisheries in Thailand, something which non-governmental organizations, civil society organizations and small-scale fisher communities will need to work hard to follow up on in the coming months. This paper will present the main lessons coming out of this implementation process.

Gender policies of fisheries and fishing communities in Japan

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In the present day, women's issues are attracting greater attention in Japan. A new bill to promote women's participation was enacted in August 2015, and the fourth Basic Plan for Gender Equality was drawn up in December 2015. This bill and the Basic Plan represent an attempt to promote the hiring and appointment of women and to increase human resources to grow into leadership positions in order to expand women's participation in every arena. Looking at the ratio of female participation gives one indication for understanding actual conditions; however, increasing the ratio of women simply for the sake of number-crunching is problematic. One such indication in the fisheries and fishing communities in Japan is the ratio of women who are regular members or board members of the Fishery Cooperative Association (FCA). The FCA principally decides on policymaking about

local fisheries and fishing communities. Only regular members or board members can participate in the decision-making process of the FCA. However, the ratio of female regular members of the FCA is 5.4%, while the ratio of female board members is 0.5%. These are extremely low values. In addition, the Ministry of Agriculture, Forestry and Fisheries of Japan provides support for women's entrepreneurship. The majority of women's entrepreneurship is involved in making and selling processed goods using local agricultural, forestry and fishery products. However, even if women do start up their own businesses, women's entrepreneurship alone cannot resolve the gender problems in fisheries and fishing communities.

Based on the above, I will discuss in this presentation what is required for the gender policies of fisheries and fishing communities in Japan through the case of Yamaguchi Prefecture, which has strongly supported women in fisheries in Japan.

Women access and benefits of involving aquaculture end market chain: Analysis from empowerment approaches

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Fisheries are the second subsector of Agriculture in Bangladesh on which about 1.25 million people (over 11%) depends for their livelihood (DOF, 2013). As per the FAO study, in Bangladesh, women represent 20% of all fishers and fish farmers (FAO 2012). The study identified the levels of women famers' participation in fisheries market chain, challenges and benefits from it in a coastal district in Bangladesh. It conducted Key informant interviews, Focus Group Discussion (FGD) and some success case study with the lead farmers, women framer groups and some successful women fishers etc. that women-owned rural businesses tend to face many more constraints and receive far fewer services and support than those owned by men. Fish production on an average 10-20% has been increased (4500 kg/ha/year). In addition, women involvement and employment in fish farming also increase their workloads (Men 7 hours; women: 15 hours – field survey) at all

levels. In the project areas, there was a significant degree of women's participation in aquaculture; although they were located at the lower end of the market chain, such as fry collection and fish processing in the factories (peeling, de-heading and cleaning). Women employment is characterised by highly gender blind and informal employment relations, where women make up the bulk of the casual and contingent labour supplied throughout the chain. Women involvement in selling and marketing of the products is very limited and as such they have little access and control over earned money. The analysis from Empowerment Approach takes into consideration gender, to recognize and acknowledge men and women's need based support would be offered to make them competitive and enable them to obtain better returns from the farm production and market chain.

Between women space in the fish port complex and the value chain nodes of the fishing industry in general Santos City, Philippines: An ethnographic study

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This study seeks to ethnographically map and describe the spaces of women in the Fish Port Tambler Complex of General Santos City, and investigate the points of convergence with and divergence from the value-chain nodes of the tuna fishing industry. Guided by the rudiments of ethnography, this study shall privilege the local and contextual meanings that women attach to the physical and social spaces in the Fish Port Complex, and their perspectives on the relation of such spaces to the value-chain nodes of the tuna fishing industry. The standpoint of Henri Lefebvre (1991) on social spaces shall also serve as the theoretical lens of this research. With this perspective, the fish port – through the narratives of women, shall be interpreted as a perceived, conceived and lived space. As lived space, the values and symbolisms that women attach to the market shall be the key interests; as perceived space, the relations and processes – including the tensions and

contradictions, that women find themselves in shall be explored; and as conceived space, the boundaries, rules and functions that are assigned to spaces that women follow, or negotiate with as they subsist in the spaces of the market shall be characterized in detail.

Gender and poverty dimensions in a value chain analysis of milkfish in Region 10, Philippines

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This paper presents gender issues in a value chain analysis of milkfish that is mainly harvested from a mariculture park in Region 10, Philippines and distributed solely within the region. It also gives powerful insights on why both poverty and capital accumulation simultaneously occur among key players in the chain. Findings were obtained through a triangulation of primary and secondary data sources. Mapping the chain involved primary data gathering through actual observation, surveys, informal and key informant interviews, and focus group discussions. The milkfish industry assessment largely emanated from secondary data sources.

The big, medium and marginal fish cage operators – mainly men – are the upstream players in the chain. Along the chain are men and women milkfish brokers/traders, wholesalers, and retailers. Processing along the value chain was practically non-existent; milkfish was generally sold fresh, except for the negligible value-adding done by a women's cooperative. Food products, however, face stringent certification requirements, rendering precarious the women's access to the lucrative processed foods market. Brokers/traders were found to earn the ***highest aggregate net income*** in the chain, and only ***within two days*** of trading, while marginal fish cage operators earned the least and only ***after four months*** of production**.**

The difficulty in sourcing fingerlings and the increasing cost of feeds were major constraints of fish cage operators, affecting more the marginal ones. Meanwhile, opportunities and upgrading solutions such as production of their own fingerlings and feeds, and the various ways of milkfish processing to add value and to allow exportation, favor the larger players.

Such scenarios in the chain and the increasing number of big and medium players in the mariculture park – which earlier was the fishing ground of small fishers – calls for an evaluation to determine if inclusive growth and development are being achieved along the chain and in its setting.

A gendered value chain analysis of post-harvest losses in the Barotse Floodplain, Zambia

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The small-scale fisheries sector is of vital economic importance for many African nations. It provides millions of people with livelihood opportunities from fishing through to post-harvest processing and trading whilst also providing fish for consumption. Almost a third of the fish catch is thought to experience significant losses in quality as it transitions from net to plate creating economic losses for fishers, processors and traders, and nutrient losses for consumers. Women and men who take part in fishing and post-harvest activities face these losses due to a variety of technical, economic and larger structural and social issues. The literature on post-harvest losses tends to privilege the technical and economic aspects that drive losses within low-income countries. This paper pays particular attention to the social and gender attitudes, practices and power relations that shape and possibly play a role in driving post-harvest losses in the Barotse Floodplain fishery

value chain in western Zambia. Quantitative data were collected using multiple survey instruments in 2015 on post-harvest losses, gross margins, and empowerment (e.g., decision making) at various nodes in the value chain. Preliminary results show that women face the bulk of the weight of losses whilst also experiencing significant economic losses as a result. Women endure extra time and labor burdens; restricted access to key assets and different decision-making powers all of which function within a context where unequal societal norms are prevalent. This paper argues that such attitudes, practices and gendered power relations can cause high post-harvest losses especially in roles where women are traditionally expected to perform in a fisheries value chain. The paper details a current project that aims to help both address the technical issues and challenge the perverse norms and power relations that create post-harvest fish losses for women.

Lake Chapala's fish value chain dependence on female labor

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Lake Chapala, the largest lake in Mexico, has riparian communities historically dedicated to fishing, and some of them started to process fish caught from the lake since the 1980's. Filleting is a well-known activity to add value to fish, the same link of the value chain where women participate the most.

This research study is divided into phases. The explorative part where the aim is to find out the importance of women's work in Lake Chapala's fishing activity considering the second most important processing village, Petatán. The next phase will include Jamay, the first largest fish processing community, and will consider the impact of women's fileting work in the household, its impact on women's health and in which senses can this activity be empowering women in both communities.

Hence, the explorative phase of this work, based on fieldwork carried out in 2015,

intends to find out the importance of women processing activities in Petatán. Petatán is one of the riparian communities in Lake Chapala and as a response to the economic crises that affected the country during the 1980's developed this processing industry in which the women in the community immediately adopted the activity.

In this phase of the study results show that filleting was a way to add value to fish as a response to the economic crises, and at the same time an opportunity for women to enter the labor market and generate an essential income for family wellbeing, especially when fish-catch is low, creating an empowerment opportunity for the female population. Moreover, filleting satisfies multiple purposes in the value chain: it is essential to sell the fish to middlemen and to create a place for this fish in the market, and it is a way to hide the size of the fish and avoid sanctions for IUU fishing.

The role and women in Maldives pole-and-line tuna fisheries

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It is argued that in an occupation as gender biased as fishing, in order for fisheries management and policy to be successful, a profile of what really matters to people – both men and women - is important. This presentation introduces a new programme of research with both the International Pole and Line Foundation (IPNLF) and the Government of the Maldives, that seeks to understand the contribution of women to the tuna supply chain and the impact the tuna fishing industry has on women within Maldivian fishing communities.

The presentation will introduce two aspects of this work: research conducted to map the roles women are playing in tuna supply chains in the Maldives; and work to develop and test indicators that can represent the gender dimension of these fisheries in a broader programme of social and economic monitoring of tuna fisheries in the Maldives. The indicators will be grouped into categories relating to: resource use and dependency; ecosystem benefits and wellbeing; and drivers of change.

The presentation highlights how understanding the role of women in this complex fishery will help understand how resource management measures may impact wellbeing, access to assets and capabilities of women; provide unprecedented insight into women-oriented components of the tuna social-ecological system; and demonstrate the feasibility of integrating gender into broader social and economic monitoring programmes.

Identifying gender inequalities and possibilities for change in shrimp value chains in Indonesia and Vietnam

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The Oxfam programme "***Gender Transformative & Responsible Business Investment in South East Asia***" (GRAISEA) works with the support of the government of Sweden on the promotion of corporate social responsibility in South-East Asia with ASEAN and its member states and with leading agribusiness companies. Among others it does this by demonstrating gender transformative and responsible agribusiness investments models for smallholders in two selected value chains: palm oil and shrimp aquaculture.

In aquaculture improvement schemes, especially those planning to certify towards the Aquacultural Stewardship Council (ASC) standard, Participatory Social Impact Assessments (PSIAs) are applied to analyse, monitor and contribute to manage social consequences of fish farming. Theapplication of PSIA in smallholder aquaculture is however still in its starting phases and according to Oxfam gender equality issues are not yet systematically addressed in standing PSIA guidelines. In the past year as part of GRAISEA Oxfam and partners piloted the application of PSIA in smallholder led shrimp aquaculture using two gender analysis and action planning approaches and in two different locations: Tarakan, North Kalimantan in Indonesia and in the Mekong delta in Vietnam.

In Indonesia the ASC guidelines for PSIA were "engendered" both in terms of process (which groups to talk to, how, and when) and in terms of contents (what

gender specific questions to ask, how to discover gender specific social impacts, how to come to gender specific action planning). In Vietnam the PSIA analysis was combined with the use of the Gender Action Learning System (GALS). GALS approach aims toa.developing gender action learning skills of vulnerable stakeholder groups in the value chain to identify and implement sustainable strategies for economic empowerment; and b.engaging skills,energies and resources of the private sector and institutional stakeholders in the value chain to change power and gender relations.

The paper will describe the key characteristics of both approaches used, the challenges experienced and lessons learned, initial results of the assessments and a discussion on how to improve gender specific analysis and action planning in PSIAs.

Women initiative in introducing the brand name Siamese fighting fish via social media in Thailand

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Over the last three decades society at large has been integrated into the digital world. This continues to expand as the newer devices of information technology and interpersonal and inter-organizational communication are introduced and with new users keep adding. An online business is no more alien in the country.

This state of affairs can effectively contribute towards the women empowerment especially those operating small business in a household premises.

The aquaculture of Siamese fighting fish is a popular business in almost all parts of Thailand. It can be dubbed as business-cum-hobby. Small scale production is a household phenomenon. Thus an urban-rural divide in this case is practically irrelevant. This situation can be particularly advantageous for women in a rural household to earn a business online with the only alternative to physical travelling.

The Department of Fisheries is taking steps to pursue the government objective of involving the women as part of the program to having active participation in the betta business.

The change of masculinities pattern under amended law: Case studies from Samut Sakorn

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On April 28th 2015, Thai military government has passed a new law relating to fishing in order to eradicate trafficking on account of EU and USA's caution against on-board labour trafficking and exploitation by the fishing industry. The tightened law enforcement has however disrupted fishermen's livelihood because they haven't been able to comply to all the mandated requirements as per the amended law.

Regarding to the previous studies, patterns of masculinity in fishery can be impacted by amendment of legal bodies or policies which tighten implementation of rule concerning safety and requirement of license for fishing so as to conserve fish. Under these conditions, men who cannot conform the same practice as prior to such amendment as their previous generation need to construct new patterns of masculinity which differs from their previous generation.

In this study, I will use relevant literature concerning the concept of masculinity to draw the framework employed for analysis and will utilize preliminary data gathered from visiting the impacted fishermen in order to illustrate the impact of the new Thai new law on the pattern of masculinity of fishermen living in Samut Sakorn.

Is migration a route out of poverty for women in fishing communities?

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Fishing communities are one of the poorest groups of people in many Asian countries. We explore how poor women and men in fishing communities strategise their livelihood when fishing resources get depleted and they are not able to earn enough from fishing resources. Based on a literature review and preliminary research in Cambodia, the paper discusses potential route out of poverty for women and men in fishing communities. Some households might decide to let some of their family members to migrate. Some might decide to work together and form groups. It is assumed that such livelihood decisions are influenced and shaped by various factors, and the decisions are made differently by people of different sex, age and class. The paper attempts to map out the various options for fishing women and men, and the different factors that influence their decision and possibly the potential implication of such decisions.

First study on gender issue(s) in fisheries and aquaculture in Lao PDR

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The government of Lao is committed to promote and advance of gender equity policy through the socio-economic development strategy and five year national economic development plan. Both women and men are involved in fishing activities. Women are especially engaged in the management of fish ponds and fish culture in the rice fields. They further play a key role in processing and marketing fish.

The first ever study on gender in fisheries and aquaculture in Pakse and Phothong districts focused on the issue of the gender issue in organisation and the second part on gender issues at household level.

The results from the review of secondary data and focus group discussion shows that women and children are involved in fisheries and aquaculture activities mainly in the fish processing and selling activities. Recently, the Advance Women Sector has been trying to promote gender equality and equity at the organization by reserving some of the higher positions in the organization. Although, it has been recognized that the roles of both man and women are important in fisheries and aquaculture development, there is however no evidence to prove that the gender promotion in fisheries and aquaculture sectors in Lao PDR has been achieved. The limited budget to implement the gender plan and lack of gender disaggregate data for planning is one reason. The staff who work on gender at provincial level are still lacking in knowledge and skill and have limited access to new information and technology.

Women and men's division of labour and time use in Vietnam: A comparison of rice and rice-shrimp in Soc Trang province

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Small family farms in Asia are the backbone of rural society, they often have limited resources and rely heavily on family labour. The recognition of different labour inputsis an important precondition to access resources and inputs needed for farming. The full extent of women's labour contribution to livelihoods and food security is often under reported and less visible because it tends to be relegated to unpaid subsistence farming. Moreover, women are burdened with responsibilities that range from household and family care to productive and community roles.

The objective of this study is to make women's contribution visible and assess

whether they have access to technologies and services they need to perform their work.

Relying on primary data collection, the study explores the different labour inputs and return to labourof smallholder women and men in the livelihood systems dominated by rice and rice shrimp farming in southern Vietnam. It therefore also assesses labour contributions to important complementary productive activities such as vegetables and livestock. The study reports on differences in work burden and access to technologies and services and elaborates key findings and recommendations from a gender perspective.

Engendering statistics for fisheries and aquaculture

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The role of women in fisheries and aquaculture is often not well represented in formal statistics. Their work is often invisible, under-valued and, resultantly, not well enumerated. The poor accounting of women's engagement in the fisheries and aquaculturesectors has direct and detrimental impacts on the development of inclusive and evidence-based policy as strong data forms the foundation of strong policies.

Through the lens of the fisheriesstatistics of the Food and Agriculture Organization (FAO), the current state of gender disaggregated fisheries sector statistics will be discussed along with ongoing projects to improve the quality of statistics. This year, for the first time the FAO reporting of employment for the sector will include a gender disaggregated data set. It is estimated that, overall, in 2014 women accounted for more than 19 percent of all people directly engaged in the primary sector of fisheries and aquaculture. However, when the broader industry is considered this figure swells to one in every two workers. Improved statistical reporting that builds on the findings of projects is critical as enhanced gender disaggregated statistics for both industrial and small scale operators, together

with data on the secondary sector, would greatly improve the understanding of importance of women's contribution to fisheries and aquaculture, food security and livelihoods.

In the recently published document, Guideline to Enhance Small Scale Fisheries and Aquaculture Statistics, methodology for the collection of data and information on various aspects of the fisheries and aquaculture sector, especially concerning small-scale operators and the contributions of women to the sector, are presented and provide one means of improving available statistics

Gender and emotions in the management of climate-related risks in inland aquaculture

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Many studies have documented that farmers are risk averse but did not consider gender. In any case, conventional measures of risk aversion and appraisal do not fully explain decision behavior of women or men, suggesting it may be necessary to also consider emotions. This study drew on a combination of in-depth interviews, direct observations, a role-playing game, and quantitative surveys to assess how gender and emotions influence the management of climate-related risks. At the farm level, women give greater importance than men to monitoring, reducing costs, preparing equipment, and diversifying income sources as climate risk management strategies. At the river level, women give greater importance than men to operation of water infrastructure and watershed management, but did not attach more importance to participation in water governance where they have little influence. Differences in climate-related risk management practices could not be explained by attitudes towards risk: women and men showed similar levels of risk aversion on two standard scales. Some additional insights, however, were gained from considering emotional responses to risk and decisions. Women and men expressed similar emotions when discussing fish farming risks, except for pride and frustration which men expressed significantly more frequently. Feeling

worried, concerned, anxious or stressed, were the most common negative emotions referred to in interviews. Fear was a reason for not-taking risks. Anxiety in the period prior to harvest helps motivate risk management practices, such as close monitoring and aeration. Men who expressed pride performed better in the role-playing simulation game than those who had not, but for women there was no difference. Men who expressed feeling excited or thrilled chose riskier options than women. In conclusion, gender differences and emotions both influence risk-taking and decision-making and thus are a significant factor in how climate-related risks are managed.

Assessing the impact of environmental changes on the livelihoods of coastal women with socio-economic and gender analysis (SEAGA)

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The people in coastal villages, particularly the women, face challenges due to climate and environmental changes. From traditional occupations, coastal women have now turned towards adopting new livelihood practices. They play an important but under recognized role by taking part in capture and culture fisheries. Disaster mortality rates are also higher in women and children than in men, as a result of socially constructed gender roles and unawareness among women. These gendered impacts need to be considered by researchers and developmental agencies. So far, detailed gender and livelihood analyses have never been attempted in assessing the impact of environmental changes on the livelihoods of coastal people. For this study 200 women and men including tribal groups from 4 coastal districts of Tamil Nadu, South India, were selected. Participatory Rural Appraisal (PRA) tool and SEAGA analysis were carried out. The SEAGA tool kits included (i) the development context, (ii) livelihood analysis and (iii) stakeholders priorities for development. The environmental impacts are the invasion of sea water into the coastal villages, loss of livelihoods and possessions due to tsunami, shrinking of freshwater ponds

and wells, and drinking water problems. The social consequences include stress and drudgery among women and migration of men to the cities, the challenges faced by beneficiaries and researchers, majority of the households were led by women; women's Self Help Groups (WSHG) facilitated the adoption of technologies; men dominated off-shore activities, women dominated on-shore activities. Few men supported women in the household activities such as taking care of children, etc., and encouraged women in forming WSHGs. Alternative livelihoods helped women to augment family income. The findings will help the developmental agencies to integrate socio-economic and gender issues in negotiations, policy actions and initiatives to be taken by the governments and coastal communities to maintain and build adaptive measures towards the effects of environmental changes.

Coastal women's agency in the aftermath of Haiyan

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In November 2013 super typhoon Haiyan wreaked havoc on the coastal communities of Northern Iloilo and other areas of the Visayas group of islands in the Philippines. Tremendous losses in livelihood and property were recorded in the wake of the calamity, along with profound feelings of helplessness and despair among survivors. As various international, national and local institutions responded through immediate and strategic interventions, very few focused on the differential impact of disasters among women and men. Such is the case in the island-barangay of Bayas, Estancia in Northern Iloilo; thus affirming established scholarly work on the gendered nature of disasters. Utilizing feminist standpoint theory, the focus of this paper was to cull out women's situated knowledges by highlighting the coastal community women's experiences of disaster and corresponding resiliency. Using the post-Haiyan experiences of women in Bayas as case study, the paper also chronicles and highlights the rather rare opportunity that post-disaster contexts provide for coastal women's agency and empowerment.

Qualitative data for the study were gathered through a series of gender sensitivity orientations cum focus group discussions, as well as through key informant interviews with community members and leaders. Results indicated that cultural discriminations against coastal community women impede on their access and utilization of institutional relief efforts. The coastal women of Bayas were not engaged in offshore fishing and did not directly benefit from the various boat replacement assistance extended to fishing families. Thus the coastal women organize themselves and lobbied in order to address security and sustainability concerns, as well as strategic gender interests. Such opportunity in adversity needs to be harnessed by existing social networks and leadership, lest it be undermined by cultural practices that continue to marginalize and disempower women in coastal areas.

Gender integration strategies of the oceans and fisheries partnership in Asia-Pacific region

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Fisheries is a gendered activity, with men and women involved in various roles along the fisheries value chain. Initiatives introduced or implemented in fisheries should be considerate of the various gender nuances, i.e. differences and needs, for inclusivity and equity. Women in fisheries face more challengesand are at a disadvantage compared to men, i.e. in access to credit, capacity building, safety, and opportunities for better compensation and market information. The Oceans and Fisheries Partnership Activity (Oceans), a collaborative project with USAID, Southeast Asian Fisheries Development Center (SEAFDEC) and Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF), recognizes the need for a gender integrated approach in its activities. Oceans aims to increase the ability of regional fisheries organizations to conserve marine biodiversity by combatting illegal, unreported and unregulated (IUU) fishing in Asia-Pacific, through the development of a catch documentation and traceability (CDT) system, based on an ecosystems approach to fisheries management (EAFM). Other key interventions

include capacity-building, public-private partnerships, and addressing relevant human welfare issues. Key human welfare goals, including gender and labor, will be considered in the development of the CDT and EAFM implementation. Women actors will be consulted ontheir motivations ordesired incentives to encourage them to be involved or engaged in sustainable fisheries management, and implementation of the CDT. A gender analysis will determine existing gender in fisheries initiatives, and, through participatory approaches, will identify strategic areas of intervention. These gender-specific interventions will be in the areas of women's economic and social empowerment, capacity building and strengthening constituencies to achieve Oceans objectives.

Oceans aims to consider gender in laws, policies and strategies arising from the project, and efforts will be taken to consider gender and women's role and participation in the fisheries value chain in the development of technological procedures and tools.

Gender role and relationship in wetland resource management

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Wetlands are integral part of our environment and intimately associated with human society. Even then, there is an increasing concern particularly on conservation of wetlands as habitats for wetland biodiversity. India is rich in natural and manmade freshwater wetlands. Amongst these ecological types, freshwater wetlands such as ponds, pools, chhappar, jalgahanetc are distributed widely all over India. And amongst these freshwater wetlands womenfolk are especially concerned with smaller water bodies, shallow marshes and lowland depressions like ***jheels***, paddy fields, ***jalgah, chaur, kol, dhab, maon***, canal and roadside ***nullah*** which offer suitable sites for fishing small indigenous fishes and collecting edible freshwater snails/ mussels. It has been seen that rural women in village areas in India are more related with the use,care and conservation of wetland resources than men. Rural women

regularly depend on these wetlands for collecting edible plant food materials for domestic consumption as well as ethnomedicinal plants for cure of various ailments. The collection of aquatic resources, viz; weed fishes, crustaceans, mollusks, water hyacinth, and commercially important edible plant species naturally grown in Indian wetlands are enlisted. It has further been noticed that the role of rural womenfolk in fishing and collecting aquatic resources are intimate, deep rooted and deeply dependent. The relationships of rural womenfolk with wetlands are highlighted in this communication along with necessity for generation to protect the wetlands from natural shrinkage, growing reclamation and toxic hazards.

Roxas City experience in sustainable livelihood for women in coastal areas to support resource rehabilitation for fisheries and aquaculture security

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Roxas City's coastal resources have been under stress with the proliferation of illegal structures, indiscriminate garbage disposal, cutting of mangroves and illegal fishing. The implementation of the City's Fishery/CRM ordinance to sustain local fisheries displaced fisher folks who demanded an alternative livelihood. Women are most affected as they carry the burden of meeting family needs. The local government was faced with the challenge of coming up with an alternative livelihood sufficient enough to replace fishers' former income from fishing. Introducing alternative livelihoods not only decreases fishing pressure but also augments family income where women can take significant roles.

Community organization process is a necessary groundwork for sustainability. Community-based ecotourismworked as a strategy to sustain resource rehabilitation efforts, and provided good income from the diversified products developed. Ecotourism, with climate change mitigation as a selling point,enabled schools to participate in environmental efforts, and companies to express their CSR, resulting in continuous visitors at the ecosites.

Fisherfolk Associations were organized in affected areas, forming a partnership with the local government. They were also given the privilege to operate ecotourism in their areas. Ecotourism evolved into diverse business ventures, generating employment for women in coastal areas. An income of over P15M was generated from more than 90,000 visitor arrivals. They participated in mangrove planting and coastal clean-up. Fish and shellfishes were revived and catches increased. When Typhoon Yolanda struck Roxas City in 2013, these organizations rebuilt their structures from their own savings, without any investment from the city government.

Empowerment and proper guidance from sponsoring organizations enabled the fisher folks especially women to operate their ecotourism business sustainably. Their involvement from visioning,strategic action planning, until implementation showed their stake in the resources being managed. Transparency and commitment of the local government will earn trust from the people, thereby facilitating cooperation.

Gender, resource use, and coastal management: The case of sea cucumber ranching in Pandaraonan, Guimaras, Philippines

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Resource management initiatives are ideally gender-blind, however, there remains a big gap between theory and practice. This study focuses on the gender dimension of the sea ranching project of sandfish (***Holuthuria scabra***) in Barangay Pandaraonan in Guimaras province, central Philippines, being started by the SEAFDEC/Aquaculture Department through assistance from the Australian Center for International Agricultural Research (ACIAR). The project aims to enhance and sustain local sandfish population and promote sea ranching as an alternative or supplementary income source.

A survey among sixty (60) households, focus group discussions, key informant

interviews and resource mapping workshops were conducted to understand and analyse fishing activities, resource use practices and coastal management schemes acceptable to the community in support of the on-going project. Results show that although both men and women have access to the coastal and marine resources, majority of the men (98%) maintained control and ownership of gears and boats while women were limited to gleaning at the intertidal zone. Income disparity was apparent with men earning more ($p < 0.001$), indicating that women's activities were intended to obtain food for consumption or as subsidiary to their husbands' earnings. Only 22% of the households collected sea cucumber, mostly ***Holuthuriascabra***, yet, majority (70%) believed that collection should be regulated through size (58%), gear (45%), and time (40%) restrictions. Majority (58%) was interested to participate but records show that women dominated the attendance (58%) during meetings and consultations. Women serve as income earners and household representatives to various activities in the community – roles that should not be overlooked in project planning, monitoring and evaluation.

Fisher women's contribution for hilsa fishery management in Bangladesh

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Hilsa (***Tenualosailisha***), is an anadromous fish, called 'Ilish' in Bengali and commonly known as 'Indian shad', that is honoured as the national fish of Bangladesh. Approximately 0.45 million fishers directly depend on Hilsa fishing for their livelihood, another 2.5 million people are indirectly dependent on the Hilsa fisheries value chain. Women's participation in Hilsa fisheries value chain in Bangladesh is largely invisible. They are assumed either not to fish in the coastal waters, or not to participate directly in the fishing as this is considered mostly men's work. However, women can play an important role in Hilsa fisheries value chain and thus, can contribute to the decision making in sustainable fisheries management.

In an effort to improve resilience of the Meghna River system and the communities reliant on Hilsa fishery, a USAID funded "Enhanced Coastal Fisheries in Bangladesh (ECOFISH^{BD})" initiative has been jointly implemented by WorldFish and Department of Fisheries (DoF), Bangladesh. Gender equity and women empowerment have been considered as important inbuilt component in the ECOFISH^{BD}project. It is believed that women's involvement and leadership can have a positive role on natural resource management, and on reducing gender-discriminatory norms and practices that negatively affect their lives and livelihoods. At the community level both women and men should be included in decision making that matters to their improved livelihoods as well as establishing fisheries co-management through engagement of fishers and different stakeholders. To increase resilience and social cohesion, ECOFISH^{BD} addresses gender mainstreaming in all its activities. The project targets 100,000 fishers family members (around 50% women), who will be benefitted directly from the project. Also, 200 Fishers' WomenCommunity Savings Groups (CSG) will be formed over the five years in different villages scattered throughout six Hilsa fish sanctuaries. CSG consist of active participation of women to ensure gender equitable systems and structures, higher participation and leadership of women in community-led initiatives as well as women's economic empowerment. Fishers' women has been provided with different on-farm and non-farm alternative income generating activities (AIGAs) to support the households during the fishing ban period and thus to influence the compliance of the management plan of the Government of Bangladesh.

Assessment of the contributions of women to sustainable coastal fisheries in Ogun Waterside Local Government, Ogun State, Nigeria

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Due to the nature of fisheries, men are often considered as the main actors. However because of the women's quest to find livelihood to reduce poverty, they

now play a substantial role in fisheries. This paper attempts to assess the contributions and the efforts women are playing to serve as agent of sustainability in fisheries in the coastal artisanal fishery sector in Ogun State Waterside Local Government, Ogun state, Nigeria. The specific objective was to describe the socio economic characteristics of the women in the study area, examine the role of women in fishing sector and identify problems facing the women.A well-structured interview guide was used to collect primary data from 74 respondents in four fishing communities (Iwopin, Oni, Makun – Omi and Agbalegio). The information collected was analyzed using descriptive method. The study revealed significant contributions of women as fishers, fish processors and fish traders. However, women in coastal fisheries are confronted with problems such as inadequate capital and poor means of transportation. This study therefore recommends capacity building for women and adequate infrastructure such as good roads and electricity in the rural fishing villages. Adequate credit facilities should be provided for the women for the expansion of their fishing business. Fishing inputs such as outboard engine, net and marketing facilities at a subsidisedrate should also be provided.

Participation, roles, and willingness to be involved in mariculture among men and women inmariculture areas

in the Philippines

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Mariculture was envisioned to contribute to poverty reduction by increasing employment opportunities and income in the area where it is situated. This paper assessed the participation of local men and women in seven mariculture sites in

the country, the roles they perform, and their willingness-to-be-involved in mariculture operation. The data used were collected through a household survey, focus group discussion and key informant interviews conducted in January to August 2015. Results show that only 23 % of the 785 households had members with any participation in mariculture since they were established in the area. By site, household participation ranged between 4% and 44%. This was translated to only 228 individuals in all sites. Although men dominated mariculture, the women had demonstrated that they can equally contribute to mariculture as an operator, caretaker or feeder. The willingness to be involved in mariculture was high in the study areas, particularly among the men from fishing households. Specifically, the willingness to become a mariculture operator was higher among women than men. Engaging women to become mariculture operators can be one of the areas to be explored to increase the participation of the local residents toward achieving the employment and poverty goals set for mariculture.

Women's empowerment in aquaculture: Case studies from Bangladesh

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Women are involved in and play important roles at different levels in the aquaculture value chain in Bangladesh. However, empirically-based understanding regarding the degree to which aquaculture contributes to women's social and economic empowerment in this context is lacking. This knowledge is critical to inform aquaculture-related policy and development interventions and investments at various scales. In response to this need, in order to understand the gendered roles diverse women play in the sector, and the degree to which these roles contribute to empowerment a small study was undertaken through a partnership between the FAO and WorldFish. The study focused on two areas along the value chain: homestead aquaculture (Kutakhali village in Khulna District) and factory-based shrimp processing (in shrimp factories in Khulna city). This study sheds light onthe enabling and constraining factors shaping both women's engagement and success in aquaculture, as well as analyzing the associated social and economic

empowerment.This includes analysis of underlying social and gender norms and power relations that inform everyday gendered practices and outcomes. The method of collecting data for the two case studies involved focus group discussions, key informant interviews and transect walks.

The study found that rural-urban, Hindu-Muslim and production-processing contrasts provideintersectional insightsregardingthe factors enabling and constraining women from different backgrounds. The study found direct income from aquaculture to be a key factor in increasing the respectaccorded to women, as well as their economic freedom. It also elucidated several pre-conditions for women to be able to successfully uptake aquaculture work and receive this direct income, and found that these pre-conditions are defined by the gender norms and traditions that guide the extent of acceptability of various roles for women. Fear of repercussions and injuries to ideals of femininity and masculinity were identified as contributing togender role conformity; in contrast, the drive to fulfil basic necessitieswere found to stretch boundaries. The study also suggested that once these basic needs were fulfilled, higher order needs of self-esteem, security and reputation re-constrained gender roles, and associated benefits and freedoms.

Socio-economic status of fishers depending on Ramgrah Lake, Gorakhpur (India) for livelihood

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Fisheries isone of the important sectors in most of the developed and developing countries of the world from employment and income generation point of view. This sector is gaining momentum owing to the introduction of advanced techniques to increase the yield per unit area of water and in foreign export earnings. Ramgarh Lake, a natural oxbow-lake formed by river Rapti (95 msl), is situated to southeast of Gorakhpur (India) (2629°-27′13°′ N; 83° 05′-8356°′E) and covers an area of about 723 ha with the catchment area around 11,500 ha. Rapti River flows about 2-3 km

south-west of the lake. This lake is surrounded by 18 villages. Data for socio-economic status of 139 fishers (137 males, 02 females) belonging to Fisheries Co-operative Society, Meharwa-ki-Bari, Gorakhpur and dependent on Ramgarh Lake for their livelihood were collected during March 2013-February 2015 through a questionnaire developed for the purpose, tabulated and analyzed following the standard methodologies. The fisher folk were registered with Fisheries Cooperative Society Limited, Meharwa-ki-Bari, Ramgarh Tal, Gorakhpur (India).Registration of the society is being renewed and office bearers elected for the term of 3 years. Since this lake is being leased regularly since 1987, fishers are involved in stocking, rearing, harvesting and drying of the fish and possess fishing gears like gill-net, cast-net (jhiguri net) and dragnet. They use small boats (locally called 'Dongi') for fishing activities. Thoughfishers depend mainly on fishery of the lake for livelihood but also work as labour during off seasons.Analysis of the socio-economic status of fishers showed that occupation, income, fish-eating habit, communication facility, situational variables together with seven variables such asage, category, family-type, house-type, education, contact with extension agency and knowledge about culture practiceswere significantly correlated with knowledge of adoption of the fisheries technologies. Fishermen were mainly involved in capture and transportation of fishes in remote areas from Ramgarh Lake while fisherwomen (35-40%) assisted in net weaving, sorting out (segregation) of the species, sun-drying and door-to-door as well as local market selling of the fishes.

Women molluscs gatherers organization in Costa Rica: A way to move forward towards recognition of a hard work near the sea.

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Within the Costa Rican artisanal fishery sector the sub-sector of the mollusks gatherers or "molusqueros" and "molusqueras" as they are known in Costa Rica is a very important one. The mollusks gatherers is a group composed mainly of women, in many cases partners of fishermen, or single mothers, who see in the mangroves an option to provide money to their homes.The work in the mangroves clearly defines a cultural identity near the sea. They have to work long hours under the sun with their hands looking for mollusks in the mud and a bag as her only working tools. There is very little recognition and knowledge about this sub-sector of small scale fisheries in the country. Women in Chomes, Puntarenas are example of these brave women.

To get organized seems to be the way in which women can fight for recognition of their work, which up to now is not even recognized by the State as a formal work. The women in Chomes, have got together in the "Asociación de Mujeres Molusqueras de Chomes". This partnership has enabled them to have a more important role in decision making in the sector at national leveland fight for their rights as molluscs gatherers.

For them, it has been important to search for strengthening their skills in aspects related to labor issues and promote their empowerment and recognition in the sector. Considering these experience, a series of workshops facilitated by CoopeSoliDar R.L with the financial support of FAO have been organized on issues related to labour rights and the importance of the participation of women in the fisheries sector and an exhibition of photographs portraying her work as molluscs gatherers was done to dignify and recognized these women work.This is the beginning of a process that seeks the visibility of this activity and the empowerment of coastal women harvesters.

Women in the seafood industry: Different countries, diverse level of knowledge and awareness

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On a global scale, quantitative and qualitative data on the participation of women in the seafood industry is sparse and when it exists it may be of poor quality and only cover some segments of the industry. Thus, the knowledge and understanding of the very complex distribution of roles, power, access to resources and profits between genders are incomplete and vary greatly between regions and industry sectors. This presentation illustrates the level of knowledge, the level of awareness and understanding in 6 different countries. This simple tool is not meant to run comparisons between countries.

The study carried out in early 2015 for GLOBEFISH the unit in the FAO Fisheries Department responsible for information on international fish trade summarizes the knowledges on "the role of women in the seafood industry". What is known, documented? Does sex disaggregated data over the full employment spectrum in the seafood industry and sociological, anthropological and economical studies on the role and power distribution between sexes exist?

This research evidences that the quality of data varies greatly between countries and, interestingly enough, is not linked to the level of economic development. Developing countries like India and Senegal, for instance, offer rather good records because these important fishing and aquaculture nations have received the attention of gender sensitive development aid agencies. In contrast, the participation of women in the industry is still poorly documented and researched in most developed countries, such as France and Croatia.

Occupational safety and health (OSH) risks for female workers engaged in shrimp processing industry in Bangladesh

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The Occupational Safety and Health (OSH) risks are seen as an emergent issue for the shrimp processing industry in Bangladesh where majority of the workforce are female. After accidents of fire and building collapse in the garments industry, local shrimp factory owners and the government have started looking at the OSH matters carefully across the shrimp processing sector.

Recent investigation srevealed that the 'fire safety' and 'building safety' across the shrimp industry is considered safer. Working with wet raw materials in cool condition has made it less risky from fire. Processing of shrimp being done in ground floor appeared safer from building safety and most of the shrimp processing factories are two storied buildings. But working in cold and moist condition for longer periods without adequate personal protection causes health problems for female workers. Colds, cough, asthma, backache and musculo-skeletal pains are the common ailments reported by shrimp processing workers.

Other OSH risks reported include faults in electric lines and connections to run processing machineries. Improper electric lines may cause electric shocks leading to instant death or severe injuries. Working in conditions of constant noise and vibration from machine rooms and exposure to the same without protective earplugs may cause impaired hearing. The compressor machines and ammonia gas cylinders are also associated with high risk of explosion and leakage of toxic gases causing breathing problem or mass deaths in serious accidents.

This paper presents findings of a study to assess the OSH status of shrimp processing workers and to review the industrial rules related to health and safety and their compliance level. Attempt was made also to assess the training needs and recommend policy guidelines or how to improve the OSH conditions which can lead to the creation of making an efficient and healthy workforce for the important export industry for the country to remain competitive in the international market.

Empowering women entrepreneurs in running agribusinesses in Myanmar

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When Myanmar started opening the doors for international organizations to assist development process especially in rural areas, the Ministry of Foreign Affairs, Italy showed an interest in supporting a food security program. A project called ***e-Women*** project (entrepreneurship in women) was designed through a long discussion among partners, University of Tuscia, AIT and EERi and finally started from January 2013. The main objective of the project was to build the capacity of women in running agri-businesses in Twantay township, a Nargis affected area.

Before starting the project, good partnership with the Yangon Region Government was established. In cooperation with Regional and Local Government, nine potential women with low income were selected in each of the 11 villages of Twantay township. The Project Team conducted a participatory rural appraisal (PRA) and focus group discussion to identifiy the need and the problems of the rural communities which were lack of job opportunities, limited technical skills, limited mobility, lack of credit or high interest rate (10-15% per month), land and market access. At the same time, the Project Team also identfied some potential agribusiness options for each village based on the potential profitabilities. Among the options, four categories were selected viz: 1) fish or prawn nursing and/or grow-out, 2) animal husbandry e.g. pigs, goats or ducks; 3) mushroom cultivation and 4) vegetable production.

The nine women in each village were asked to choose one of the potential options. The project contributed only 50% of the cost of the first crop. They contributed as labour and land rent as their costs. They were trained by the local trainers, some of whom were trained in Thailand. Experts from UoT and AIT also provided technical

back-ups. They were also trained in keeping all the input costs and sales revenues, and in conducting monthly meeting in each village to discuss their problems, and make new plans. The project also provided a seed fund for each group on the condition that each woman also collects monthly savings to add to the revolving fund opening an account per group. Each women was then entitled to take a loan for each season with the condition to pay it back with an interest. After testing the business options for about year, it was found that fish fingerling nursing and prawn culture in some villages, while in others mushroom cultivation, raising goats and pigs, vegetables and mushroom were found to be the best agribusinesses. The project was extended until December 2015, and evaluation was carried in November 2015. It was amazing to see that the women's groups were still actively working. Some of them were progressing well starting more profitable businesses. All the women were very satisfied with the project and committed to continue as long as possible.

Gender roles and livelihood status of ornamental fish enterprise in Maharashtra State, India

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The study was carried out to study the gender roles and livelihood profile of ornamental fish producers Mumbai and Thane districts in Maharashtra state, India. Majority of the entrepreneurs were middle aged and had more than five years of experience in ornamental fish breeding and rearing. The social participationthrough self help groups (SHGs) and co-operative society was high and they had moderate decision making power in family. Most of the entrepreneurs (85%) were literate. They spent about 14 hrs a day in maintaining the ornamental fish production unit and its management.Ornamental fish production was the primary occupation for their livelihood and secondary occupations included agriculture, other fisheries activity, services and other is business. The activity profile indicated that the maximum time was spent for cleaning of tanks and siphoning, feeding, observations

of health and filtration system followed by household work.

Access to household, fishery related resources were high and to financial resources was low for women as compared to men as well as control over these resources is minimal. Community norms, social hierarchy and institutional structures were the possible influencing factors. Education and health were basic needs and good quality seed and feed availability along with market facility and training, expert advice were the practical fishery needs for men. For women, market facility was the basic practical need and control of resources and access to credit were strategic basic needs besides fishery needs like seed availability and marketing.

An update on gender in aquaculture and fisheries value chains in India

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Though there is tacit understanding of the important roles that women play in fisheries and aquaculture, the lack of information in number terms, on how many of them are active in the value chains and what and where they contribute, is sadly lacking, despite researchers and academicians discussing this issue for several years now. This lack of data leads to lack of attention to gender roles and relations,which ultimately lead to failure in policies or programmes in improving livelihoods or reducing vulnerabilities of fishing communities. It is essential to bring into perspective the contribution of fisherwomen to the sector by identifying the critical issues that need to be addressed from the different levels like livelihoods, technology, skill and policy. The present communication attempts to cover the baseline gender information in fisheries and aquaculture value chain that is currently available in India, from the works that have been carried out or from published and grey literature. The objective of the present study is to elucidate the gender roles in fisheries and aquaculture value chains in India, identify the issues of social, cultural and economic importance that pertains to restricting the women roles in the sector and also analyzing the policies that could serve as avenues for a change.

For a country with a coastline of more than 8000 km and other rich resources of water bodies like rivers, canals, reservoirs, ponds, tanks, brackish water etc., the contribution of fisheries and aquaculture to the economy is significant. It has been recognized as a powerful income and employment generator as it stimulates growth of a number of subsidiary industries and is a source of cheap and nutritious food besides being a foreign exchange earner. Most importantly, it is the source of livelihood for a large section of economically backward population of the country. This is one of the reasons that women tend to be involved in a lot of activities along the value chain ,as small scale and often subsistence level of fisheries makes it imperative for both men and women to engage in the sector for livelihood. Developments in the sector from the technological point of view have rendered women's work redundant in some areas. Whether other avenues have opened, how women have coped with the changes are some of the issues that will be looked at.

An overview of women in aquaculture and fisheries in Bangladesh

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Women in Bangladesh are traditionally involved in various household works and raising children as these responsibilities have been bestowed upon them through cultural, religious and social norms. Their role in aquaculture and fisheries is deeply biased by caste, religion and position in the family hierarchy. Women contribute greatly to the fisheries and aquaculture value chains in Bangladesh. Published research work, however, on women in fisheries and aquaculture are relatively scanty. The outcomes of the researches would be necessary to understand ways and means for ensuring gender sensitive interventions in the fisheries sector. This study reviews the general status of women in fisheries and their potential in Bangladesh. There are critical disparities between the economic, social and political ranks of men and women in fish sector of the country. Though fishing is the second most important occupation in the non-farm sector in Bangladesh, only about 3%

working women are involved in fisheries. The women are mainly involved in fishing, fish handling, sorting, small fish trading, preservation and processing as primary or secondary source of income and a supplementary source of protein for home consumption. Muslim women do not prefer to engage in fishing directly but they willingly participate in fish drying, salting and other associated works. Hindu women in many areas of southwest of Bangladesh participate in catching fish for household consumption and for selling in the market. In a populous country like Bangladesh, where half of the population is women, it is crucial to increase participation of women in decision-making in fisheries conservation and management for sustenance of the sector. Initiatives have been taken to involve females in small-scale aquaculture through different government projects and non-government organizations (NGOs). WorldFish, DFID, USAID, BRAC etc in collaboration with government organizations are helping to improve awareness of women to involve in fisheries. In aquaculture presently women significantly contribute in small scale farming (both freshwater and marine) in different stages of operation and their numbers have been gradually increasing. Involvement of women in different aquaculture sector including pond fisheries, farming mini ponds, shrimp culture, crab fattening, cages operations and integrated rice-fish farming also contribute to the family income considerably, ensure good supply of family nutrition, generate self-employment opportunity and strengthen their overall socio-economic condition. The proper guidelines, planning and programs should be formulated and executed to make sure access of women to aquatic resource and services. Finally, the potential of women in fisheries and aquaculture value chain should be duly evaluated and acknowledged for meeting the sustainable development goal of a developing country like Bangladesh.

Gender, aquaculture and empowerment: A seven country review

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Emerging experience suggests that aquaculture is gendered not only in terms of roles, but also in terms of enabling and constraining factors and multi-faceted costs and benefits. Although women's involvement in aquaculture production, particularly in small-scale aquaculture helps to increase productivity and fish consumption within households, their participation is relatively low compared to men's. Factors underlying women's lower participation include lack of access to and control over key assets, capital, skills, technologies and extension services. Moreover, some studies have indicated the potent role that social norms and power relations play in shaping and limiting women's adoption and use of aquaculture knowledge, technologies and practices. These gendered patterns however need further examination and elucidation within and across contexts. In particular, there is a need for further analysis of the existing literature, including on identifyingthe social and gender norms and power relations that constrain women's access to and control over land and other key aquaculture inputs and technologies. This studyresponds to that need by reviewing the roles of women in aquaculture, the enabling and impeding social factors that informs the social and gender norms and power relations constraining their access to and control over land and other key aquaculture inputs and technologies. It will also look into the outcomes of women's increased involvement in aquaculture. The review will be done on seven countries from Africa and Asiawhere people rely on aquatic resources for living: Egypt; Nigeria; Zambia; Tanzania; Bangladesh; Cambodia; and, Myanmar. A systematic online search of databases and search engines for journal articles, reports and other non-print materials will be carried out using a large number of search terms and various permutations. Publications areas on the websites of organizations such as The Department of Fisheries, Bangladesh, Fisheries and Aquaculture Department of the Food and Agriculture Organization and WorldFish will be searched. The search will be iterative until a saturation point is

reached or until no new relevant sources appear. The review will inform interventions that aim to enable an increase in women's engagement in small-scale aquaculture productivity, an in particular that addresses barriers to women's control over assets, and constructively shifts underlying gender norms and relations towards gender-equitable assets and ultimately, engagement.

Women in fishing - guests at men's table

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Only 2.8% or 260 of the Norwegian fishers are women.However, womenhave been and still are in many ways "the shore crew", performing important tasks on land in order for men to fish. These tasks as well as the fishers' work and working conditions have changed through the years. The fishery population has had to adapt not only to new international, national and local conditions concerning fish markets and production, technology, management systems such as quota regulations, but also education and gender equality etc.

In this presentation, I will focus on gender and equality questions relevant for coastal fishingby bringing in the national, regional and local level relevant for fishing. I will start by presenting and discussing the numbers of fishers, boat owners and quota owners.

Since fishing does not exist in a vacuum, I will thereafterlook at women's participation in politics by concentrating on women as political actors on the ministerial level in Norway, as well as political activities on the regional and local level through political actions and demonstrations. I will give examples of how women have performed their roles as fishers in the context of a fishing village in the Finnmark, the northernmost county of Norway. Towards the end of the presentation, I will discuss my findings from the national, regional and local levels in a gender perspective.

The gender perspectives are concentrated on research carried out earlier, mostly by women, focusing on women's conditions in fishing and fishery, but also on perspectives developed in other resource based industrial and global-oriented sectors.

My own standpoint is that women in fishing and the tasks they perform should be as much valued and give the same economic, political and social rights as men have.

Caribbean fisheries: perspectives on gender

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The Caribbean Community (CARICOM) is a geo-political body with a membership of fifteen small island developing states. Most of these countries are English-speaking and heavily dependent on the marine resources of the Caribbean Sea for tourism and fisheries. While tourism is the most important economic sector in many countries, fisheries typically rank near the least economically important according to official statistics. It is argued that these statistics do not appropriately or accurately measure the real contribution of fisheries to social, economic and cultural assets and incomes of CARICOM states. In such arguments, and in the official statistics, gender is customarily ignored.

Although sex disaggregated fisheries statistics are scarce, it is clear that men dominate the harvest sector labour force of CARICOM fisheries while women dominate landing site fish vending and as labour in fish processing plants. Most CARICOM fisheries are small scale, but semi-industrial and industrial fisheries exist.

Big investors in fisheries are mainly men in both harvest and postharvest, but there is evidence that investment by women is underestimated. Female fisheries officers, fisherfolk leaders, researchers and NGO staff are often as common as men. Yet gender in Caribbean fisheries is poorly documented and gender is not considered in regional and national fisheries decision-making. The newly established Gender In Fisheries Team (GIFT) provides data and information that address the above with perspectives on gender mainly from Caribbean fisherfolk leaders.

Decent work beyond the sea: The role of Costa Rican women in fisheries

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In Costa Rica the productive work related to fishing goes much beyond the action to catch the fishes every day. The act of capturing the fish, like in other Central American countries is more common among men, but women have an important role in activities pre and post fishing. These activities become an essential issue that brings a more equitable and just distribution of the benefits of small scale fishing in coastal communities. In the pre fishing activities we find the work of the "lujadora", a woman who is responsible for organizing the line with hooks used in line fishing. This work is done by hand and requires a lot of skill that can only be achieved with years of experience.. "Lujar" is a family activity where,mothers teach their daughters the art since the girls are very young, passing knowledge from generation to generation.

Post fishing activities are also part of women's responsibilities. They are responsible for the preparation and marketing of fish and other sea products. They help (in the case of artisanal fishery) their partners not only in moving the productfrom the boat, but also many of them are responsible for negotiating with intermediaries the best price for the fish.Along with all these almost always invisible tasks, women are mothers, wives and homemakers and in some cases perform other work to provide an income for their families and become community leaders. All of that without proper recognition of their work directly and indirectly related with fishing work.

Part of the reason that could explain this invisibility of women's work is in the conceptualization of the fisheries work as productive chains and not as value chains. In a value chain, fishing is focused as a community activity in which the activities taking place before and after fishing become visible, including the women's work.

The survival story of wife in securing household's economy in fishing community of Pemalang Regency - Indonesia

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Fishers in Pemalang are mostly conventional and small-scale. Asemdoyong, Tanjungsari and Mojo are considered as the three biggest fish landing centres in Pemalang. Perhaps due to climate change and/ or saturation of fish stocks, the catch taken home by fishers is declining significantly. Nowadays, cantrang, a modified baby trawl which is usually widely used by fishers in Pemalang, is prohibited by the Government of Indonesia. The fishers are left without any other alternative income. In fact, cash outflow for their household must be secured every day and the wife is taking-over the problems to sustain the household's economy. The level of success of the wife in maintaining the life of the fisherhousehold will be depend on the survival efforts put on by wife. The main objective of this study is to investigate the role of the wife in securing her family's economy and community life. The approach of mixed-method has been employed as analytical tool. The study found that vulnerabilities of the sector have increased the work load of the women who have to handle productive, reproductive as well as community roles.

Small-scale fisheries in Indonesia: benefits to households, the roles of women, and opportunities for improving livelihoods

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Increasingly, small-scale fisheries (SSFs) are receiving recognition for their contribution to food security, poverty alleviation and to the livelihoods of households in remote coastal communities. The number of women involved in the SSF and aquaculture sectors in Indonesia is largely unknown as women's work in the sector, and their associated value chains, is often not recorded in government statistics. The international literature has identified significant research gaps in the extent of women's participation in all aspects of the fisheries and aquaculture sector and its supply chains identifying the need for policies and programs to take better account of gender and encourage gender equality and the implications that has for poverty alleviation, development policy, livelihoods and resource management.

Many attempts have been made to improve or develop new livelihoods for coastal communities in eastern Indonesia, but the documentation of these initiatives, particularly their successes and failures, is in general poor. Further, a gender approach to livelihood enhancement programs and benefits is also often lacking. Understanding the social and economic value of small-scale fisheries, the roles of women in fisheries were identified as priority areas for research in the 10 year plan for the ACIAR Fisheries Program in Indonesia in 2014.

In this paper we report on preliminary findings of a collaborative research activity

between researchers from Australian and Indonesian Universities and NGOs to: 1) develop an understanding of the significance of SSF in Indonesia, their contributions and women's roles; 2) identify success factors in developing enhanced livelihoods in SSF communities, including for women, 3) identify opportunities where livelihoods may be strengthened, diversified or alternatives developed, and 4) document knowledge gaps and future research needs.

We present preliminary results from our review and case study evaluations of livelihood enhancement projects. The synthesis of available knowledge and analysis of different initiatives will help to identify common factors for enhancing livelihoods successfully, as a basis for more applied, action-driven research in Indonesia in the future.

Integrating subsistence fisheries in local food systems:

Case study of Palma District, Mozambique

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This research discusses the factors leading to the deficient integration of subsistence fisheries in the local food systems using the evidences from the district of Palma, Northern Mozambique. one of the critical findings of this study is that, the majority of subsistence fishers are women (>70%) and that, subsistence fishing constitutes one of the most important sources of food and incomes for the local communities. However, despite government efforts in creating institutional platforms and opportunities that encourage small scale fisheries participation in food security and nutrition, subsistence fishing always remains amongst the most marginalized food systems in the district. In most cases, it is not the lack of opportunities or spaces at all, but the fact that subsistence fishing is not taken seriously, and fisherwomen are always included in these processes in disadvantageous and discriminatory ways. As a response to this exclusion, subsistence fishers are creating parallel spaces to sustain their livelihoods. These spaces are based on informal

structures but, are rich and powerful: Through these structures, subsistence fishers are able to access and use gainful markets, as well as to perform arrangements that strengthen their connectionswith other important sources of food and incomes (subsistence farming and small business). These findings are very important, as they can bring serious changeson the ways subsistence fishing and fisherwomen are dealt with so far. Possibly, subsistence fishing and associated structures need to be taken seriously and used as useful entry points in structuring functional integrated community food systems in this district.

Food security practices among women-headed households in urban coastal areas in Iloilo City, Philippines

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There is a growing strand of literature on urban poverty and the role of women in obtaining food security for their households. While men play a major role in food production, women play vital roles in food preparation, income augmentation and household income budgeting, and provision of sufficient food supply every day. Still, gender inequalities exist in food production and understanding how these emerged, how they function and how these are upheld are major research gaps. This paper contributes to the discussion by examining the experiential measures of food security by women-headed households in three coastal villages in the highly urbanized Iloilo City. Using surveys, interviews with officials and secondary sources, data show that these women live below the poverty threshold, unemployed, and have limited to non-existent access to human, social, financial, physical, and natural assets. They are also largely food consumers, are not food producers although they have exhibited skills as food managers. The paper argues that cultural and institutional factors contribute to the emergence and persistence of the challenges experienced by women in obtaining food security. The study shows that food production of the locale is challenging in securing food because of lack of education resulted to limited skills in food preparation, absence of

economic opportunities and livelihood of the women headed household. Most part of their income focuses on the day to day household food consumption while education has the least expense incurred. Food accessibility becomes very costly due to limited space in growing their own food supply as their food source. A group approach to food production, creation of public land banks, and establishment of a resource center may address constraints experienced by these women. This signifies that women demonstrate an essential role on household food security by contributing to food production through addressing the challenges.

Women of the coast: Life histories of deep-sea women fishers

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Using the life history approach (Ojermark,2007), this paper attempts to understand the status and plight of deep-sea women fishers by presenting three stories from three different barangays, namely - Montserrat, Nangan, and Surop in Governor Generoso, Davao Oriental. ***Nanay*** Soping (age 62), ***Ate*** Nene (49), and ***Auntie*** Alet (55), are deep-sea women fishers who employ different fishing methods – ***pamasol*** and ***pangundak*** (hook-and-line fishing), barter (exchange of fish for other commodities between ***basketeras*** and ***basketeros*** or small traders and commercial fishers), and ***panapyaw*** (uses sapyaw and sibot [fish nets] in catching fish over the bigger gill-nets of commercial fishing vessels.) I draw on these three life histories to examine larger socio-cultural practices and processes that inform the lives of women of the coast. Instead of stressing on women's disempowerment in the fisheries sector, I lay more emphasis on their individual capabilities as deep-sea fishers and highlight their abilities as equally-functioning agents. This paper also examines the existence, or lack thereof, of women fishers' groups and organizations. Pink's (2009) 'sensory ethnography', audio and visual documentations and participant observation are the methods of this study.

The value of marine protected areas: Through the eyes of the community members

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Values (social norm) and beliefs (shared understanding) play a vital role in how people make choices and undertake actions related to marine resource use. This information is vital for MPA managers since values and beliefs influenced behavior of the community members, which in turn may affect the management operation of the MPA. Understanding this factor guide MPA managers in effectively incorporating local values and beliefs in the MPA management structure and in designing appropriate social marketing strategies.

In a study conducted to evaluate the marine protected areas in Southern Iloilo, Philippines, one of the indicators used is determining the local values and beliefs about the marine resources. The indicator describes how people make choices and undertake actions related to marine resource use and management based on their values about what is good, just and desirable and their beliefs of how the world works (Pomeroy, 2011).

Results of the survey of 499 respondents showed that most of them believed that the sea is important because it is a source of food and livelihood. About 74% of the respondents very strongly agree that we need to manage the sea to ensure that there will be fish left for the next generations. On the statement that "***We do not have to worry about the fish. God will take care of it for us"***, 21% of the respondents disagree on it while 17% very strongly agree on it. About 64% of the respondents consider fishing as a source of livelihood and only 20% consider it as a source of food. The results were also segregated to compare the men's vis a vis the women's perspectives.

Engaging women and men in small-scale fisheries and agriculture development

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Women play a critical role in each stage of small-scale fisheries value chains, including their participation in extraction, processing and marketing of fish and fish products. Yet, women's contributions are undervalued, and tend to be marginalized from efforts to manage natural resources and develop small-scale fisheries. Gender equity is highlighted by donors and managers as critical to success, but these initiatives have failed to translate into substantial and equitable changes to natural resource management processes and outcomes in practice. There remains a need for more opportunities to create space for women to fairly participate, contribute to, and benefit from natural resource management and development programs and projects. A first step in tackling this challenge is to understand gender differentiated barriers and opportunities related to small-scale fisheries participation and management. This presentation will use Solomon Islands as a case study, where most people's livelihoods and food security are tied to agriculture and fisheries. We explore how gender norms are promoting or hindering women and men's engagement in small-scale fisheries development, and the implications these norms have upon the wellbeing of women and men. We examine interview and focus group discussion data and find that women face greater restrictions in access to information and support services, divisions in productive labour, participation in decision-making processes, physical mobility, and hold differing motivations for the use of natural resources. We find that cultural norms and customary rights systems are highly influential and critical to carefully navigate. We explain how these insights have translated into changes in the way in which we work within small-scale fisheries and community development in Solomon Islands, and in WorldFish programs globally. This presentation offers practical solutions, and highlights further challenges, for development initiatives that seek to be more gender sensitive by strengthening women's engagement in small-scale fisheries management and development.

Improving nutritional status and livelihood for marginalized women household in south west of Bangladesh through aquaculture

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Mud crab (***Scylla serrata***) fattening and culturing is an emerging industry in Bangladesh and directly benefiting women-led households in coastal region of Bangladesh. Currently, 37.8% of crab fattening and culturing facilities are owned and operated by women. Many of the household members of these women-owners are malnourished and live in impoverished. The study was conducted in order to promote the integration of tilapia (***Oreochromis mossambicus***) into traditional mud crab culture, thus diversifying their crops and improving household nutrition. A baseline survey of 150 mud crab farmers in the Satkhira, Khulna, and Bagerhat regions was conducted focusing on their food consumption, dietary nutrition and earned incomes. Household demographic and socio-economic information was also collected. The survey revealed that the majority of mud crab farmers are poorly educated, receive low dietary nutrients, and are malnourished. The second part of this study, integrating tilapia in mud crab culturewas conducted with 45 farmers, 15 from each region originally surveyed. Five farmers continued with the traditional mud crab fattening procedures. Ten of these farmers were instructed on methods of mud crab and tilapia stocking. Mixed sex tilapia were used to allow continuous breeding. Five of these ten farmers sold their tilapia products to market while the other five kept the tilapia for direct consumption by their household members. In both groups small tilapia were fed to mud crab to reduce reliance on wild-caught trash fish as feed for crab. The study revealed that the inclusion of tilapia in mud crab fattening and culture farms led to greater overall growth and production of mud crabs. Addition of tilapia had benefitedin increasingincome and availability ofnutrient-rich foods for farmer's households.

The women and their household membershad consumed more high quality protein in their diets leading to better health and decreased malnourishment.

Feminization and defeminization of fish supply chains: Are women becoming less equal?

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For fish supply chains, sex-disaggregated statistics are rare. At any scale and over time, the quantum and form of women's participation cannot be tracked. Researchers wanting to make a positive difference for women in fish supply chains have tended to focus on local and endogenous constraints and opportunities. This "development" approach endeavors to understand the current, past and potential future activities of women, and find interventions to positively influence their lives, such as how to secure women's access to fish and how to create more women entrepreneurs. The approach usually focuses on entry level and small scale activities, tending to ignore larger comparisons within and outside fisheries, such as how the women's opportunities may compare with those of the mainly male operators at other scales and in other sectors.

Yet, most likely, the main forces shaping participation and quality/inequality in fish supply chains are exogenous and operate at massive scale. These include the economic competitive forces of capitalism, technology changes in production, processing and logistics, the social forces of gender norms and power relationships, policy factors such as trade preferences agreements, resource access and rights allocation policies, environment sustainability and climate change. These forces are gender blind but have gendered impacts, positive and negative, much greater than those of local development interventions.

Since time series of sex-disaggregated data are not available, this presentation will review selected studies that provide trend information on how the larger exogenous forces affect gender participation and equality. In the fish sector

workforce, trends in feminization, defeminization and sometimes both will be examined in an attempt to understand the key drivers and impacts. Forces such as international trade and logistics, technology change, food standards and political conflict will be examined in cases from Asia, Africa, Europe and South America, raising the question of how these forces relate to small, local development interventions on gender.

Sectorial gender action plans hardly reduce gender inequality in aquaculture and fisheries

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Although Vietnam has a weak patriarchy and has implemented at least two 5-year gender action plans (GAP) for the aquaculture and fisheries sector, in terms of gender equality little progress has taken place and international project support continues. To assist the Vietnamese aquaculture department to prepare a new action plan, the EU-AquASEM09 project funded one pilot workshop, where, next to ministry staff, six provinces were represented. Only some of these provinces had gender activities based upon a sector specific GAP. Whether or not a province has a sectorial GAP might depend on the gender of the leader of the department or its aquaculture section, the presence or absence of a specifically trained person, or an active Women Committee. According to Trần Thị Thu Nga (2013, former head of a provincial Aquaculture section) a GAP could succeed only if, next to the plan, there were: (1) a budget; (2) a committee, and (3) collaboration between the Women Committee and the leaders of the provincial departments. Moreover, the latter need to be accountable for reaching the goals of the GAP.

The workshop identified several gender biases that are constraints to reducing gender inequality in the sector. Some of these have been published and are objective, e.g.: ***getting less paid for the same labor***, ***limited access to technologies and extension services, loss of income and properties due to hazards related to reproductive tasks***, and ***not enough women involved in decision-making***. Others

are less known or more subjective: ***disadvantaged in recruitment, appointments and higher education/training*** as considered not useful for women as they will be bound to the house to take care of children, ***violence against vulnerable genders***, ***pressure on giving birth to boys***, and the related ***inferiority complex that reduce women's confidence***.

Though 'Raising awareness at all levels' is one of the action areas in the related Ministry's GAP, one may wonder if addressing the issues at sector level will relieve the main constraints. At least three of the constraints to gender equality identified by participants: ***Roles and perceptions based upon culture and customs***; ***Preconceptions/prejudices on gender***; ***Violence against vulnerable genders***, do require a broader public awareness before changes may be reached. These three constraints are related to the role in which women (leaders) may be forced by their husband, and by both their own and the in-law families, and thus to macho attitudes and general cultural values, even in these weak patriarchal societies. Thus deep cultural and political changes going beyond the strategies of the technical ministries are needed to reduce gender inequality.

Comparing awareness and behavior between male and female milkfish purchase decision makers towards food consumption trends in the Province of Iloilo, Philippines

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A number of studies have validated that consumer awareness is not univocally consistent with behavior. This study attempts to compare awareness and behavior of milkfish purchase decision makers in the Province of Iloilo, Philippines towards food consumption trends. Food consumption trends included are: (1) food safety; (2) organic food; (3) sustainability in production; (4) good agricultural practices; (5) traceability; (6) local production; (7) support to local farmers; and (8) food labeling.

Respondents for the study consisted of 375 milkfish purchase decision makers. Sampling of respondents was done by stratified random sampling with geographic location as basis of stratification. Sampling frame was developed from a list of households obtained from Iloilo's different municipalities. To determine level of awareness and behavior, respondents were to answer an interview schedule with 5-point Likert scale-type questions for awareness and 7-point Likert scale type for behavior. A one-way ANOVA was conducted to explore the effect of gender on awareness and attitude towards the eight food consumption trends.

Results show that there is no significant difference between male and female purchase decision makers on the level of awareness for all eight identified consumption trends. In terms of behavior, there was a statistically significant difference in the level of behavior between male and female purchase decision makers for all eight food consumption trends. Difference in the level of behavior was found to be highest on the issue of food safety with the male having an average of 5.9 (true of me) vis-à-vis 5.2 for females (somewhat true of me).

It is recommended that more information/ dissemination campaign targeted to female purchase decision –makers is needed in order to convert level of awareness to increase in declared behavior.

A model for gender-based post-harvest fisheries technology transfer initiatives

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The implementation of new and innovative management strategies and interventions responds to the social and economic problems that beset the coastal fishing communities in the Philippines. These management interventions include the establishment of marine protected areas, stock enhancement, ecotourism, regulations of fishing gears and methods, and provision of livelihood, among others. In the past years, there have been a number of skills trainings conducted in coastal communities in the country that aimed to transfer available technologies to these communities. Although there have been reported success stories on these initiatives, there is still a need to change the approach so as to make these skills trainings more effective and appropriate to the needs of these communities while considering the status of fisheries resources in the area.

A study on a gender-based post harvest fisheries technology transfer was designed to offer an alternative intervention model that could provide more effective and responsible livelihood activities for coastal communities. The study included a rapid resource and needs assessment, and the design of skills training modules for the women, of Carles, a coastal town in northern Iloilo, Philippines. Results reveal the recent status of the coastal resources in the area, the existence of problems similar to other coastal communities in the country, and the strong need to empower women in these communities ***via*** provision of alternative livelihood activities for them. Appropriate and executable training modules for these women ranged from those dealing with Food Safety and basic Hygiene and Sanitation, Fisheries Post Harvest Technologies designed for coastal communities, to Enterprise Planning and Development, including food packaging, marketing, and networking. The same approach in transfer of post harvest technologies may be replicated in other coastal communities in the country.

Special session abstracts

A simple technical approach for shrimp farmers for sustainable production with biosecure biofloc technology

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Biosecure Biofloc technology applied in shrimp farming is in fact adapted from the basic minimum water exchange shrimp intensive culture system used in Indonesia since early late 1990s. The system then was to position aerators within culture ponds to concentrate waste (sludge) into centre of ponds which were then siphon out physically or through central drain system. The aerators were operated almost 24 hours to have optimum culture pond environmental condition. The system creates clean water column and bottom feeding area and separated the sludge area (Taw 2015). The system had been applied in Indonesia in Lampung (Taw, 2005; Taw, et al 2007).

Shrimp biofloc system is somewhat an upgraded system by introducing carbon such as molasses and wheat flour to develop a heterotrophic environment and suspend biofloc colony within pond water column. The biofloc system develop base on what shrimp farmers are used to by developing algae first and later cross over to biofloc to have self-nutrification process sets in (Taw 2014). Main economic benefits of shrimp biofloc system are – better biosecurity, low FCR, higher production, higher energy efficiency and sustainable production.

Biofloc system alone cannot prevent ever emerging shrimp diseases. However, biofloc and biosecure shrimp farm design, construction and operation system have shown to prevent diseases entering the farm facilities (Taw 2005; Taw et al 2008, & Taw & Setio 2014). In Malaysia biosecure biofloc technology has been

applied at Blue Archipelago shrimp farm since October 2011 and has been operating successfully without any incident of EMS/AHPND which was a major threat to China, Vietnam, Malaysia and Thailand (Taw, et al. 2013 & Taw 2014).

According to In-Kwon (2012 &2014) there were more than 2,000 bacterial species in well-developed biofloc water. This biofloc may enhance immune activity based on mRNA expression of six immune-related genes – ProPO1, ProPO2, PPAE, ran, mas and SP1. A study at Bogor University, Indonesia and Ghent University, Belgium revealed that biofloc system contributes to the enhancement of immune response and survival after IMNV challenge regardless the carbon source. The application of BFT brings about beneficial effect in disease control and management in shrimp culture (Ekasari, et al., 2014).

Nutritional contribution of bioflocs to cultured aquatic animals

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Scientific literature on biofloc technology (BFT) shows that it improves growth of various aquaculture species, reduce FCR, enhance digestive enzyme activity, hematology and immune response (Long et al, 2015), and improve larval survival and seed quality (Ekasari et al, 2015). Furthermore, it reduces daytime pH fluctuation, removes TAN, is a source of probiotic bacteria (Ferreira et al, 2015), and thus stabilize aquaculture pond environment by mimicking the natural aquatic systems (http://www.bioshrimp.com/).

Microbial flocs are produced by adding carbohydrate sources such as acetate, glycerol, glucose, cassava, cellulose, corn flour, sorghum meal, dextrose, cassava, wheat flour, molasses, wheat bran, and rice bran to the culture environment. Nutritional quality of bioflocs is dependent on carbon source and particle size of the flocs (Crab et al, 2010; Ekasari et al, 2014). The reported protein and lipid content of bioflocs by various studies range from 18 – 50% and 0.5 – 13%, respectively.

However, the ash content of biofloc can as low as 6% (Long et al, 2015) or as high as 65% (Neto et al, 2015).

There are conflicting claims of nutritional contribution from bioflocs to the cultured animals. While Burford et al (2004) showed 22 – 28% protein from natural biota was retained by ***Litopenaeus vannamei***, Neto et al (2015) showed appetent digestibility coefficient (ADC) of bioflocs as low as 25%. This low digestibility might have resulted from high ash content of bioflocs (59 – 65%) reported by the authors. Wang et al (2015) showed that addition of biofloc up to 10% improved the growth and feed utilization of crucian carp (***Carassius auratus***) but adding beyond that reduces both growth and feed utilization parameters significantly. Addition of microbial floc of 8 -15% improved the growth performance of ***L. vannamei*** compared to bioflocs-free diets (Khun et al, 2009). A tank experiment showed that feeding rate can be lowered by 25% of the conventional feeding rate for ***Penaeus monodon*** (Panjaitan, 2010). This paper critically reviews these discrepancies of nutritional contribution of bioflocs to the cultured aquatic animals and evaluates whether BFT can help to enhance aquaculture sustainability either by reduction of fishmeal in aquafeeds or reducing external feed requirement.

Biofloc aquaculture: sustainable aquaculture development in Thailand

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Thailand has remained among the top ten countries in world aquaculture production for many years. However, total production has stagnated at about 1.5 million tonnes since the last decade. The outbreak of EMS disease affected white shrimp (***Litopenaeus vannamei***) culture areas in 2012 hence severely impacting the social and economic fabric of the country. This situation is apparently linked to unsustainable aquaculture practice. In addition to unsustainability, aquaculture is being confronted by emerging challenges; flood and drought, environmental deterioration (particularly poor quality of surface water) and fish meal scarcity. These factors are contributing to the retarding aquaculture production of the

country. In this context, Biofloc technology holds a potential to promote further aquaculture development.

Trial on biofloc system for tilapia culture has been conducted at Fisheries Research Station, Faculty of Fisheries, Kasetsart University Kamphaengsaen Campus, from March to May 2016. All male tilapia of average weight 79 g were stocked in two outdoor circular tanks (5 m^3 each). Two treatments were administered: with and without biofloc starter. Fish was stocked at 60 fish/m^3, and fed at the rate of 2% body weight with pelleted feed (25% protein) once daily. Aeration was applied to maintain dissolved oxygen well above 4 ppm as well as to mix water thoroughly to suspend floc. Total Ammonia Nitrogen was managed to remain < 2 mg/l by adding molasses as organic carbon source. Fish was harvested after a culture period of 75 days. The average survival rate, total production and individual weight were 98.3%, 61.6 kg and 209.4 g, respectively. Salient features of this production are presented here which highlights the potential of biofloc aquaculture development in Thailand.

Amino acid and fatty acid profiles of bioflocs obtained from shrimp culture ponds

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Fish meal, an important source of protein in commercial shrimp feed, has been distasted by society as it is obtained from trashed and small fish harvested from the sea. The use of fish meal in commercial shrimp and fish feed is therefore considered detrimental to environment. Replacement of fish meal by protein from plant, especially soy bean, and other land animals has been tried with variable success. Bioflocs from shrimp ponds have also been considered as a good candidate since they are particles composing microorganisms, zooplanktons and nematodes.

To determine the suitability of bioflocs in being the protein source in substitute for fish meal in shrimp and fish feed, total protein and lipid contents, and amino acid and fatty acid profiles were determined from bioflocs obtained from shrimp (***Penaeus monodon***) culture ponds. Total protein was found to vary from 25% to 50% (dry weight), depending on the level of microalgae - that lowered the protein level - or zooplanktons (and other types of tiny animals) - that increased the protein level - present in the bioflocs. Total lipids varied from 7% to 10% (dried weight). For amino acid profile, by comparing percentage of essential amino acids with other sources of proteins, i.e., fish meal, rendered meat meal, poultry by-product meal, blood meal and soy bean meal, the pattern of amino acid profile of bioflocs was most similar to that of fish meal. For fatty acid profile, it revealed that some essential fatty acids, especially linoleic acid (C18:2n6), arachidonic acid (AA, C20:4n6), eicosapentaenoic acid (EPA, C20:5n3) and docosahexaenoic acid (DHA, C22:6n3), were lowered than those of the fish meal.

To ascertain of not being the source of shrimp pathogens, bioflocs were tested for white-spot syndrome virus (WSSV), acute hepatopancreatic necrosis-producing ***Vibrio parahaemolyticus*** (VP_{AHPND}) and ***Enterocytozoon hepatopenaei*** (EHP) by polymerase chain reaction (PCR) methods. The three pathogens are currently main problems of shrimp culture worldwide. The results revealed that bioflocs under study were free from all the three pathogens.

From the protein contents and amino acid profile, it is possible to use bioflocs - with minimum level of microalgae - as protein source to substitute, at least in part, for fish meal in commercial shrimp or fish feed. On-going works are focussed on economic harvesting method of bioflocs, which is as well considered as a part of the must-do work on modern intensive shrimp (especially ***Litopenaeus vannamei***) culture under bioflocs, biosecure and sedimentation removal system.

Comparative efficacies of tilapia green water and biofloc technology (bft) in suppressing population growth of green vibrios and *Vibrio parahaemolyticus* in the intensive tank culture of *Penaeus vannamei*

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The use of tilapia green water (TGW) and biofloc technology (BFT) to control abundance of green colony forming ***Vibrio*** species and ***Vibrio parahaemolyticus*** in the intensive tank culture of ***Penaeus vannamei*** was evaluated. The study was performed over a 60-d outdoor culture of ***P. vannamei*** in 1000-L concrete tank with three replicates each culture system. The densities of ***Vibrio*** spp. in the rearing water and attached on surfaces were monitored at 6-d intervals. ***V. parahemolyticus*** was enumerated using a chromogenic bacterial medium. The BFT culture system promoted higher densities of total culturable ***Vibrio*** species in both water and surface samples while tilapia green water has consistently lower densities of attached total culturable Vibrios. Percentage of green colony Vibrios in the total culturable ***Vibrio*** count in the water were generally lower in TGW and BFT. Furthermore, the densities of ***V. parahaemolyticus*** in the water samples as well as on surfaces were generally lower in the tilapia green water than in the other culture systems. The present findings demonstrated that the practice of tilapia green water technology is an effective ecological method of controlling growth of potentially pathogenic bacterial species such as the green colony-forming Vibrios and ***V. parahaemolyticus*** in the intensive tank culture of ***P. vannamei.***

Effect of biodegradable substrate and biofloc on the growth performance of *Macrobrachium rosenbergii* nursed in zero-water exchange, non-recirculating system

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The effect of a biodegradable substrate and biofloc, on the growth performance of ***Macrobrachium rosenbergii*** was observed during a 30-day nursing period. The study was conducted at Universiti Putra Malaysia's aquaculture experimental station in Puchong, Selangor, Malaysia. Postlarvae (PL) nursing facility consisted of fiberglass reinforced plastic (FRP) tanks containing water volume and surface area (sides and bottom) of 800 L and 4m^2 respectively. Sugarcane bagasse was used as the biodegradable substrate that increased the available surface area by 100%. The three treatments were substrate-only, substrate with biofloc, and biofloc-only. Continuous aeration was provided. No water exchange was done throughout the study. Uniformly-sized PL were randomly stocked at a density of 1 PL / Liter (800 PL / tank). Sinking-type starter feed pellets containing 40% crude protein were fed to prawns twice (9-10 am and 5-6 pm) daily at 15% body weight. Among the treatments, the combination of substrate and biofloc resulted in the highest juvenile prawn performance in terms of mean individual harvested weight (0.269 ± 0.015g), survival (93.7 ± 2.5%), SGR (7.66 ± 0.18) and total yield (176.8 ± 7.0g). However, the results were not significantly different from the treatment with substrate-only. The lowest FCR (1.1 ± 0.2) and PER (2.5 ± 0.5) was achieved with the substrate-only treatment. The treatment with biofloc-only resulted in the lowest performance, which was significantly low for all performance indicators among all the treatments tested. This study suggests that during the nursery phase of freshwater prawn, the combination of biofloc and substrate do not provide any additional advantage to juvenile freshwater prawn growth performance compared to using substrate only.

Business model for biofloc farming in Thailand

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The global business environment has changed tremendously within the past few decades and it is imperative for countries in Asia to move fast at the global pace to ensure competitiveness and market share protection. Aquaculture technology transfer has followed models from the USA and the EU with fast learning blazing the trail. However, business skills need to be modeled according to local needs as well as international standards. Which direction should Asian aquaculture go considering increased scale or technology? This requires a careful study of the business and technology before making an investment decision. However, the norm has been a blind approach to aquaculture business with the belief that it does not require skill and expertise. This approach has led to loss of investments. Biofloc technology offers a unique method of aquaculture that can reduce costs and increase benefits. Environmental concerns, climate change and the need for sustainability have all placed a burden on us to change our methods of natural resource use. Biofloc technology offers a window for the sustainability of aquaculture in the long run. Since every investment option has its risks and benefits, it is necessary to explain the risks and costs involved in biofloc technology so as to give investors a good insight into the market benefits derivable from its adoption. Biofloc technology is easy to adopt and can be of benefit to Thai aquaculture as well as Asian aquaculture in general.

TAR Biofloctech was established by Prof. Yoram Avnimelech and Mr Naret Maidee. It is located in Chiangmai, Thailand. TAR Biofloctech features a well-equipped training centre for people who are interested in biofloc. We aim to make biofloc aquaculture popular all over Thailand and AEC. At TAR Farm, we have 13 Tilapia biofloc tanks for research as well as tanks for other fish that can be reared in a biofloc system. Biofloc system is ideal for dealing with persistent issues such as water scarcity, diseases, and waste discharge into the environment. We can add value to aquaculture products from the biofloc system while upholding the organic nature of the technology with the exclusion of chemicals, and organic matter residues. This technology offers the best choice for environmentally conscious consumers.

Special session on cross-country studies on coastal resource management

Does COREMAP program improve fishers' welfare in southeast Sulawesi, Indonesia?

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Poverty and resource degradation are two immense problems in Indonesia faced by fishers who live in coastal and small islands. In response to the issue, the Indonesian government has established a program on Coral Reef Rehabilitation and Management Program (COREMAP) funded by World Bank (eastern part of Indonesia) and Asian Development Bank (western part of Indonesia) to address the problem. The program provides assistances on capacity building to the villages involved in the program, including training in business management, training on alternative livelihood and programs on marine resource management. This study thus has the objective to evaluate the impact of COREMAP program on fishers' welfare by comparing the beneficiaries with non-beneficiaries (counterfactual group) and also analyzing marketing practices in both areas. This study analyzes 240 fishers' households in Southeast Sulawesi in the district of Wakatobi and Muna (as a control) based on a survey conducted from January to March 2016. To assess the impact of COREMAP program on various aspects, propensity score matching (PSM) is employed on COREMAP and non COREMAP villages. To complement the analysis, a national survey on household's welfare on the COREMAP villages and non-COREMAP Villages will be used. As it is now the COREMAP III is being implemented, the study will be useful to provide critical inputs for the ongoing implementation and the planning and designing of other similar programs in the future especially for marine resource management in Indonesia. In particular, the result from this study is supposed to provide strategic directions toward program evaluation, market and product development for coastal resource management as a whole.

The effects of conservation groups and marketing integration on income of coastal-dependent households in southern Thailand

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The conservation activities roles of the coastal resource dependent households are essential issues. It can be considered as the bottom-up approach and has been the spontaneous move of the local communities to organize themselves into conservation groups. There are evident confirmations of the positive outcomes of these efforts in terms of increase in diversities and abundance of fish population as well as other aquatic species and plants. Therefore, their impacts on income of coastal resource dependent households are value for further investigation.

This study is designed for households surveyed from two different groups, the areas with and without conservation group activities, to gather primary data for Propensity Score Matching analysis. The 480 samples were randomly selected from the small scale fishermen in the southern Thailand, with half of them were from the households who live in the areas with a conservation groups, and another half were from areas without conservation groups.

With the aimed at optimal management for sustainable fishery resource use to increase the income for the villagers, the results of this study will be provided to related government agency, NGOs and local community organizations as an input in the formulation or revision of marine and coastal management policies.

Assessment of the impact of fishery reform policy and the influence of community fishery on fisher's income in the Tonle Sap lake

in Cambodia

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Even though there are plenty of literatures on the Tonle Sap, but almost none of them pay strong attention to the relation of community fisheries and the livelihoods of the fishermen, especially using economic approaches. In addition, the majority of the studies were conducted before 2012 when the government decided to abolish all the fishing lots in the Tonle Sap and allocated some areas to the community fisheries. The shift of policy has had influence on the fishery management as well as the livelihood of the fishermen through new access regime. Thus, this study will fill the gap of the previous studies by assessing the impact of the fishery reform policy and the influence of community fishery on the fishermen's income in the Tonle Sap Lake in Cambodia. The data were being collected from April to the mid of May 2016 from 600 fishing households in Kampong Chhang and Siem Reap Province. Key informant interview and focus group discussion will be conducted to gather more indepth information to complement the data from the household survey. This study will use propensity score matching approach to examine the influence of the community fishery on fishermen's income, both member and non-member. The results from this study will provide useful case studies information for policy makers whether to design future fishery management regime through either fishing lots system or community fishery management in the context of Tonle Sap Lake.

Assessing the impacts of marine protected areas on the welfare of small scale fishers in southern Iloilo, Philippines

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In the Philippines, marine protected area (MPA) has been a common management tool since the 1970s. Available studies put too much emphasis on the biological aspects and too little emphasis on the socioeconomic considerations. This study addressed the question: Are the fishers in marine protected areas better off than the fishers not in marine protected areas? The study uses data of fishers from municipalities with and without marine protected areas in southern Iloilo using Propensity Score Matching. Data were collected in February to April 2016 from interviews with 240 fishing households in the municipality of San Joaquin where MPAs were established since 2009 and from 240 fishing households in the municipality of Miagao (counterfactual group). Focus group discussions and key informant interviews were conducted to complement data from the household survey. The results of the study will be inputs in understanding the impacts of marine protected areas on the small scale fishers towards better design and implementation.

Special session on food security in small-scale fisheries

Importance of small-scale fisheries to food security: Overview and prospects

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Despite the importance of fish in export and trade, discourse about food security is predominantly related to land-based food systems. When fisheries are discussed as part of food security, the emphasis has mostly been about large-scale industrial fisheries rather than small-scale. As such, the importance of small-scale fisheries to food security remains implicit, yet widely acknowledged. This study aims to rectify the situation by examining the interconnectivity between small-scale fisheries and food security. First, we conduct literature review, documenting when small-scale fisheries entered food security discourse and in what context. Further, we capture the extent to which the four dimensions of food security, i.e. availability, accessibility, utilization, and stability, or vulnerability to climate change in the context of our study, are related to small-scale fisheries. Next, we overlay this information with small-scale fisheries catches and other relevant data to analyze the degree of correspondence between food security research and small-scale fisheries production. Finally, we discuss data needs and research gaps, as well as future prospects for securing and/or enhancing the contribution of small-scale fisheries to local and global food security.

Inland fisheries based food system for food and nutrition security in Nepal

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This paper aims to elucidate the contribution and potential of inland fisheries based food system for food and nutrition security in Nepal. Generally, inland fisheries is rated low comparing to marine in terms of commercial and livelihood contributions. However, recent technological innovations in cold-water fisheries, warm water hatchery, feed with insured marketing, the contribution of inland aquaculture has increased substantially in food system. Nepal, a small Himalayan land-locked country surrounded by India and China, where capture fishery is a primitive tradition; and fish has been depicted for fertility and prosperity probably due to its high nutritive food quality, genetic diversity and water resources. In Nepal, predominantly carp are produced in ponds, cages, raceways, lakes, reservoir, rice fields and tanks with additional scope to use Himalayan pristine cold waters for species like rainbow trout (***Oncorhynchus mykiss***) commercial cultivation in mountains and mid hills, while Tilapia and Pangas in warmer southern plains. Currently, the contribution of fisheries sub sector in agriculture has reached only about 2%, with more promising future. The per capita fish consumption based on internal production has increased from 125 g in 1975 to 2060 g in year 2013; 16.5 times more in last 38 years. The present fish production and per capita consumption in major five development regions varies across and altitudinal gradients of terai, mid hills and mountainous region of the country. The central development region ranked first in fish production among all others, probably due to comparatively better support services, market accessibility, awareness of consumers and farmers contrasting to others especially, the far-western regions with lowest production despite of highly suitable flat land, water resources, climate and other features. However, on altitudinal landscape basis, it is the southern plain known as 'terai' contributing highest fish production than mid hills and mountainous zones. The mountain areas with immense cold water resources contributes least fish production regardless of the development regions, implying future support services and innovation need to be extended in far western and mountainous parts of the country for improving food and nutrition security.

Does traditional knowledge on the nutritional value of fish play an important role in determining fish allocation for consumption at household level?

Dr. Horacio Francisco Gervasio

Mozambique

An important challenge on fish consumption among fishing communities and households is related to the preferences they give to fish for family consumption and fish for selling. This is especially true for the fishing households that rely on fish as the main source of both, incomes and food for consumption. In Mozambique, market failures are amongst the most important factors determining food access and allocation at local and household levels (Ministerio das Pescas, 2010). Recently, studies and participatory assessments on food security and nutrition have indicated that, artisanal fishers face serious challenges in determining allocation of fish for family direct consumption and fish for trade. These studies inform that fish for food allocation processes at household level are influenced by multiple among which fish preference based on cultural motivations and traditional knowledge on the nutritional value of specific species of fish, play the major role. This study is an ethnographic exploration of the prevalent cultural beliefs and traditional knowledge on nutritional value of fish among artisanal fishers of Cabo Delgado province (Mocimboa da Praia and Pemba).

Fish consumption in Myanmar

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Animal source foods, including fish, are rich in micronutrients, in addition to which their consumption enhances the bioavailablility of micronutrients from vegetable components of the diet. This paper sets out the importance of fish consumption for food and nutrition security in Myanmar, using the nationally representative Integrated Household Living Conditions Assessment (IHLCA) survey dataset for 2010 and supporting data sources. Fish accounted for 50% of animal source food consumed in Myanmar in 2010, with meat contributing 35%. Estimated average fish consumption per capita in Myanmar stood at 18.9 kg. Four main categories of fish were consumed: fresh fish from inland capture fisheries (27% of total consumption); fresh marine capture fish (21%); fresh fish from aquaculture (18%); and, dried/fermented products, which accounted for a surprisingly large share of total fish consumption (34%). There were big geographical variations in consumption of fish by quantity and source, with consumption greatest in Lower Myanmar, close to the main sites of production, and lowest in the arid, hilly and remote areas of Upper Myanmar. Fish was the cheapest animal source food, costing 29% less on average than meat. Fermented fish products were especially cheap, with an average price per unit less than half that of meat, representing an extremely important source of micronutrients for the poorest consumers. Fish from aquaculture were the most expensive among fresh fish products. However, demand for farmed fish is growing faster than demand for fish of any other type, in line with rapid urbanization and rising incomes. The real (inflation adjusted) price of farmed fish fell by 0.6% per annum on average from 2008 to 2014 due to rapidly increasing supply, whereas the real price of marine and freshwater capture fish species rose sharply, suggesting a contraction of supply relative to demand.

The humble sardine - fish as food or fodder

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Small pelagic fish are the largest group of fish landed globally and a significant proportion of this nutrient rich food is processed and lost to livestock feed, fish feed, fish oil, pet food and omega rich vitamins. The nutritional importance of small pelagics as an easy digestible protein source, rich in essential lipids with fatty acids (EPA/DHA) all essential amino acids, minerals and vitamins, are well known and documented. Small pelagics contain all the elements of a healthy and nutritionally optimal diet and is an important contributor to the food and nutritional security of many poor, low-income households in developing countries. The consumption patterns of small pelagics in developing countries vary from canned fish in South Africa and Namibia, air dried, salted and smoked in Angola, Tanzania, Zimbabwe, Malawi, Uganda and fresh in many other parts of the world. The important role of small-scale fisheries in this sector is crucial in relation to food and nutrition security for many poor coastal communities. However, this does not mean that larger-scale canned sardine operations do not contribute to food and nutrition security and provide food easy transportable, long shelve life to rural and urban poor in developing or emergent countries in certain circumstances. Yet, 69% large-scale small pelagic fisheries in South Africa and Peru are reduced to fishmeal, fish oil, etc. This trend is also now prevalent in Tanzania where most of the daggaa fishery, an important fish protein of many poor, is resorted to fishmeal in Kenya for animal feed. Key research questions for this paper include - What is the nutritional importance of small-pelagics especially to the poor and vulnerable in the developing countries? What are the consumption patterns of small-pelagics in the developing world? To what extent does large-scale small-pelagic fisheries contribute to food and nutrition security? Why is there an increasing trend to reduce small pelagics (coastal and inland) for animal feed, aquaculture feed, fish oil, etc.?

Aquatic value chain of brackish water shrimp culture in India: issues and challenges at farm level

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The sustainability of aquaculture depends up on how effectively it is governed at different levels of value chain, particularly at the level of production and disposal. The shrimp culture is a fast growing sector particularly in South-East Asian region where the share of ***L. vannamei*** has increased substantially after 2001 and surpassed the production of ***P. monodon***. The production trend of ***L. vannamei*** shows there was no significant increase in its production globally till 2000 but started accelerating since then, while the production of ***P. monodon*** remained constant throughout this period. As a result, various stakeholders particularly the seafood exporters association in India lobbied for the introduction ***L. vannamei*** in the country. The demand from farmers were also strong since they were facing the loss from the outbreak of White Spot Syndrome Virus in cultured ***P. monodon.*** In response to these demands, the Government of India has introduced the species in Andhra Pradesh for commercial purpose since 2008. The basic idea of introducing this species was its profitability and capacity to resistant white spot syndrome virus as compared to P. Monodon. In this context, this paper presents an overall performance of shrimp culture particularly ***L. vannamei*** culture in Andhra Pradesh, India and discuss the major governance challenges at the bottom of the its value chain. The factors influencing the value chain at farm level has been captured by conducting primary survey among farmers, hatcheries, feed suppliers and processors. Here, we argue that international trade restrictions on quality issues and competitiveness seems to have made a positive impact on Indian approach towards production and sustainability of shrimp culture, but farmers and other stakeholders faced various constraints and challenges to cope with the new situation due to lack of infrastructure, information asymmetries, and inadequate coordination between different agencies at grass root level.

Ongoing transformations in inland fisheries and implications for governance on the east coast of India

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The East Coast of India, particularly the Odisha state, is historically known for its inland fishery resources which formed a significant part of the entire small-scale fishery sector in the region. The role of inland fisheries in ensuring food security for millions of small-scale-marginalised fishers in the region has been significant. Here, inland fisheries is traditionally characterised by a dominant caste system where fishing occupations were customarily restricted to specific caste groups engaged in capture fishing, local and regional level fishery institutions (e.g., primary fisherman cooperatives), use of non-mechanised fishing techniques, linkages with local and regional markets, and certain policy instruments in place to protect the interests of this sector. However, the inland fishery sector has undergone significant changes in the last three to four decades, especially after the boom in aquaculture starting in early 1980's. Consequently, much of the inland fisheries have been reduced to fresh and brackish water aquaculture. There is a corresponding shift in policy, market and civil society responses, all favouring a shift to an aquaculture-led inland fishery system.

On this backdrop, this paper will use qualitative case studies and secondary literature review to examine key transformations taking place within the inland fishery sector of Odisha state. In particular, four related areas will be analysed: (1) resource conflicts and contestations resulting from the dynamic interactions between capture- and aquaculture-based inland fisheries; (2) the role of multi-level drivers influencing major changes in inland fishery; (3) loss of values and identity of inland capture fishery ecosystems and the fishers who have customarily depended on them for their livelihoods; (4) resulting governance challenges and possible institutional, policy and civil society responses.

Aquaculture in transition: Land governance and uneven development in Myanmar's Ayeyarwady Delta

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This paper presents findings from the most comprehensive study of aquaculture ever conducted in Myanmar's Ayeyarwady delta, where 90% of the country's farmed fish production is concentrated. Throughout most of Asia, aquaculture value chains are dominated of large numbers of small and medium scale enterprises, and the size of the average fish farm is only somewhat larger than that of the average rice farm. In contrast, the distribution of fish farm sizes in Myanmar resembles that found in plantation agriculture, with the majority of fish production originating from very large operations. This 'unbalanced' form of agrarian development is an outcome of the unique history of Myanmar's land governance and its role in the country's lengthy and uneven transition toward a market economy.

A nascent fish farm sector began to emerge in Myanmar during in the early 1980s, but its development was initially hindered by strongly enforced prohibitions on the construction of fish ponds on paddy land. Partial economic liberalization after 1989 established conditions under which some aquaculture could grow. In particular, a law promoting the establishment of new aquaculture operations through the allocation of land concessions on so-called "wastelands" benefited large farms and companies, allowing them to dominate the sector.

At the same time, continued state control over how paddy land in Myanmar may be utilized has hindered the development of a more balanced sector. Nevertheless, small and medium scale commercial fish farms have begun to emerge in surprising numbers in some areas where land use regulations have been relaxed informally. This tendency indicates the potential for much more widespread, inclusive and equitable aquaculture development to occur if Myanmar's newly elected

government supports land governance reform to facilitate freedom of crop choice among farmers.

Freshwater fish trade in Chiangmai, Thailand: Patterns and challenges

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Freshwater fish trades in Thailand are largely under-studied and neither quantity nor pattern is known. This paper presents a study about fish trade patterns in local markets in Chiangmai, the main economic hub in northern Thailand. The study describes fish production, marketing channels as well as obstacles faced in trading of these freshwater fish, including those from aquaculture. The results show that only a few species of fish are traded in local markets, namely Nile tilapia, walking catfish, red tilapia, snakehead fish and stripped catfish. Fish collectors play a major role in the marketing channel, buying fish from Chiangmai and neighboring provinces and distributing them to wholesalers and retailers. However, the marketing channel of red tilapia is different from other species because it involves large-scale companies in the market chain, offering advanced capital to farmers and buying back products to the company for distribution. The study also reveals obstacles in freshwater fish trades including small profit margin due to high cost associated with fish farming, especially in Chiangmai. The cost of fish farming may be reduced through research on low-cost fish feed. Moreover, co-operation among fish farmers should be encouraged, in order to develop strategies to gain better prices.

Lessons on the development of Lake Chiuta transboundary fisheries co-management arrangement

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This paper presents challenges and prospects on the development of Lake Chiuta transboundary fisheries co-management (TFC). The lake is shallow with a mean depth of 5 m and is shared between Malawi and Mozambique. While from the early 1990s fisheries co-management arrangement was developed on the Malawian side, as of recent there have been a common understanding by the fishing communities to adopt the regime on the Mozambican side of the lake driven by a common goal of addressing fishing-related conflicts among the users from both Malawi and Mozambique and attaining sustainability in fish resource management. Fishing co-management was introduced on the Malawian side with formation of Beach Village Committees (BVCs) to represent interests of the fishing community while traditional leaders advanced fishing rules on the Mozambican side. The BVCs banned use of seines to sustain the fishery while the Mozambican traditional leaders allowed seining operations which, as fishers and researchers claim, resulted in resource decline. To address the conflicts a TFC arrangement was proposed by fisheries authorities from both sides in 2003. The TFC has gone through two phase including field-based coordination and collaboration; and signing of a formal agreement between Malawi and Mozambique. Apparently, by going through the two both phases, conflicts have now been addressed. Key lessons from the establishment of the TFC include need for use of traditional values and culture, policy on community participation; and willingness of parties to negotiate at community level. Effective TFC models for small-scale fisheries should always be community-driven.

Competing claims in a multipurpose recreational lake: mapping resource conflicts on Lake Kariba, Zambia/Zimbabwe

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Lake Kariba, which is shared by Zambia and Zimbabwe, is a transboundary man-made lake on the Zambezi River. Although the Lake was created primarily for hydro-electric power generation, it is now a multi-purpose recreational area which supports several economic activities that include capture fisheries (both large-scale commercial and artisanal), aquaculture (both finfish and crocodiles) and tourism (both consumptive and non-consumptive). These diverse activities have given rise to both intra-sectoral and inter-sectoral conflicts. This paper examines the nature of these conflicts as well as the existing framework for collaboration. Recommendations are also made on possible interventions that would enhance synergy and collaboration among the various stakeholders both at national and bilateral level.

Water-sharers: inter-sectoral fisheries governance issues and solutions on the Cauvery River, India

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Home to some of the world's most iconic rivers and large numbers of lakes, ponds, estuaries and canals, India is the second largest producer of inland fish in the world. The freshwater resources of India feature high biodiversity and endemism, collectively threatened by increasing numbers of invasive species, agricultural pollution, and habitat loss. Fishers and local communities that rely on inland water resources in India represent an equally wide-ranging human landscape, speaking over 300 languages and coming from diverse religious, economic, and social backgrounds. These communities face severe challenges regarding resource access and livelihood security in a rapidly changing governance system. Given these characteristics, establishing effective and equitable management of inland resources could seem an impossible challenge. Yet, in South India numerous fishing communities manage to combine traditional and formal management techniques in various ways, including through use of panchayat-style decision-making processes, government programs, and community cooperatives. We discuss these governance attributes, their benefits, and their constraints with a focus on the Cauvery River commercial, subsistence, and recreational fisheries and explore the ways in which these management structures address community participation and socio-political equality.

Understanding fishery conflicts in hilsa sanctuaries of Meghna River system in Bangladesh

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This study examines the causes of conflict and social tensions in hilsa sanctuaries of the Meghna River system in Bangladesh. The analysis shows that conflict in hilsa fishery are related to a number of factors such as increased competition over fishing space, irregularities in distribution of economic incentives. Conflicts in the fishery negatively affect the well-being of hilsa fishers and increased social tension in the communities. Thus a challenge for policy makers is to find a solution that benefits both the fishery conservation and poverty reduction. Based on the findings, the present study submits that co-management could be an effective solution for synergistic relationship among resources users and government which will ultimately lead to poverty reduction and fishery conservation.

Inter-sectoral governance of inland fisheries: a case study of Badagry Creek, Lagos State, Nigeria

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The challenges of governing Common Pool Resource (CPR) in which small-scale fishers operate are tremendous, thus exposing them to additional risks accentuated by conflicts beyond the already difficult terrain of fishing. An effective social order that encompasses traditional institutions and cultural and religious beliefs built over many centuries often ensures that fishing-related conflicts are often resolved amicably and within the existing fishing governance structure. However, inter-

sectoral governance of inland fisheries is often beyond the simple, sophisticated and traditional governance structure aided by long historical, cultural and traditional institutions that is well entrenched in the larger community of the society, in which the fishers are often considered as powerless. This case study shows that the traditional systems work effectively to reduce the fishing conflicts but are not able to deal with other inter-sectoral governance issues between the fishers and non-fishers. Transportation and tourism activities in Badagry Creek are perceived by the fishers to generate positive externality and, therefore, mutual cooperation exists between these sectors and the fishing community. However, the activities of small-scale fisheries and sand mining are known to generate negative externality to the fishers as the sound generated from the miners' tools from their practice of wet pit mining is believed to produce a huge noise effect which drives fishes away further offshore. Other negative effects of sand mining activities include river bank erosion, river bed degradation, river buffer zone encroachment and deterioration of river water quality. Recommendations made aimed at eliminating this conflict include prohibiting sand mining operation around the areas the fishers identified as fishing grounds and spawning floors for the fishes. In conclusion, the need for the state government to deploy scientific knowledge in formulating policies and guidelines that will steer mining activities towards an amicable operation with the fishing community is emphasised among others.

Intra- and inter-sectoral governance of inland fisheries – what have we learned?

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This presentation offers a synthesis of the experiences gathered around the world on the issues of inter-sectoral governance of inland fisheries. The lessons are drawn from 10 cases from different regions in Europe, Asia and Africa and include diverse settings that include river delta, alpine lake and urban wetlands. Accounts of intra-sectoral conflicts where different interests and positions in fishing were at odds with each other, were widely reported. However, cooperation was also common and even simultaneously occurring with the conflicting situations. Similarly, fisheries' struggles and their synergies with non-fishery sectors such as tourism industry, hydroelectricity generation, nature preservation and urban development was shown to create a far-reaching effect on the viability of the fisheries, both in terms of positive and negative impacts. What emerged are two points for further discussion that could provide alternative entry points for making sense of inland fishery's societal interactions and diagnosing its future trajectories: first, conflicts and synergy between different sectors may be evident in one situation, thus they are not mutually exclusive and may be representing two sides of the same coin. This recognition would call for a more balanced and less biased

appraisal of the situation. Secondly, and perhaps more importantly, what tips the scale between conflicts and synergies would lie in the higher-level governance aspirations and decisions that occur (or have occurred) beyond the immediate resource or fishery scale. We suggest that these historical or political considerations ultimately govern the sectoral fisheries interactions by way of 'meta-governance', i.e., governing of governance. Subsequently, the utility of this synthesis would hinge on teasing out such theoretical contributions as well as generating a useful analytical lens to inform each of the 10 inland fisheries governance cases compiled here.

Poster session

Conservation values of selected Bacolod City High School students for coral reefs ın Sagay Marine Reserve, Negros Occidental, Philippines

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Most studies on economic valuation take household heads as respondents since they earn money for the family and usually make most of the decisions. Other sectors of the society, especially the students or members of the youth, are rarely involved in these kinds of studies. Contrary to popular practices, this study considers the youth as the respondents of the survey. Through stratified and systematic random sampling, 400 respondents have been chosen from five public high schools. Data was gathered from 80 students per school through a group administered survey. The researchers have come up with a protocol to be used in order to ensure that data is collected in an unbiased, organized and systematic way. This study aims to determine the willingness-to-pay of students in selected public high schools in Bacolod City for the conservation of the coral reefs in Sagay Marine Reserve (SMR). Moreover, this study will also describe the coral reefs and identify its ecological and economic benefits and persistent threats; identify the top 3 reasons for their decision to pay or not to pay for the conservation of coral reefs in SMR and; identify the socio-economic factors affecting the students' willingness-to-pay. This study may be significant to the youth by amplifying their roles in the conservation of natural resources particularly coral reefs.

Subsistence aquaculture and experiences in mangrove rehabilitation and aquasilviculture livelihood project implementation in Partido Area, Philippines

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This paper described the status of aquaculture in Partido and the experiences in the implementation of the mangrove rehabilitation and aquasilviculture projects in the selected areas of the District.

Partido District has a total of 435.8 hectares of brackishwater pond, mariculture and hatchery facilities covering an aggregate of 245.51, 161.2 and 10 hectares respectively. Its over-all annual aquaculture productions were estimated at: 147,959 kgs for fishpond, 574,500 pcs for hatchery and 241,023 kgs (wet weight) for mariculture. Inadequate training opportunities, insufficiency of knowledge in aqua farming, flood and typhoons are the main issues that constraints aquaculture in the District.

The Mangrove Rehabilitation Project and Aquasilviculture Projects were implemented in Camarines Sur in 2012-2014 under the Philippine National Aquasilviculture Program to rehabilitate mangrove ecosystems and alleviate poverty in the area. The projects covered the selected sites in the municipalities of Caramoan, Garchitorena and Tinambac. For mangrove rehabilitation project, a total of 183,000 mangrove seedlings were replanted covering 61 hectares benefitting 125 fishing households and utilizing a total of PhP967,125 for the mangrove propagules collection and planting. The survival rate of replanted propagules posted more than 77%. For aquasilviculture project, a total of 16 units of aquasilviculture farm were distributed to the beneficiaries utilizing total of PhP 831,093 for fencing materials, labor support and farm inputs. Initial operation of aquasilviculture units showed promising results posting 85% mud crab survival rate with PhP17,050 gross revenue per unit.

The general subsistence nature of aquaculture in Partido highly justified the implementation of resource enhancement and livelihood promotion. The implementation of PNAP in the area complement the subsistence nature of aquaculture in Partido by increasing the level of awareness for environmental

protection, augmenting household income and showcasing sustainable aquaculture technology in the area.

Small-scale fishers as protectors of marine protected areas (MPAs) in Negros Occidental, Philippines

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The poster examines the potential of small-scale fishers as environmental protectors and as powerful allies in the implementation of marine protected areas (MPAs). This is one value of the small-scale fishers that is most often taken for granted. Three cases of small-scale fishers in the context of MPAs in three different local government units in Negros Occidental Province, Philippines were used. These include the Sagay Marine Reserve (SMR) in Sagay City, Danjugan Island Marine Reserve and Sanctuaries (DIMRS) in the municipality of Cauayan, and the Sipalay City Marine Reserve (SCMR). Survey data from three separate studies conducted in years 2008-2011 were revisited to draw new meaning and information, with supplement from focus group discussions (FGDs) and secondary data. Despite being poor and highly dependent on the fishery resources, the small-scale fishers in the three MPAs indicated that they value the fishery resources and the need for its protection and management to ensure food and income in the future. They want to be consulted on matters pertaining to the MPAs and to participate in their management. Their reported levels of participation differed by site from low participation to high participation. Participation in the management of the marine protected area seems to promote favourable attitude towards the MPA. By involving fishers more directly into the decision-making process and by encouraging their participation in the management since "step zero", they are more likely to agree

and comply with the rules and regulations, thereby increasing success of the MPAs. Moreover, knowing the factors that explains the level of acceptance of small-scale fishers of the marine MPAs can help further in developing policies toward the sustainability of MPAs.

Distribution of costs and benefits among selected local stakeholders in the establishment Suyac Island Mangrove Eco-Park in Sagay City, Negros Occidental

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Mangrove ecosystem is one of the most diverse and highly productive ecosystems but despite the benefits that the ecosystem can offer they were consistently undervalued and taken for granted in the coastal development process. Undervaluation of this ecosystem is one of the main reasons why they are susceptible to conversion and deforestation. Increase in appreciation of what mangrove ecosystem can offer as well as its dwindling population heightened different conservation programs that aims to protect and sustainably managed the resource. One of the highly documented conservation technique used is the community based ecotourism, this technique aims to conserve the resource while sustaining the well being of the host population by providing them livelihood without compromising the culture of the community. The success of this type of ecotourism is dependent on the support they would receive from different types of stakeholders of the protected areas. To ensure the success of the ecotourism the benefit that the stakeholders enjoyed must outweigh the costs they bear because of the conservation of the resource. And these benefits must be well distributed to the different stakeholders around the area. This study focus on the distribution of costs and benefits of the different local stakeholders of the Suyac Island Mangrove Eco-Park in Sagay City, Negros Occidental, local stakeholders in the coastal barangay of Taba-ao were divided into three strata: the private sector, the social sector and the public sector. Cost benefit analysis in each sector will be conducted in order to weigh whether or not the benefits received and costs incurred by these stakeholders were balanced.

Effects of different routes of vaccination against *Streptococcus agalactiae* in red hybrid tilapia fingerlingS (*Oreochromis* sp.)

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Streptococcosis is a disease that develops following infection by Streptococcus sp. It is a major problem for fish production worldwide, and it is associated with high economic losses. This study was aimed at investigating the effects of different vaccination route against Streptococcus agalatiae in Red hybrid tilapia fingerlings.

Ninety fingerlings were randomly divided into three groups, 1, 2 and 3 of 30 each. Two formalin- killed vaccine formulations were developed, feed based and spray. Group 1 was vaccinated using spray vaccine for 3 consecutive days in the week 1 and a booster dose for 3 consecutive days in the week 3. Group 2 was vaccinated once by using spray vaccine followed by a booster dose using the feed-based vaccine. While Group 3 served as a control group without any vaccination. All groups were challenged with 100 µL of ***S. agalactiae*** (109 CFU/mL) intraperitoneally. Following challenge, the fingerlings were observed for any clinical signs and mortality. Mucus samples of five fish from each group at sampling time were collected by using sterile swab at the surface of the skin. Gut-lavage fluid was also collected, and both samples were subjected to indirect enzyme- linked immunosorbent assay (ELISA) to determine the IgM antibody levels against ***S. agalactiae***. The results showed that the IgM antibody response in mucus and gut lavage fluids produced by the tilapia immunized with vaccination were not significantly different with each other even though different routes of vaccination were used.

Site directed mutagenesis of virulence-associated protease gene from *Vibrio harveyi* as live attenuated vaccine candidate against Vibriosis

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Vaccination strategy relies as one of the successful and reliable health diseases management for aquaculture industry. Among all type of vaccines available, live attenuated vaccine is more effective due to its ability to cause a self-limiting infection which mimics to the infection induced by the fully virulent pathogen. This study aims to develop a potential mutant variants of virulence associated protease gene of ***V. harveyi*** isolated from diseased grouper. Serine endoprotease (***vhs***) produced by this isolate is located in the periplasm and have separable functions as both protease and chaperone that might played an important role in its virulent activity. An overlapping PCR was employed to perform a site directed mutagenesis by deletion on a specific amino acid residue that represents a catalytic site of the protease gene. A total of six mutant variants consisting a single deletion (DS, DH and DD) and a double deletion (combination of two deletion in amino acid residue, DHDD, DHDS and DSDD) have been successfully developed. Theoretically, a deletion of the amino acid residue will influence the conformational protein and lead to down-regulation of this proteins. Evaluation of protease activity

by using a quantitative assay showed a mutant with double mutation sites recorded the highest relative protease activity compared to single mutation sites. Relative protease activity recorded by the mutant variants are 6.37% (DSDD), 4.89% (DHDD), 4.38% (DHDS) in double mutation sites, followed by 3.77% (DD), 3.99% (DH) and 2.18% (DS) in single mutation sites. Degree of reduction in protease activity from highest to the lesser are DSDD > DHDD > DHDS > DD > DH >DS. A significant difference ($p<0.005$) were observed between each mutant variants against native protease. This indicated that mutation by deletion of specific catalytic site might influence the conformational of protease protein, resulting in reduction of its activity. In future, construction of live-attenuated vaccine candidate will be further extended by using this mutant variant.

Seasonal gonad cycle, body composition and induced breeding of the silver therapon *Leiopotherapon plumbeus* (Perciformes: Terapontidae)

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The silver therapon ***Leiopotherapon plumbeus*** (Kner, 1864), a native fish species of Laguna Lake on southern Luzon Island, Philippines, is an important food fish which commands a good market price and is considered an emerging species for aquaculture. To obtain information useful for aquaculture and conservation management of this species, seasonal reproduction, body composition and the optimal method for induced spawning of silver therapon were investigated.

Wild and cultured fish specimens were obtained from July 2015 to March 2016 and their gonadosomatic index (GSI), protein and lipid composition of muscle tissues were determined. Mean monthly GSIs in both sexes of wild fish decreased

from July to December (female: 4.7–1.7%; male: 4.4–2.1%) and then increased thereafter. High mean monthly GSIs in both sexes of cultured fish peaked in September (female: 13.4%; male: 11%), and declined between November and January (female: 8.2–5.5%; male: 7.9–6.8%), but increased again in February and March (female: 5.6–10.2%; male: 5.1–5.3%). Muscle protein content was relatively constant, ranging from 59.6 to 67.8% and 54.2 to 61.3% of dry weight in wild and cultured fish, respectively. Muscle lipid content was more stable, but much higher in both sexes of cultured (males: 21.03.1%±; females: 19.12.8%±) than their wild counterparts (male: 13.11.6%±; female: 13.44.7%±). Based on spawning parameters, the combination of human chorionic gonadotropin (hCG) and Ovaprim (10 IU g^{-1} + 0.5 ml kg^{-1} BW) was the most effective hormone in inducing ovulation in silver therapon.

A photobioreactor for phosphorus removal in a recirculating aquaculture system

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In zero water exchange recirculating aquaculture systems (RASs), most nutrients are accumulated in the systems. Carbon and nitrogen can be removed out of the systems via transforming into gaseous forms of CO_2 and N_2. However, phosphorus

is still accumulated in the systems. The common form of phosphorus in RASs is soluble inorganic phosphate, which is actively taken up and stored by photosynthetic organisms, algae and cyanobacteria. In this study, the unicellular cynobacterium ***Synechocystis*** sp. was used for treatment of the phosphate in raw water from RAS by trapping all cells in a column photobioreactor. This photobioreactor was able to grow the cyanobacterial cells up to 6 mg chlorophyll ***a***/L. The photobioreactor was efficiently performed over 10 cycles of phosphate treatment from single inoculation with the average of 99% phosphate removal.

Determination of chemical composition and growth performance of common frog (*Rana ridibunda* Pallas, 1771) fed with commercially formulated pelleted carp feeds

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The market for frog and frog legs is of great interest in many countries of Europe and America because of their palatability and having a colour and taste similar to that of chicken meat. Frog meat is a delicate meal which you can find in luxury restaurants. Europeean countries prefer a more traditionally small 50–60 g. ***Rana esculanta*** and ***Rana ridibunda*** which are abundant in our country.

After seven months of feeding in earthen ponds, frogs that were fed with pellets gained a mean 85 g. (from 2,3 ± 1,28 g. to 84,77 ± 9,78 g.) body weight and they were harvested. In this study, chemical composition of pelleted feed (I) and common frog (II) were analyzed.

At the end of the trial, protein, lipid, moisture, ash, and carbohydrate were calculated for pelleted feed (I), and frogs which were fed with carp feeds (II). Results were; %32(I) and % 18,86(II) protein; % 21,21(I) and % 1,32(II) lipid; % 8,13(I) and % 78,04(II) moisture; % 9,93(I) and % 0,84(II) ash; %27,74(I) and %0,94(II) carbohydrate).

On the other hand, total essential amino acids for pelleted feed (I) and Carp feed fed frogs (II) were 16.978 and 10.550 mg./100 g., semi essential amino acids were 3.439 and 3.239 mg./100 g, and non-essential amino acids were 11.079 and 7.987 mg./100 g. respectively. Important amino acids, aspartic acid and glutamic acid were calculated as 996(I), 1.720 (II) mg./100 g. and 2.614 (I), 3.204,5(II) mg./100 g., respectively.

PUFA and some fatty acid compositions in carp pellets and pellet fed frogs were as follows; $C_{18:3}$ n-3 Linolenic acid (%1,830(I) and %2,610(II)), C20:5 n-3Eicosapentaenoic acid (%6,806(I) and %2,911(II), C22:6 n-3 Docosahexaenoicacid (%7,686(I) and%5,207(II)), PUFA (%28,242(I) and % 27,201(II)).

These results show that cultured frog have a higher quality chemical composition than wild frogs. Better growth performance was recorded for cultured frogs which were fed with pelleted carp feeds.

Phenotypic and genetic parameter for body conformation and body weight of four different sources of Asian sea bass (*Lates calcarifer*) culture in Thailand

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Asian sea bass is also known as Barramundi is one of the major brackish water aquacultured fish with the highest production in Thailand. In 2013, the Department of Fishery of Thailand implemented genetic improvement program for this species, with the goal of improving its productivity. At the beginning, this study aimed to understand the differentiation among fish stocks. We determined growth performance and body conformation of fish that was produced from 4 different origins; namely, Chachoengsao Fishery Research and Development Center (ChaCFRDC), Satun Fishery Research and Development Center (SatFRDC), and private hatchery at Phuket province (PhuH) that were delivered to Coastal Aquaculture Research Institute (CARI) and raised until they reached maturation. Brood fish from every origin were selected and put separately in spawning tanks. Both female and male were injected with LHRHa to induce spawning. Hormone injection was done in the same day at all locations. Only fry which hatched on same day were used and stocked and raised separately by its origin. During nursing period, fish were separated by size every 3-5 days to avoid cannibalism. Segregation was repeatedly done until the smallest fish reached 4 inches long. When the smallest size of fish reached 4 inches,, every size of fish from the same origin were combined and kept in the same tank for at least one week. Then fish from different origin were randomly picked, tagged and stocked in the same cage (communal

cage). Fish were raised in cages for 5 months and was individually weighed every month. Initial stocked and fifth month old fish were individually photographed and the body conformations were measured with selected software. Growth performance and possibly genetic correlation among parameters will be discussed.

Digestibility efficiency of seaweed and different alternative protein ingredients in diet of Pacific white shrimp (*Litopenaeus vannamei* Boone, 1931)

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Two experiments were set to study apparent digestibility of protein and energy in Pacific white shrimp (***Litopenaeus vannamei***). Shrimp, weight range from 4.5-4.97 g, were used in both experiments and were stocked at 20 individuals per aquaria of 18.5 x 36 x 18.5 inches. Three aquariums were assigned to each treatment of both experiments. Shrimp were fed at satiation level two times a day for 6 weeks. Experimental diets contained basal diet and tested ingredient at ratio 85:15 for the first experiment and 70:30 for the second experiment. Chromic oxide was used as inert marker in all experimental diet. In the first experiment, three type of seaweed, viz., ***Ulva rigida*** (Treatment 1)***, Acanthophora spicifera*** (Treatment 2***)*** and ***Halymenia durvillei*** (Treatment 3) were used as tested ingredients. After 6 weeks of feeding trial, weight gain and survival rate of shrimp did not show any significantly difference ($p > 0.05$) between the Treatment 1 and 2. However, shrimp in Treatment 3 was not accepted tested diet and all shrimp died before the end of testing period. Apparent protein digestibility in Treatment 1and 2 was 75.14 and 72.94 %

respectively, which was significantly different between the treatments. Moreover, there was no statistical significantly difference for apparent energy digestibility. In the second experiment, as many as 11 tested diets were evaluated. The Treatment 1 was fed basal diet and the Treatments 2-11 were fed diet composed of fishmeal (FM), Squid Meal (SQM), Krill Meal (KM), Shrimp head meal (SHM), Poultry meal (PM), Dehulled Soybean Meal (DSBM), Soy Bean Meal (SBM), Soy Protein Concentrate (SPC), Lupin Meal (LM) and Corn Gluten Meal (CGM). After 6 weeks of feeding, apparent protein digestibility of protein in SQM, CGM, DSBM, SBM, FM, SPC, LM, KM, SHM and PM was 86.6 ,88 and 86, 72.2 ,74.6 ,79.1 ,80.6 ,81.9 ,83.3 and 60.1% respectively. Apparent digestibility protein of SQM, CGM and DSBM was not significantly different among treatments ($p>0.05$) but was significantly higher ($p<0.05$) than other treatments. The current result from both experiments will be used in future study to develop appropriate diet for Pacific white shrimp culture in Thailand.

Identification and analysis of the envelope protein VP56 of shrimp white spot syndrome virus (WSSV)

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White spot syndrome virus (WSSV) is the causative agent of a disease that has led to severe mortalities of cultured shrimps all over the world. WSSV is an enveloped, ellipsoid, large, double-stranded DNA virus and it has a wide host range among crustaceans. Until now, at least WSSV 58 structural proteins have been identified. In addition, over 30 proteins were classified as envelope proteins within the structural proteins. VP56 was identified as one of WSSV envelope proteins, and the protein-protein interaction between VP56 and other WSSV envelope proteins was identified by far western blotting. In this study, neutralization experiment using recombinant VP56 could delay WSSV infection. These data indicate that VP56 participates in the WSSV protein complex that may be involved in WSSV infection. This finding may introduce another future way to prevent the outbreak of white spot in shrimp culture.

Effect of SYNLAC® aquaprobiotics on growth performance of Asian seabass (*Lates calcarifer*) and pacific white shrimp (*Litopenaeus vannamei*)

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Asian seabass (***Lates calcarifer***) and pacific white shrimp (***Litopenaeus vannamei***) are the economically important species of aquaculture in Southeast Asia and Taiwan. The objective of this study was to investigate the effect of feeding probiotic on the growth performance of seabass and white shrimp at commercial aquaculture farms. In the study of seabass, total of 62 thousands of seabass fry at average weight of 5.88g were randomly distributed into two groups fed basal diet or basal diet plus multi-strain probiotic SYNLAC®-aquaprobiotic at 10^6CFU/g of the feed. The result showed that SYNLAC®-fed group had significantly higher feed conversion efficiency compare to control group (86.17% vs 76.91, respectively). In the study of white shrimp, total of 0.5 million shrimp larvae were stocked and fed diet with SYNLAC®-aquaprobiotic at 10^6CFU/g of the feed. Growth performance was compared to the historical data of previous years. SYNLAC®-aquaprobiotic promoted growth rate, shorten growth cycle from 110 days to 76 days, increased the survival rate from 4.5% to 9.7%, and finally increased 67.6% annual production. From the results of this study, SYNLAC®-aquaprobiotic could be used in aquaculture as a dietary supplement to improve the growth performance of fish and shrimp.

Dietary α-linolenic acid and linoleic acid ratio affects the efficacy of fish-oil finishing diet in cobia

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Use of fish oil-containing finishing feeds at the final grow-out period to increase content of highly unsaturated fatty acids and health benefits of cultured aquatic animals has attracted much interests from the academic and practioners. Many factors have been linked to the efficacy of the finishing dietary practice. We reported here the results of a study evaluating the effects of dietary α-linolenic acid (LNA, 18:3n-3) to linoleic acid (LOA, 18:2n-6) ratio in the grow-out period on fatty acid deposition of the marine finfish cobia in the subsequent fish oil-containing finishing feeding. The experimental diets were formulated with LNA/LOA ratios between 0.1 and 2.0. A fish oil diet was used as the control. The experiment was carried out within a 10-week grow-out period in which the experimental diets were given and a subsequent finishing period of 8 weeks in which the fish oil-containing diet was given. The cobia fed with the diet with a low LNA/LOA ratio in the grow-out period had significantly higher concentrations of DHA in the muscle at the end of the finishing period. Dietary LNA/LOA ratio not only affected the fatty acid profile of the cobia in grow-out period, but also increased the efficiency of HUFA deposition in the subsequent finishing period.

Identification of the main proteins binding with reovirus directly in *Portunus trituberculatus* hemocyanin

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Swimming crab, ***Portunus trituberculatus*** (Miers, 1876) (Crustacea: Decapoda: Brachyura),is the most widely fished species of crab in the world. In recent years, disease outbreaks have caused massive mortality and a great loss to the swimming crab cultivation industry, and particularly from the outbreaks caused by the primary lethal pathogen of swimming crab ***P. trituberculatus*** reovirus (SCRV).

In the absence of acquired immunity and the ability to produce clonally derived immunoglobulins, swimming crab, like other invertebrates, rely on their effective cellular and humoral innate immunity to survive the microbiologically challenging and varied environment. In crustaceans, including swimming crab, major immune reactions take place in hemolymph. Recent studies have found hemocyanin in shrimp hemolymph has phenol oxidase and agglutination, hemolysis and other immunological activity in specific conditions. Hemocyanin is an important non-specific immune protein present in the hemolymph of both mollusks and arthropods. Hemocyanins are multifunctional proteins, responsible for oxygen transport and contributing to innate immunity through phenoloxidase-like activity. However, little is known about the interaction between the hemocyanin from swimming crab and SCRV. In this study, the binding protein of crude hemocyanin with SCRV was screened by viral overlay protein binding assay (VOPBA), identified

by coimmunoprecipitation. All the findings suggest that the interaction between SCRV and hemocyanin.

By applying VOPBA, an about 120 kDa protein in the crude hemocyanin of swimming crab was found to interact with SCRV. MALDI-TOF MS-MS analysis of the 120 kDa protein exhibited the homology to hemocyanin.

The interaction between hemocyanin and SCRV was further confirmed with coimmunoprecipitation. In this study, the binding protein of crude hemocyanin with SCRV was screened by VOPBA, analysed by MALDI-TOF MS-MS and identified by coimmunoprecipitation. Hemocyanins are multifunctional proteins, the application research of the hemocyanin has a well development prospect.

Effects of *Lactobacillus paracasei* on growth, physiological and immune responses, and survival to *Vibrio alginolyticus* in white shrimp, *Litopenaeus vannamei*

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Probiotic supplementation from live microorganisms is potentially helpful to prevent disease in aquaculture, thereby increasing production and decreasing economic loss. The study was to investigate the effects of dietary supplement with probiotics ***Lactobacillus paracasei*** (10^6, 10^7 and 10^8 cfu kg^{-1} diet) on growth

performance (weight gain and feed efficiency), physiological (haemolymph glucose, lactate and lipid) and immune responses (total haemocyte count (THC), phenoloxidase activity (PO), respiratory bursts (release of superoxide anion, O_2^-) and superoxide dismutase (SOD) activity), and survival rate in white shrimp (***Litopenaeus vannamei***) to ***Vibrio alginolyticus*** challenge. Results showed that the weight gain and feed efficiency obviously increased for ***L. vannamei*** supplemented with any dose of ***L. paracasei***. After 56 days of culture, shrimp fed the diets supplemented with 10^6, 10^7 and 10^8 cfu kg^{-1} ***L. paracasei*** had significantly greater weight gain and feed efficiency than the controls. Furthermore, shrimp fed the 10^8 cfu kg^{-1} diet maintained lower glucose, lactate, and lipid levels in response to ***V. alginolyticus*** challenge after 12~24, 24~36, and 24~48 hr, respectively. Significantly increased PO and respiratory burst levels were found in shrimp fed the diet supplemented with 10^8 cfu kg^{-1} ***L. paracasei*** under ***V. alginolyticus*** challenge after12~72 h. However, no significant difference in the THC and SOD were seen at any dose. Survival rates at 4~7 days of ***L. vannamei*** fed the diets supplemented with all doses of ***L. paracasei*** were significantly higher than the control shrimp challenged by ***V. alginolyticus***. It was therefore concluded that the growth, immune ability and resistance against ***V. alginolyticus*** infection were increased in ***L. vannamei*** fed the diet supplemented with 10^8 cfu kg^{-1} ***L. paracasei***.

Apolipoprotein B on *Trionyx Sinensis* liver cells is a putative receptor for Soft-shelled turtle systemic sepsis spherical virus (STSSSV)

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Soft-shelled turtle systemic septicemia spherical virus (STSSSV) is causative agent of serious diseases with high mortality in the cultured Chinese turtle ***Trionyx***

Sinensis. However, the mechanism of viral infection is poorly understood. In this study we searched for molecules that could participate in STSSSV infection of ***T. sinensis*** hepatocyte. By using viral overlay protein binding assay (VOPBA), STSSSV was found to bind to a protein of approximately 260 kDa. MALDI-TOF MS–MS analysis revealed that the protein shared the closest homology with apolipoprotein B-100, and blotting assay showed that anti-mouse apolipoprotein B could crossreact with putative ***Pelodiscus sinensis*** apolipoprotein B-100 (PApoB). The interaction between STSSSV and PApoB was further confirmed with coimmunoprecipitation. STSSSV infection in vitro could be blocked by PApoB-specific antibody. These findings suggest that PApoB might play a role in STSSSV infection.

Dietary organic acid supplementation enhances dry matter and mineral digestibility for giant grouper, *Epinephelus lanceolatus*, fed with high soybean meal diet

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The study was to evaluate the effects of dietary organic acid (butyrate and lactate) supplementation on growth, body composition and nutrient digestibility of giant grouper, ***Epinephelus lanceolatus***, fed high soybean meal diet. Basal diet containing soybean meal (replaced 40% fish meal protein) was supplemented with 1% butyrate or lactate. Basal diet without organic acid and all fish meal diet were used for comparison. A total of four experimental diets were each fed to triplicate groups of giant grouper (initial wt: 17.37 ± 0.18 g) in a recirculating rearing system for 8 weeks. After growth trial, nutrient digestibility of the fish were determined by using 0.5% Cr_2O_3 as an inert indicator. Fish fed with all fish meals diet had higher ($P<0.05$) weight gain than fish fed with the control diet and 1% lactate diet. Hepatic thiobarbituric acid reactive substance (TBARS) value was higher in fish fed the basal diet than other dietary treatments. Dry matter digestibility was higher in 1% butyrate and lactate supplemented groups than that in fish fed the control diet. Copper (Cu), zinc (Zn) and phosphorus (P) digestibility were higher in fish fed all

fish meal diet, 1% butyrate and lactate supplemented diets than that in fish fed the control diet. Fish fed with all fish meals diet and 1% lactate supplemented diet had higher calcium (Ca) digestibility than fish fed with the control diet and 1% butyrate supplemented diet. The results indicated that soybean meal-replaced fish meal protein in diet caused the depression of growth and nutrient digestibility of giant grouper. Nutrient digestibility but not growth of the fish was improved when the fish fed diets with 1% butyrate or lactate.

Influences of whey or L-tryptophan on growth performance, immune response and disease resistance of barramundi, *Lates calcarifer* (Bloch) against *Aeromonas hydrophila* by oral administration

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The effects of dietary L-tryptophan (Trp) and whey on growth performance, immune response, and disease resistance against *Aeromonas hydrophila*. Isonitrogenous (45%) and isolipid (10%) diets were accessed to meet the nutritional requirements of barramundi with 0.1% Trp (0.1%T), 0.5% Trp (0.5%T), 1% Trp (1%T), whey (16.9%, W), or nothing (as controls) added. After feeding experimental diets for 58 days, the results indicated Trp supplementation significantly decreased growth performance as a result of feed intake inhibition, but no significant differences in growth performance and feed intake were found in the W group compared to controls. Brain serotonin has significantly increased in the meal contain whey and 1% Trp, but there were no decreased cannibalism found in fish survival. However, W and 1%T were having good expression in lysozyme activity, respiratory burst and Mx gene expression in head kidneys after nerve necrosis virus (NNV) injection, especially W which had significantly lower cumulative mortality than controls and others. Therefore, the diet added whey (16.9%) is concluded as a good way to improve immune response and disease resistance in barramundi without affecting their growth performance.

Effects of probiotic *Bacillus subtilis* E20 on growth performance and feed utilization of kelp grouper *Epinephelus moara*

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Kelp grouper, ***Epinephelus moara***, is an important aquaculture species in Pacific-Asia countries. Its aquaculture production has been increased due to its high demand and market price. However, poor growth of farmed kelp grouper ***E.moara*** is one of most concerns due to cost production and economic profit. Therefore, the aim of this study was to improve the growth performance of ***E. moara*** by using probiotic ***Bacillus subtilis*** E20 via oral administration. The kelp grouper ***E. moara*** were fed the diets incorporated with probiotic ***B. subtilis*** E20 at 0 (control), 10^8, 10^9, and 10^{10} cfu kg^{-1} of feed for 8 weeks; and then the growth performance indices and feeding efficiency (FE) were evaluated. The results showed that grouper fed a diet containing ***B. subtilis*** at 10^9 cfu kg^{-1} had significantly higher FE (0.91±0.02) than that of control group (0.78±0.06). However, no significant difference in percent weight gain (PWG) and specific growth rate (SGR) was found among treatments. The obtained results indicate that the probiotic ***B. subtilis*** E20 can be used suitably to improve growth performance and feed utilization of aquacultural kelp grouper ***E. moara*** at dose of 10^9 cfu kg^{-1} of feed.

Characterization of reproductive development in giant grouper (*Epinephelus lanceolatus*) with gonad specific expressed gene markers

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The groupers of genus ***Epinephelus*** have long been known as protogynous teleost, which means they can change sex from female to male in their life cycle when reach a specific body size. This process can take about 10 years and has become an obstacle for breeding. To study differentiation and development of gonads is important for understanding the precise mechanism of sex change in giant grouper. Therefore, this study mainly characterizes the ontology of primordial germ cells (PGCs) and gonadogenesis by cloning the potential germ cell markers Vasa and Piwi from the giant grouper, ***Epinephelus lanceolatus***. Vasa is an RNA binding protein with an RNA-dependent helicase. Phylogenetic tree analysis and comparisons of the deduced amino acid sequence of giant grouper Vasa (ggVasa) with other vertebrates has revealed the high homology (73-85%) and is belonged to marine teleosts. Piwi which encodes regulatory proteins is involved in the piRNA pathway related to the sex differentiation. Both of the genes have been reported to be responsible for germ cell development and can be potential gene markers to trace the gonad development in giant grouper. From the results, these marker genes are highly expressed in gonad, and increase with gonadal development. IHC staining shows that ggVasa distributes in the cytoplasm of germ cells. Whole-mount in situ hybridization and immunostaining data indicate that PGCs migrate to germinal ridge at 3 day post fertilization. The present study has demonstrated the characterization and evaluation of potential germ cell markers Vasa and Piwi, and their expression in early larvae stages, gonadal development of groupers. Together, these findings are the first step to understand germline specification and genes related to gonadogenesis in giant grouper.

Effects of dietary L-carnitine and lipid supplementation on growth performance, survival and body composition of grouper larvae, *Epinephelus lanceolatus*

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A feeding experiment was conducted to study the effects of dietary L-carnitine and lipid levels on the growth, muscle and liver fatty acid profile of ***Epinephelus lanceolatus*** larvae (initial mean weight 0.136 g). Two levels of supplemental lipid, 5 or 14% were tested in combination with three levels (0, 0.5 and 1%) of L-carnitine. Each diet was randomly assigned to three replicate groups of groupers larvae for 42 days. The fatty acid compositions of grouper larval muscle and liver were influenced by dietary L-carnitine and lipid. The n-3 high unsaturated fatty acids (n-3 HUFA) of muscle and liver of grouper larvae fed diets supplemented with L-carnitine were significantly lower than that of grouper larvae fed diets without L-carnitine. The grouper larvae fed diets containing 14% lipid had the significantly higher weight gain than those fed diets containing 5% lipid. The grouper larvae fed diets containing 5% lipid and without L-carnitine supplementation had the worst weight gain. The grouper larvae fed diets containing 14% lipid and supplemented with 0.5% L-carnitine had the highest weight gain among treatments. The hepatosomatic index (HSI) of grouper larvae increased with dietary lipid increasing, while HSI of grouper larvae decreased with the increasing dietary L-carnitine. Lipid contents of muscle and liver of grouper larvae increased with increasing dietary lipid level, whereas lipid levels of muscle and liver of grouper larvae fed diets supplemented with L-carnitine decreased. The muscle protein content significantly increased with increasing dietary L-carnitine. The survival of grouper larvae fed diet containing 14% lipid was significantly higher than that of grouper larvae fed diets containing 5% lipid. This study revealed the positive effects of dietary L-carnitine supplementation on growth of grouper larvae.

Sodium alginate retarding the impact of hypothermal stress in white shrimp, *Litopenaeus vannamei*

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The changes in the physiological responses including haemolymph norepinephrine, glucose, and lactate were detected of white shrimp, ***Litopenaeus vannamei***, fed with diets containing sodium alginate at 0 mg kg^{-1} (the control diet, C) and 1000 mg kg^{-1} (the trial diet, T) for 7 days; and then were transferred from 28°C to 22 (hypothermal stress; C-22, T-22) and 28°C (the optimal temperature; C-28, T-28) respectively within 96 hours. The susceptibility of those parameters against pathogen infection within 96 hours were investigated. The results showed that haemolymph norepinephrine level of shrimp in T-28 treatment was significant lower than C-28 at initial, and those in T-22 treatment showed no significant difference within 96 hours of exposure compared to individual C-28 at the same sampling time. The content of glucose and lactate under hypothermal stress for 24 hours revealed no significant difference between T-22 and C-28 treatments, and recovered to the initial level after 48 hours. The susceptibility of the shrimps fed with the diets containing sodium alginate for 7 days followed with the injection of ***Vibrio alginolyticus*** showed no significant difference between T-22 and C-28 treatments within 96 hours of exposure, and in addition, those in C-22 treatments showed significantly decreased levels compared to the other treatments. These conclude that ***L. vannamei*** fed with diet containing sodium alginate retard the effects of hypothermal stress on physiological response and susceptibility to pathogen.

Studies on fungi and bacteria infection to snakehead (*Channa striata*) culture in the Mekong Delta Vietnam

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Series of studies were conducted to to identify pathogens in snakehead cultured in Mekong Delta, Vietnam. First, we studied the classification of fungus isolated from juvenile, and secondly determine whether ***A. hydrophila*** is a hemorrhagic pathogen in snakehead fingerlings. A total of 296 samples, showing lethargic swimming behavior, feeding reduction, mucus mass, red spots and white spots on the body and threadfin, were colected from the ponds from March 2010 to August 2012. Our results indicated that fungi were prominent in the first three months of culture period, of which, ***Achlya*** appeared only in the first sampling time. Three genera of fungi, namely, ***Acremonium***, ***Fusarium*** and ***Geotrichum*** were firstly isolated from cultured snakehead. Bacteria including ***Aeromonas***, ***Edwardsiella***, ***Streptococcus*** and ***Pseudomonas*** appeared at a frequency of 54.3, 17.3, 14.8 and 13.6%, respectively. We used morphological characteristics, unsexual pre-productive process of fungi, expressed sequence tag (EST) and BLAST search were used to identify ***Achlya***; ***Achlya bisexualis*** is isolatedfrom our infected snakehead. On the other hand, bacterial disease is prominent in the fingerling stage, in which fish showed clinical signs such as floating and impaired swimming, hemorrhagic and ulcerative lesions on the body, and protruding scales.A strain of ***A. hydrophila***, designated as CD1012, was isolated from these snakeheads. The pathogenicity of this isolate was assessed using intraperitoneal injection in snakehead fingerlings. Inoculation with ***A. hydrophila*** CD1012 was associated with clinical signs similar to those in naturally infected snakehead. Mortality rate based on LD_{50} was $1.16´10^5$ CFU/fish. Molecular characterization demonstrated that the same bacterial strain was re-isolated from the artificially infected fish. Thus, ***A. hydrophila*** CD1012is pathogenic to snakehead fingerlings.

Tubulin mediates *Portunus trituberculatus* reovirus infection

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Reoviruses are widespread and infect a broad range of hosts. To date, no study has been reported on an aquatic reovirus receptor. By using viral overlay protein binding assay (VOPBA), swimming crab ***Portunus trituberculatus*** reovirus (SCRV) was found to bind to a protein of approximately 550 kDa. MALDI-TOF MS–MS analysis revealed that the protein shares the closest homology with β-tubulin. Mouse membrane proteins were tested by western blot with antibodies against the SCRV-binding protein and mouse tubulin, and uniform positive bands were obtained. The results indicated that the SCRV-binding protein was tubulin. The interaction between tubulin and SCRV was further confirmed with coimmunoprecipitation. SCRV infection in vitro could be blocked by a tubulin-specific antibody. The role of tubulin as a major cell surface protein has been reported previously. These findings suggest that tubulin mediates SCRV infection and may function as a receptor for SCRV.

Observation of the performance of wild jalkapur (*Pseudeutropius murius batarensis*) fry in ponds at Trishuli, Nepal

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Jalkapur (***Pseudeutropius murius batarensis***) is a valuable indigenous migratory fish species, popular for its taste, food value and sporty nature. It is well distributed in snow-fed river of mountain regions of Nepal, northern India and Bangladesh to a lowest altitude of 570 msl. Their natural population has been reported to be declined from various natural habitats due to anthropogenic activities and habitat destruction, thus the species is enlisted under threatened category. In view of its aquaculture potential and e conservation value, domestication efforts of Jalkapur have been initiated at Fisheries Research Centre, Trishuli, Nepal. Jalkapur fry with an average weight of 1.0 g were collected from Trishuli River and reared in 8 m^2 earthen ponds which continuously receive water from Trishuli River. The fishes were fed with crumble trout feed, earthworm and white grubs with boiled tilapia meat as an alternate feed. Preliminary observation revealed that the optimum temperature for the growth and survival of Jalkapur ranged from 18°C to 23°C and the lowest temperature for its survival is 14°C. Fry survived and grew well at 6.5 to 8.6 mg/L of dissolved oxygen and 6.5 to 8.7 water pH. Feed refusal and fish mortality was observed at temperature below 12°C during November to January. Fish became highly vulnerable to fungal infection at low water temperature (<12°C) and over-handling of fish during winter months synergized the mortality. Mean body weight of fish reached to 80.0 g with a mean growth rate of 0.167 g/day in a rearing period of 13 months. Environmental manipulation (temperature control) and feed development for the rearing of Jalkapur in captive conditions is the prime focus area of research.

Effects of irradiated chitosan on growth, immune response and survival of Nile tilapia (*Oreochromis niloticus*) juveniles

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In aquaculture, use of harmful chemicals to minimize the incidence of diseases in farmed aquatic animals is not encouraged. Hence natural, organic immunostimulants have been promoted for aquatic animal health management. This study investigated the effects of irradiated chitosan on the growth, immune response and survival of Nile tilapia. Uniformly-sized tilapia juveniles (30 pcs/tank) were randomly stocked in triplicate tanks each for (a) Treatment where fish were fed a diet containing 10gKg^{-1} irradiated chitosan and (b) Control where fish were fed the same formulated feed but without irradiated chitosan. Growth and food utilization parameters were noted. Specific Growth Rate (SGR), Mean Weight Gain (MWG) and Feed Conversion Efficiency (FCE) were analyzed using t-test. The efficacy of irradiated chitosan as an immunostimulant was measured using total immunoglobulin (Ig), lysozyme andnitroblue tetrazolium (NBT) assays while its antimicrobial ability was assessed through bacterial challenge tests using a virulent strain of ***Aeromonashydrophila***. Results showed that irradiated chitosan in the feed do not retard the growth of ***O. niloticus*** as seen in a higher SGR (1.41+0.14% per day) and MWG (5.07 +1.66g) however there was no significant difference between treatments. FCE (0.52+0.05) was higher in fish fed diet with irradiated chitosan indicating better feed performance. There was likewise an increase in the immune activity in the Treatment group especially from the 21st day of feeding. The survival percentage of ***O. niloticus*** during the bacterial challenge test was significantly higher in the treatment group (86.95%) compared to the control (50%) after 14 days of oral administration. In conclusion, 10 g kg^{-1} of irradiated chitosan in the fish diet enhances the growth, immune response and survival of Nile tilapia (***O. niloticus).***

The effects of using calcium silicate material in shrimp culture

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This study examined how Ceraclean, a porous material made of calcium silicate improves the productivity of shrimp culture. The experiments were divided into 2 groups (the control and Ceraclean added), using each of 4 replications. 20 shrimps (***Litopenaeus vannamei***) were cultured in 350 L tank. For the Ceraclean group, 60 mg/L of Ceraclean was added to every 3 days. After 60 days, ADG (average daily growth (g)) and survival rates of the shrimps were examined. The study examined the effects of Ceraclean on BioFloc technology that has been attracting attention as a new culture technology. Using 60 shrimps kept in 500 L tank, 4 test groups (including control, Ceraclean, BioFloc, and Ceraclean+BioFloc groups) were examined by ADG and survival rate after 60 days. 60 mg/L of Ceraclean was added every 7 days to the Ceraclean and BioFloc+Ceraclean groups.

The calcium concentration was found to be stabilized at a high level for the Ceraclean group compared to the control. ADG of the shrimp increased by 0.02 g: 0.060.02± in the control group while 0.080.02± in the Ceraclean group, and survival rates (%) increased by 24.2%: 37.520.6± in the control and 61.717.6± in the Ceraclean group. DG were 0.080.01± in the control, 0.090.01± in the Ceraclean, 0.090.01± in the BioFloc, and 0.100.01± in the Ceraclean+BioFloc, and survival rates (%) were 63.55.1±77.1 ,1.2±74.5 ,9.7±, and 81.53.4±, respectively. This data indicates that using BioFloc technology and Ceraclean improved ADG and survival rate compared to the control, by 0.02 g and 18%, respectively.

These results indicate that using Ceraclean in shrimp culture could accelerate growth of shrimp and also improve survival rate.

Developing feed formulation for snakehead (*Channa striata*) culture

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Traditional methods for snakehead ***Chana striata*** culture in Vietnam involved catching wild juveniles from the river,holding, and feeding them on trash fish collected from the wild. Conversion of trash fish into commercial pelleted feed for snakehead is urgently needed. We conducted series study to a) optimize the weaning protocol to enable hatchery-reared fish to adapt to formulated feeds, b) determine protein, lipid, and energy requirement for grow-out stage, c) assess digestibility of different feed ingredients, d) develop formulated feeds that maximize the amount of plant proteins to reduce fish meal usage, and e) replacement of fishmeal by soybean meal in supplemented with soluble fish attractant and, alpha-galactosidase and mannan oligosaccharides to enhance the immune system of snakehead. Results showed that the optimal weaning period for snakehead in the hatchery was 17 days from post-hatching, and replacement of 10% of low value-fish with formulated feed for 10 days. Hatchery-reared and weaned snakehead were further used in laboratory feeding trials to identify the maximum levels of soybean meal, rice bran and cassava meal, and soybean protein concentration as replacements for fish meal in snakehead diets. Results showed that, up to 40% of fish meal could be replaced by plant proteins in grow-out diets. Grow-out trials in fish pond showed that there was no significant difference on fish growth as well as fillet sensory quality between fish fed new formulated diets and trash fish.

Effects of different routes of vaccination against *Streptococcus agalactiae* in red hybrid tilapia fingerlings (*Oreochromis* sp.)

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Streptococcosis is a disease that develops following infection by ***Streptococcus*** sp. It is a major problem for fish production worldwide, and it is associated with high economic losses. This study was aimed at investigating the effects of different vaccination route against ***Streptococcus agalatiae*** in red hybrid tilapia fingerlings.

Ninety fingerlings were randomly and equally divided into three groups, 1, 2 and 3h. Two formalin-killed vaccine formulations were developed, feed based and spray. Group 1 was vaccinated using spray vaccine for 3 consecutive days in the week 1 and a booster dose for 3 consecutive days in the week 3. Group 2 was vaccinated once by using spray vaccine followed by a booster dose using the feed-based vaccine. While Group 3 served as a control group without any vaccination. All groups were challenged with 100 µL of ***S. agalactiae*** (10^9 CFU/mL) intraperitoneally. Following challenge, the fingerlings were observed for any clinical signs and mortality. Mucus samples of five fish from each group at sampling time were collected by using sterile swab at the surface of the skin. Gut-lavage fluid was also collected, and both samples were subjected to indirect enzyme-linked immunosorbent assay (ELISA) to determine the IgM antibody levels against ***S. agalactiae***. The results showed that the IgM antibody response in mucus and gut lavage fluids produced by the tilapia immunized with vaccination were not significantly different among each group.

Induced spawning of Philippine silver therapon, *Leiopotherapon plumbeus* (kner, 1864) using various hormones

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The silver perch, ***Leiopotherapon plumbeus,*** locally known as ***Ayungin***, is an endemic freshwater fish that is commercially valuable as it commands a high price in the local market. Local ***L. plumbeus*** stocks are observed to be depleting due to excessive fishing and other potential causes such as predation by invasive alien species. Hence, there is a need for an induced breeding protocol to propagate silver therapon and conserve what remains of the fishery resource. In this study, 60 females (total length or TL: 108.5±11.8 mm; total body weight or TBW: 20.0±5.9 g) and 120 males (TL: 95.9±10.3 mm; TBW: 17.9±4.4 g) were distributed into different treatment groups and injected once intra-muscularly with various hormones. Different dosages of human chorionic gonadotropin (HCG), luteinizing hormone releasing hormone analog (LHRHa) and salmon gonadotropin releasing hormone (sGNRH) were tried and assessed to identify the most effective dosage and hormone that could result to high ovulation, fertilization, and hatching rates. For sGNRH, 20, 30 and 40 µg/kg body weight (BW) were the doses used while 10, 20 and 30 µg/kg BW were used for LHRHa. The dosage used for HCG was 50 IU/g BW. Results showed that the use of 20 µg/kg BW sGNRH gave high fertilization and hatching rates. However, for the ovulation rate, 20 µg/kg BW sGNRH showed no significant difference when compared to the other dosages of hormones. The result of this experiment would provide an efficient breeding protocol for the local fishermen, so that they can produce and supply quality seed of this economically important fish species on demand.

Carp brood stock management in private hatcheries of Nepal

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Aquaculture is rapidly expanding in Nepal and in such case access to adequate quality seed is the basis for sustainable aquaculture development. Constant efforts have been made to encourage private sector for the production of carp seed to fulfill the required demand. A survey of 40 private fish hatcheries was conducted from different regions (Eastern-9; Central-19, Western-6, Midwestern-3 and Farwestern-3) representing 15 districts of Terai and inner Terai to assess the status of broodstock management and their potential for seed production from 2009 to 2013. In Nepal three indigenous carps, viz., rohu (***Labeo rohita***), mrigal (***Cirrhinus mrigala***) and bhakur (***Catla catla***); and four exotic carps, viz., grass carp (***Ctenopharyngodon idella***), silver carp (***Hypophthalmichthys molitrix***), bighead carp (***Aristichthys nobilis***) and common carp (***Cyprinus carpio***) are widely cultivated, which contribute more than 95% in total aquaculture production. Normally stocking is done 1500-2000 kg/ha with species composition of 50-60% surface feeder, 20-30% column feeder and 15-25% bottom feeder in polyculture. While 62.5% hatcheries resort to stocking of 1500-2000 kg/ha, 20.0% hatcheries stock higher biomass of 3000 kg/ha and 7.5% hatcheries goes for lower stocking of 1000 kg/ha. Water depth varies from 1.5 to 2 m. Ponds are fertilized weekly or fortnightly using organic and inorganic fertilizers. Rice bran, maize, wheat flour, soybean flour and oil cake, especially mustard oil cake are used as feed. Brood fish are fed at 3-5% body weight daily. Almost all hatcheries raise their own stock of brood and often condition of such brood is not good due to poor management and inbreeding depression, which result poor reproductive performance. Though some hatcheries faced problems of bacterial, fungal and protozoan infections, the parasitic infestations due to ***Argulus*** and ***Dactylogyrus*** were most common. Further, studies are recommended to overcome constraints on carp brood stock management.

In situ dig-labeling, loop-mediated DNA amplification (ISDL) for highly sensitive detection of infectious hypodermal and hematopoietic necrosis virus (IHHNV)

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Infectious hypodermal and hematopoietic necrosis virus (IHHNV) is also known as ***Penaeus stylirostris*** densovirus (PstDNV). Since it is listed as a reportable crustacean disease by the World Organization for Animal Health (OIE), many countries require testing for IHHNV in shrimp stocks imported for aquaculture, necessitating rapid and highly sensitive detection methods to guarantee and maintain absence of IHHNV in traded stocks. Here we describe a new, highly sensitive method for detection of IHHNV in shrimp tissues. It involves ***in situ*** loop-mediated DNA amplification (IS-LAMP) employing digoxigenin-11-dUTP (DIG-dUTP) as part of the deoxynucleotide triphosphate (dNTP) mix. This resulted in DIG-labelling of the DNA amplicons (i.e., ***in situ***, DIG-labelling LAMP or ISDL) allowing direct ***in situ***, immuno-histochemical detection of IHHNV using an anti-DIG antibody conjugated with alkaline phosphatase, and eliminating the lengthy hybridization step of conventional ISH. The target region for the method is at the 3'end of the

IHHNV genome that has been reported least likely to give rise to endogenous viral elements (EVE) in the shrimp genome. When compared to the results for IHHNV detection by conventional ***in situ*** hybridization (ISH) using a DIG-labelled oligonucleotide probe, signals from the ISDL method were stronger and also gave positive results with some tissues unreactive by the conventional ISH method. Additional comparison of the two methods revealed that the proteinase-K digestion step needed for normal ISH was unnecessary for ISDL. This further shortened the assay time and improved the tissue integrity necessary to clearly indicate the location of positive hybridization signals. The ISDL method gave no cross- reactions with tissues of shrimp infected with other common pathogens, and the total time needed to carry out ISDL was one-third of that needed for conventional ISH.

Effects of illipe oil-crude palm oil ratios on the growth performance, body composition and fatty acid profile of juvenile Malaysian mahseer, *Tor tambroides*

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Illipe is one of the riverine fruits that are commonly consumed by Malaysian mahseer ***Tor tambroides*** in their natural habitat. This study was performed to investigate the effects of illipe oil (ILI) and its replacement ratio with crude palm oil (CPO) on the growth performance, body composition and fatty acid profile of juvenile ***Tor tambroides***. Five test diets containing varying ILI-CPO ratio (100:0, 75:25, 50:50, 25:75 and 0:100) were fed to ***T. tambroides*** juveniles (2.09 ± 0.12 g) for 12 weeks in triplicate groups. Similar survival, growth performance, body indices,

lean portion and body composition results were observed among juveniles fed on different dietary ILI-CPO ratios. However, juveniles fed illipe oil free diet had a significantly higher (P<0.05) HSI than those fed on a mixture of 25% illipe oil and 75% CPO. Juveniles fed on 100% illipe oil contained significantly higher (P<0.05) ash compared to those given 100% dietary CPO. A significantly higher (P<0.05) lipid retention was found in fish given 0% dietary illipe oil than those given 50% dietary illipe oil. A significantly higher (P<0.05) gross energy retention was also found in juveniles fed illipe oil free diet. Different tissue fatty acid compositions and retentions were found in juveniles fed various dietary ILI-CPO ratios. The best fatty acid composition was found in the tissues of juveniles fed illipe oil free diet. The overall results of this study indicated that illipe oil was not superior than CPO as a dietary lipid source for ***T. tambroides***.

Sperm quality from regenerated testis of Red Tailed Mystus

Hemibagruswyckioides **(Chaux and Fang, 1949)**

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The objective of this study was to compare the sperm motility, duration, density and quality of original and regenerated testis of Red tail Mystus ***hemibagrus wyckioides*** (Chaux and Fang, 1949) by artificial breeding and histology The study was done at Pitsanuloak Inland Fisheries Research and Development Center, Pitsanuloak province from June 2010 to August 2011. Results showed that the Red tail testis can regenerated within one year it has been removed. Sperm motility of original and regenerated testis were 73.88±13.88 and 74.39±10.29%, sperm duration were 429.45±129.12 and 418.73±163.68 sec., sperm density were

1.59±0.38×10^9 and 1.57±0.30×10^9 cell/ml, fertilization rate were 78.20±4.05and78.60±4.48%, hatching rate were 77.02±2.94 and 77.23±2.91%, and survival rate were 89.29±2.52 and 89.51±2.58 %, respectively. All parameters were not significant ($p>0.05$). Histology of heterogeneity showed that the regenerated testis of Red tail still have testicles structure intact, and the cell still produce spermlike original testis. Results of this study indicate the ability of Red tail to regenerate testes after gonadectomy which could be an alternative way for artificial breeding of this species without sacrificing male broodfish.

Status of pangasius culture in Nepal

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Pangasius (***Pangasius hypothalamaus***) culture in subtropical and tropical climate of southern Nepal has been initiated by farmers since last few years. Pangasius fries are bought from India fry vendor. Stocking density varies from 5 to 9 fries per m^2. Pond depths are maintained about 1.5 m. The growing period is 7 month and above and desirable marketable size is 800 g. Most of the farmers use home-made mass feed, commercial farm use extruded pellet feed and mixture of extruded pellet and general pellet feed. The productivity ranges from 70-90 ton/ha with extruded feed and 20-30 ton/ha from local farm made feed. The average FCR for extruded pellet feed is 1.6 and local pellet feed is 2.5. The challenges observed are lack of regular supply of seed, winter kill and stresses due to multiple netting and harvest for sale from same pond. Some of the basic requirements for the development of pangasius culture in Nepal are: development of pangasius hatchery, regular supply of pellet feed, culture cycle to avoid winter mortality.

Genetic relatedness of broodstock of striped catfish, *Pangasianodon hypophthalmus*

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A broodstock management plan was designed for the striped catfish (***Pangasianodon hypophthalmus***), based on multi locus genotypes of six microsatellite loci (two panels of triplex PCR). The broodstock included a total of 98 pit-tagged mature striped catfish from five fisheries stations (four Inland Fisheries Research and Development Center and Aquaculture Genetic Research and Development Center) in Thailand. The genetic variation within stocks was relatively low (A=3.170.75-± 1.67±5.00; A_e=2.38±0.99±2.89-0.87; A_r=3.14±1.40±4.08-0.72; H_o=0.484±-0.179 0.378±0.756; H_e=0.553±0.123±0.647-0.187). The genetic relatedness (r_{xy}) was used to identify the unrelated pairs wherein a minimum value of r_{xy} for half-sib family (r_{xy}= -0.355) was considered as a critical value of unrelatedness. The average r_{xy} within stocks (0.1172.56±0.286-2.64±) was relatively high compared to the overall average r_{xy} (-0.010±0.279). The results suggest that the breeding pairs should be carefully selected based on low genetic relatedness to avoid inbreeding.

Comparison of VHSV susceptibility in olive flounder by the different infection manner

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Viral hemorrhagic septicemia virus (VHSV), genogroup Iva is highly infectious to cultured olive flounder, ***Paralichthys olivaceus***. Mortality due to VHSV infection in olive flounder usually appear during cold-water seasons at 8 to 15 ˚C.. VHSV infection can cause mortality as high as 90% resulting in serious economic losses to the aquaculture industry. In this study, we investigated the virus susceptibility at 10˚C infected with intramuscular (IM) injection ($10^{2.5}$, $10^{4.5}$, $10^{6.5}$ and $10^{8.5}$ $TCID_{50}$/100μL/fish) and immersion ($10^{3.5}$, $10^{5.5}$ and $10^{7.5}$ $TCID_{50}$/mL) in olive flounder. Results showed that olive flounder were highly susceptible to the virus, showing 90 to 100% mortality in IM injected group, and 0 to 70% mortality in immersion group. Higher cumulative mortality was observed in IM injection group than immersion group. The VHSV titration in gill, muscle, brain, spleen, kidney, and heart of experimentally VHSV-infected flounder was estimated. The VHSV infectivity was variable in each tissue, and ranges from $10^{4.9}$ to $10^{8.8}$ and $10^{5.5}$ to $10^{8.3}$ $TCID_{50}$/mL on IM injection and immersion group, respectively. The high VHSV infectivity was found in kidney and spleen followed by heart, muscle, brain and gill. Furthermore, VHSV infectivity in target tissues of VHSV-infected flounder have similar patterns, inspite of different doses of VHSV infection. It is suspected that the exposure-dose of VHSV might be insignificant for the onset of VHS epizootics and mortality. Further studies are needed to quantify VHSV in fish organs and to interpret the VHSV infection process and interaction between VHSV and host organs.

Investigation of VHSV infectivity titer in blood of VHSV-infected olive flounder, *Paralichthys olivaceus*

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Viral hemorrhagic septicemia (VHS) is one of the most serious viral diseases affecting cultured olive flounder (***Paralichthys olivaceus***). VHSV, the etiological agent of VHS, causes an acute and systemic disease during cold-water temperature at 8 -15 ˚C. VHSV from diseased fish can be isolated from the hematopoietic organs such as spleen and kidney, in which has been considered as the main target of VHSV. In addition, the blood vessels have been suspected as one of the main targets of VHSV. In this study, we estimated the levels of VHSV infectivity during 10 days post infection (d.p.i) at 10 ˚C. The olive flounder was exposed with VHSV by IM injection ($10^{4.5}$ $TCID_{50}$/100 μL/fish) then the blood samples were collected at 1, 3, 5, 7 and 10 d.p.i., respectively. The VHSV was initially detected at 3 d.p.i. and ranging from 2.8 to 5.3 $\log_{10}TCID_{50}$/mL. The titer of VHSV in blood was peaked at 7 d.p.i., ranging from 6.3 to 8.8 $\log_{10}TCID_{50}$/mL, indicating that VHSV is high in the blood. These results suggests that the VHSV can be transmitted to the whole body and tissues via blood. These results could an important tool for screening of VHS, as well as for understanding the progress of VHS in fish. Further studies are needed to estimate the VHSV infectivity levels between blood and other tissues and organs of VHSV-infected flounder.

Study of VHSV infectivity titers on the tissue of target organs in olive flounder, *Paralichthys olivaceus* by two different challenge routes and water temperatures

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VHSV infection can cause cumulative mortality as high as 90% resulting in serious economic losses in cultured olive flounder (***Paralichthys olivacesu***). VHSV has been isolated from the hematopoietic organs such as spleen and kidney which has been considered as the main target of VHSV. For studying of VHSV infection, injection challenges are commonly used, but are extremely artificial and do not mimic disease transmission in nature. In this study, the VHSV infectivity in six-targeted organs were calculated and compared by different VHSV challenge routes (IM injection and immersion) and water temperature at 10 and 13 ˚C. The VHSV-challenged flounders (by IM injection or immersion) were randomly collected at 0, 3, 5, 7 and 10 d.p.i. from both temperatures at 10 and 13 ˚C, respectively. The cumulative mortalities of IM injection and immersion challenge group at 13 ˚C were 80% and 10%, respectively, while the cumulative mortalities of that at 10 ˚C were 100% and 50%, respectively. The cumulative mortality in IM injection tended to be higher than those by immersion challenge. The infectivity by IM injection was highest in heart, spleen and kidney, followed by brain, gill and muscle. For the immersion challenge group, the VHSV infectivity was highest in muscle, kidney, brain, followed by gill, spleen and heart at 7 d.p.i at 10 ˚C. Also we found that the VHSV infectivity in six targeted organs by immersion were approximately 100 times lower than IM injection route, indicating that the mucus and skin tissue might have play important role to prevent the VHSV invasion in fish body. The VHSV infectivity showed the sequentially increased during 7 d.p.i. at 10 ˚C, meanwhile the VHSV infectivity undulated at intervals of about two days at 13 ˚C.

Applications of microbial as feed supplements for enhancement of digestible efficiency, nutrient utilization efficiency and growth performance in sex reversed Nile tilapia

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Feeding trial was undertaken to determine the efficiency of ***Lactobacillus rhamnosus***, ***Lactobacillus plantarum***, ***Bacillus subtilis***, ***Bacillus licheniformis***, PM 1, PD 1 and commercial yoghurt at the same concentration of 10^6 CFU/g in Nile tilapia diet. Each test diet was given to 30 juvenile of Nile tilapia cultured in 250 L plastic tank in triplicates for 10 week. At the end of experiment, 6,785.11-7,100.77 % weight gain with no significantly different were observed (P>0.05). Specific growth rate, feed conversion and survival were not different among treatment (P>0.05). Moisture in final fish body did not differ, but protein content in the fish fed diet added with ***Lactobacillus plantarum*** was higher than other diets. Lipid content were not significantly different among treatments (P>0.05) but ash content in tilapia fed control diet was higher than the fish received PD 1 supplemented diet. However ash content in tilapia fed other diet were not different to the fish fed either control or PD 1 diets (P>0.05). Protein efficiency ratio (PER) were not statistically different among treatments. But 0.30 ± 39.73 % of protein retention was observed in the fish fed ***Lactobacillus plantarum***, this value was higher than other treatment. Moreover, lipid retention in fish fed ***Lactobacillus plantarum*** was significantly higher than control (P<0.05**)**. Supplementation of ***Lactobacillus plantarum*** in the test diet resulted in increasing protein digestibility and significantly higher than fish fed either control or ***Bacillus licheniformis*** (P<0.05). In conclusion, ***Lactobacillus plantarum*** supplemented showed beneficial effects for increasing of fish protein content, protein and lipid retention and protein digestibility.

Identification of IFN-like molecule "vago" in kuruma shrimp (*Marsupenaeus japonicus*)

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Invertebrates namely shrimps do not have any adaptive immunity. However, they possess a variety of innate immune responses to resist pathogens. After the outbreak of several viral diseases, many studies about shrimp anti-viral immune system have been carried out. A certain phenomenon in penaeid shrimp has been identified, that the injection of non-specific double stranded RNA (dsRNA) or its synthetic analog polyinosine-polycytidylic acid (poly I:C) can protect shrimps against viral infection. Although the phenomenon has been reported in various shrimp species, molecules involved in this system are still unclear. In vertebrates including fish, injection of dsRNA or poly I:C can induce transcription of interferon (IFN) which regulate transcription of anti-viral proteins. Recently in fruit fly (***Drosophila melanogaster***), IFN like molecule named as "Vago" has been identified.

In this study, for further understanding of invertebrate anti-viral system, we have characterized Vago genes of kuruma shrimp (***Marsupenaeus japonicus***). From EST data base of kuruma shrimp, 5 kind of partial sequences of Vago named as MjVago 1, 3, 4, 5 and 6, were identified by 5'- and 3'- RACE PCR method. Then the domain structures were estimated and phylogenetic analysis was performed from the sequences. In addition, the three-dimensional structures of MjVago proteins were predicted and compared to ***D. melanogaster*** Vago. Furthermore, relative expression of mRNA of MjVago 1, 3, 4, 5 and 6 in 10 organs of apparently healthy kuruma shrimp were analyzed by quantitative PCR to evaluate the possible functions as an IFN-like molecule.

Laminin receptor is identified to interact with grouper nervous necrosis virus (NNV) coat protein

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Nervous necrosis virus (NNV) is a devastating pathogen of more than 40 fish species. It is a non-enveloped icosahedral particle with 2 single-stranded positive-sense bipartite RNA virus and cause damage to the central nervous system, which resulted in high mortality rates. However, the mechanism of how NNV enter into host cell is poorly understood. In this study, yeast two-hybrid (Y2H) system is applied to screen the proteins interacting with NNV. Laminin receptor (LR) is revealed by using NNV coat protein, the only structural protein of the virion, as the bait in Y2H system. To date, LR is identified to be the receptor for many viruses such as sindbis virus, adeno-associated virus (AAV), dengue virus, yellow head virus (YHV) and infectious myonecrosis virus (IMNV). Although right now we cannot clarify how, when and the effect the NNV coat protein interacts host LR, this pioneer work indeed gives a direction for further study.

Effects of vitamin E and zinc on growth performance, antioxidant status and innate immunity of grass carp *Ctenopharyngodon idellus*

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An 8-week feeding trial was conducted to investigate the effects of dietary vitamin E and zinc on growth performance, antioxidant status and innate immunity of juvenile grass carp. The basal diet was supplemented with all-rac-α-tocopheryl

acetate (0, 250, 250, 200, 150, 100 mg kg^{-1}) and zinc (50, 0, 50, 40, 30, 20 mg kg^{-1}) respectively. Growth performance, body composition, antioxidant activity, lysozyme and complement C3 activity were determined. The maximum weight gain (WG), specific growth ratio (SGR), feed efficiency (FE), protein efficiency ratio (PER) and splenic index (SI) were achieved in fish fed on a diet supplemented with 200 mg kg^{-1} vitamin E and 40 mg kg^{-1} zinc. Vitamin E and zinc supplementation appeared to improve hepatic, muscle, serum total antioxidant capacity (T-AOC), superoxide dismutase (SOD) activity significantly than those fed the basal diet and addition vitamin E or zinc only. However, the malondialdehyde (MDA) values were inversely related to the dietary vitamin E and zinc levels. The activities of serum, head kidney and spleen lysozyme, were significantly influenced by the dietary vitamin E and zinc levels, fish fed the basal diet had lower lysozyme, than those fed diets supplemented with vitamin E and/or zinc. Higher activity of serum complement C3 was displayed in diets fed different dietary vitamin E and/or zinc additions for 12 weeks. The effect of diets with combined vitamin E and zinc additions had a synergistic role and dose-dependent, compared with that of diets with single vitamine E or zinc addition. The diet with 200 mg kg^{-1} vitamin E and 40 mg kg^{-1} zinc added, was found to be the optimum under our experimental conditions.

Progress of shrimp and prawn aquaculture in the world: A book

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Shrimp and prawn are one of the most important aquaculture species in the world, and has undergone a series of development, challenges and innovations towards sustainable production. In this book, we tried our best to invite outstanding scholars and experts to contribute chapters with scientific information, old and new developments, and some historical review. The book has 18 chapters including 10 chapters describing regional prawn farming research and production, one

chapter on nutritional requirements, four chapters on diseases, one chapter on operation, management and business of prawn farming, one chapter on freshwater prawns, and one chapter to summarize five decades of prawn aquaculture research and development. Appendixes include photos of dorsal and lateral views of 15 species of prawn, morphological features of wild and pond-cultured grass prawn, and rare grass prawn with red color strip on its back. Based on the fact that the primary objective of shrimp and prawn aquaculture is to offer affordable food for general public, gourmet cuisines were also included to give a lighter touch for the readers to enjoy.

This book is fourth in the series of important aquaculture species in the region and in the world. The Table below summarizes the book series that were published to date.

No.	Title	Publication date	Number of Chapters	Total pages	Price(NT$) not include postage
1	Cobia Aquaculture: Research Development and Commercial Production	2007/02	12	xviii + 178	NT$826
2	The Aquaculture of Groupers	2008/08	13	xx + 241	NT$1200
3	Milkfish Aquaculture in Asia	2010.03	15	xii + 195	NT$1100
4	Progress of Shrimp and Prawn Aquaculture in the World	2016/01	18	xiv + 444	NT$1500

By and large, the present book provides a great deal of information on the established technologies of shrimp/prawn aquaculture in the world. Information included in this book are useful for students, prawn biologists, researchers, and stakeholders in commercial sectors, as well as those who are interested to venture into the popular and profitable prawn aquaculture enterprise.

Effects of sodium dodecyl sulfate on formosan striped-dace, *Candidia barbata* : toxicity, growth, and hematology

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The aim of this investigation is to evaluate the effects of SDS on survival, growth, lethal D.O., hematology and histology of formosan striped-dace, ***Candidia barbata***, and to quantify the LC_{50} and safe concentration of SDS to ***Candidia barbata***.

The 24-, 48-, 72- and 96-h LC50s (median lethal concentrations) of SDS on ***Candidia barbata*** juveniles (0.11±0.02g) were 4.42, 4.35, 4.31 and 4.29 (ppm), respectively.

The weight gain (%) and feeding rate (%) were lower significantly than the control group after fish were exposed to 0.429ppm and 0.858ppm of SDS for 8 weeks ($p<0.05$).

Lethal DO was elevated following the increasing of SDS concentration and the highest value was found in SDS concentration of 0.858 and 2.145ppm with size of 0.09 and 0.25g. It was found that blood osmolality decreased significantly after 24hr exposure to SDS with concentration higher than 0.442ppm ($p<0.05$). Blood glucose concentration was also elevated significantly with increasing SDS concentrations, and the highest value was found in SDS concentration of 2.21 ppm after 12hr exposure ($p<0.05$).

The safe concentration without influence to the growth and physiological responses of ***Candidia barbata*** was at 0.0858 ppm or below!

Effects of dietary inclusion of soybean meal and *Lactobacillus* spp. fermented soybean meal on growth, immune responses and oxidative status of Pacific white shrimp

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The study was to compare the effects of partial replacement of fish meal (FM) by soybean meal (SBM) and ***Lactobacillus*** fermented soybean meal (FSBM) on growth, immune responses and oxidative status of Pacific white shrimp, ***Litopenaeus vannamei***. Twenty-five percent of FM protein was replaced by SBM and FSBM in the basal diet. All FM diet was also included as comparison. Total of three experimental diets were each fed to triplicate groups of shrimp (initial wt: 0.63 ± 0.01 g) in a recirculating rearing system for 12 weeks. Weight gain, feed efficiency and survival were similar among all the dietary treatments. Total hemocyte, hyaline cell, semigranular cell and granular cell counts were the highest in shrimp fed the control diet, followed by shrimp fed the FSBM-diet, and the lowest in shrimp fed the SBM-diet. Hemolymph phenol oxidase activity was higher in shrimp fed with the control diet and the FSBM-diet than that in shrimp fed the SBM-diet. Shrimp fed with the SBM diet had the highest hepatopancreatic thiobarbituric acid-reactive substance (TBARS) value, followed by shrimp fed the FSBM-diet, and lowest in shrimp fed the control diet. Hepatopancreatic superoxide dismutase (SOD) activity was the highest in shrimp fed with the control diet, followed by shrimp fed the FSBM-diet, and lowest in shrimp fed the SBM-diet. The results indicated that 25% FM protein replaced by SBM significantly suppress immune responses and induce oxidative stress for white shrimp. Soybean meal fermented by ***Lactobacillus*** can improve these negative effects for the species.

Antimicrobial peptides derived from fermented soybean meal as natural therapeutic agents for shrimp

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Studies on antimicrobial peptides (AMPs) derived from food proteins with bioactivities for preventing diseases have been becoming a main trend in recent years. Being used as protein replacement, ***Bacillus subtilis*** E20-femented soybean meal may be considered to be a rich source of AMPs for aquaculture uses. This study was carried out to purify the AMPs from ***B. subtilis*** E20-FSBM using 5 kDa ultracentrifugation, gel-filtration with Sephadex G15, reversed phase high performance liquid chromatography (RP-HPLC), and then the fractions with antimicrobial activity was sequenced by a high performance liquid chromatography-mass spectrometry (LC-MS). The results indicated that two fractions had antimicrobial activities against ***Vibrio alginolyticus*** which is known as an endemic opportunistic pathogen in white shrimp ***Litopenaeus vannamei*** culture. Among two fractions, 12 AMPs were detected. It is therefore included that AMPs from ***B. subtilis*** E20-FSBM can be used as natural therapeutic agents other than chemotherapeutic approaches in aquaculture.

Abundance and temporal distribution of off-flavour substances geosmin and 2-methylisoborneol in different tilapia culture systems in south China

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Off flavour in tilapia is a rising concern among consumers and researchers. In south China, tilapias are cultured in various systems, such as reservoirs, intensive ponds and fish-livestock integrated ponds. To study composition and concentration of off-flavour substances in culture water under different culture systems, this paper analysed concentration and temporal distribution of Geosmin (GSM) and 2-Methylisoborneol (2-MIB), two main odour substances in water by using Purge and Trap pre-treatment with Gas Chromatography-Mass Spectrometry method. Water samples were collected from intensive ponds (6) and one reservoir in Wenchang, Hainan province, and intensive ponds (6), reservoirs (3) and fish-pig integrated ponds (6) in Maoming, Guangdong province in China in May, August and October 2013. The results showed that 2-MIB is the main odour substance in both Wenchang and Hainan with concentrations ranging from 4.57-65.61 μg/L, while GSM occurred less frequently and at lower concentrations ranging from 2.93 to 11.77μg/L. There was no significant temporal effect of 2-MIB concentrations over the three months, except for the integrated ponds in May and August in Maoming. In the three culture systems, the reservoirs had the lowest levels of 2-MIB and GSM, followed by intensive ponds, and the integrated ponds the highest. There were significant differences between culture systems in terms of 2-MIB concentrations ($P<0.05$). The results indicated that different culture patterns could cause different concentration of odour components in water.

Potentiality and use of plant protein as an alternative to fish meal in India for aquafeed development – a concept of bio-resource management

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Aquaculture is a fast growing food production sector in the world. The production of world aquaculture "food fish" reached about 55.7 million tons in 2015. Among the Asian countries, India ranks second in aquaculture and third in capture fisheries production. Fish and shellfish production contributes about 6.0 million tons annually from both capture fisheries and aquaculture. Production increased by more than five times and the contribution of fisheries to the GDP of India has also increased three times, which is one of the highest among the food production sectors. However, per capita fish availability to an average Indian is about 9 kg, less than the world average (12 kg), and the quantity (11 kg) recommended by the WHO for nutritional security. According to the increasing population and demand of fish for food security of India, our country needs to double the production of aquaculture in coming years. To support further development of aquaculture, development of cost-effective well balanced aqua feed is also an essential prerequisite. It is well known that fishmeal is the major source of protein for aqua feed which is becoming scanty and costly. Simultaneously the requirement of aquafeeds and its main component i.e. demands of fish meal, also increased day by day. Today, fish meal is used in aquafeed more than 45% of annual fishmeal production. As a result aqua-feed production is currently one of the fastest expanding agricultural industries of the world, with annual growth rates in excess of 30% per year. It is assumed that demand of fish meal also increase in coming years. Therefore, time has been come to think about alternative protein sources specially plant protein sources to minimize usage of fish meal as our country is also rich with different varieties agricultural products like cereals, pulses, oilseed cake, legumes,tuber crops, plantation crops etc. and their byproducts.

Dynamics of red bloom in fish ponds in three different regions of Nepal

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Red-blooming in fish pond is becoming a common problem in Nepal. The red algae concentrate at the water surface is blamed to this phenomenon. Field surveys on water and soil quality from five red bloomed and five green fish ponds of eastern, central, and western region of Nepal were carried out from June 2015 to March 2016. It was found that total phosphorus, total nitrogen, total ammonia, total dissolved solids, conductivity and chlorophyll-a were significantly higher in red ponds than in non-red ponds, while dissolved oxygen was significantly lower. Soil analysis showed that total phosphorus, total nitrogen and organic carbon were significantly higher in red fish ponds than in non-red fish ponds. The red coloration in red fish ponds is directly proportional to the density of algae ***Euglena sanguine***. Red bloomed fish ponds were found to be more stagnant, un-drainable, with high organic matter load and filled with under-ground water.

Amylase and protease activities of fresh water pearl mussel, *Chamberlainia hainesiana*

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Fresh water pearl mussel, ***Chamberlainia hainesiana***, is the biggest mussel found in Thailand. It is one of the economically important species. Due to its thick nacreous layer, it has the high potential to use for fresh water pearl production which has been used in jewelry, pharmaceutical and cosmetic industry. Its shell is used for making the accessories, and decorating of utensils and furniture. The mussel meat can be used as human food. Last but not least, live mussel can be used as a bioindicator of the water resources. Unfortunately, the contamination of polluted water from domestic and agricultural waste resulted in the declining of the natural stock. Although the Kanchanaburi Inland Research and Development Center has successfully bred and produced the seed since 1991, the survival of nursing and rearing mussel is quite low. Thus the characteristics and activities of digestive enzymes were studied in order to investigate about the suitable food for rearing mussel in each stages of life.

Amylase and protease characteristics of adult fresh water mussel, average width and length of 7.51+0.93, 9.16+1.07 cm, were studied at various pH (1-13) and temperatures (10-80°C). Digestive gland and stomach of mussels were collected, ground and centrifuged, then supernatant were collected and kept at -80°C until analysed. The highest activities of amylase and protease were found at pH 7 and 60°C and at pH 4 and 60°C, respectively. After that, the enzyme activities of 2 sizes of fresh water pearl mussel, with the average width and length of 7.51,0.93± 9.16±1.07 and 4.16±0.50±4.97 ,0.39 cm, were studied. Amylase and protease specific activities were 55.503±25.413 and 29.801±7.027 μmol min^{-1} mg $protein^{-1}$; 2.908±0.401 and 2.136±0.701 mU min^{-1} mg $protein^{-1}$, respectively.

Identification of SNPs of immune gene related to streptococcosis resistance in Nile tilapia (*Oreochromis niloticus*)

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The study aimed to identify SNPs of immune genes related to the streptococcosis resistance in Nile tilapia (***Oreochromis niloticus***). Around 40 Nile tilapia fish from each of several different stocks in Thailand were injected with 2.43 x 10^4 CFU/ml of ***Streptococcus agalactiae***, resulting in two stocks of the highest and lowest survival performance. The live and dead fish from each of the two stocks were then analyzed by SSCP. It was found that amplicons from 10 gene-specific primers including BPI/LBP, TCR alpha, MHC class II beta, NOD1, transferrin, IgM heavy chain, CD8, TCR beta, IL8 and hepcidine showed no difference; whereas the granzyme gene, identically shown as the ***Oreochromis niloticus*** granzyme by DNA sequence analysis, was found to have polymorphism with 6 SNPs appearing. Two of the 6 SNPs were shown in the highest survival group to be significantly related to the disease resistance ($p<0.05$), while one of the two was also similarly shown in the lowest survival and its relation to the disease resistance was significantly confirmed ($p<0.05$). This one SNP, confirmed by the two fish groups of opposite performance, could be potentially developed as DNA marker for streptococcosis resistance in Nile tilapia.

Protein skimmer and suitable flow rate ofwater on particulate organic matter removal efficiency for culture of sea bass (*Lates calcarifer* Bloch, 1970) in recirculating aquaculture systems

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The experiment was conducted to determine the suitable water flow rate of protein skimmer for effectively removing particulate organic matter (POM). Three protein skimmers, 700 liters in size, were set at 35 cubic meter asian sea bass culturepond. Three different pumps (treatments) which were differenced in sizes of horsepower were individually set at each protein skimmers to make the different water flow rate. The different sizes of horsepower were 1 (T1), 1.5 (T2) and 2 (T3) Hp respectively. Each treatment was set to a proportional ratio of air and water flow rate. The effectiveness of each treatment was check at 0, 1, 2, 3, 4, 5, 6, 7 and 8 hrs after feeding. The POM removing efficiency of T1, T2 and T3 were 25.00±1.00, 31.66±5.85 and 45.66±5.13 % respectively, which was significantly different ($p<0.05$) amongtreatments. The removing rate of POM was 19.78±6.80, 38.12±10.10 and 50.05±10.22 g/hr for T1, T2 and T3 respectively. The highest time of POM removing efficiency was 7±0.30, 6±0.40 and 5±0.45 hr. after feeding in T1, T2 and T3 respectively. The ratio of air and water flow rate of each treatment were 6.6±0.66 (T3), 5.7±0.70 (T2) and 4.6±0.20 (T3) which was lowest in T3 and was significantly different among treatments ($p<0.05$). Base on this study, it can be concluded that protein skimmer with 2 Hp pump is the most effective to remove POM and should be recommended to use for remove POM in asian sea bass aquaculture in recirculating system.

Combination of sand substrate and other shelters used for nursing of blue swimming crab (*Portunus pelagicus* Linnaeus, 1758) from megalopa stage to 1 cm sized young crab

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The aim of this study was to determine the effects of combination of sand substrate and other shelters in nursing of blue swimming crab (***Portunus pelagicus*** Linnaeus, 1758) in order to minimize cannibalism during nursing of megalopa stage to 1 cm sized young crab in 1.9 x 9.7 x 0.9 m concrete tanks. Net cages of 1.9 x 9.0 x 0.5 m size were set into each tank containing 0.4 m water depth. Megalopa larvae stage were initially stocked into each tank at a stocking density of 1 ind./L and nursed for 14-15 days. The trial was separated into four treatments with three replicates: treatment 1) sand substrate 2) sand substrate combined with pine tree branches 3) sand substrate combined with net and 4) no sand substrate and no shelter which was used as control. At the end of the experiment the number of 1 cm sized young crab, body weight and carapace width data were collected.

The results showed that the blue swimming young crab in each treatment had grown to 1.04 ± 0.06, 0.99 ± 0.02, 0.96 ± 0.03 and 0.99 ± 0.06 cm average carapace widths whilst average body weights were 0.09 ± 0.01, 0.08 ± 0.00, 0.07 ± 0.01 and 0.08 ± 0.01 g, with the average survival rates of 31.49 ± 1.40, 51.01 ± 2.76, 43.78 ± 3.04 and 26.27 ± 2.37 %, respectively. The periods of nursing were 14.67 ± 0.58, 14.00 ± 0.00, 14.00 ± 0.00 and 15.00 ± 0.00 days, respectively. Statistically, the final average survival rates had significant differences among treatments ($P<0.05$). The average body weights of treatment 1 were higher than treatment 3 ($P<0.05$), however, there were no significant differences between treatments 2 and 4 ($P>0.05$). The average nursing periods of treatments 1 and 4 were not significantly different ($P>0.05$) and took a greater amount of time than treatments 2 and 3 ($P<0.05$), while treatments 2 and 3 were not significantly different ($P>0.05$). In terms of the average carapace widths, there were no statistically significant differences among treatments ($P>0.05$).

In conclusion, the effectiveness of using sand substrate combined with pine tree

branches as shelter showed significantly increased survival rates over others, with an average survival rate of young crabs at 51.01 ± 2.76 %. In contrast, the lowest average survival rate (26.27 ± 2.37 %) was recorded when there were no sand substrate and shelter provided.

Comprehensive identification of genes induced by immunostimulants in Asian seabass (*Lates calcarifer*)

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Asian seabass (*Lates calcarifer*), also known as barramundi, is a species widely cultured in many countries including Thailand. In recent years, the production of this species in Thailand is more than 10 kilo ton per year. As the production increases, bacterial and viral diseases become serious problems to the aquaculture industry. Vaccination is a measure to control the diseases. In order to develop an effective vaccine, knowledge on the immunity of the host animal is indispensable. However, information on the Asian seabass immune system is still limited.

The comprehensive transcriptome analysis on certain tissues involved in the host defense provides a bulk of information on the immune system of the host animal. The recent advance of next generation sequencing (NGS) technology allows us to obtain a number of sequences even from the non-model organisms. In this study, we performed NGS analysis on the kidney of Asian seabass treated with lipopolysaccharide (LPS) and polyinosinic-polycytidylic acid (polyI:C). By using MiSeq (Illumina), a total of 15 million reads were obtained, which were assembled into 60 thousands contigs. By differential expression analyses, 36 and 212 genes were identified to be up-regulated more than 2-fold by LPS and polyI:C treatments, respectively, which include 33 genes induced by both treatments. A hepcidin and 2 chemokine genes were identified as up-regulated genes only by the LPS treatment. In contrast, 179 genes including a novel lectin homologue were up-regulated only by the polyI:C treatment.

Development of low-cost and stable live food culture technique for tropical aquaculture: The Kenyan perspective

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The global increase of aquaculture activities has certainly created high demand for zooplankton as suitable starter food for larval fish rearing. In Kenya, the commonly used inert diets as first food for larval fish are characterized by poor survival and high mortality. To alleviate these challenges, sufficient and consistent supply of the live food resources is important. However, live food production requires unlimited supply of microalgae, which are costly (e.g. concentrated ***Chlorella*** product) or laborious to produce. Studies have modified outdoor microalgal and rotifer culture systems but their stability and purity are not guaranteed. Therefore, developing alternative low-cost and stable live food culture techniques are necessary.

This study targeted the freshwater rotifer ***Brachionus angularis*** (Kenyan strain) and the tropical euryhaline ***Brachionus rotundiformis*** (S-type). First, we identified the Kenyan strain through morphological and molecular means before investigating its life table demography and reproductive traits at varying temperatures and food densities. The life table demography parameters e.g. fecundity, reproduction rate, intrinsic rate of natural increase, life expectancy at hatching and generation time were optimal at 25°C with 2.5×10^6 cells mL^{-1} of ***Chlorella vulgaris***. The highest population density and growth rate also occurred at 25°C with 2.5×10^6 cells mL^{-1}.

Chicken manure extract (CME) was used to investigate the mass production potential of ***B. angularis***, while gamma aminobutyric acid (GABA) was applied to determine the mass production potential of ***B. rotundiformis*** using dried microalgal

diets. Also, fish waste was used to develop low-cost microalgal replacement diet (MRD) for mass culture of ***B. rotundiformis***. In these studies, 2mL.L^{-1} of CME significantly increased the asexual reproduction of ***B. angularis*** while 50mgL^{-1} of GABA applied at lag phase effectively increased the population density of ***B. rotundiformis***. Meanwhile, a significantly higher population density and growth rate was reported for the MRD-fed rotifers compared to those given microalgal diet.

Immune gene expression in hepatopancreas of river prawn *Macrobrachium rosenbergii* challenged by *Aeromonas hydrophila*

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Bacterial and viral diseases are major problems that reduce production and profitability of river prawn farming, particularly in the intensive post-larval production. This study was aimed to understand the principles of innate immune response in river prawn and to identify specific genes that play important role during bacterial infection. We used quantitative real-time PCR to determine the expression levels of immune-relevant genes in juveniles (3 months old; body weight = 2.3±0.5 g) after injection with the LD50 dose of ***Aeromonas hydrophila***. Twelve immune genes identified by 454 pyrosequencing were analyzed, including Anti-lipopolysaccharide factor isoform 3 (***ALF3***), Cathepsin b (***CTSb***), Calmodulin (***CaM***), Ferritin (***FER***), Glutathione S-transferase (***GSTd***), Hemocyanin (***Hem***), lipopolysaccharide-β-glucan binding protein (***LGBP***), Lectin 2 (***LEC2***), Pacifastin heavy chain (***PAFh***), Superoxide dismutase (***SOD***), Translationally controlled tumor

protein (***TCTP***) and Thioredoxin1 (***TRX-1***). These genes were chosen to represent the cellular and humoral responses of river prawn. After bacterial challenge, prawns were divided into susceptible and resistant groups. The control was injected with saline solution. Hepatopancreas tissues were collected from individuals of the control at 0 h whereas tissues of prawns in the susceptible and resistant groups were collected between 16-48 h and 72-96 h respectively. The expression levels of ***ALF3***, ***LEC2***, ***SOD***, ***GSTd***, ***TRX-1***, ***FER***, ***PAFh*** and ***TCTP*** were significantly up-regulated in susceptible prawns ($P < 0.05$), but Hem gene was down-regulated. Prawns that survived infection showed similar levels of gene expression to the control, except for two genes (***ALF3*** and ***SOD***) which were significantly up-regulated at 96 h ($P < 0.05$). The results indicated ***ALF3***, ***LEC2***, ***SOD***, ***GSTd***, ***TRX-1***, ***FER***, ***PAFh*** and ***TCTP*** were involved in immune mechanism against ***A. hydrophila*** infection.

Status of tilapia culture in Nepal

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Nile tilapia (***Oreochromis niloticus***) is widely cultured aquaculture species throughout the world. This species (Chitralada strain) was introduced to Nepal in 1985 from Thailand. Research and farming initiated since then at the Institute of Agriculture and Animal Science (Currently Agriculture and Forestry University) and Nepal Agricultural Research Council (NARC). Another strain of Nile tilapia (GIFT – genetically improved farm tilapia) was introduced by NARC during 2004 from Asian Institute of Technology (AIT) Thailand.

The major tilapia experiments conducted in Nepal aimed on developing culture technologies suitable for local conditions. These experiments included polyculture of mixed sex Nile tilapia with carps and sahar, cage-pond integration of Nile tilapia, and use of natural androgens to produce all-male Nile tilapia. Promising results with yield of 2.5-8 ton/ha was obtained in tilapia based culture systems in both on-station and on-farm trials.

Few private farms have started culture and production of tilapia in Nepal. It is available in specific market in limited quantity. Currently, government data shows around 4% of total aquaculture farms/farmers include tilapia in their culture system and contributes in total fish production of the country. Initially the Government did not prioritize tilapia culture because of its prolific breeding behavior and possible threats to the aquatic ecology. The aquaculture importance of this species has been realized and the Government has initiated to support and establish private hatchery for mono-sex seed production. Tilapia aquaculture is expected to expand very soon due its increasing market demand, interest of farmers, and available technology along with Government emphasis

Probiotic, *Bacillus subtilis* E20, modulates the innate immunity and disease resistance of grouper, *Epinephelus moara*

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Kelp grouper, ***Epinephelus morara***, is one of the most economically important grouper species. Unfortunately, kelp grouper ***E. morara*** culture has been now continuing to be beset by endemic disease as ***Vibrio*** spp. which caused serious economic losses due to high mortality at larval stage. This study was carried out to examine the immune response and resistance to ***Vibrio alginolyticus*** in the kelp grouper ***E. moara*** that being fed probiotic Bacillus subtilis E20 respectively. At 0 (control), 10^8, 10^9, and 10^{10} cfu kg^{-1} of feed, after 8 weeks of feeding, fish were evaluated for immune parameters such as respiratory brust (RB), lysozyme activity, superoxide dismutase (SOD), phagocytic activity, and survival rate after ***V. alginolyticus*** infection. The results showed that the survival of fish that being fed ***B. subtilis*** E20 at 10^9, and 10^{10} cfu kg^{-1} of feed were significantly higher than those of control post ***V. alginolyticus*** challenge. RBs of head kidney leucocytes and serum lysozyme activity of fish fed diets containing ***B. subtilis*** at 10^8, 10^9 and 10^{10} cfu kg^{-1} were also significantly higher than those of control group. However, the differences in phagocytic activity and SOD of head kidney leucocytes were insignificant among

treatments. It is therefore recommended that by dietary ***B. subtilis*** E20 at 10^9 - 10^{10} cfu kg^{-1} could enhance immune response and resistance of kelp grouper ***E. moara*** to endemic disease in culture.

Molecular cloning and characterization of a translationally controlled tumor protein (TCTP) from giant freshwater prawn (*Macrobrachium rosenbergii)*

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Macrobrachium rosenbergii or giant freshwater prawn is one of a major prawn specie cultured in Thailand and has market worth of four point five billion baht per year. Major problem in cultivation of this specie is infectious diseases caused by virus, bacteria, and fungi especially by ***Macrobrachium rosenbergii*** nodavirus (***Mr***NV) that can cause up to 100% mortality rate in post larvae hatchery. Therefore, the study of shrimp's immune response is needed in order to restrain diseases outbreak in shrimp culture industries.

Translationally controlled tumour protein (TCTP) or fortilin is a highly conserved protein among eukaryotes and has important biological roles including anti-apoptotic activity which involved in elimination of virus-infected cells. In this study, the full-length cDNA of ***Macrobrachium rosenbergii***'s TCTP was cloned through 3'and 5'Rapid Amplification of Complementary DNA Ends (RACE) using SMARTer™ RACE Amplification Kit. The sequence consisted of 783 bp with a 507 bp open reading frame which encoded 168 amino acid polypeptide. The predicted molecular mass of ***M. rosenbergii***'s TCTP was 18.94 kDa and had 84 and 83 percent similarity to those of ***Eriocheir sinensis*** (chinese mitten crab) and ***Scylla paramamosain*** (mud crab) according to BLASTp analysis. Phylogenic relationship analysis revealed that the deduced amino acid sequence of ***M. rosenbergii***'s TCTP was in the same clade of invertebrate including arthropods and crustaceans with relatively high

bootstrap values. The mRNA expression distribution among tissues were analysed using reverse transcription-polymerase chain reaction (RT-PCR) using beta-actin as reference gene. The results showed that ***M. rosenbergii***'s TCTP expressed in every tissues examined and preferentially in hepatopancreas and muscle. Nonetheless, the roles of ***M. rosenbergii***'s TCTP in innate immune system is needed to be further evaluated.

A natural *PirA^{vp-}/PirB^{vp+} Vibrio parahaemolyticus* isolate produces no Pir^{vp} toxins or AHPND pathology but still kills shrimp

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Acute hepatopancreatic necrosis disease (AHPND) in shrimp caused by virulence strains of ***Vibrio parahaemolyticus*** (VP) has been an emerging disease problem in several shrimp producing countries. Typical histological characteristic of AHPND is defined by sloughing of the hepatopancreas tubule epithelial cells into the lumen. By experimental based evidence, it has been demonstrated that binary ***Photorhabdus*** insect-related (Pir) toxin encoded by $PirA^{vp}$ and $PirB^{vp}$ genes in the virulence ~70 kb plasmid resided in the bacterial hosts are responsible for cell sloughing pathogenesis. Here, we reported a natural isolate of VP lacking of $PirA^{vp}$ ($PirA^{vp-}/PirB^{vp+}$) among $PirA^{vp+}/PirB^{vp+}$ VP_{AHPND} isolates obtained from Vietnam. The absence of $PirA^{vp}$ gene was confirmed by an established duplex PCR detection for both toxin genes in the virulence plasmid. Subsequent sequence analysis revealed the absence of $PirA^{vp}$ gene in the ***VP*** isolate was due to the insertion of a 1053 bp-fragment containing a putative transposase gene. RT-PCR and sequencing results indicated that $PirA^{vp}$ and $PirB^{vp}$ genes of VP_{AHPND} isolate bi-cystronic transcribed but the mutant harboring a transposon insertion resulted in no $PirAB^{vp}$ transcript production that would explain the negative western blot results for both $PirA^{vp}$ and $PirB^{vp}$ in culture broth from the mutant isolate. Virulence assay by immersion method and histological examination indicated that VP strains harboring both $PirA^{vp}$ and $PirB^{vp}$ caused typical APHND pathology while $PirA^{vp-}/PirB^{vp+}$ strain resulted in 50% mortality without AHPND lesions. In conclusion, we characterize a VP isolate harboring a mutant pAP1 plasmid that produces no Pir toxins and does not cause AHPND lesions but is still virulent for shrimp (50% mortality). Thus, the shrimp farming industry should be aware that mortality from such isolates constitutes a probable component of EMS that has been previously overlooked because of absence of AHPND lesions in affected shrimp.

Micropropagation and soilless culture of Thai native aquatic plant *Cryptocoryne griffithii* Schott

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Micropropagation of the Thai native ornamental aquatic plant ***Cryptocoryne griffithii*** Schott was studied. Shoot buds were surface-sterilized in 4% Clorox for 15 minutes. Explants were then sterilized in 0.2 % $HgCl_2$ for 10 minutes. The plant tissues were cultured for 4 weeks on semi-solid MS medium supplemented with 6-Benzylaminopurine (BA) or kinetin at 0, 2, 4, 8 and 16 µM in combination with α-***naphthaleneacetic acid*** (NAA) or 2,4-dichlorophenoxyacetic acid (2,4-D) at 0 and 2 µM, at 25±2ºC under a 12/12 light dark cycle, 2,500-3,000 lux for 4 weeks to induced shoot multiplication. The plantlets from tissue culture were then transfer to the greenhouse and cultured in soilless system with different concentrations of nutrient solution (electrical conductivity of 2 ,1 ,0 and 3 mS/cm) for 8 weeks.

The results indicated that the effects of plant growth regulators, BA and NAA on inducing shoots, roots and leaves were statistically significant ($p<0.05$). The appropriate medium for inducing shoots and roots was semi-solid MS medium supplemented with 4 µM BA in combination with 2 µM NAA. The average number of shoots and roots were 0.76 ± 5.52 shoots/explant and 6.10 ± 1.37 roots/explants after cultured for 4 weeks. The electrical conductivity of nutrient solution of 1 mS/cm was appropriate to promote growth of the plantlets. The average weight, plant height and number of leaves were 2.33 ± 0.07 g/plant, 9.32 ± 0.33 cm and 24.03 ± 1.21 leaves/plant respectively, and the survival rate of 100% after cultured in soilless system for 8 weeks. The results of this hopefully be able to improve the aquatic plants propagation, cultivation and reducing the risk of extinction.

Molecular studies on steroid receptor genes in black tiger shrimp, *Penaeus monodon*

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Ecdysone (Ec) and methyl farnesoate (MF) are major steroids that regulate many aspects of growth, development and reproduction of crustaceans. Their effects are mediated through specific nuclear steroid receptors. Understanding the structures and functions of these receptors will be useful for developing the methods for controlling shrimp maturation. The main objective of this study is to increase knowledge on function of steroid hormones and their receptors that affect the reproductive development and maturation mechanisms in ***P. monodon***. In this study, steroid receptor genes and steroid response elements which complex with these receptors were studied. Currently, cDNA sequences of ***P. monodon*** steroid receptors including EcR, RXR, and E75 genes were obtained and their expression patterns were determined in both male and female normal and MF-injected shrimp. There were some significant differences between sexes and doses of MF applied to the shrimp. Antibodies against PmRXR were firstly produced and used for detecting steroid response elements in chromatin immunoprecipitation assay. A number of potential half sites of EcR response elements (EcRE) were located within the obtaining fragments. Once these target genes and sequences are obtained, genes that are regulated by this mechanism and are important for reproductive development of the shrimp will be revealed. The fulfillment of this study will provide valuable information for the development of advanced techniques to control growth and reproductive development in ***P. monodon***.

The potential application of banana peel for *Macrobrachium rosenbergii*

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The banana (***Musa acuminata***) peel, a major by-product of banana processing industries, has recently gained attention as a rich source of phenolic and bioactive compounds. The hot-water extract of banana peel (BPE) has medicinal application as replacement to synthetic antibiotics which possess immunological properties essentially for human health. However, limited information is available on the aquaculture field. Thus, the effects of BPE on the immunological response, disease resistance, hypothermal resistance, growth performance, and immune genes expression of ***Macrobrachium rosenbergii*** are proposed, and furthermore, its efficacy is also mentioned at short- and long-term of feeding trials. Total haemocyte count (THC), different haemocyte count (DHC), phenoloxidase (PO) activity, respiratory burst activity, superoxide dismutase (SOD) activity, glutathione peroxidase (GPx) activity, transglutaminase (TGase) activity, and haemolymph coagulation time were conducted to assess the immunological response. The phagocytosis and clearance efficiency, resistance to pathogens, growth performance, and immune genes expressions were further investigated. THC, DHC, PO, SOD, phagocytic activity, and clearance efficiency as well as susceptibility of prawn against ***Lactococcus garvieae*** infection and hypothermal stress were increased, whereas haemolymph coagulation time was shortened after BPE dietary administration for 32 and 120 days of feeding trial. The growth performance showed that the percent weight giant (PWG), percent length giant (PLG), feed efficiency (FE), and survival rate increased significantly more than those of the control group. Moreover, at the long-term feeding trial, the immune-related genes expressions levels were significantly higher than in the control group. In conclusion, the BPE (***M. acuminata***) has the potential for applying in the enhancement of the immunological response, the resistance against ***L. garvieae*** or hypothermal stress condition, and improvement of growth performance and survival rate of ***M. rosenbergii*** culture.

Employability in selected aquaculture sites in central Philippines

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Nine aquaculture sites in Cebu were studied based on the municipality's active involvement in the Integrated Coastal Resource Management Program (ICRMP) projects. Employment profile, status, satisfaction and prospects were studied employing a descriptive survey method complemented with focus group discussion and key informant interviews.

Results revealed that majority of the employed workers were male caretakers or helpers on contractual or on-call basis. Only a quarter of regularly employed individuals received benefits such as GSIS, SSS, Philhealth and Pag-ibig and earned income below the poverty threshold. Recruitment was through relatives and friends. Compensation package was satisfactory for those employed with tenure. Significant factors of employment were gender, family influence and proximity to aquaculture sites.

Socio-economics of aquaculture communities in central Philippines

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Aquaculture industry has grown globally to fill in the shortage of fish supply from the sea. A study of aquaculture communities in ICRMP sites of Central Visayas was conducted to determine the socio-cultural and economic aspects of aquaculture. Results revealed that 79% of aquaculture systems are in freshwater and brackish ponds with 50% ***Oreochromis niloticus and*** 43% ***Chanos chanos*** as common cultured species. Ponds are operated by private individuals and conform to the standard culture systems of cultured species.

Employed individuals in aquaculture are mostly caretakers and helpers and basically non-permanent and on-call basis. In spite of employment in aquaculture, communities near aquaculture sites are considered poor since majority of households are living below the poverty thresholds. Periodic consumption of aquaculture products creates demand in the community.

Evaluating quality of Nile tilapia (*Oreochromis niloticus*) eggs and juveniles from different commercial sources

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Our objective was to assess the quality of eggs and juvenile Nile tilapia (***Oreochromis niloticus***) from brood stock of three commercial sources used (H1, H2, and H3). There were no significant differences in wet weight, size, number, hatching rate of eggs and biochemical components in eggs and juveniles among the three brood stocks. Larval weight was significantly higher in sources H2 and H3. At the end of a 45-day growth trial, weight of juveniles of source H2 was higher than sources H1 and H3, while specific growth rate was significantly higher in source H1 and H2. No significant differences were detected in survival and feed conversion ratio. After an ammonia stress test, no significant differences in mortality were found among the brood stock from the three sources, although a positive relationship between carbohydrate content in eggs and juvenile mortality was observed. After a salinity stress test, the lowest and highest mortality occurred in sources H1 and H3 (24.2 and 57.8%). We concluded that the origin of the strains of tilapia brood stock did not affect egg quality, but juvenile growth performance,

carbohydrate content, and survival when exposed to the salinity stress test, should be considered as potential quality criteria.

Immune responses upon feed-based *Streptococcus iniae* vaccine against streptococcosis in red hybrid tilapia fingerlings (*Oreochromis* sp.)

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Streptococcosis has been reported to cause morbidity and mortality worldwide. Although not reported in Malaysia, ***S. iniae*** is one of the important species that causes streptococcosis. This study was done to determine the antibody responses in mucus and gut-lavage in Red hybrid tilapia fingerlings upon feed-based formalin-killed of ***S. iniae*** vaccination and to determine the survivability upon challenge with this pathogen.

The study was conducted within five weeks, and the fish were divided into three groups. Group 1 was vaccinated once, using the feed-based vaccine in the week 1 and followed by a booster dose in the week 3. Group 2 was, however, vaccinated in week 1 and 3 for three consecutive days each. Group 3 served as the control group, fed with a commercial feed formulation. Mucus and gut lavage were collected weekly for six weeks to analyse mucosal and systemic antibody responses using enzyme-linked immunosorbent assay (ELISA). All groups were challenged in the week 5 intraperitoneally (IP) with 100 µL of 1.5×10^9 CFU/mL ***S. iniae***. Following challenge, they were observed for clinical signs and mortality for seven days. No mortality due to ***S. iniae*** was recorded in seven days post-challenge in all groups.

Potential use of crinkle grass, *Rhizoclonium riparium var implexum* as ingredient in the diet of the pacific white shrimp *Penaeus vannamei* postlarvae

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Presently, macroalgae are used worldwide as an alternate protein source replacing fishmeal successfully. A 60-day feeding experiment was conducted to evaluate the potential of the crinkle grass ***Rhizoclonium riparium var implexum*** meal (RM) as a substitute for soybean in the diet of Pacific white shrimp, ***Penaeus vannamei*** postlarvae. Five dietary treatments were formulated with increasing level of RM inclusion, namely 0%, (control), 5.25%, 10.50%, 15.75%, and 16.75%, as ingredient for simultaneous soybean meal and mineral replacement and were fed to 4 replicates of shrimp post larvae. Feeding was done thrice daily (08:00, 12:00 and 16:00) at a ration starting at 20% of average wet body weight and decreased to 6 % towards the end of the experimental period.Statistical analysis of weight gain (WG), feed conversion efficiency (FCE), protein efficiency ratio (PER), specific growth rate (SGR) and protein gained (PG) reflected no significant differences among treatments ($P > 0.05$). Based on the broken-line model analysis, the computed optimum inclusion level of RM using PER as response parameter for postlarvae ***Penaeus vannamei*** was at 10.53%. However, the optimum level of RM inclusion was found best within the range of 10.50-15.75%, corresponding to 30.0-45.0% soybean meal replacement. Moreover, RM could also replace all the minerals in the diet without affecting the body composition of the shrimp. Survival was excellent in the duration of the experiment.

Brackishwater aquaculture based entrepreneurship development among coastal people

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Coastal aquaculture technologies have seen large peaks and troughs in their level of community acceptance. Perhaps this is because the levels of investment in this sector ranges from public limited companies to livelihood option levels.

Aquaculture offers one of the best livelihood options for coastal people either as families or when organized as Self Help Groups (SHGs). Livelihood enterprises offer plenty of scope for diversification for those who live below the poverty line. Adoption of viable alternative livelihood options along with capacity enhancement and institutional support for backward and forward linkages will facilitate resource poor families to escape their poverty.

The ICAR Central Institute of Brackishwater Aquaculture (CIBA) has developed technologies such as mud crab (***Scylla serrata***) fattening in pens and ponds, Asia sea bass (***Lates calcarifer***) and mud crab culture in community ponds, ornamental fish farming in tanks, farm made aqua feed development and value added fish food product development tailored to suit the needs of fisher folk. CIBA has also made efforts in transferring these technologies and practices to the coastal SHGs and families in to open their eyes to opportunities for socio-economically viable enterprises. The coastal SHGs and families who have access to credit, technology, training and other facilities can adopt these eco-friendly technologies to create alternative livelhihoods through entrepreneurship. If these technologies are adopted, they can very effectively create viable enterprises to improve their livelihoods. Owing to the relative simplicity of the techniques, their reasonably good profit margins and the familiarity of coastal communities with marine-based activities, the adoption of these technologies has succeeded for the coastal SHGs and families.

Important point in study of hemocytes in shrimp

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Shrimp immune responses take place in the hemocytes. However, we do not know how many different types of hemocytes in shrimp. In addition, if there are several different types of hemocytes in shrimp, we should know that functions and roles of different types hemocytes therefore their classification are very important for understanding hemocytes function, as well as the entire immune system. Morphological features of hemocytes are ambiguous and results may vary depending on the method used so that an accurate method is needed to establish classification of hemocytes. In this paper, we will discuss about 2 topics; changing hemocytes proportion after microbial infections and different genes expressions in different types of hemocytes from kuruma shrimp.

In case of a Kunitz-type protease inhibitor (MjKuPI) in kuruma shrimp ***Marsupenaeus japonicus***, gene expression level of MjKuPI in hemocytes increased approximately 20 to 30 folds after microbial infections. However, the proportion of MjKuPI expressing hemocytes also increased 20 to 25 folds after microbial infections. These results indicated that the different gene expression level of MjKuPI after microbial infection is due to increasing a number of MjKuPI expressing hemocytes.

Total hemocytes from kuruma shrimp were distinguished 2 groups by flow cytometry analysis and density gradient centrifugation (upper layer and lower layer). Transcriptome analysis in each layer was conducted by using NGS MiSeq and qPCR. Sixteen genes which showed more than eight times difference in total number of reads were selected from transcriptome analysis. These results imply that hemocytes can be separated into two types through morphological features, where sixteen candidate genes were identified to be possible markers, which may further classify hemocytes to different types. These results may provide technical basis for the classification of shrimp hemocytes.

Proteomic discovery of diverse immunity molecules in orange-spotted grouper, *Epinephelus coiodes* after fed with choline-supplement diet

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Choline is known as an essential nutrient for animal. In this experiment, orange-spotted grouper, ***Epinephelus coioides***, were fed with fish meal basal diets containing 0 (control) and 1 g kg^{-1} of choline chloride (CC) for 4 weeks. At the end of the feeding trail, fish were evaluated for disease resistance to ***Vibrio alginolyticus*** and plasma proteome. The results revealed that cumulative mortality of fish in CC group was significantly lower than those in control after pathogen injection. Interestingly, six different expression of immune-related proteins were discovered including complement C3, fibrinogen beta chain precursor, activity-dependent neuroprotector, alpha-2-macroglobulin, immunoglobulin mu heavy chain and Ighm protein. This is therefore suggested choline may work as immunomodulatory for fish.

Water temperature and hardness influences ornamental fish, red spotted green notatus (*Heros severus*) reproduction

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Red spotted green notatus (***Heros severus***) is a freshwater tropical cichlid. It is also an important species found in the aquarium trade. In this study, the effects of two important water conditions, viz., water temperature (20, 25 and 30°C) and water

hardness (50, 150 and 250 mg/l) on the reproduction of ***H. severus*** were evaluated. The results showed that a mature female of ***H. severus*** could laid 651.322.35± eggs each times. In addition, the time intervals between eggs laid was increased as water temperature decreased. Whereas, larval hatching time was decreased as water temperature decreased. Water hardness did not influence the time intervals between eggs laid, but egg fertilization did. It is therefore, concluded that the water conditions of higher temperature (30°C) and lower water hardness (50 mg/l) are suitable for ***H. severus*** breeding.

Reclamation of saline and alkaline soils through aquaculture - a review and prospects for future research

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Secondary salinization of agricultural lands in any irrigation projects of the world is the major issue in the recent past. Currently, it is estimated that the 954 mh of saline and alkaline soil is present in the world. Thousands of hectares of land are added every year. In India, out of 142.80 million hectare (mh) cropped area, 42.10 mh is an irrigated area. Of which, more than 9 mh (about 16.6%) of land is found to be alkaline or saline.

Due to continuous utilization of same land for same agricultural activities, excessive usage of fertilizers and water have led to most of the soils become alkaline, saline or water logged. These lands are low in productivity and at times totally unfit for

agricultural activities. These soils may or may not posses good physical condition, but plants may suffer from its inability to absorb water from salty solution. Plants suffer from dehydration and loose water to the soil, shrink, resulted to death of plant. This process is called plasmolysis.

It is the fact that soil is an independent, dynamic inorganic body of nature that acquires properties in accordance with forces which act upon it. Aquaculture is one of the solutions to utilize such problematic soils for food production. Excess salts gets into impoundments and management of salt is easier in water than in the soil. Due to high organic input in aquaculture such as feed, manure and continuous deposition of fecal matter, pH of the soil gets reduced and over the period of time such soils can be put back into the original activity.

Under National Agricultural Development Program (NADP), the project was implemented in 258 villages of Mandya District, Karnataka State, India and found that these lands can be effectively utilized for fish culture and increase the protein-based food production by many folds.

R&D perspectives of rainbow trout (*Oncorhynchus mykiss*) farming in India

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Rainbow trout (***Oncorhynchus mykiss***) farming is going on in many parts of the world outside the species' native region in western North America. More than 60 countries are represented in the trout production statistics. Farming of salmonids (trout and salmon) has experienced exponential growth during recent decades and Chile and Norway accounting for over 80% of the global salmonid aquaculture production (FAO, 2014) and ocean cage production of steelheads has expanded to supply export markets. Inland production of rainbow trout to supply domestic markets has increased in countries such as Italy, France, Germany, Denmark and

Spain. Other significant producing countries include the USA, Iran, Germany and the United Kingdom. In Asian countries China and Japan are the major trout producer countries. Rainbow trout has established itself as prime cultivable coldwater species in the Indian Himalayan regions and now farmed on commercial scale. The production in India has increased markedly in last ten years (2004-2016) from 147.0 to 852.0 tonnes, with a growth rate of 31 percent per annum. Availability of technical know-how of trout farming, breeding and artificial diets has immensely helped in promoting aquaculture of trout in the country. North-western Himalayan region is the major producer of rainbow trout (81.2%) while contribution from central and north-eastern regions of the country is meagre. In spite of increase in production in recent years, number of issues such as improvement in infrastructure and culture practices in terms of brood stock management, feeding, stock handling and stress management need consideration. Supply of inputs such as seed and feed as well as marketing were identified as major constraints in the expansion of trout farming in India. Further increase in total production requires more ingenious and scientific ways of rainbow trout farming which are discussed. For sustainable development of rainbow trout farming in India, constant support from policy makers, research organizations and concerned line departments is advocated.

Immune responses and resistance to vibriosis of juvenile Pacific whiteleg shrimp *Penaeus vannamei* fed with high dose mannan oligosaccharide and β-glucan

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A 45-day feeding trial was conducted to evaluate the effects of mannan oligosaccharide (MOS) and β- glucan supplementation in Pacific whiteleg shrimp, ***Penaeus vannamei*** juvenile. Shrimps (0.6 g ABW) were fed diets supplemented with different levels of mannan oligosaccharide (MOS) and β- glucan (BZT® PRE-GE) as immunostimulants. Experimental diets were formulated to contain 0.2, 0.4 and

0.8% and a control. The feeding trial was conducted in 50-L capacity rectangular plastic container stocked with 20 shrimps each in triplicates. Growth, survival, resistance to ***Vibrio parahaemolyticus***, total haemocyte count (THC), respiratory burst activity, phenoloxidase activity, and clearance efficiency were evaluated. Results showed that growth and survival were not affected by supplementation of immunostimulant. On the other hand, bacterial challenge showed 100% mortality in 0.8% MOS + β- glucan fed group though not significant with the control. Total haemocyte count, respiratory burst and phenoloxidase activity were significantly enhanced in the group supplemented with 0.4% and 0.2% of MOS + β- glucan. Immune responses of the group fed with the highest concentration (0.8%) were significantly suppressed. The same trend was obtained for the clearance efficiency. The present results demonstrated that using MOS + β- glucan less than or equal to 0.4% activate immune responses and resistance against vibriosis, otherwise overstimulation of the immune indices could cause immunosuppression.

Quantitative genetic parameters for resistance to bacterial diseases in *Oreochromis niloticus*

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Bacterial diseases known as motile aeromonas septicaemia, columnaris and streptococcosis are commonly found in Nile tilapia under intensive culture environments. The pathogenic bacteria have been identified as ***Aeromonas hydrophila***, ***Flavobacterium columnare*** and ***Streptoccoccus agalactiae***, respectively. These diseases cause mass mortality in every growth stages from fry, fingerling to adult, particularly during the summer season. This paper described the estimation of genetic parameters for resistance to bacterial diseases in the Chitralada 4 strain of Nile tilapia. Initially, families were produced from single-pair mating of 60 pairs of males and females using the partial factorial design. Fry at the age of 14 days post hatch were challenged by immersion in bacterial solution at 96 h LD_{50}

concentration for 14 days. Data from 25 full-sib and 14 half-sib families were used to estimate variance components by animal model using ASReml. Kaplan-Meier survival analysis indicated that survival data of fish in three challenge tests were not significantly different. The estimates of heritability for time until death (days) were low for resistance to ***A. hydrophila*** (0.09±0.00), ***S. agalactiae*** (0.08±0.00) and ***F. columnare*** (0.08±0.00). Low genetic correlations were observed between resistances to ***A. hydrophila***, ***F. columnare*** and ***S. agalactiae*** ranging between (0.1-0.12), i.e., genetic correlation between resistances were (0.11±0.00) for ***A. hydrophila*** v.s. ***S. agalactiae*** and (0.12±0.00) for ***A. hydrophila*** v.s. ***F. columnare***. However, genetic estimations based on time until death, were easily biased with short period of challenge test. Assessing large number of families is recommended to obtain reliable estimations of the genetic correlations. In conclusion, results in this study suggest that breeding programs should be established to improve resistance to each of the diseases separately.

Development of DNA extraction method to minimize PCR inhibitors from water samples from shrimp ponds

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Understanding the bacteria associated with the aquaculture rearing environments can help in better controlling and managing disease. However, in soil sediment and water from shrimp ponds, humic acid inhibitors are often co-extracted along with genomic DNA, and can interfere with PCR amplification. The presence of PCR inhibitors as demonstrated by the brown to black color in the DNA solution can affect the subsequent analysis and study of the bacterial communities. Currently, the best method to extract environmental DNA requires the use of a costly imported commercial DNA extraction kit.

In this study, DNA extraction methods with and without chemical flocculation

using aluminum sulfate ($Al_2(SO4)_3$) to remove PCR inhibitors were compared with the commercial extraction kit. Bacteria from approximately 500 mL of water samples from shrimp ponds was filtered onto two successive membrane filter (5µm and 0.22µm pore sizes). DNA extraction was performed on the membrane filters. The quality of DNA and effectiveness of PCR inhibitor removal were examined in terms of total DNA yield, visual inspection, PCR amplification of 16S rDNA, and bacterial community analysis using Automated Ribosomal Intergenic Spacer Analysis (ARISA) and 16S rDNA clone libraries.

Our results showed that aluminum sulfate flocculation can be combined with many DNA extraction methods to reduce PCR inhibitors and improve the PCR amplification. There was no significant change in DNA yield when the concentration of aluminum sulfate was kept below 100mM. Further work in optimizing the DNA extraction methods and testing on wider varieties of sample are needed to validate the chemical flocculation protocols to use with aquaculture samples.

Microbiota dynamic from the early developmental stages of Pacific white shrimp (*Litopenaeus vannamei*) in hatcheries in Thailand

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A recent disease of farmed Penaeid shrimp called "Early Mortality Syndrome" (EMS)

that can causes up to 100% mortality within 20–30 days after stocking in ponds has been reported in many countries. An EMS condition called Acute Hepatopancreatic Necrosis Disease (AHPND) was caused by a pathogenic strain of ***Vibrio parahaemolyticus***. At present, there is limited information on the bacterial community during the hatchery period, and whether this pathogen might be present in hatcheries. The objective of this experiment is to examine bacterial communities associated with the early developmental stages of Pacific white shrimp (***Litopeneaus vannamei***) with screening of AHPND associated ***Vibrio*** in Thailand's shrimp hatcheries.

We collected representative white shrimp samples from early developmental stages (nauplii, mysis and two postlarvae, PL) along with rearing water from two hatcheries (3 tanks each) in Chonburi and Chachoengsao, Thailand. Rearing water was separated into two fractions: plankton-associated (>5 µm) and free-living bacteria (> 0.22 µm). Genomic DNA from all types of samples were extracted using commercial kits. Bacteria communities was determined by Automated Ribosomal Intergenic Spacer Analysis (ARISA) method using primer ITS-F and ITS-R and barcode pyrosequencing of 16S rRNA gene using primer 338F and 786R. In addition AHPND associated ***Vibrio*** in all shrimp samples was detected using AP4 primers.

In early developmental stages (mysis and early PL), Alphaproteobacteria was the most abundance group of bacteria (80-90% of all sequence reads) followed by phylum Bacteroidetes (10-20%). In late PL stage (PL9-10), Gammaproteobacteria started to become more abundant (approximately 10%). Plankton associated bacteria shared similar community succession as that of the shrimp, while bacteria in rearing water appeared to be unique compared to other sources. No AHPND-***Vibrio*** was detected. Understanding the bacterial communities in hatcheries can help to manage and control the bacterial population to prevent emerging diseases in the future.

First report of disease outbreakd due to cyprinid herpesvirus 2 in goldfish Carassius auratus in India

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Ornamental fish culture has improved in popularity for its economic benefits in India. Aquaculture of goldfish ***Carassius auratus*** in ponds along with Indian major carps is very common in many states of India. West Bengal is the largest hub of ornamental fish farming. Mass mortalities of goldfish, ***Carassius auratus*** with gill lesions in polyculture fish farms of Hooghly district, West Bengal, India were reported by farmers during November 2014-15. The affected samples were found positive for Cyprinid Herpes virus 2 (CyHV-2) by the amplification of fragment of DNA polymerase gene in PCR. The nucleotide sequence was found to have 99% similarity to the other CyHV-2 sequences in NCBI GenBank. Histopathological lesions of affected goldfish revealed area of necrosis and enlargement of nuclei with intranuclear inclusions, and marginated chromatin in spleen and kidney. Section of the gills showed fusion of secondary lamellae and marginated chromatin in epithelial cells. The mature viral particles (approximately 90 – 120 nm in diameter with an envelope of 170 –200 nm in diameter) was demonstrated in cytoplasm

CyHV-2 infected gills cells of goldfish, ***Carassius auratus*** by transmission electron microscopy (TEM). The viral inoculums of the affected tissue homogenate produced cytopathic effect (CPE) in fish cell lines of Koi carp fin cell line showing focal areas of granulation, cell vacuolization, and appearance of rounded phase-bright cells typical to CyHV-2 infection. The cell culture supernatant and affected cells from all three different cell lines found positive for CyHV-2 by PCR. In this study, we isolated and confirmed CyHV-2 disease outbreak from Goldfish in India.

Morphological observation during sexual differentiation of Malaysian mahseer (*Tor tambroides*) in captivity

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High market demands of ***Tor tambroides*** at various stages of their lifespan has put a serious threat on their wild-stock population and are now considered as an endangered species in Malaysia. Therefore, it is crucial to establish a breeding program for ***T. tambroides*** to replenish wild-stock population and at the same time satisfy high market demands of this species via mass production from aquaculture industry. In the present study, seven morphometric and 21 truss measurements were taken from 30 domesticated male and female ***T. tambroides*** broodstocks to gather basic information on sexual dimorphism***s***. Results from independent T-test revealed significant differences between sexes ($P<0.05$) in two of the morphometric and nine from the truss measurements. It showed that the differences were located mainly on abdominal and the caudal regions, which is important in describing the sexual differentiation for ***T. tambroides*** broodstocks. The information gathered in this study provided basic information for more detailed study on this species.

Determination of the complete mitochondrial genome sequence of mussel *Cristaria plicata* Leach mitochondrial DNA

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In the present study, the total mitochondrial genome of a freshwater mussel *Cristaria plicata* (Leach) was sequenced and determined. The mitogenome is 15,710 bp in length. It consists of 13 protein-coding genes, 22 tRNA genes and 2 rRNA genes. The total base composition is: 36.49% A, 27.23% T, 23.21% C and 13.07% G with an A+T rich feature (63.72%). These results provide useful data to study of the genetics, systematics and conservation of mussel ***C. plicata***.

Sequence identification and description of the mitochondrial genome of *Abbottina rivularis* (Cypriniformes: Cyprinidae) mitochondrial DNA

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In this study, the complete mitochondrial genome of ***Abbottina rivularis*** was determined; the phylogenetic analysis with other individuals and closely related species of the gudgeons was carried out. The complete mitogenome of ***A. rivularis*** was 16,597 bp in length, which consists of 22 tRNA genes, 13 protein-coding genes, 2 rRNA genes, and 2 non-coding regions: (D-loop and OL). The overall nucleotide composition of the ***A. rivularis*** mitogenome was A: 29.92%, T: 25.75%, G: 17.15% and C: 27.18%, with an A+T rich feature (57.1%). This study provides useful data to genetics, conservation and evolution study of the gudgeons.

Opening doors, markets, and waters: Developing seaweed aquaculture in Indonesia's blue economy era

Emily Wright

Indonesia launched its 'blue economy' program in 2013, illustrating a recent global trend in development policy to sustainably harness the productive capacity of oceans for economic growth, food security, and poverty alleviation. Central to the blue economy platform is the expansion of seafood processing sectors to increase the value of export products, a strategy being taken in the case of seaweed, Indonesia's largest aquaculture export by volume. Turning raw seaweed into value-added products (e.g., carrageenan) holds potential for attracting private investment while creating scaling-up opportunities for the rural smallholder farmers that supply nearly all of Indonesia's seaweed. Yet the intensification of production that would accompany this market growth may compromise the stability of environmental and social conditions supporting rural production systems. This study examines the social organization of rural seaweed aquaculture in Lombok, West Nusa Tenggara province to understand the implications of Indonesia's blue economy policies on the sustainability of production and the governance of the seaweed value chain. The findings of this study can inform approaches to developing aquaculture and seafood value chains in a sustainable manner that considers the social and ecological systems that are at the foundation of aquaculture production.

Dietary supplementation of probiotic *Bacillus subtilis* E20 enhances the growth performance and feed utilization of juvenile parrot fish (*Oplegnathus fasciatus*)

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Parrot fish, ***Oplegnathus fasciatus*** is regarded as an emerging aquaculture species due to its high economic value and excellent flesh quality. However, poor growth of farmed parrot fish is one of most concerns due to high cost of production and low profit. Therefore, the aim of this study was to elucidate the effect of dietary administration of probiotic ***Bacillus subtilis*** E20 on the growth performance of juvenile parrot fish. The parrot fish were fed the diets incorporated with probiotic ***B. subtilis*** E20 at 0 (control), 10^8, 10^9, and 10^{10} cfu kg^{-1} of feed for 8 weeks, and then the growth performance indices and feeding efficiency (FE) were evaluated. The results showed the significant increase of growth performance at dietary ***B. subtilis*** E20 level of 10^8 cfu kg^{-1} but no further improvement was observed at higher ***B. subtilis*** E20 levels. Significantly higher FE, specific growth rate (SGR) and percent weight gain (PWG) were obtained in fish fed the 10^8 cfu kg^{-1} diets than those fed control diet. The findings suggest that the probiotic ***B. subtilis*** E20 can be used suitably to improve growth performance and feed utilization efficiency of juvenile parrot fish at dose of 10^8 cfu kg^{-1} of the diet.

Effects of spawning substrates and water temperature on rainbowfish (*Melanotaenia herbertaxelrodi*) breeding

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Rainbowfish (***Melanotaenia herbertaxelrodi***) is a freshwater ornamental fish found in the aquarium trade and ideally suited to a heavily planted setup and higher water temperature. This fish lays egg on the roots of floating plants, but the rotten roots of floating plants might be deleterious to water quality. In the present study, different spawning substrates, including floating plants, black wool and plastic threads were used for rainbowfish spawning. The results showed that rainbowfish prefer to lay egg on the root of floating plants and wool rather than plastic threads and the egg numbers on each floating plant and black wool were not significantly different. The trial of water temperature influencing egg hatching showed that the egg hatching time was decreased as the water temperature (22 and 28°C) increased. Therefore, it is suggested that black wool is a better spawning substrate than plastic thread, and higher water temperature (28°C) are much more suitable for rainbowfish egg hatching.

Estimation of heritabilities for body weight and length in Asian seabass (*Lates calcarifer*)

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The Asian seabass is an important food fish species in Thailand which can be cultivated in both brackishwater and freshwater ponds. Thailand is a major international supplier for fry and fingerlings, although the genetically improved strains of seabass are not available. In this study, genetic parameters for body weight and length at fingerling were estimated for seabass stock from a medium-sized private hatchery to determine the potential for its selective breeding. The experiment was conducted under a working condition at the hatchery. Fry were produced by mass spawning of 18 males and 48 females, which were marked by PIT tags for identification. Pedigrees were reconstructed based on seven microsatellite loci (***LcaM***27, ***LcaM***32, ***Lca***58, ***Lca***98, ***Lca***185, ***Lca***260 and ***Lca***284) using the computer program COLONY 2. Mass spawning produced 97 full-sib and 349 half-sib families. Families with fewer than five progeny were excluded from the datasets. At 12 days post-hatch, fry were graded and reared separately until 90 days. A total of 807 individuals were measured at 90 days post-hatch with the average of 563.58±220.90 mg for body weight, 32.49±8.71 mm for total length and 8.99±2.30 mm for body depth. Seabass fingerlings displayed relatively large size differences, likely due to strong competition within the population. Variance components were estimated by multivariate animal model using ASReml. Estimates of heritability±S.E. were 0.150.09± for body weight, 0.200.12± for body length and 0.190.11± for body depth. It is likely that the heritabilities were underestimated due to the effect of size grading. Body length was highly correlated with body depth, with the value±S.E. of 0.940.01±. However, genetic correlation was moderate between body weight and body length (0.410.00±). The results suggested selection for body length for improvement of fingerling body weight in this seabass stock.

Small-scale fishers' perceptions of climate change and their adaptation strategies in Miagao, Iloilo, Philippines

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Using random sampling long-time fishers in 22 coastal barangays in Miagao, Iloilo, Philippines, were identified for their perception of climate change and its effects on fishing and their adaptive response. Data were collected from 158 fishers using a pilot-tested interview schedule from December 2011 to February 2012. The results showed that the majority of the fishers had heard, observed, and experienced most climate change manifestations after Typhoon Frank in 2008. The most common ones reported by the fishers were increased daytime temperature, increased typhoon frequency and intensity, longer hot season, erratic weather conditions, and abnormal changes in wind patterns. Fish catch and profit, number of fishers, and household/community welfare were perceived to be sensitive to these climate change manifestations. The majority of fishers reported more different combinations of anticipatory and concurrent measures and less reactive measures. They also reported a cancellation of fishing activity during the occurrence of a typhoon. The study recommends for the dissemination of quality information on climate change to the fishers and the establishment of informed community-based adaptation strategies.

Analysis of precipitation and temperature trends on seaweed aquaculture in Nanao Island, Guangdong, China

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The success of seaweed aquaculture is heavily dependent on environmental conditions and ecology. Moreover, seaweed aquaculture operations are highly exposed to the climate change impacts such as changes in precipitation, water temperature, rising sea level, and storm intensity. In this study, we analyzed precipitation and temperature trends on seaweed aquaculture in Nanao Island, Guangdong P.R China, focusing on the most commonly farmed species, ***Kappaphycus*** and ***Eucheuma***. Analysis of time series data over the past 40 years from published literature and current investigations shows that the annual mean surface temperature of the coastal area of Nanao Island has increased 0.8°C from 1970 to 2010. The intensity of precipitation increased in the winter months, while summers became drier. The results indicate that while the impacts are continuously dealt with by seaweed aquaculture activity they will pose a threat to the future of seaweed aquaculture in Nanao Island.

Integrating the culture of indigenous species with climate-smart aquaculture

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In an era of global climate change and a growing demand for animal protein, increasing the production of fish through sustainable and environmentally sensitive practices is critical. The concept of climate-smart agriculture is applied to aquaculture, in which management strategies for increasing production integrate

climate resilience. Incorporating the use of native species in climate-smart aquaculture not only provides the potential to grow local economies, it also addresses some of the concerns about environmental threats and takes advantage of the evolutionary ecology of the species in its native landscape. People around the world rely on fish as a primary source of protein and income, and the growing aquaculture industry provides roughly half of the global fish supply. However, to meet the demands of a rapidly growing population, a rising middle class, and an increasingly urban population, protein consumption is expected to increase to 45 kg per capita by 2020, a 25% increase from 1997. The development of sustainable, climate-smart aquaculture will provide responsible options to the growing industry.

Effects of temperature and salinity on oxygen consumption and ammonia excretion in different colour strains of the Manila clam, *Ruditapes philippinarum*

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The metabolic responses of different color strains of ***Ruditapes philippinarum*** in terms of oxygen consumption and ammonia excretion to changes in temperature (15-35°C) and salinity (20-40 ppt) were investigated. In the temperature range of 15-35 °C, oxygen consumption rate (OCR) increased in cultivated strains (white and zebra) in opposition to the effect in the wild strain which reached a maximum at 25 °C. The highest Q_{10} coefficients were 2.741 for the zebra strain, 4.326 for the white strain, and 1.944 for the wild strain at temperatures of 25–30 °C, 30–35 °C, and 20–25 °C, respectively. In the salinity range of 20-40 **ppt**, OCRs of the white strain and the zebra strain firstly decreased to the lowest level at 25 ppt and 30 ppt, and then increased to the highest level at 35 ppt and 40 ppt, respectively. When the salinity is beyond 35 ppt, the OCR decreased and the turning point was found in the white strain and the wild strain, but the OCR of the zebra strain still increased to a highest level (1.906 $mg \cdot g^{-1} \cdot h^{-1}$) at 40 ($P < 0.05$). The OCRs of the two color strains of ***R. philippinarum*** were significantly influenced by temperature and

salinity ($P < 0.05$), but was not significant in the wild strain. The temperature of 35 °C and salinity of 40 ppt could be considered stressful to the white strain. The results of this study showed that the zebra strain could adapt to salinity between 20 ppt and 40 ppt and to temperature between 15 °C and 35 °C better than the white strain, suggesting the zebra strain might have a better temperature and salinity resistant or tolerance ability than the white strain. These results show that the cultivated color strains of ***R. philippinarum*** were different from the wild strain in terms of metabolic responses, and information on its response to different temperature and salinity have implications in the aquaculture industry.

Transcriptomic responses to low temperature stress in the Manila clam, *Ruditapes philippinarum*

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The Manila clam, ***Ruditapes philippinarum***, is an economically important shellfish in marine aquaculture. It has a broad thermal tolerance with an ability to cope with cold stress. A cold-tolerant clam that can survive the winter at temperatures below 0 °C might extend our understanding of the mechanisms underlying the response to cold stress. In this study, the transcriptional response of the Manila clam to cold stress (-1 °C) was characterized using RNA sequencing. The transcriptomes of a cold-treatment (O) group of clams, which survived under cold stress, and the control group (OC2), which was not subjected to cold stress, were sequenced with the Illumina HiSeq platform. In all, 148,593 unigenes were generated. Compared with the unigene expression profile of the control group, 1,760 unigenes were up regulated and 2,147 unigenes were down regulated in the O group. Gene Ontology and Kyoto Encyclopedia of Genes and Genomes analyses revealed that signal transduction, mitochondrial metabolism, cellular component organization or biogenesis, and immune system processes were the most highly enriched pathways among the genes that were differentially expressed under cold stress. All these pathways could be assigned to the following biological

functions in the cold-tolerant Manila clam: signal response to cold stress, antioxidant response, cell proliferation, and energy production.

Toxicity analysis of coal washery effluent using fish bioassay

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During washing and processing of coal, coal washery effluent (CWE) is produced from washary plants and contain suspended particles, different chemicals, detergents, and many toxic metals. CWE is released directly into the different water bodies causing serious water pollution and affects the health of water biota. This study evaluates the toxicity of CWE and its impact on aquatic organisms. The CWE was collected from the Bharat Coking Coal Limited, Jharkhand, India. Different physicochemical parameters (BOD, dissolved CO_2, total solids, total dissolved solids, hardness, acidity, turbidity, and others) were analysed using the methods of APHA (1998). The concentration of different metals (Pb, Cd, Ni, Mg, Zn, As, Al, Fe, and Cu) were estimated in the effluent sample using ICP-MS (Inductively Coupled Plasma Mass Spectrometry). All the above mentioned physicochemical parameters and concentration of different metals were found to be much above their safe limits (EPA 2003) making the effluent very toxic. To evaluate the effect of CWE on aquatic organisms, ***Channa punctaus*** (snakehead) was exposed to CWE. Different stress markers (e.g., metal accumulation, metallothionein concentration), activity of antioxidant enzymes (e.g., SOD, catalase, GSH, GPX) and lipid peroxidation were measured in the gill and liver of the CWE-exposed fish. FTIR (Fourier Tranform InfraRed) spectra of the exposed liver and gills were analysed to assess the changes in the binding of functional groups with pollutants.

Parrotfish abundance on coral communities in the Gulf of Thailand after the 2010 coral bleaching event

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Mass mortality of corals following the coral bleaching events is recognized as one of the severe impacts of global change on marine ecosystems. The coral bleaching may affect coral reef fish abundance, richness and biodiversity. The loss of live coral cover may have a profound impact on fish biodiversity and abundance. Parrotfish are important components of coral communities as they feed on macroalgae that would otherwise displace reef-building corals. In some cases, parrotfish may feed on live corals and have negative impacts on corals. The severe coral bleaching event in 2010 resulted in high percentages of coral mortality in the Eastern and Western Gulf of Thailand. This study examined spatial patterns of parrotfish abundance on twenty coral communities in Mu Ko Samet, Rayong Province, the Eastern Gulf of Thailand, Mu Ko Chumphon, Chumphon Province and Mu Ko Angthong, Surat Thani Province, and the Western Gulf of Thailand. The parrotfish abundance was observed by using a standard visual census technique in the belt-transects, 50x5 m for each. High abundance of parrotfish was recorded at Ko Ngamyai, Mu Ko Chumphon, Ko Thaipao, and Mu Ko Angthong. High population densities of parrotfish were also observed at Ko Rang Ka Jiu, Ko Lawa, and Mu Ko Chumphon. Many colonies of the massive ***Porites*** species complex, the most dominant reef-building corals in the Gulf of Thailand, exhibited a number of parrotfish grazing scars. This study implies the importance of parrotfish studies in the Gulf of Thailand, particularly their feeding behavior, population ecology, and relationships with coral community structure and coral recovery processes following major disturbances. This study also provides baseline data for further studies and management of coral communities under the high frequency of coral bleaching events.

Catch analysis of crab pot off Guimaras Island, central Philippines

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Sustainable fisheries has always been elusive in multi-species fisheries because of a lack of information. This study hopes to add information by analyzing the catch data of a commercial crab pot operating in Guimaras ($10^0$35' North and $122^0$28' East), central Philippines. A total of 180 conical (base diameter 40.97+2.69 cm, top diameter 26.21+1.85, opening diameter 9.39+1.06, height 10.85+1.40, retention panel height 6.30+0.78) crab pots connected in series, five meters apart were used. The net has an almost equal primary and secondary hanging ratio ($E_1 = E_2$) at the base and an increasing primary hanging ratio (E_1 close to 1) as the mesh nears the top. Further, three nets with three different mesh opening (MO) sizes (15 mm, 17 mm and 19 mm) were used. The gear was baited with trash fish and operated using usual the practice of a soaking time 3.99+0.14 Hr. Thirty two fishing trips were conducted. A total of 382 organisms were caught comprising 21 species. Of these, seven are target (crab) species while 14 are bycatch species. The bycatch species comprise 11 finfishes, two cephalopods and one shrimp. Further, MO size showed species specific effect on the two dominant catches. For the crucifix crab, ***Charybdis. feriatus***, sex distribution showed parity ($\chi^2 = 3.32$, $P > 0.05$) for all MO sizes and a decreasing individual weight and size as MO size increases. While for the blue swimmer crab, ***Portunis pelagicus***, the proportion of caught female increased as the MO size increases ($\chi^2 = 6.90$, $P< 0.05$). Further, the effect of MO was significant for size ($H = 15.49$, $P < 0.05$) and individual weight ($H = 18.92$, $P < 0.05$) for ***P. pelagicus*** at 19 mm when compared with the rest of the MO sizes. These information can be used to evaluate the use of MO as a mechanism for catch size regulation.

Crustacean assemblages in three seagrass areas in Central Philippines

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Seagrass beds in shallow marine environments support high faunal abundance and diversity. Monthly trawl surveys were conducted at night from June 2011 to May 2012 to investigate the abundance, composition and distribution of crustaceans in three seagrass areas (Talibon Bohol, Palompon Leyte, and Concepcion Iloilo) in Central Philippines. Five stations were established in each area and monitored in triplicates. Surveys were done using a 2.5m long trawl net with 1cm mesh fitted to a modified 1-meter mini sled trawl and towed for 10 minutes at a speed of 2 knots.

Overall mean crustacean density was highest in Talibon (57.3 individuals (ind.)/100m^2), followed by Palompon (14.5 ind./100m^2) and lowest in Concepcion (10.3 ind./100m^2). Hermit crabs dominated the catches in all seagrass sites. Crabs and shrimps were more likely to be caught inshore and among seagrass stations in close proximity with mangroves. No clear patterns of seasonality were observed in Talibon and Palompon with multiple peaks throughout the year. In contrast, Concepcion, with the lowest mean density, showed some signals of seasonality from September to October. Crustaceans comprised 15%, 32%, and 23% of the total trawlable epibenthic fauna in Talibon, Palompon and Concepcion, respectively. Multivariate analysis was performed to describe the assemblages in relation to different biotic and abiotic parameters available in this study.

Fishers and the fisheries in Western Visayas, Philippines

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In developing a responsive management strategy, the fisheries and the fishers, as perceived by the fishers, need to be well understood. This poster describes the fishers in Western Visayas, Philippines, using selected demographic and socio-economic characteristics, and describes their use and dependence on the fishery resources including their perception of the status of the fisheries, and their participation in the management of the fishery resources. It also describes the problems and issues related to fishing that face them and those that they perceived facing the fishery resources. Data were collected through a survey of 227 fishers in Batan and Altavas, Aklan in 2012 and 302 fishers from Concepcion and Miagao, Iloilo and Jordan, Guimaras in 2013, and focus group discussions (FGDs) with fishers, women, and the youth. The fishers were highly dependent on the fishery resources; they were locked-in into the fishery sector and quite pessimistic about the future of the fishery resources, particularly the fishers in Batan Bay area. They are highly supportive of fisheries management and their participation can be further enhanced. The information is useful as inputs towards policy and decision-making that balances the dual objective of saving the fishers and the fisheries on which they depend on.

Ecological modelling of aquatic larval connectivity links for mapping marine protected areas (MPAs)

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This study outlines the use of numerical simulations for identifying marine protected areas (MPAs) for aquatic organisms. Numerical models are useful for studying fish and other aquatic invertebrate larval connectivity links and numerical simulation is an attempt to supplement the existing decision support systems. The role of currents in a closed area and geological structures such as mounts in an open area are explored to see their role of fish aggregation, thereby creating fishing and nursery grounds. Numerical and particle transport models was used for generating hydrodynamics and further for identifying areas of fish aggregation. Validations of the models were done with ***insitu*** observations. Likelihood retention areas of larval aggregations indicated formation of nursery grounds, but the situations are complex and there are many uncertainties. The role of coastal processes in fish and shell fish production and dynamics deserves further investigation with improved time series sampling of early life stages in marine organisms. There is potential for numerical simulation data to serve in future as a surrogate for marine aquatic biomass. The combination of satellite data sets with fisheries data can lead to robust conclusions.

Annual trends in sardine fisheries production in the northern Zamboanga Peninsula, Philippines: understanding human-environment synergy in stock dynamics and fisheries management

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High annual production of the sardine (Clupeiformes: Clupeidae) fisheries in the Zamboanga Peninsula in southern Philippines motivated the rapid growth of the post-harvest industry, thereby contributing to the country's export market. Concerns on dwindling stocks, overfishing, and vulnerability to climate-associated factors motivated the Philippine government to fund two collaborative research projects into the spatio-temporal dynamics of sardine fisheries in the northern Zamboanga Peninsula to aid management policy toward sustaining the country's sardine stocks. Monitoring of sardine fisheries was undertaken in 2009-2011 under the Resilient Seas program and in 2011-2014 under the SarDyn program, aided by a satellite-based, participatory research approach called Research in Sardine Volunteer Program (RSVP) to produce time-series maps of fishing effort, area-specific catch data, and potential spawning grounds. Landed catch data covering the period 2009-2014 show interannual variability in sardine production that is possibly influenced by ENSO events, seasonal wind patterns, food availability, and changes in fishing effort. Geo-referenced effort maps show that both commercial and municipal fishing on sardine generally occurs within municipal waters – a constant source of conflict in resource use being addressed by government through a periodic fishing closure implemented for three years (2011-2014). A brief analysis of impacts of the sardine fishing closure is also provided.

Ecology and fisheries status of Keshopur Chhamb Miani wetland (community reserves) at Distt- Gurdaspur (Punjab) india

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Keshopur wetland of Gurdaspur district was declared a community reserve by Punjab Government in 2007 under Wildlife Protection Act. It is located at an altitude of 245 m. and covers an area of 850 acres. The ecological boundaries of ecosystem extend much beyond boundaries of the community reserve and the entire tract serves as an important habitat for fish species, migratory birds and other bioorganisms. Keshopur wetland comprises marshes which covers an area of 340 ha and recognized as an important bird habitat. Five village Panchayats occur in two marshes of Keshopur wetland which includes Miani, Dalla, Keshopur and Matwa and Magarmudian as area.

At present 83% area of Keshopur wetland is under anthropogenic activities in the form of fish ponds, cultivation of lotus, trapa and weeds through long term lease mechanisms, which has profound impact on rural economy and community participation by local people. Water samples collected from three spots of Keshopur wetland were subjected for the analysis of water quality parameters. Fish species diversity and catch composition were recorded at landing sites/local market in Gurdaspur during field visit.

The values of water quality parameters were found to be normal. The pH showed wetland water is alkaline throughout the year. Conductivity revealed positive linear correlation with TDS while both conductivity and TDS were found correlated significantly with other parameters. Turbidity showed significant correlation with HCO_3 and total alkalinity. The alkalinity is mainly caused due to carbonate, bicarbonate and hydroxyl ions, whereas hardness is due to Ca and Mg content in the water. The nutrient parameters also revealed seasonal variation which is linked to the hydrological cycle. A total of 26 fish species was observed during the survey in Keshopur Chhamb Miani wetland. The wetland is habitat to more fish species during monsoon season. More than 70 bird species, including migratory species,

were also identified in the wetland of Gurdaspur. Wetland resources need to be conserved properly for providing natural habitat to diverse form of flora & fauna.

Reproductive biology and gonad stages of the oceanic paddler crab, *Varuna litterata* (Fabricius, 1798) in a river in Antique, Philippines

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The oceanic paddler crab, ***Varuna litterata*** (Fabricius, 1798) is an edible crab that inhabits burrows along embankments of mangroves, brackish water ponds and rivers. This species has been reported from all over the Indo-West Pacific. To protect their population, it is important to determine their reproductive biology. For one year, a total of 585 samples of ***V. litterata*** (10.2- 53.2 mm CW) were collected. The smallest ***V. litterata*** female with mature gonad was 26.4 mm CW while the smallest male was 14 mm. The smallest juvenile with mature gonad was 16 mm CW and the largest was 44.2 mm. In females, the color of the ovaries changed from transparent (immature, stage 1) to creamy-white (early maturing, stage 2), yellow orange (late maturing, stage 3), then different shades of brown (light, reddish and dark; fully mature, stage 4). The immature ovaries were thin and cylindrical in shape; the early maturing were also cylindrical but increased in size; the late maturing stage were likewise cylindrical but slightly thicker than the previous stage; the fully mature stage was composed of various shades of brown. When light brown in color, the ovaries were cylindrical, with lobules that are already apparent, and had significant increase in volume. When reddish brown in color, the gonads were slightly compressed dorsoventrally and had lobules. Lastly, when

dark brown in color, the ovaries were considerably larger than the previous stages. At this stage, the anterior lobes were swollen with large ova which cover the entire hepatopancreas. In males, the color of the testes varies from translucent (immature) to white (maturing), and to milky white (mature). The juveniles on the other hand had two stages: immature (translucent) and mature (white). Histological appearance of the oocytes in each stage of gonad development was described.

Some remarks on the fishing regulations in relation to the conservation of coastal habitats in Turkey

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The fishing regulations and adopted measures in Turkey are very important for the conservation of the coastal habitat and fishing resources. By means of these regulations, the aim is to control the fishing activities, especially with respect to biological limits. Turkey has extensive marine resources along its long coastlines between the Black Sea and the Mediterranean Sea, and it is also rich in a variety of marine resources. These long coasts allow a wide range of fishing techniques including large-scale fishing such as trawl and purse seine fishing, and small-scale fishing such as gillnets and long lines. In 2014, total fishery production in Turkey was 537,345 tonne, consisting of marine fisheries 49.52%, aquaculture 43.76%, and inland fisheries 6.72%. In this study, we focus on some management measures used to protect the coastal habitats.

The legislation system in Turkey has significantly been improved through many provisions regarding the protection of the environment including gear restrictions, closed fishing zones, and protected areas. In 2012, the minimum legal depth of purse seining was increased from waters deeper than 18 m to 24 m in all territorial waters of Turkey. Except for the tuna purse seines, the using of purse seine nets with a depth of more than 90 fathoms (164 m) is prohibited in order to conserve Turkish coastal habitats. Bottom trawlers are only allowed at distances more than 3 miles from the coast. Boat seines and all types of beach seines were completely

prohibited in 2012 with the exception of boat seines for shrimp in the Sea of Marmara. Fortunately, there is a growing awareness about the significance and priorities of the Turkish coastal habitats for an optimal fisheries utilization. In conclusion, a considerable number of measures have been included in the fisheries management in order to protect the coastal habitats in Turkey within the scope of recent management notifications.

Small scale fishing profile of Istanbul, Turkey

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Istanbul is a major fishing center of Turkey. Commercially important pelagic fishes migrate from the Mediterranean Sea to the Black Sea by passing through the Istanbul Strait. This geographical advantage makes small-scale and industrial fishing economically important to Istanbul. In this study, questionnaires were carried out in order to determine current situation in 31 fishing ports, including the number of vessels, types of vessels, variety of fishing gears, fishing season and target species in the Istanbul provincial borders. Technical plans of demersal and pelagic nets were introduced for the first time according to the FAO standards.

It was determined that 25 of ports have a deficiency in various sub-structures and 24 of 31 in various super-structures. Questionnaires also revealed that there is no sub- or super-structure in three fishing ports, no super-structure in 6 fishing ports, and no sub-structure in one fishing port. Although one fishing port is complete in terms of sub-structure, there is no ideal fishing port. There was electricity in 77.4% of the examined fishing ports, harbor launches in 64.5%, administrative buildings in 58%, fresh water in 51.6%, net mending areas in 35.4%, retailing areas in 35.4%, covered storage in 32.2%, lighthouses in 12.9%, precooling storage in 12.9%, fishing net drying areas in 6.4%, fisherman local areas in 3.2% and ice-making plants in 3.2%. The fishing fleet includes 1,639 artisanal vessels, 204 trawl-purse seiners, 83 purse seiners and 18 trawlers. Gill and trammel nets and hand lines are used in almost all fishing ports but bottom trawls are used only in the Black Sea

side and purse seines are concentrated in some ports in both the Black Sea and Marmara Sea. The artisanal fleet is commonly composed of boats of 6-8m. A total of 13 types demersal set nets (7 gill nets and 6 trammel nets), 7 various types pelagic set nets (5 gill nets and 2 trammel nets) were identified. The main target species of these nets are the red mullet, striped red mullet, bluefish, bonito, horse mackerel, whiting, sole and flounder.

Heavy metal accumulation in different organ systems of edible catfish *Clarias batrachus* when exposed to coalmine effluent

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The objective of the present study was to determine the concentration of eight heavy metals in Rajrappa coalmine effluent and also their accumulation in various organs (skin, muscles, air breathing organ (ABO), gills, liver, kidney and brain) of the freshwater food fish, ***Clarias batrachus*** exposed to the above coalmine effluent (CME) for 10 and 20 days, respectively. It was found that the concentrations (mg Kg^{-1} DW) of all the detected metals in the CME were above the permissible limit suggested by the Environmental Protection Agency (EPA, 2002). Amongst these metals, the concentration of Fe was the highest (18.21 ± 3.865) while the concentration of Cr was the lowest (0.15 ± 0.014). Further, the concentrations of different metals in various tissues were not identical. Following 10 days of exposure the fish tissues accumulated metals in following order kidney > liver > gills > skin > ABO > brain > muscles. After 20 days of exposure significant ($p<0.05$) accumulation of metals was observed in the order liver > kidney > gills > skin > brain > ABO > muscles. The liver tissue accumulated highest concentration of metals in the order Fe > Zn > Mn > Cu > Cr > Pb > Ni > Cd while lowest in the muscles Zn > Fe > Mn > Ni > Cu > Pb > Cd > Cr. The results indicate that the heavy metal accumulation gradually increases during the exposure period and also reveals the danger of bio concentration of metals to higher trophic level following consumption of such polluted fishes. Our findings recommend the prohibition of fish culture around coalmines and consumption of these contaminated fish.

Catch distribution and biological characteristics of the diamondback squid *Thysanoteuthis rhombus* in the northeast Cebu Island, central Philippines

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Diamondback squid is a seafood product of high commercial value in the Visayas region. It is in high demand both in local and foreign markets, but its catch distribution and biological characteristics are not yet fully examined. This study was conducted northeast portion of the Camotes Sea off Carmen, Catmon and Sogod, Cebu to examine the catch distribution and biological characteristics of the squid. The study site was located between 10° 35'N and between 120° 12' 30"E and 120° 10"E.

Catch distribution differed significantly in across the areas at 1% level (F=36.73; Ft=18), and the results show that the town of Carmen had the highest catch compared to the other area. In terms of biological characteristics, the results indicated that the total length of the squid was directly proportional to its weight, mantle length, fins width and tentacle head. The total weights were found to be larger in July than in February and March. In terms of sex ratio, it was found out that in February to June the catch were females while males were found to be dominant in the month of July. Gonad weight was highest in the February and declined in the following months. These results indicate that the reproduction of this species started during February as the physical environment became favorable for spawning.

Effects of interplay waters on geospatial and temporal distribution of mesozooplankton and copepods in the southern East China Sea

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The two water masses - warm Kuroshio Current and the cold China Coastal Current - influence the oceanic biota in the southern East China Sea. The present study investigated that composition structure of mesozooplankton and copepods in northern Taiwan. In total 23 major mesozooplankton taxa were found, with the Calanoida (relative abundance (RA): 64.41%) and Poecilostomatoida (RA: 25.64%) being the most abundant. Mesozooplankton densities ranged between 44.41 individuals (ind.) m^{-3} in November 2009 and 6911.88 (ind. m^{-3}) in March 2010 (mean ± SD: 1306.7 ± 1617.1 ind. m^{-3}). Among all the samples, 77 copepod species were identified in total, belonging to 4 orders, 21 families, and 36 genera. The average abundance of all copepods ranged from 220.2 ± 200.3 (ind. m^{-3}) in October-November 2009 to 1773.3 ± 1782.1 (ind. m^{-3}) in March 2009. The most abundant were: ***Temora turbinata*** (RA: 31.74 %), ***Corycaeus*** (***Ditrichocorycaeus***) ***affinis*** (RA: 27.42 %), and ***Paracalanus parvus*** (RA: 20.38 %). Results of one-way ANOVA revealed that the number of copepod species, their total abundance, indices of richness, evenness, and Shannon-Wiener diversity were significantly different during the 3 different periods studied. The density of 7 mesozooplankton taxa and 17 copepod species exhibited a significant positive correlation with seawater temperature, whereas the densities of 3 mesozooplankton taxa and 6 copepod species correlated significantly negative with seawater temperature. The results of this study demonstrated that interplay waters influenced the seasonal succession and changesd geospatial variations of planktonic biota in the coastal area of northern Taiwan.

Histochemical analysis of glycoproteins in the secretory cells in the epidermis of the head skin of an angler catfish *Chaca chaca* (Siluriformes, Chacidae)

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A number of histochemical methods were employed to identify the different classes of glycoproteins (GPs) elaborated by the epithelium in the epidermis of the head skin of an Angler catfish ***Chaca chaca***. The fish is a bottom-dweller and is often found in mud or in soft substrates where they bury themselves well, camouflaged both for protection and to feed. The epithelium covering the skin of head region revealed differential distribution of various cell types and their glycoprotein composition. Analysis of the histochemical results revealed that the various cellular components elaborate a mixture of different classes of GPs. Release of GPs with oxidizable vicinal diols on the surface of the epithelium in small amounts by the superficial layer epithelial cells and in high concentration by the mucous goblet cells may be concerned with the diversified physiological activities. These GPs may control the acidity of acidic GPs, and protect the mucosa against proteolytic degradation. Secretion of moderate amounts of GPs with carboxyl groups and small amounts of GPs with O-sulphate esters on the surface epithelium by mucous goblet cells in skin of ***C. chaca*** could function in preventing bacterial colonization and proliferation, as well as provide lubrication to protect the skin against mechanical damage. The present histochemical study provides the histochemical evidence for the differentiation and the localisation of different classes of GPs in the epidermis of the head skin of the catfish, ***C. chaca.*** The secretions at the surface of the skin are considered to perform different functions and play important role in the maintenance of the structural and functional integrity, an adaptation for the fish in relation to its habits and habitat.

Ecology and reproductive biology of the senatorial scallop *Chlamys senatoria* (Gmelin 1791) in Gigants Islands, Carles, central Philippines

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The senatorial scallop ***Chlamys senatoria*** (Gmelin 1791) is a commercially important species, but poorly understood in the Philippines. In order to provide biological information for future conservation and management, the ecology and reproductive biology of the senatorial scallop in Gigantes Islands, Carles, central Philippines were investigated from June 2013 to May 2014. Scallops were collected monthly from the catches of hired divers. Ecological parameters were also monitored during the sampling period. The samples were measured, dissected and processed for histological analysis and fecundity was determined. Results demonstrated that ***C. senatoria*** occurs in rocky and sandy areas at 18-22 m. Physico-chemical parameters showed minimal variations over an annual cycle with sea bottom water temperature of 25-27 °C, salinity of 33-35, pH of 8.0-8.4, and dissolved oxygen of 5.6-6.7 mgL^{-1}. Macroscopic and microscopic examination of gonads confirmed that this species is dioecious with no apparent external dimorphism. Five distinct gonad stages were observed: developing, ripe, spawning, redeveloping and spent. This species spawns throughout the year (protracted or continuous) with a major peak from December to February and a minor peak in August. Size at maturity (50% of population mature) was 57.1 mm and 59.5 mm shell height for males and females, respectively. Fecundity ranged from 5.8×10^5 to 2.7×10^6 oocytes $female^{-1}$ with a mean of $1.3 \times 10^6 \pm 5.4 \times 10^5$ oocytes $female^{-1}$. Harvesting of scallops should be regulated during the months of peak spawning activities (August and December to February) and sizes should be limited to individuals >59.5 mm shell height.

Evaluation of reproductive biology of sea cucumber, *Holothuria scabra* at two different sites in Sabah

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The reproductive status of holothuroid species ***Holothuria scabra*** was studied over a six month period in Kg. Telaga Tujuh Kunak (N04^{0}39'52.05", E118^{0}15'49.01") and Kg. Limau-Limauan Kudat (N06^{0}49'24.4", E116^{0}51'42.0") Sabah from July 2015 to December 2015. Approximately nine to 15 samples of ***H. scabra*** were collected on a monthly basis from each location. The reproductive status was evaluated by the gonad index (GI) method and by histology of gonad development. All specimens were dissected to obtain the gonad, while the total length (TL), total weight (TW), gutted body weight (GBW) and gonad weight (GW) of the sample was recorded. The minimum TW of the sample was 172.38g and 194.93g whereas the maximum TW was 282.68g and 318.89g, respectively, for Kg. Limau-Limauan Kudat and Kg. Telaga Tujuh Kunak. TL of the sample for Kudat and Kunak ranged from 156.04mm to 186.06mm and 151.03mm to 205.56mm, respectively. GBW for Kudat's sample was ranged from 74.00g to 128.51g while for the Kunak sample it ranged from 74.01g to 140.67g. GI recorded in Kudat ranged from 0.0002 to 0.0168% while in Kunak it ranged from 0.0025 to 0.0349%. There no correlation between the GI and GBW of ***H. scabra*** (r^2= 0.02). Gametogenesis pattern for the six months observations showed that the highest peak of GI in Kunak during September and the lowest during November in Kudat. The reproductive biology information is crucial for brood stock management so that better brood stock can be selected for spawning induction in the hatchery.

Histo-pathological alterations in gill and kidney of *Labeo calbasu* (Hamilton, 1822) collected from sewage discharge point of Tamgrah Lake, Gorakhpur (India)

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Ramgarh Lake, a natural oxbow-lake formed by the river Rapti, is situated to southeast of Gorakhpur in Uttar Pradesh and covers an area of about 723 ha with the catchment area around 11,500 ha. The Rapti river flows about 2-3 km south-west of the lake. Pollution threats to the lake comes mainly from the residential settlements located in (1) Maharwa-ki-Bari, (2) Navalpura, (3) Bhagta, (4) Siktaur, (5) Parsahia Tola, (6) Rampur, (7) Buddha Vihar, (8) Sorahia Tola, (9) Bilandpur, (10) Gopalapur, (11) Padleyganj, (12) Champa Park, (13) Mohaddipur, (14) Kuraghat, (15) Jharkhandi Mahedeo, (16) Avas Vikas Colony, (17) Shivpuri and (18) Bhairavpur discharging more than 1,090 quintals (1 quintal = 100kg) of wastes daily into this water body. An attempt was made to record the histo-pathological changes occurring in gill and kidney of ***Labeo calbasu*** collected from N.E.R. Railway Colony sewage discharge point (Mohaddipur) in Ramgarh Lake (Gorakhpur).

The gills of ***L. calbasu*** collected from non-polluted sites consisted of primary and secondary gill lamellae, pilaster or pillar cells, chloride cells and epithelial lining cells. The gill appeared normal with wide inter-lamellar spaces facilitating normal respiration. However, mild oedematous separation of epithelial cells from pillar/pilaster cells were noticed from the branchial tissue of fish collected from sewage discharge point of Ramgarh Lake. Further, secondary gill lamellae depicted hyperplasia (increase in number of cells) leading to the partial filling of inter-lamellar spaces with epithelial cells. The kidneys of ***L. calbasu*** were a mixed organ consisting of haemopoietic, reticulo-endothelial, endocrine and excretory components. The kidney was a dark brown organ extending the length of body cavity close to vertebral column. Kidneys of the fish collected from non-polluted sites depicted normal architecture with renal tubules and haemopoietic organ. However, mild degenerative changes were noticed the kidney of fish collected from sewage discharge point of Ramgarh Lake.

Informational service oriented database for freshwater fish biodiversity of Uttar Pradesh - its design and implementation

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The freshwater eco-regions in the Uttar Pradesh state of India contain a large freshwater fish diversity. The present study discusses the design and implementation of an informational service-oriented database application for freshwater fish biodiversity of Uttar Pradesh. To develop the database application, data on fish biodiversity covering taxonomy, synonyms, local name, common name, morphology, biology, distribution, habitat, economic importance, conservation status and other fishery information was compiled from primary and published sources. Primary sources include data generated from the exploratory studies done under different research projects and published sources includes books, journals, on- and off- line databases. Microsoft ACCESS relational database management system was used to develop the database and Visual Basic language for developing the user interfaces included with search, query and access capabilities. The system presently covers taxonomy, synonyms, local name, common name, morphology, biology, distribution, habitat, economic importance, conservation status and other fishery information for 122 freshwater fishes belonging to 17 subfamilies, 32 families and 11 orders. The system through different window components provides ability for the user to work with the database interactively and easily. Thus, the standalone application

of the system can easily be deployed and operated on any Windows based Intel x86 machine. In addition, it can be deployed easily on the mobile storages devices like CD-ROM, Pen drive and PCMCIA card. This is the first version of the database application built especially for the users of developing countries where computational hardware and software resources are scarce.

Cost analysis of coral gardening in Bato Bukay marine protected area (MPA), Guimbal, Iloilo, Philippines

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Since corals are decreasing alarmingly in number, there is a need to conserve them for the sustainable production of fish. In the Philippines, fishing is one means of livelihood for many people, and accordingly the government is trying to solve the rapid decline of corals. One way of doing this is by implementing coral gardening on places where there is sufficient number of healthy corals. This study mainly aims to evaluate the costs incurred from undertaking coral gardening in Bato Bukay MPA, Brgy. Nalundan, Guimbal, Iloilo through time. The study also analyzes the willingness to support through cash and/or services by the residents of the 3 neighboring barangays that are located near the coral gardening site, namely: Brgy. Cabubugan, Brgy. Nalundan and Brgy. Calampitao, using the contingent valuation method (CVM).

Identification of the mitogenome of *Sarcocheilichthy snigripinnis* (Cypriniformes:Cyprinidae)

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The complete mitochondrial genome of the ***Sarcocheilichthys nigripinnis*** (Cypriniformes: Cyprinidae) was sequenced and identified, and the phylogenetic analysis with other individuals of Sarcocheilichthys fishes was carried out. Totally, this genome is 16,679 bp in length, which consists of 13 PCDs, 22 tRNA genes, 2 rRNA genes, and 2 non-coding regions. The total base composition is: 30.05% A, 26.40% T, 26.70% C, and 16.85% G, respectively. These results will provide useful data for species identification and genetics study of ***Sarcocheilichthys*** fishes.

Assessment of heavy metal levels in coastal organisms from four selected fish markets in Taiwan

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Concentrations of Arsenic (As) cadmium (Cd), lead (Pb), Mercury (Hg), zinc (Zn) and copper (Cu) were measured in muscle of six species of coastal organisms (***Chelon macrolepis, Penaeus marginatus, Loligo chinensis, Psenopsis anomala, Scomber scombrus, Sepia pharaonis***) which were collected from four fish markets (Budai, Zihguan, Cianjhen and Donggang) in Taiwan.

Concentrations of all heavy metal not exceed the food safety standards of China, EU, Japan and Taiwan, except Zn. The level of Zn that exceed 0.1 mg/kg of food safety standard for Japan. The target hazard quotients (THQs) values indicate that the concentrations of Cu, Zn, As, Pb, Cd, and Hg in muscle of those economic aquatic organisms, may no cause health risk to human consumption.

Health risk assessment of heavy metals in tilapia (*Oreochromis* spp.) from aquaculture ponds in Chiayi, Taiwan

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Concentrations of copper (Cu), zinc (Zn), lead (Pb) and cadmium (Cd) were measured in tilapia (***Oreochromis*** spp.) collected from fish ponds in Chiayi County, Taiwan

The concentration of metals was measured by an atomic absorption spectrophotometer. Metal concentrations varied among tissues. Whole body concentrations of copper, zinc, lead and cadmium were 8.34±0.88 mg/kg.ww, 15.00±0.29 mg/kg.ww, 62.15±4.47 µg/kg.ww and 3.00±0.30 µg/kg.ww, respectively. The average concentrations of copper, zinc, lead and cadmium in tilapia muscle were 0.16±0.01 mg/kg.ww, 1.36±0.01 mg/kg.ww, 3.99±0.41µg/kg.ww and 0.28±0.02 µg/kg.ww, respectively.

THQ (Target Hazard Quotient) of copper, zinc, lead and cadmium for tilapia muscle tissue were 0.0008 ~ 0.0015, 0.0094 ~ 0.0111, 0.0067 ~ 0.0098 and 0.0002 ~ 0.0007, respectively. The health risk analysis of the heavy metals indicated that tilapia from aquaculture ponds in Chiayi County are safe for human consumption.

Characterization of the post-harvest treatments on the nutritional composition of the egg mass of the wedge seahare *Dolabella auricularia* (lightfoot, 1786)

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The wedge sea hare ***Dolabella auricularia*** produces a gelatinous string-like egg mass locally known as ***"lukot" i***n Cebu, Central Philippines. The egg mass were collected and treated with varying methods to determine its effects on the nutritional composition. The egg mass was subjected to the different post harvest treatments such as: fresh (control (T_1), treated with vinegar (T_2), boiling (T_3) and the combination of boiling and vinegar (T_4). Results revealed that in terms of the effect of post harvest treatments on the proximate composition of the egg mass,

there was a significant difference ***(p-0.05.*** In terms of moisture content, T_2 shows the highest amount. High fat and ash content were observed in T_1; while T_4 has high crude protein and carbohydrate content. In terms of mineral content, it was observed that the treatment used shows significant difference also ***(p-0.05)*** of which T_1 is high in zinc, T_2 is high in calcium and sodium, T_3 has been found to be high in potassium and T_4 is high in iron. Results indicate that every post harvest treatment shows different effect on the nutritional content of the egg mass.

Heavy metal content (as, Cu, Ni, Pb and Zn) in green mussel (*Perna viridis*) in Marudu Bay, Sabah, Malaysia

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Some marine animals such as bivalves can accumulate much high rate of heavy metals than others. Despite having high rate of heavy metals accumulation, bivalve such as green mussel (***Perna viridis***) is still one of the delicacies in seafood restaurants in Sabah, Malaysia. One of the popular bivalve farming sites in Sabah is in Marudu Bay. However, concern over heavy metals content in mussels farmed in the bay rises due to a recent increase in agricultural activity that is taking place surrounding the bay. Hence, this paper examines the heavy metals content in farmed green mussels in relation to environmental variables in Marudu Bay. Samples of green mussels were collected from a farm in Marudu Bay, Malaysia (6° 35' to 7° N, 116° 45' to 117° E). Tissue samples were dried and grounded using mortar and pestle, and digested using acid mixture HNO3-HClO4-HCl. Heavy metal analysis was done using ICP-OES. The data were analyzed using one-way ANOVA.

The results showed that heavy metal content (dry weight basis) in green mussel ranged between 0.117- 0.381 mg/kg (As), 0.163- 5.423 mg/kg (Cu), 0.037- 0.620 mg/kg (Ni), -0.001- 0.044 mg/kg (Pb), 0.740- 3.290 mg/kg (Zn). The content of these metals in the mussels farmed in the bay is below the permissible limit set by the Malaysian Food Regulation (1985) and the Food and Drug Administration

(2013). Pearson's correlation (PC) test was applied to highlight relationships between heavy metal content in green mussels and environmental parameters. It revealed that, As was negatively correlated ($p<0.05$) with clay silt content, Cu was negatively correlated ($p<0.05$) with salinity, Ni was negatively correlated ($p<0.05$) with organic content, Ni was negatively correlated ($p<0.05$) with temperature, pH and organic content, Pb was negatively correlated ($p<0.05$) with organic content, Zn was negatively correlated ($p<0.05$) with temperature and pH.

Based on these results, it can be concluded that heavy metals content in sediment and green mussels is not only attributed to environmental variables but also influenced by anthropogenic activities. On aquaculture view point, Marudu Bay, Sabah, Malaysia is still suitable for aquaculture farming area.

Development of seaweed noodles product from *Sargassum* and evaluation of its property

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The seaweed ***Sargassum*** is widely distributed throughout the coastal waters of Asia and has high commercial value. This seaweed has been reported with functions of antioxidant, anticancer and reducing adipogenesis. This study used 1%, 3%, 5% ***Sargassum*** powder as the main ingredient to develop a new "seaweed noodles". We analyzed its texture profile analysis (TPA) and further evaluated consumer preferences. The results indicated that the 3% seaweed noodles had good springiness, chewiness and not sticky teeth. On the other hand, the consumer preferences for each investigated items were all above 5 points (total score 7

points) in 3% seaweed noodles. We know the 3% seaweed noodles have good acceptability to consumers. These results suggest that ***Sargassum*** seaweed noodles may have positive effects on the texture profile, and the high consumer acceptance. Seaweed noodles not only make people healthy in their daily life but also promote the development in the market and create the worthy of economy. The results may be used as the preliminary information to support that ***Sargassum*** would be commercially valuable in food industry.

Extraction of acid-soluble collagen from Nile tilapia (*Oreochromisniloticus*) skin

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The objective of this research was collagen extraction from Nile tilapia (***Oreochromis niloticus***)skin by using 3 levels of acetic acid concentration as 0.25, 0.5 and 0.75 M. The some properties of acid-soluble collagens (ASC) of Nile tilapia skin were investigated. All the preparative procedures were performed at 4ºC with the continuous stirring. The skin was soaked with 0.1 N NaOH to remove non-collagenous proteins. Deproteinised skin were defatted with 10% butyl alcohol. Defatted skin was extracted with 3 levels of acetic acid that mention above for 1 day then filtration.The collagen was precipitated by the addition of NaCl to a final concentration of 0.9 M and of 2.6 M in 0.05 M Tris-HCl (pH 7.5). The resultant precipitate was collected by centrifugation then dissolved in 0.5 M acetic acid. The solution was dialysed against 0.1 M acetic acid and distilled water, respectively. The dialysate was freeze-dried and referred to as ASC.Collagen extraction by using 0.5 Macetic acid showed the highest yieldof 39.23% by dry weight.The properties of ASC from 3 treatments showed the results in the same direction. All samples exhibited a maximum UV absorbance at 232 nm. They were found that glycine was the major amino acid while proline, alanine and glutamic acid were observed in descending order. ASC had good solubility at below 2% NaCl concentration. However, the solubility decreased with an increasing NaCl concentration up to 4%.These collagens also showed good solubility in acidic condition solution (pH

1 - 4) but this property decreased with an increasing of pH until neutral condition (pH 7).Moreover, the viscosity of all samples decreased gradually with increasing temperature from 4°C and became steady at above40°C.The SDS-PAGE analysis can classified these collagen as Type I collagen and Fourier Transform Infrared spectra (FTIR) investigations revealed the existence of helical arrangements of collagen.

Dietary nucleotide supplementation enhances growth, non-specific immune responses and survival to *Vibrio alginolyticus* for pacific white shrimp

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The study was to investigate the effect of dietary nucleotide (NT) on growth, non-specific immune responses and survival to ***Vibrio alginolyticus*** in Pacific white shrimp, ***Litopenaeus vannamei***. Nucleotide was added to basal diet at 0, 60, 120 and 240 mg NT/kg diet for a total of 4 experimental diets. Each diet was fed to triplicate groups of tilapia (initial body weight: 1.69 ± 0.02 g) in a recirculated rearing system for 8 weeks. Final weight and weight gain were significantly higher ($P<0.05$) in shrimp fed diets with ≥ 60 mg NT/kg diet than that in shrimp fed the NT-free control diet.

Total hemocyte and hemi-granular cells counts were highest in shrimp fed the diet with 240 mg NT/kg diet, followed by shrimp fed the diet with 60 mg NT/kg diet, and lowest in shrimp fed the control diet. Shrimp fed diets with ≥ 60 mg NT/kg diet had higher granular cells count than shrimp fed the control diet. Respiratory burst activity (O_2^- production ratio) was higher in shrimp fed diets with 120 and 240 mg NT/kg diet than that in shrimp fed the control diet. Phenoloxidase (PO)

activity was higher in shrimp fed diets with 60-120 mg NT/kg diet than that in shrimp fed the control diet. After injection with ***Vibrio alginolyticus***, shrimp fed the diet with 60 mg NT/kg diet had higher survival than shrimp fed the control diet. These results suggest that nucleotide supplemented at 60-120 mg NT/kg in diet enhances growth, immune responses and survival to pathogen of Pacific white shrimp.

Species, volumes and values of imported-exported salmon via the fish inspection office in Thailand 2011-2014

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A study on salmon imports and exports was conducted via the Fish Inspection Office in Thailand for the years 2011-2014. There were nine species of salmonids found during the collection periods, namely ***Salmo salar***, ***Hucho hucho***, ***Oncorhynchus nerka***, ***Oncorhynchus gorbuscha***, ***Oncorhynchus keta***, ***Oncorhynchus tshawytscha***, ***Oncorhynchus kisutch***, ***Oncorhynchus masou*** and ***Oncorhynchus rhodurus***. Total quantities and total values of imported salmonids were 119,295.74 tonnes and 17,615.75 million baht respectively, while the average volume was 29,823.94 tonnes/year and average value was 4,403.94 million baht/year. It was found that in 2011, the total imported volume was 31,901.06 tonnes while the value was 4,619.44 million baht. For 2012, the total imported volume was 11,426.49 tonnes while the value was 18,92.84 million baht. For 2013, the total imported volume was 4628.32 tonnes while the value was 36,585.11 million baht. For 2014, the total imported volume was 39,383.08 tonnes while the value was 6475.15 million baht. Most of the ***O. gorbuscha*** were imported from United State through Lat Krabang Fish Inspection Office. These salmonid shipments were processed and frozen as whole fish for re-export. The total quantity of salmonid exports was 27,146.81 tonnes with value 9,454.86 million baht while the average volume was 6,786.70 tonnes/year and the average value was 2,363.72 million baht/year. For year 2011, the exported volume was 7,966.68 tonnes with value 2,992.23 million

bath. For year 2012, the exported volume was 3,091.35 tonnes with value 1,478.84 million bath. For year 2013, the total export volume was 6,146.71 tonnes with value 2,089.16 million baht. For year 2014, the total exported volume was 9,912.07 tonnes with value 2,894.63 million bath. Among the exports, it was found that most shipments of ***S. Salar*** were exported through the Chonburi Fish Inspection Office. The majority of export commodity was frozen fish fillets that was destined for Japan. The study also found that trends for both increasing volumes and values of imported/exported salmonids in 2014.

There are two steps in the import-export procedures; 1) procedures under the regulations on importing aquatic animals into the Kingdom of Thailand and 2) procedures under the regulation on exporting aquatic animals out of the Kingdom of Thailand. The import regulations are empowered under the framework of three laws, namely the Fisheries Act, B.E.2490 (1947), the Animal Epidemic Act, B.E.2499 (1956) and the Food Act, B.E.2522 (1979.). The export regulations are empowered only by the Animal Epidemic Act, B.E.2499 (1956).

Diversity and marketing system of dried fish products in Nepal

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Dried fish products are common in the diet of ethnic people of Nepal. The information on diversity and marketing system of dried fish products in the country is scarce. Survey on dried fish was carried out in 15 districts to elucidate the species diversity, market channels and consumer preference of dried fish in the country. About 45 fish species were recorded in the form of dried fish products available marketed in which 30 species were exotic and 15 were indigenous. Exotic species imported from several Asian countries shares approximately 70 percent of the dry fish market of the country. The dried fish products available in the market were in the form of sundried, smoked and pickle. Most of the products are found displayed in open yard in rural weekly market. Survey showed that market channel for dried fish comprised of processing of few reared species to some extent, and wholesale

and retail of exotic fish at large extent. The dried fish products were used for household consumption, animal and poultry feed, and fertilizer for flower nurseries. Price of dried fish varied greatly being high in rainy season associated with short supply and relatively low during winter months because of increased demand and supply. Survey results indicated that consumer's preference on dried fish species is different with their different believes and traditional knowledge and eco-region. Sidra was the dominant fish species (40-50%) in warmer Terai region while Kechaki (30-40%) followed by shrimp (20-30%) and Bamala (10-15%) were the key dried fish species in markets of relatively cooler hills and mountain valley. Results of this survey suggests the need for a study on quality of dried fish representing market channels, eco-region, and different season and fish species to find the ways of conserving nutritional and hygienic status of dried fish in Nepal.

A sarcoplasmic reticular lipid peroxidation system in some fish and shellfish muscle

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An iron-catalyzed sarcoplasmic reticular lipid peroxidation system has been reported in marine finfish species more than 20 years ago. The system utilizes NADH rather than NADPH as a reducing agent that is distinctly different from terrestrial animals. In recent years, we further extended the investigations of target species to fresh water finfish, marine and fresh water shrimps, as well as marine and fresh water clams. The present presentation is a summary of the characteristics including effects from reaction temperatures, pHs, reaction times, and reducing agents, that were identified in these species. It appears, like in marine finfish, the membranal lipid oxidation system in these species also prefers NADH to NADPH for reducing power. Some attempts to apply this system to test the candidate antioxidants are also described.

Exploring factors that influence consumption of dried and salted fish products: a study among Iloilo consumers, Philippines

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Dried and salted fish used to be considered a poor man's food but this perception has changed over the years as consumers of different social status learned to enjoy them, especially with the proliferation of innovative recipes that incorporate dried and salted fish products. This study examined the factors that influenced consumption intention towards dried and salted fish products using the extended Theory of Planned Behavior (TPB) model. Primary data was collected from 271 randomly selected individuals in Iloilo City, Philippines using a structured questionnaire. Descriptive statistics, test of reliability, test of differences, and multiple regression analysis were used to analyze the data. Results indicated that intention to consume dried and salted fish products were significantly influenced by consumer's attitude and their knowledge about product preparation and health benefits. Consumers' attitude in turn was significantly influenced by their beliefs about taste, color, and nutritional value. Attitude and knowledge about the health benefits varied across age and educational attainment; while knowledge concerning how the product was prepared did not vary across gender, educational attainment, annual income and age. The top five attributes of dried and salted fish products that were considered important by the respondents were taste, appearance, nutritional value, price and color. The control factors that either encouraged or hindered consumption were ease of storage, preparation, convenience, availability and suitability for cooking delicious meals. Respondents identified parents, relatives, siblings and friends as having significant influence on their consumption intention for dried and salted fish products. Results of the study may serve as guide in the development of market specific demand stimulation strategies.

Toxicity of electrolyzed saline water and its potential applications

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Electrolyzed saline water (ESW) is often used as sanitizer in industries of food, aquaculture, agriculture, and hospital due to its bactericidal effect, lower cost, and higher manipulating safety than sodium hypochlorite (SH). ESW had better hygienic effects than SH at same levels of ClO^-. Therefore, the toxicity of ESW and sodium hypochlorite to two bacteria, ***Vibrio alginolyticus*** and ***Escherichia coli***; and to two aquatic organisms, ***Artemia salina*** and ***Oryzias latipes***, were evaluated for potential application.

The reduction percentages of ***E. coli*** were correspondingly 71% and 8% and were 27% and 3% for ***V. alginolyticus***, with treatments of ESW and SH comparing to the control. The results show that the ESW had higher hygiene effects on bacteria than the SH. In addition, the toxic unit of ESW were correspondingly 30.7 and 61.7 to ***Artemia salina*** and ***Oryzias latipes***, while were 23.8 and 34.8 to ***Artemia salina*** and ***Oryzias latipes*** in treatment of SH. The toxicities of ESW to ***Artemia salina*** and ***Oryzias latipes*** are significantly higher than SH. In conclusion**,** the ESW shows potential applications in hygiene and biosecurity to the studied organisms than the SH.

Women fish farmers of rural Bangladesh benefit from market access

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Prawn is very high in demand in Bangladesh, both in its export and local market. However, traditional cultivation methods lead to poor yield for farmers, which result in the large demand- supply gap present in the local markets. On average, a Bangladeshi prawn farmer produces 6 folds less yield than countries following modern cultivation techniques. Implementation of modern cultivation methods can positively increase their prawn cultivation yield.

Although the women of rural Bangladesh have been an integral part of prawn cultivation in their homestead ponds for many generations, culturally and contextually, they have a limited exposure to the input and forward market.

Barriers such as lack of knowledge on modern cultivation techniques coupled with limited access to finance, prawn feed, aqua-chemicals and fingerlings prevent the cultivation yield of prawn for these women farmers.

To strengthen women farmers' contribution in the prawn value chain, Katalyst implemented an intervention which linked these farmers with relevant market players (prawn feed & aqua-chemical company, nurseries & micro-finance institutions). Since sourcing a single wild larva has a negative impact of destroying around 120 other fish species, special emphasis was given to increase usage of Hatchery Prawn Larvae.

Through this intervention, more than 25,000 women farmers have improved access to quality inputs & relevant knowledge. The production cycle has been observed to reduce to 9 months & their profits have almost doubled, which has had a positive impact in their economic empowerment levels.

Gender perception of mangrove value in Indramayu west Java

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Coastal resources such as mangroves, coral reefs, seagrass beds, and others, provide the benefits of both market and nonmarket benefits to for coastal communities. Most coastal people do not clearly understand the non-market value of natural resources, especially with regard to its function in the overall natural ecosystems. Ignorance of the value of coastal resources, most of which are public goods, often results in externalities. This is due to market failures, which are not capable of correcting costs arising from the utilization of coastal resources. Symptoms such as overfishing and degradation of coastal resources, are examples of the failure of the market.

This paper analyses the perception of gender on mangrove resources, in terms of knowledge, awareness of the importance of mangrove, management, and institutional development. Furthermore, this paper analyzes the value of mangrove resources of gender perception, using the Contingent Valuation Method (CVM). Willingness to pay (WTP) of coastal communities obtained from this study, is a mangrove ecosystem service values they willing to pay, so that mangroves can be maintained properly.

This study also analyzes the institutional schemes for environmental services payment system, and also the conservation programthat most desired by the coastal communities in the gender perspectives. The study was conducted in the coastal areas of Indramayu Regency (Karangsong Beach), which has mangrove forests that already suffered significant damage.

Gender participation on the environmental protection practices of northern Cebu coastal resorts

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This study focus on how selected beaches of Northern Cebu, Philippines was being protected. The major activities for protection of beaches were waste segregation and management; cleaning and land scaping. Privately –owned beach resorts protected the area by land scaping and reforestation with endemic species of trees. This activity was dominated by men. Ecotourism operated by women had mostly women tourists and beach related protection activities were also women led. For sustaining tourist activity, both men and women participate.

Examining gender authorship in aquaculture journals

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While gender disparities are decreasing in some areas of academia, studies have shown that gender inequities in scholarly literature still persist (West et al. 2013, Breuning and Sanders 2007, Jagsi et al. 2006, and Dubey et al. 2016). A study by West et al. 2013 found that men predominate in the first and last author positions and women are underrepresented in single-authored papers in a review of more than eight million papers across disciplines in natural sciences, social sciences, and humanities. Other studies have assessed women authorship in disciplines including political science and medicine, and found that a gender gap in published literature still remains (Breuning and Sander 2007, Jagsi et al. 2006, and Dubey et al. 2016). This study attempts to apply the methodology of West et al. 2013 to the broad discipline of aquaculture peer-reviewed journals. A survey of more than 1,000 people in the broader AquaFish Innovation Lab (CRSP) network revealed

the most influential journals within aquaculture. The surveys also provided information regarding gender authorship of the first and last author of prominent peer-reviewed aquaculture journals since 1980, the time period when the discipline began to grow substantially. Learning how authorship gender has changed in the aquaculture discipline over the last few decades is critical for promoting gender equity for future aquaculture scholarship and the sustainability of the discipline.

Attitude towards mariculture among men and women in mariculture areas in the Philippines

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Mariculture is being promoted in the country in response to the declining productivity and resource depletion in capture fisheries and the persistent poverty among coastal communities. One of the challenges is the low uptake in the community with mariculture operation. To contribute in crafting policies to promote support for mariculture operation, this paper focused on the attitude towards mariculture among men and women in seven mariculture sites in the country. Survey data collected in January to August 2015 from 467 men and 318 women from fishing and non-fishing households were used. Three components of attitude were examined: cognitive component, which deals with the beliefs they have on the effect of mariculture on the community's employment, food security, income, and pollution; affective component, which deals with whether they like or dislike having mariculture in their area; and the behavior component, which deals with the fishing and gleaning activities as well as recreational activities before and after the establishment of mariculture. Results show that the proportion of men who like having a mariculture operation in their area was higher (68%) than the women

(60%). In general, there is a significant association between gender and the attitude toward mariculture but it was not true in case of specific sites. The proportion of men and women who like having mariculture operation was higher for non-fishing households, but there was no significant association between household type and attitude toward mariculture by gender. Fishing and gleaning as well as leisure activities including swimming and strolling decreased after mariculture was established. Similarly, local employment was perceived to have improved by the mariculture operation in most sites, but food security and income of the community remained the same as before mariculture operation. Increasing women's involvement in mariculture operation may increase their support in mariculture operation.

Gender's participation in seaweed production in NTT, Indonesia

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Despite the significant presence of women in the seaweed production in Indonesia, most of the data collected in official statistics fail to capture the participation of women in seaweed production. These data gaps reinforce the policy neglect of gender issues in seaweed culture that also affects strategy to increase seaweed production and quality. This study examines the role of women and men in seaweed production in NTT Province, Indonesia. The case study takes place in three districts (Alor, Rote and Kupang districts) which represent the production area of seaweed in NTT. The study presents the different characteristic of producers, including socio economic classes, ethnic groups, past occupations of men and women and how gender affects farming location. A value chain analysis was used to present the insight analysis and strategies to improve gender's participation in increasing seaweed production. The study findswomen and men contribute similar amounts of labourto most processes in seaweed production in NTT. A number of issues is highlighted and need to be addressed in order to improve the production and quality of seaweed. This case study presents the production system in NTT and possibly in other Indonesia.

Tribal Women in fisheries of Arunachal Pradesh, North east India

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The article presents an account of involvement of tribal women in various fishery sectors of Arunachal Pradesh in North East India where the major part of demography is formed with 26 major tribes and more than 100 sub tribes. While travelling across the length and breadth of the entire area of the state during extensive field visits for research works, the authors witnessed diverse role of women in fishery related activities. Here, an attempt has been made to study the level of participation of tribal women in general in capture, culture, processing and marketing sectors of fisheries in the state. The levels of involvement of women in fisheries activities varied among the local tribal population. However, a clear edge to women over their male counterpart in fish marketing sector was seen in the state similar to the tribal people of other sister north eastern Indian states, while in other sectors their level of participation is very less.

Roles of men and women in sergestid shrimp (*Acetes spp.*) catching, processing, and trading in Oton and Tigbauan, Iloilo Province, Philippines

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The sergestid shrimp industry is important to the local economy in the municipalities of Oton and Tigbauan in Iloilo Province. The study described the roles performed by men and women in sergisted shrimp catching, trading, and processing using data collected from personal interviews of all actively operating shrimp catching operators or boat captains (9 males and 2 females), raw shrimp traders (8 females and 1 male), shrimp processors (6 males and 5 females), and a female shrimp product trader in January to March 2014. The study participants identified 98 men and women in shrimp catching, 56 in shrimp processing, and 26 in shrimp trading. The men dominated shrimp catching. Men and women collaborated more in performing the tasks in shrimp processing and trading. The women performed more tasks that required negotiation and more time, while the men performed more tasks that required physical activity and effort.

A multifaceted approach to closing the gender gap in aquaculture for improving global nutrition

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The United Nations Food and Agriculture Organization estimates that nearly 842 million people, or roughly one in eight people in the world, suffered from chronic hunger and undernourishment from 2010-2012. Hunger is concentrated in developing nations and especially effects women and children in poor, rural

environments. As demand for animal-source proteins continues to grow, aquaculture stands out as an efficient and sustainable method for food production. The nutrients in fish can help fill gaps that represent some of the most widespread deficiencies among vulnerable populations, specifically iron, zinc, and vitamin A. While women play various roles in aquaculture and their representation in the industry has improved in recent years, they remain a marginalized group. Women are key to the growth of the aquaculture sector and are gatekeepers of household nutrition, therefore a multifaceted approach to gender integration in aquaculture can help address global hunger and nutrition needs. As part of this effort, the AquaFish Innovation Lab is working to address hunger and under nutrition in Africa and Asia through aquaculture research and through the equitable involvement of women in leadership and training activities.

Food safety implentation in fish processing technology: Gender roles

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Food safety is everybody's concern, thus the Cebu Technological University (CTU), Cebu, Philippines researchers enjoined to disseminate good manufacturing practices (GMP) and Hazard Analysis Critical Control Point (HACCP) awareness to fish processors. This study aimed to implement food safety practices in processing of fish and other fishery products. Two active cooperatives of Sta. Fe, Cebu, Philippines and Madridejos, Cebu, Philippines were selected as beneficiaries. Food safety procedures were implemented on various process and products like coconut water based brine solution for bottled sardines in tomato sauce and in oil and washing the anchovies with chilled brine solution as pretreatment of fermenting small anchovies and dry-salted sardines. Most of the procurement level decisions and handling were dominated by men, while marketing of finished products were dominated by women.

Income of Fishing Households before and after Typhoon Haiyan: A Study on Coastal Communities of Batan and Altavas, Aklan, Philippines

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Typhoon Haiyan (Local Name: Yolanda) is the most devastating tropical cyclone that hit the Philippines in recorded history. Haiyan, which occurred in November 2013, claimed 6,300 lives, injured 28,688 individuals, and 1,062 were reported missing. The typhoon also damaged houses, communication lines, and other infrastructures. Coastal communities in Central Philippines were heavily affected because of strong winds and storm surges brought by the Typhoon. The Province of Aklan in Panay Island is one of the areas that was hit by Yolanda. This paper compares the income of fishing households before and after the occurrence of Typhoon Haiyan (Local Name: Yolanda) in coastal areas of Batan and Altavas, Aklan. Initial data gathering was done with randomly selected fishing households in 2012 using an interview schedule. Return visit to the households was done in 2014. Majority of the fishing households reported a decline in income after the typhoon. Households which are more dependent on fishery resources experienced higher reduction income mainly because of damages in fishing boats and fishing gears. Findings of this study provide useful information in understanding the relationship of well-being and natural disasters in coastal areas.

The role of women in blue swimming crab (*Portunus pelagicus*) fisheries in the Philippines

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The blue swimming crab (***Portunus pelagicus***) is one of the most important aquatic invertebrates in the Philippines that contributes significantly to fish food supply. Its fisheries belongs to the top export fisheries commodities of the country, with products traded as fresh frozen and pasteurized crab meat mainly in the United States and some Asian markets. Blue swimming crab fishing is also one of the main sources of income for small-scale fishers in the country especially in the Visayas region. Clearly, the blue swimmer crab fisheries is commercially and economically important, contributing dramatically to food security, employment, and economic development of the different stakeholders of the industry.

This study was conducted to characterize the role of women as one of the key players in the blue swimming crab fisheries. Results revealed that women are involved in the series of activities along the blue swimming crab supply chain, from fishing preparation and operation, including gear construction, to marketing and processing. They are also involved in the top level management of crab processing plants and in the management of crab fisheries resources through community-based initiatives. Indeed, women play a vital role in the blue swimming crab fisheries industry in the country.

Feminization of the shrimp processing industry in Bangladesh: Pace of women empowerment and poverty reduction

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Feminization of Bangladesh labor force is perceived as one of the main contributory factors to its economic growth. The shrimp processing industry utilises a large number of female workers after the readymade garment industry. The industry has been playing an important role in foreign exchange earnings and employment generation, especially for the poor women engaging them in the post harvest and processing segment of the supply chain. But these poor female workers seem to suffer from gender disparities in their workplaces revealed in a recent labor force survey. Many of them are found to be marginalized in unpleasant job at the bottom level with lower wages, deprivation of leaves and allowances and other benefits than their male counterparts.

This paper will analyses and investigates if women engaged in the formal labor sector across the shrimp supply chain are empowered adequately analysing gender sensitive economic indicators. It will also evaluate the potential of poverty reduction and women empowerment through better compliance of existing labor rules. The study will utilize data on over 530 workers randomly chosen and interviewed from 40 shrimp processing factories across the six coastal districts of the country. This paper will attempt to identify constraints to gender disparity and women empowerment across the shrimp industry and make policy recommendations to avert them.

Gender participation in south reclamation project affected families success stories on street food production

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South Reclamation Project-Project Affected Families (SRP-PAF) is a non-government organization with 13 member barangays comprising 3,700 households in the City of Cebu. Cebu Technological University (CTU) is an institution mandated through Republic Act 9744 to deliver instruction, conduct research and perform relevant and responsive extension services that addresses community needs. Descriptive-survey method was used in the study employing triangulation strategy. There were 65 respondents in the study , all of them are members of the SRP-PAF organization and had availed the extension services of CTU-Main Campus, Cebu City. Majority of the respondents were female (92.31%). Most of them were middle-aged 45-54 years. Roughly PhP 5,000.00 to PhP 15,000.00 is the gross family monthly income in most of the households. The extension program as perceived by the beneficiaries was "Highly Effective" based on the identified parameters. The program extended had an impact on the economic, social and environmental aspects and therefore recommended to sustain and enhance the implementation of the extension program.

Participation of women farmers in an on farm training of sustainable periphyton enhanced system

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The two best treatments obtained from on-station trial done at Agriculture and Forestry University, Chitwan, Nepal were tested in household ponds of 37 women farmers in Chitwan (15 farmers) and Nawalparasi (22 farmers) districts. Carp polyculture with 100% feeding and carp+SIS+substrate with 50% feeding were introduced to 19 and 18 women farmers, respectively. In Chitwan, participants were members of Sundardeep women fish farmer's cooperative whereas in Nawalparasi farmers were in the process of establishing a cooperative. Farmers stocked carp and SIS, fed them with supplementary feed, and fixed bamboo substrate to ponds at the rate of 1 % of pond surface area to enhance periphyton growth. Purpose of periphyton enhancement was to supplement natural food to carp and reduce feed cost. Farmers netted and weighed fish monthly to check fish growth and calculate ration. Farmers were provided with a book to record fish that were consumed, sold, or that had died. Final harvest was conducted after eight months of culture in December by netting fish following partial water withdrawal from ponds. Since farmers wished to keep fish for their biggest festival "Maghi" that fell on January 15, netted fish were counted, weighed, and returned to the pond. During "Maghi", major sales of fish occur because fish is an important food item during this celebration. Some farmers also saved fish in ponds for year-round consumption and to fetch higher prices later when there is less fish in the village. About, 84% of farmers consumed fish at home, and 41% of farmers sold the crap. Total fish production and gross margin were 19.3% and 51.7% higher in carp+SIS+substrate with 50% feeding than in carp polyculture with 100% feeding. Training on carp+SIS+substrate technology was also provided to another 28 women and 7 men farmers through a workshop in Chitwan.

Women's Empowerment in Aquaculture: Indonesian Case Studies

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Women contribute to a range of aquaculture activities such as fish processing and operating backyard hatcheries in Indonesia, yet these roles are often unrecognised by development intervention due to patriarchy and local traditions. This lack of recognition reflects a critical gap in knowledge regarding factors that enhance or limit the participation and empowerment of women in Indonesian aquaculture. This study examined the processed milkfish industry in East Java and shrimp farming in South Sulawesi Indonesia to fill knowledge gaps and to underpin strategies to improve gender equality in aquaculture development in Indonesia. This study applied qualitative methods, namely semi-structured interviews, focus group discussions and observation. This study found that the processed milkfish industry has greater potential for social and economic empowerment of women compared to shrimp farming. However, participating in both type of aquaculture activities significantly increases women's responsibilities and time burden. Earning money to enhance opportunity for the family beyond the earnings of spouses was a driving factor for women's participation in both industries. Access to natural resources required for aquaculture is the critical enabling factor for women's direct participation in shrimp farming. Entrepreneurship, access to raw materials, financial capital and market access facilitate women's ability to establish milkfish processing business. Nevertheless, women still face obstacles that limit their success in these endeavours, including a lack of technical knowledge. In particular, for milkfish processing, women still lack skills in business strategy, especially in identifying a market niche and understanding product competitiveness. Additionally, access to financial capital and branding are critically important to the success of women in milkfish processing. Gender and social norms, especially gender norms that control the assignment of roles, are significant limiting factors. In terms of empowering women through aquaculture, an integrated strategy to address both gender constraints and the technical and capacity development barriers is recommended.

Women-led river bank aquaculture for livelihoods of rural poor community in foot hills of Nepal

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Small-scale pond aquaculture for rural poor isone of the options forimproving household family nutrition with supplemental income.However, availabilityof suitable land for pond construction is amajor limitation in most of the cases. An attempt has been made to construct the ponds on both sides of the foot hill river bank covered by small gravel and boulders at the rural remote village of poor community. The main goal was to use available local resources to improve livelihood of the community.

Ninety ponds for fifty three households were constructed ranging from 100-500 m^2 with the average size of 170 m^2. The methods and process followed were: inception workshop, group formation, exposure visit,monthly technical training, pond construction, supply fingerlings,vegetable seed supply forpod dike farming, establishment of weekly market, group registration in District Agriculture Development Office, tie up with existing cooperative.Fish species used for culture were: grass carp, common carp and Nile tilapia. Local river species were allowed to enter and grow in ponds, and asked to harvest regularly for family consumption. Pond dikes were used for vegetable farming and grass cultivation. Some households made pig stay in dike and raised pigs. The program was launched for one year and culture period for fish were for about 6 months. Total income estimated from the aquaculture and pond dike farming was NRs 1,350,000 (US$ 13500).

Production item	**Production (kg)**
Fish production	2755
Local fish production	1590
Pulses	600
Vegetables	173
Banana	150
Pig	380

The program benefited poor ethnic communities, empowered women, supported family nutrition, enhanced family income, increased food security, and developed saving behavior of women by proper use of availablenatural resource.

An assesment of women's participation in aquaculture in south east region of Bangladesh

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Aquaculture has an important role in income generation and poverty alleviation as well as household nutrition of rural people of Bangladesh. Rural women are engaged in aquaculture production activities. But their role is not often acknowledged and documented. A study was conducted to assess the level of women's participation in aquaculture production activities in some selected areas of south-west of Bangladesh. A total of 450 households(225 USAID-Aquaculture for Income and Nutrition project beneficiary and 225 non project beneficiary households) were surveyed through a pre-tested structured questionnaire. Data were also collected through focus group discussions.The study reveals that women in 65% households were involved in aquaculture along with their male counterparts, and 48% played active role. The level of participation varied with the types of aquaculture and the inclusion in project. Women were more involved in activities of homestead aquaculture (30%) than that of commercial fish (23%) and shrimp culture (12%). Women participation belonging to project intervened households were observed more than non-project households. Women were more involved in stocking, feeding, monitoring of ponds and partial harvesting with maximum involvement (21% independently and 77% along with male) in application of feed. Involvement was found less in the removal of mud, dyke building and final harvesting. The

result of logistic regression analysis revealed that the participation of women in aquaculture is positively related with family size, pond size, training received, and members of cooperatives but negatively related with distance of ponds. Educational status and age of women however had no significant effect on participation in aquaculture. Findings also indicated that various socio-cultural, practical and knowledge constraints hinder the level of women's participation in aquaculture. It concludes that education, motivation, need-based training, credit facilities and quality inputs supply have the potential to increase women's participation in aquaculture production and management.

Cage Farming headed for equal opportunity in aquaculture development In Kerala, India

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Women's contribution to aquaculture in India is often under-estimated and the benefits from their involvement in aquaculture activity are also not factually considered. The present study is focused on the participation of women in cage aquaculture in Ernakulam District of Kerala, India. The observations reveal that their role is significant and forms a major component in social development as well as family wellbeing. A case study at PIzhala, a fishing village near Ernakulam showed that women have more knowledge in terms of the management of cage farms like, seed procurement, nursery rearing, feed scheduling, feeding, cage maintenance, marketing etc. Women have been found to be directly involved in fabrication of cage and its maintenance, procuring good quality fish seed and its stocking. They are also found to be selling fish on their own and assure more profit in terms of money as well as quality of the product is well preserved with proper handling. Women sell the produce directly at farm-gate and in local markets to assure elimination of middlemen. The most significant and positive aspect of involvement of women in cage farming is that since their family income has increased and it is being used for food, health care and education of the family members. Women's participation can ensure social and economic empowerment in the rural societies in India like the one at PIzhala, Ernakulam. Even though the village in the present study is very close to the city, development is meager due to the poor financial status of the people out there. However, with involvement of women also in cage farming activities, the village has opened up a better avenue for the development of aquaculture as well as social upliftment and equal opportunity. If women are supported more with schemes in aquaculture, a developed rural society can be assured in many areas in the country. Equal opportunity would ensure substantial societal development starting from family health, education and standard of living. It is also observed that, once involved in cage farming, women are ready to expand it further with own efforts and expenditure, which shows the positive and healthy attitude among the women farmers.

The venue

Bangkok International Trade and Exhibition Center

The conference and exposition will be held at the Bangkok International Trade and Exhibition Centre (BITEC).

BITEC is a world-class venue for meetings, incentives, conventions and exhibitions located in the heart of Bangkok. Offering several large scale, multi-purpose event halls and comprehensive exhibition services, BITEC is the first choice for exhibition and conference organisers around the world.

The BTS Skytrain provides a convenient way to reach the venue and avoid traffic: Alight at Bang Na Station and leave via Exit 1. From there, it is just a short walk to the skywalk leading directly to the Welcome Hall.

BITEC is easily accessible by car or taxi via 3 well sign-posted entrances: Entrance 1 and 2 can be accessed from Bangna-Trad Road and Entrance 3 from Sukhumvit Road, just off the expressway.

Contents

Programme schedule

3 August 2016, Wednesday	
08.00 – 22.00	Poster set up
15.00 – 18.00	Registration

4 August 2016, Thursday	
08.00 – 09.30	Registration
09.30 – 10.00	**Coffee break**
10.00 – 11.15	**Opening ceremony**
	Minister of Agriculture and Cooperatives, Thailand
	President, Eleventh Council, Asian Fisheries Society
	Director General, Department of Fisheries, Thailand
	Group photo
	Opening of Seafood Exposition and Posters
11.15 – 12.00	Tour of Seafood Exposition and Posters
12.00 – 13.00	**Lunch**
13.00 – 14.40	**Keynote presentations** **Prof. Louis Cassar (Chair)** **Dr Varin Tanasomwang (Co-Chair)**
	Countering food security threats with genetic improvement: ASEAN aquaculture scenarios **Prof. Uthairat Na Nakorn (Kasetsart University)**
	Ecosystem-based adaptation to coastal erosion and sea-level rise **Prof. Wong Poh Poh (University of Adelaide)**
	A roadmap to fisheries sustainability: Fantasy or reality? **Prof. Ratana Chuenpagdee (Memorial University)**
14.40 – 15.30	**Panel discussion with keynote speakers**
	• Prof. Uthairat Na Nakorn • Prof. Wong Poh Poh • Prof. Ratana Chuenpagdee • Prof. Roger Doyle • Dr Derek Staples
15.30 – 16.00	**Coffee break and poster session**
16.00 – 18.00	**Parallel scientific session 1**
18.30 – 20.30	**Welcome reception hosted by the Thailand Department of Fisheries**

5 August 2016, Friday	
08.30 – 9.40	**Keynote presentations**

	Genetics of growth and disease in aquaculture: The future **Prof. Roger W. Doyle (Genetic Computation Ltd.)**
	Sustainable fisheries in the Asian context **Dr Derek Staples (Australia)**
09.40 – 10.00	**Open forum**
10.00 – 10.30	**Poster session**
10.30 – 11.00	**Coffee break and poster session**
11.00 – 13.00	**Parallel scientific session 2**
13.00 – 14.00	**Lunch**
14.00 – 16.00	**Parallel scientific session 3**
16.00 – 16.30	**Coffee break and poster session**
16.30 – 18.00	**Parallel scientific session 4**
18.30 – 20.30	**General Assembly of the Asian Fisheries Society**

6 August, Saturday	
08.30 – 10.30	**Parallel scientific session 5**
10.30 – 11.00	**Coffee break and poster session**
11.00 – 13.00	**Parallel scientific session 6**
13.00 – 14.30	**Lunch**
14.30 – 16.30	**Reports of the scientific sessions** **Prof. Louis Cassar (Chair)** **Dr Varin Tanasomwang (Co-Chair)**
	Governance **Prof. Yuan Xinhua**
	Education and training **Dr Sirawut Klinbunga**
	Sustainable intensification of aquaculture **Mr Miao Weimin**
	Response to impacts of climate change **Prof. Wong Poh Poh**
	Sustainable fisheries **Dr Derek Staples**
	Seafood, post-harvest technology & food safety **Prof. Chen-Huei Huang**
	Gender in aquaculture and fisheries **Dr Meryl J. Williams**
15.50 – 16.30	**Closing ceremony and AFS awards**

7 August, Sunday	
	Post-conference day-tour to Demonstration Sea Farm, Petchaburi Province

Scientific programme

Parallel session	Room MR 211	Room MR 212	Room MR 213
4 August			
Session 1: 16.00 – 18.00	**Governance**	**Education & training**	**Aquaculture** (feed & nutrition)
5 August			
Session 2: 11.00 – 13.00	**Governance**	**Fisheries** (socio-economics)	**Aquaculture** (feed & nutrition)
Session 3: 14.00 – 16.00	**Special session:** Current governance issues in the inland fisheries of Asia-Pacific	**Special session:** Bioflocs	**Aquaculture** (genetics / biology)
Session 4: 16.30 – 18.00		**Fisheries** (taxonomy and stock structure)	**Aquaculture** (feed & nutrition)
6 August			
Session 5: 08.30 – 10.30	**Governance**	**Aquaculture** (socio-economics)	**Aquaculture** (health & disease)
Session 6: 11.00 – 13.00		**Gender in Aquaculture & Fisheries** (GAF6)	**Aquaculture** (health, genetics, & biology)

Room MR 214	Room MR 215	Room MR 216	Room MR 217
Climate change	**Fisheries** (biology & ecology)	**Seafood, post-harvest & safety** (marketing)	**Gender in Aquaculture & Fisheries** (GAF6)
Climate change	**Fisheries** (biology & ecology)	**Special session:** Small-scale fisheries and food security: Cross-pollination & synthesis	**Gender in Aquaculture & Fisheries** (GAF6)
	Fisheries (management)	**Seafood, post-harvest & safety** (food tech.)	
Special session: Cross-country studies on coastal resource management	**Fisheries** (resource assessment)	**Seafood, post-harvest & safety** (food safety)	
Aquaculture (feed and nutrition)	**Fisheries** (management)	**Seafood, post-harvest & safety** (quality assurance)	**Gender in Aquaculture & Fisheries** (GAF6)
Aquaculture (farming systems & practices)	**Fisheries** (taxonomy and stock structure)	**Seafood, post-harvest & safety** (food safety)	

Governance

4 August, Parallel Session 1, 16.00 – 18.00 [MR 211]	
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16.20 – 16.35	**Alternative livelihood options for the coastal tribal people through brackishwater aquaculture technologies** B. Shanthi, P. Mahalakshimi, V.S. Chandrasekaran, and K.K.Vijayan
16.35 – 16.50	**Inter-sectoral governance of inland fisheries: A case study of Badagry Creek, Lagos State, Nigeria** Akintola, S.L and Fakoya, K.A.
16.50 – 17.05	**Framing the perceptions of local officials and agency representatives towards Iloilo River, Philippines** Jeanette S. Deslate, Rhodella A. Ibabao, and Vicente T. Balinas
17.05 – 17.20	**Playing by whose rules? Community norms, fisheries rules and corruption in Lake Victoria (Kenya) co-management** Etiegni C.A, Irvine K. and Kooy M.
17.20 – 17.30	**Wrap up**

5 August, Parallel Session 2, 11.00 – 13.00 [MR 211]	
11.00 – 11.05	**Introduction**
11.05 – 11.20	**Assessing governability of small-scale fisheries in Batan Bay, Philippines** Alice Joan G. Ferrer, Jinky Hopanda, and Satoshi Ishikawa
11.20 – 11.35	**Myanmar fishery and aquaculture development in action** Yin Yin Moe, Thi Thi Hla, Khin May Kyi, Thandar Minn, Aye Aye Aung, Mya Mya Sint, Zaw Lin Tun, and Eduardo Pantanella
11.35 – 11.50	**Empirical analysis of patent documents related to fish biodiversity: Issues in governance, access and benefit sharing for innovation** Poonam Jayant Singh and Rehana Abidi
11.50 – 12.05	**Tuna fisheries in Turkey: Monitoring and management for sustainability** F. Saadet Karakulak and Abdullah Ekrem Kahraman
12.05 – 12.20	**Internal strategies of microfinance institutions on disaster risk management: The case of MFI's in Central Iloilo, Philippines** Frediezel G. De Leon, John G. Decomotan, Kathleen S. Sadio,Rachelle P. Sondia,Nicolea Irene B. Ycay, and Rhodella, A. Ibabao

12.20 – 12.30	**Wrap up**

6 August, Parallel Session 5, 08.30 – 10.30 [MR 211]	
08.30 – 08.35	**Introduction**
08.35 – 08.50	**Linking marine biodiversity conservation and poverty alleviation: A case study in selected rural communities of Sagay Marine Reserve, Negros Occidental** Arvie Joy Manejar, Liza May Sandoy, and Rodelio F. Subade
08.50 – 09.05	**Cost and benefit analysis of conserving marine protected areas in San Jose de Buenavista, Antique, Philippines** John Jonas Castuciano, Rheniel Dayrit, and Rodelio F. Subade
09.05 – 09.20	**Do fishers benefit from marine conservation: A case in TINMAR fishing communities, Guimaras, Philippine** Louie Marie Eluriaga, Kristine Shiela Mae Bundal, Macy Esmilla, Angel Grace Ferrer, Jaica Jacaba, Ferly Mae Jauod, Rizel Malanday, Emy Mooc, Christia Ulson, Flora May Bisan, John Paul Berdugo, Aljon Rey Catedrilla, Errol Jino-o, Pia Jestine Madriago, Lourie Ann Secreto, Roald Ray Taperla, and Rodelio F. Subade
09.20 – 09.35	**Shark conservation through community participation in Bangladesh** Sanjida Hauqe, M.J. Rahman, and Dr. Abdul Wahab
09.35 – 09.50	**Involving resource users in the evaluation of fisheries management options: The case of bivalve industry in central Philippines** Liberty N. Espectato, Ruby P. Napata, and Ernestina Peralta
09.50 – 10.05	**Conservation of marine fisheries resources: An economic valuation of seasonal fishing ban in India** Narayanakumar, R, J. Jaisankar, Shyam S. Salim, U. Ganga, and E. Vivekanandan
10.05 – 10.15	**Wrap up**

6 August, Parallel Session 6, 11.00 – 13.00 [MR 211]	
11.00 – 11.05	**Introduction**
11.05 – 11.20	**Thailand's marine fisheries management plans. National policy on the management of fisheries from 2015 to 2015** Praulai Nootmorn
11.20 – 11.35	**China’s policies and practices of distant water tuna fisheries** Shen Huihui and Huang Shuolin

11.35 – 11.50	**The Oceans and Fisheries Partnership: A regional cooperation to combat illegal, unreported and unregulated fishing and promote sustainable fisheries in the Asia – Pacific region** Geronimo T. Silvestre and Len R. Garces
11.50 – 12.05	**Engaging communities in Lao PDR in fisheries monitoring and co-management** Sinsamout Ounboundisane, Erin Loury, Shaara Ainsley, and Doug Demko
12.05 – 12.20	**Transboundary fisheries management in the bordering provinces of Bokeo, Lao PDR and Chiang Rai, Thailand: Trans-boundary issues and needs identified from joint assessment of fisheries resources and management practices** Malasri Khumsri A., Wongpathom Kamonrat, Boonsong Sricharoentham, Renu Sirimongkonthawon, Suphap Kaewlaaid, and Amporn Sakdisat
12.20 – 12.35	**Improving fisheries management in southeast Asia through fishery improvement projects** Pakawan Talawat and Geoffrey Muldoon
12.35 – 12.45	**Wrap up**

Education & training

4 August, Parallel Session 1, 16.00 - 18.00 [MR 212]	
16.00 – 16.05	**Introduction**
16.05 – 16.20	**ŵ/l·yŎŜfŧl·ŭń2y%**
16.20 – 16.35	**The Philippine fisheries education in the midst of recent developments in Philippine educational system** Encarnacion Emilia S. Yap
16.35 – 16.50	**Fisheries education in the University of Punjab, Lahore, Pakistan** Zafar Iqbal
16.50 – 17.05	**Developing a responsive curriculum for sustainable fisheries and aquaculture at the Faculty of Fisheries, Kasetsart University, Thailand** Kriengkrai Satapornvanit
17.05 – 17.20	**Aqua-centre assists aquaculture development through technology transfer and leadership development** Ram C. Bhujel
17.20 – 17.35	**Capacity building using agricultural quality system certifications to produce safe and healthy foods to support the global population** Vinai Pitiyont and Siri Ekmaharaj
17.35 – 17.45	**Wrap up**

Sustainable intensification of aquaculture

4 August, Parallel Session 1, 16.00 – 18.00 [MR 213] (feed & nutrition)	
16.00 – 16.05	**Introduction**
16.05 – 16.20	**Lactic acid enhanced prawn growth and resistance to bacterial infection when added in the feeds of the giant freshwater prawn (*Macrobrachium rosenbergii*)** Wing-Keong Ng, Chia-Ling Lim, and Beng-Chu Kua
16.20 – 16.35	**Oyster processing by-product as replacement for fishmeal or mineral mix in the diet of the Nile tilapia *Oreochromis niloticus*** Augusto E. Serrano, Jr, Barry Leonard M. Tumbokon, and Ernestina M. Peralta
16.35 – 16.50	**Nutritive value of *Rhizoclonium riparium* as feed ingredient in the diet of sex-reversed Nile tilapia fry** Barry Leonard M. Tumbokon, Paulo C. Cabanero, Augusto E. Serrano, Jr.
16.50 – 17.05	**Practical diet for the grow-out culture of the snub nosed silver pompano, *Trachinotus blochii*** Mae R. Catacutan, R.M. Coloso, O. S. Reyes, and M. F. Mallare
17.05 – 17.20	**Processed knife fish *Chitala ornata* meal as fishmeal replacement in diets improves performance of juvenile Nile tilapia *Oreochromis niloticus*** Sherilyn T. Abarra, Janice A. Ragaza, Melchor M. Tayamen, Merab A. Chan, Catherine Genevieve B. Lagunzad, and Rhea G. Abisado
17.20 – 17.35	**Diet supplementation of *Pediococcus pentosaceus* In cobia (*Rachycentron canadum*) and orange-spotted grouper (*Epinephelus coiodes*) enhances growth rate, resistance against pathogens** H. T. Chang, H. H. Hu, S. L. Yang, J. S. Lin, S. C. Chi
17.35 – 17.50	**Utilization of different carbohydrate sources in hybrid grouper, tiger grouper (*Epinephelus fuscoguttatus*) X giant grouper (*Epinephelus lanceolatus*), TGGG juveniles** Ruziah Ismail, Rossita Shapawi, Annita Yong Seok Kian, Lim Leong Seng, and Gunzo Kawamura
17.50 – 18.00	**Wrap up**

5 August, Parallel Session 2, 11.00 – 13.00 [MR 213] (feed & nutrition)	
11.00 – 11.05	**Introduction**
11.05 – 11.20	**Ingestion rate and feeding schedule of selected microalgae by zoeal stages of blue swimming crab *Portunus pelagicus*** Mhd Ikhwanuddin, Muhamad Taufik, Mohamad N Azra, and Ambok-Bolong Abol-Munafi

11.20 – 11.35	**Effects of antioxidant supplements on growth, survival, antioxidant capacity, immune response, metabolic response and oxidative stress status of Pacific white shrimp (*Litopenaeus vannamei*)** Laila M. Gallego and Yew-Hu Chien
11.35 – 11.50	**Dietary α-linolenic acid and linoleic acid ratio affects the efficacy of fish-oil finishing diet in cobia** Houng-Yung Chen
11.50 – 12.05	**Effects of dietary cholesterol supplementation on growth, cholesterol metabolism and related gene expression of giant grouper, *Epinephelus lanceolatus*, fed high soybean meal diet** Jhih-Jie Jiang, Tsung-Meng Wu and Yu-Hung Lin
12.05 – 12.20	**Effects of coconut oil supplementation in diet on growth, lipid metabolism and relative gene expression in grouper, *Epinephelus coioides*** Yi-Yen Tseng and Yu-Hung Lin
12.20 – 12.35	**Nutrient digestibility of conventionally processed canola meal in Nile tilapia** Pichet Plaipetch and Amararatne Yakupitiyage
12.35 – 12.50	**Effect of nutritional status on growth response in Indian snow trout *Schizothorax richardsonii*** M. Rajesh, B. S. Kamalam, M. S. Akhtar, P. Sharma, A. Ciji and A. K. Singh
12.50 – 13.00	**Wrap up**

5 August, Parallel Session 3, 14.00 – 16.00 [MR 213] (genetics & biology)	
14.00 – 14.05	**Introduction**
14.05 – 14.20	**Single nucleotide polymorphism in a crustacean hyperglycemic hormone gene and its association with growth performance in Pacific white shrimp *Litopenaeus vannamei*** Puttawan Rongmung, Parichat Chumtong, Piamsak Menasveta, Sirawut Klinbunga, Bavornlak Khamnamtong
14.20 – 14.35	**β-glucan binding protein purified from the haemolymph of Indian white shrimp, *Fenneropenaeus indicus* and evaluation of its functional and antimicrobial activity** Anjugam Mahalingam, Iswarya Arokiadhas, and Vaseeharan Baskaralingam
14.35 – 14.50	**Neuroendocrine regulation of ovarian maturation in giant freshwater prawn, *Macrobrachium rosenbergii*** A.K. Pandey, Anjani Kumar, Saurabh Pandey, and Shivesh P. Singh

14.50 – 15.05	**Construction of genetic linkage map and detection of growth-related quantitative trait loci in inter-specific f1 hybrids of groupers (*Epinephelus fuscoguttatus* × *E. lanceolatus*)** Satoshi Kubota, Amphai Longloy, Arkom Singhabun, Wanpen Khammee, Kanonkporn Kessuwan, Paiboon Bunlipatanon, Kom Silapajarn, Varin Tanasomwang, Akiyuki Ozaki, Nobuaki Okamoto, and Takashi Sakamoto
15.05 – 15.20	**Ovarian maturation stages of captive mud spiny lobster, *Panulirus polyphagus*** Taufik Hayimad, Safiah Jasmani, Anuar Hassan, and Mhd Ikhwanuddin
15.20 – 15.35	**Preliminary study on early larval stage of blue swimming crab, portunus pelagicus fed with free-living nematode *Panagrellus redivivus*** Imran Affandi, Mohamad N. Azra, Mhd. Ikhwanuddin, Mohammad Syahnon, and Ambok-Bolong Abol-Munafi
15.35 – 15.45	**Wrap up**

5 August, Parallel Session 4, 16.30 – 18.00 [MR 213] (feed and nutrition)	
16.30- 16.35	**Introduction**
16.35 – 16.50	**Feeding, digestion, and protein efficiency of white shrimp (*Litopenaeus vannamei*) fed with different natural food sources** Pensri Muangyao, Fukami Kimio, Youngyut Predalumphaburt , and Putth Songsangjinda
16.50 – 17.05	**Fermented banana (*Musa* spp.) peel improves growth and red blood cells of Nile tilapia (*Oreochromis niloticus*)** Isagani P. Angeles Jr, Winnielyn T. Valderamos, and Coleen P. Soliven
17.05 – 17.20	**Effect on growth by replacing various levels of fishmeal in Asian sea bass (*Lates calcarifer*) diets with fermented natto-yeast protein** Yu-Ching Huang, Che-Huang Tung, Koa-Jen Jong, and Kuo-Lung Chen
17.20 – 17.35	**Alternative microalgae paste to replace fresh microalgae for caranoid copepod (*Pseudodiaptomus annandalei*)** Pitchaya Chainark, Tawat Sriveerachai, and Kom Silapajar
17.35 – 17.50	**Nutritional value of sea lettuce (*Ulva rigida*) and application as feed ingredients in Pacific white shrimp (*Litopenaeus vannamei*) diets** Montakan Tamtin, Chatchawalee Chaisri, Prapat Kosawadpat, and Nada Laithongkho
17.50 – 18.00	**Wrap up**

6 August, Parallel Session 5, 08.30 – 10.30 [MR 212] (socio-economics)	
08.30 – 08.35	**Introduction**
08.35 – 08.50	**Role of inland fishery and aquaculture for food and nutrition security in Nepal** Tek Bahadur Gurung

08.50 – 09.05	**Strategies to attract private sector investment in aquaculture for self-sufficiency in Nepal** Rama Nanda Mishra
09.05 – 09.20	**Economic feasibility of producing fish and vegetables through aquaponics** Roel H. Bosma
09.20 – 09.35	**Analysis of influence of industrial organization form on farming performance of large yellow croaker farmers** Liu Yiyang, Zhang Xiaoli, and Gao Jian
09.35 – 09.50	**The value chain of blue swimming crab (*Portunus pelagicus*) in Losari, Brebes, Indonesia** Restiana Wisnu Ariyati, Roel Bosma, Sri Rejeki, Lestari Lakhsmi Widowati
09.50 – 10.05	**Socio-economics of aquaculture communities in Central Philippines** Rachel Luz V. Rica
10.05 – 10.15	**Wrap up**

6 August, Parallel Session 5, 08.30 – 10.30 [MR 213] (health & disease)	
08.30 – 08.35	**Introduction**
08.35 – 08.50	**Response of haemocytes receiving sodium alginate in white shrimp *Litopenaeus vannamei*** Nuri Muahiddah, Yi-Hsuan Kuoa, Yu-Yuan Chena, and Jiann-Chu Chena
08.50 – 09.05	**Immumostimulatory effect of fucoidan on white shrimp *Litopenaeus vannamei* in vitro and in vivo study** Suwaree Kitikiew, Su-Tuen Yeha, and Jiann-Chu Chena
09.05 – 09.20	**Immunological role of ß-glucan binding protein purified from the haemocytes of mud crab, *Scylla serrata* and its antibiofilm property** Anjugam Mahalingam
09.20 – 09.35	**Application of bacteriophage for combating acute hepatopancreatic necrosis disease (AHPND) in shrimp** Jin Woo Jun, Jee Eun Han, Kathy F.J. Tang, Donald V. Lightner, Sib Sankar Giri, Cheng Chi, Hyoun Joong Kim, Saekil Yun, Sang Guen Kim, and Se Chang Park
09.35 – 09.50	**Essential oils of *Nigella sativa* protects *Artemia* from the pathogenic effect of *Vibrio parahaemolyticus* Dahv2** Malaikozhundan Balasubramanian, Vijayakumar Sekar, and Vaseeharan Baskaralingam
09.50 – 10.05	**Characterization of Vp_Pira-Like And Vp_Pirb-like toxins in *Vibrio parahaemolyticus* causing acute hepatopancreatic necrosis disease** Sasiwipa Tinwongger, Yuki Nochiri, Reiko Nozaki, Hidehiro Kondo, and Ikuo Hirono

10.05 – 10.20	**A member of the immunoglobulin superfamily, orange-spotted grouper immune gene EcVig, is induced by immune stimulants and DNA virus** Ying-Chun Yeh, Ting-Yu Wang, Hsin-Yiu Chou, Han-You Lin, Tzong-Yueh Chen, Takashi Aoki, Han-Ching Wang
10.20 – 10.30	**Wrap up**

6 August, Parallel Session 5, 08.30 – 10.30 [MR 214] (feed & nutrition)	
08.30 – 08.35	**Introduction**
08.35 – 08.50	**Effects of natural diets on gonad maturations of captive male orange mud crab, *Scylla olivacea*** Ghazali Azmie, Siti Fatimah Nahar, Wendy Wee, Mohamad N Azra, Ambok-Bolong Abol-Munafi, and Mhd Ikhwanuddin
08.50 – 09.05	**Effects of various microalgae on fatty acid composition and survival rate of blue swimming crab *Portunus pelagicus* larvae** Ambok-Bolong Abol-Munafi, Muhamad Taufik, Mohamad N. Azra, and Mhd Ikhwanuddin
09.05 – 09.20	**Use of alternative ingredients as replacement for fish meal in feeds for commercially important aquaculture species in the Philippines** Mae de los Reyes Catacutan
09.20 – 09.35	**Dietary effects of saponin mix and cholesterol on rearing performance and immunoreactions of white shrimp, *Litopenaeus vannamei*** Yew-Hu Chien and Ee Ying Ling
09.35 – 09.50	**Development of microsatellite analysis platform for determination of genetic diversity of domesticated giant tiger shrimp *Penaeus monodon*** Sirikan Prasertlux
09.50 – 10.05	**Presence of endogenous viral elements of white spot syndrome virus in shrimp genome** Jiraporn Srisal, Suparat Taengchaiyaphum, Timothy William Flegel, Siripong Thitamadee, Somjai Wongtripop, Kallaya Sritunyalucksan
10.05 – 10.20	**Development of vaccination regimens against viral diseases in marine fish and crustaceans** Rolando Villarente Pakingking Jr
10.20 – 10.30	**Wrap up**

6 August, Parallel Session 6, 11.00 – 13.00 [MR 213] (genetics, health)	
11.00 – 11.05	**Introduction**
11.05 – 11.20	**Reproductive performance of wild and captive *Penaeus indicus* and growth of offspring** Sheryll Santander-Avanceña and Fe D. Parado-Estepa

11.20 – 11.35	**Genetic parameters and selection responses for growth and body color in genetic improvement program of red tilapia in Egypt: Implications for high quality seeds** Mohamed E. Megahed
11.35 – 11.50	**Spatial distribution of benthic diatom communities of Bundelkhand River with reference to the proposed Ken-Betwa Link** Jyoti Verma, Prakash Nautiyal, and Anita Gopesh
11.50 – 12.05	**Effect of squid (*Loligo* sp.) ink raw extract to survival rate of white shrimp (*Litopenaeus vannamei*) post larvae infected with *Vibrio harveyi*** Mohamad Fadjar, Kartini Zaelanie, A.R. Faqih, Wahyu Kurniallah, and Deeda Amaliya Hidayati
12.05 – 12.20	**WSSV envelope protein VP51B links structural protein complexes and may mediate virus infection** Li-Li Chen and Yi-Jhen Lee
12.20 – 12.35	**Pir-like toxins from *Vibrio parahaemolyticus* is the cause of acute hepatopancreatic necrosis disease (AHPND) in shrimp** Suparat Taengchaiyaphum, Ratchanok Sirikharina, Jiraporn Srisala, Piyachat Sanguanrat, Timothy W Flegel, Kallaya Sritunyalucksana
12.35 – 12.45	**Wrap up**

6 August, Parallel Session 6, 11.00 – 13.00 [MR 214] (farming systems)	
11.00 – 11.05	**Introduction**
11.05 – 11.20	**Marine cage culture In I.R. Iran** Hossein Ali Abdolhay and Mohammad Kazem Seiedi
11.20 – 11.35	**New intensive methods for seaweeds cultivation and management in Indonesia** Ma'ruf Kasim, Ahmad Mustafa, Muzuni, and Wardha Jalil
11.35 – 11.50	**Tetrabeads for improving water quality, survival and growth of *Penaeus monodon* postlarvae in hatchery system** Helena Khatoon and Sanjoy Banerjee
11.50 – 12.05	**Adaptive learning models in sustainable best practices for small-scale shrimp farmers in Thailand** Sally Ananya Surangpimol Haig-Brown
12.05 – 12.20	**Effects of diet and stocking density on the growth and survival of sandfish (*Holothuria scabra*) larvae** Noor Adzlina Abidin, Sitti Raehanah Muhamad Shaleh, Faihanna Ching Abdullah, Rafidah Othman, Mabel Manjaji-Matsumoto, Shigeharu Senoo and Saleem Mustafa
12.20 – 12.30	**Wrap up**

Response to impacts of climate change

4 August, Parallel Session 1, 16.00 – 18.00 [MR 214]	
16.00 – 16.05	**Introduction**
16.05 – 16.20	**Climate robust aquaculture as an adaptation strategy** Louis Lebel and Phimphakan Lebel
16.20 – 16.35	**Climate smart stocking combination for freshwater aquaculture in the Indian Sundarban Delta** Sourabh Kumar Dubey, Raman Kumar Trivedi, Bimal Kinkar Chand, and Sangram Keshari Rout
16.35 – 16.50	**Climate change impacts on freshwater aquaculture and adaptation strategies for sustainable production in the Indian Sundarban Delta** Raman Kumar Trivedi, Sourabh Kumar Dubey, Bimal Kinkar Chand, and Sangram Keshari Rout
16.50 – 17.05	**Seaweed aquaculture as sustainable climate resilient strategy in Nusa Penida Island, Bali, Indonesia** Putra Mahendra Dwi and Zou Dinghui
17.05 – 17.20	**Farmers' perceptions of climate change impacts on freshwater aquaculture: insights from the Indian Sundarban Biosphere Reserve** Bimal Kinkar Chand, Sourabh Kumar Dubey, Raman Kumar Trivedi, and Sangram Keshari Rout
17.20 – 17.35	**Risk decisions of fish farmers in a role-playing simulation game** Louis Lebel and Phimphakan Lebel
17.35 – 17.45	**Wrap up**

5 August, Parallel Session 2, 11.00 – 13.00 [MR 214]	
11.00 – 11.05	**Introduction**
11.05 – 11.20	**Fishing uncertainties: a case from island fishers community in Concepcion, Iloilo, Central Philippines** Rodelio F. Subade and Louie Marie Eluriaga
11.20 – 11.35	**Recovery of small-scale fisheries from impacts of an extreme weather event in Batan Bay, Philippines** Harold Monteclaro, Alan Dino Moscoso, Ruby Napata, Liberty Espectato, Gerald Quinitio, Kazuhiko Anraku, Kazuo Watanabe, and Satoshi Ishikawa

11.35 – 11.50	**The role of social capital in disaster mitigation and recovery: The case of fishing households in Batan Bay, Philippines** Cristabel Rose Parcon, Leah Araneta, Gay Defiesta, Alice Joan Ferrer, Hanny John Mediodia, and Satoshi Ishikawa
11.50 – 12.05	**Are environmental variables or habitat structure more influential to larval fish assemblage in Johor Strait, Malaysia?** S. M. Nurul Amin, Roushon Ara, Aziz Arshad, Mazlan A. Gaffar, and Nicholas Romano
12.05 – 12.20	**FAO-SEAFDEC/TD energy audits project for Thai trawlers** Tanasarnsakorn Suthipong, Thimklub Thaweesak, Manomayidthikarn Khunthawat
12.20 – 12.30	**Wrap up**

5 August, Parallel Session 3, 14.00 – 16.00 [MR 214]	
14.00 – 14.05	**Introduction**
14.05 – 14.20	**Adaptation to temperature in commercial breeding of Nile tilapia (*Oreochromis niloticus*)** Ram C. Bhujel and Anusha Perera
14.20 – 14.35	**Upper incipient lethal temperature of two species of mud crab, genus *Scylla* juveniles** Mohamad N Azra, Mhd Ikhwanuddin, Mohammad Syahnon and Ambok-Bolong Abol-Munafi
14.35 – 14.50	**Stress responses in the adrenal tissues of Indian freshwater fishes *C. auratus*, *C. carpio* and *H. fossilis* exposed to hypoxia** S. Srivastava and Monika Ruhela
14.50 – 15.05	**Elucidating the impacts of temperature alteration to the initial stage of life development in hybrid *Puntius* spp. for cultivation** Fadhil Syukri, Wan Norshuhada Wan Omar, Nurul Najuatul Wahidah Khalid, and Aziz Arshad
15.05 – 15.20	**Difference in response between male and female calanoid copepod (*Eurytemora affinis*) to cadmium toxicity** Estuer Kadiene, Capucine Bialais, Baghdad Ouddane, Sami Souissi, and Jiang-Shiou Hwang
15.20 – 15.30	**Wrap up**

Sustainable fisheries

4 August, Parallel Session 1, 16.00 – 18.00 [MR 215] (biology/ecology)	
16.00 – 16.05	**Introduction**
16.05 – 16.20	**Age, growth, and mortality of brown stripe snapper, *Lutjanus vitta* in West Sulu Sea** Herminie Palla and Anthony S. Ilano
16.20 – 16.35	**Study of migratory route of hilsa (*Tenualosa ilisha*) revealed from electron probe microanalysis and isotopic study of otolith** Ashim Kumar Nath and Prosenjit Ghosh B.
16.35 – 16.50	**Community characteristics of phytal organisms of *Undaria pinnatifida* in coastal artificial reef area of Zhangzi Island** Yonghu Liu, Haoyu Zhang, and Yong Chen
16.50 – 17.05	**Adaptive modifications in the skin of certain fresh water teleosts in relation to the ecological niches inhabited by them** Swati Mittal and Ajay Kumar Mittal
17.05 – 17.20	**Distribution and accumulation of heavy metal in the water and sediment of Poovar Estuary, Kerala, south west coast of India with special reference to sustainable development** Premjith Sekharapillai
17.20 – 17.35	**Six years of observations on seasonality of planktonic copepod assemblages driven by the interplay waters of Kuroshio and South China sea in a mixed semi-enclosed embayment in the ø Ocean** Li-Chun Tseng, Cheng-Han Wu, Ram Kumar, Guang-Shan Lian and Jiang-Shiou Hwang
17.35 – 17.50	**Age and growth determination of Indo-Pacific mackeral using otolith microstructure technique** Sansanee Srichanngam, Suchat Sangchan Udomsin Auksonpha-ob Nuntachai Boonjorn, and Sakda Wungchay
17.50 – 18.00	**Wrap up**

5 August, Parallel Session 2, 11.00 – 13.00 [MR 212] (socio-economics)	
11.00 – 11.05	**Introduction**
11.05 – 11.20	**Principal socio-economic characteristics of West Aceh small-scale fisheries, Aceh Province, Indonesia** Hafinuddin Hasaruddin, Syarifah Zuraidah, Nilam Shantica, and Mursyidin

11.20 – 11.35	**Keeping poverty at bay: An analysis of small scale fishers' livelihood strategies in Batan Bay, Aklan, Philippines** Gay Defiesta, Alice Joan Ferrer, Cristabel Parcon, Hanny John Mediodia and Leah Araneta
11.35 – 11.50	**Investment and profitability in marine fishing in the south west coast of India** Aswathy, N., R. Narayanakumar, and Shinoj P.
11.50 – 12.05	**Using a social representations approach to understanding coastal resource management: The case of San Joaquin, Iloilo, Philippines** Marshaley J. Baquiano
12.05 – 12.20	**Fairness at the end of the line: fair trade certification of Indonesian small-scale handline tuna fisheries** Yasmine Simbolon, Widi Artanti, Nilam Ratna, La Ode Maruf, Momo Kochen, and Deirdre Duggan
12.20-12.35	**Structural changes and impacts on economic efficiency of mechanized trawling in Kerala** Aswathy, N., R. Narayanakumar, and Somy Kuriakose.
12.35 – 12.50	**Contribution of reef gleaning to food security and nutrition of poor coastal communities in selected sites in the Philippines** Asuncion B. De Guzman, Zenaida M. Sumalde, Mariel Denerie B. Colance, Mierra Flor V. Ponce, and Gemlyn Mar S. Rance
12.50 – 13.00	**Wrap up**

5 August, Parallel Session 2, 11.00 – 13.00 [MR 215] (biology/ecology)	
11.00 – 11.05	**Introduction**
11.05 – 11.20	**Fecundity and egg quality of the white-spotted rabbitfish *Siganus canaliculatus* in Palompon, Leyte, Eastern Visayas, Philippines** Liezel Paraboles and Wilfredo L. Campos
11.20 – 11.35	**Paraneuronal NE cells in the gills of fishes: Probable extrabranchial system** Anita Gopesh
11.35 – 11.50	**Reproductive biology of the diamondback squid *Thysanoteuthis rhombus* in Camotes Sea central Philippines** Ma. Helian Lamayo, Gloria G. Delan, Roberto C. Lamayo, and Presentacion V. Bontia
11.50 – 12.05	**Seasonality of water quality and fishery resources in wild environment of the Satluj River in Punjab (India)** Syed Shabih Hassan

12.05 – 12.20	**Preliminary report on oceanographic survey in Sulu-Sulawesi seas in year 2015 using the M.V. SEAFDEC** Sukchai Arnupapboon
12.20 – 12.35	**Comparison of aquatic animal community structure and catch between complex reef and group reef in Phang Nga Province** Amnaj Siripech, Withaya Panthakit, and Orasa Petsalapsri
12.35 – 12.50	**Harmful algal blooms in the Gulf of Thailand** Noppawa Muanmee
12.50 – 13.00	**Wrap up**

5 August, Parallel Session 3, 14.00 – 16.00 [MR 215] (management)	
14.00 – 14.05	**Introduction**
14.05 – 14.20	**Evaluation of the fishing regulations on minimum landing size for some commercial species in Turkey** Abdullah Ekrem Kahraman and F. Saadet Karakulak
14.20 – 14.35	**Study and integration of modern marine ranching technology: A case of Zhangzi Island marine ranching, north Yellow Sea, China** Tao Tian, Yong Chen, Yonghu Liu, and Jun Yang
14.35 – 14.50	**Protection and restoration of salmon chum of the Sino-Russian border basin of Heilongjiang River** Liu Wei, Zhan Peirong, Wang Jilong
14.50 – 15.05	**Moving the Kaimana mud crab fishery (*Syclla Serrata*) towards sustainability and market access** Wiro Wirandi, Karel Yerusa, Momo Kochen, Matt Fox, and Deirdre Duggan
15.05 – 15.20	**Willingness to shift on pelagic fishery as a model of integrated coral reef fish management and policy** Lisda Haryani Hanaruddin, Jamaluddin Jompa, and Peter J Mumby
15.20 – 15.35	**The sea cucumber fishery in Palawan, Philippines: Challenges and opportunities** Jean Beth Jontila, Harold M. Monteclaro, Gerald F. Quinitio, Sheila Mae Santander-de Leon, and Jon P. Altamirano
15.35 – 15.50	**The stocking strategies of giant freshwater prawn *Macrobrachium rosenbergii* for culture-based fisheries** Tuantong Jutagate, Wachira Kwangkhang, Samnao Saowakoon, and Praneet Ngamsanae
15.50 – 16.00	**Wrap up**

5 August, Parallel Session 4, 16.30 – 18.00 [MR 212] (taxonomy/stocks)	
16.30 – 16.35	**Introduction**

16.35 – 16.50	**Mitochondrial DNA analysis discloses panmictic structure of narrow barred Spanish mackerel, *Scomberomorus commerson* In Indian waters** Divya P.R., Vineesh N., Kathirvelpandian A., Mohitha C., Basheer, V.S. Gopalakrishnan A., Rehana Abidi, and Jena. J.K.
16.50 – 17.05	**Identification of species composition of deep-sea fishes in the deep-sea shrimp fishery along the southern coast of India - a molecular approach** Bineesh Kinattumkara, Basheer, V.S., Akhilesh, K.V., Shanis, R., Mohitha, C. Gopalakrishnan, A. and Jena, J.K.
17.05 – 17.20	**Genetic divergence in natural populations of *Silonia silondia* on the basis of molecular markers** Sangeeta Mandal, J. K. Jena, Rajeev K. Singh, Vindhya Mohindra W. S. Lakra, Geetanjali Deshmukhe, Abhinav Pathak, Rajesh Kumar, and Kuldeep K. Lal
17.20 – 17.35	**Genetic diversity and species-diagnostic markers of freshwater mussels in North Konkan Region of Maharashtra determined by RAPD Analysis** M. J. Nakhwa, Bharat M. Yadav. H. S. Dhakad, M. M. Shirdhankar, M. S. Sawant, and S. T. Indulkar
17.35 – 17.45	**Wrap up**

5 August, Parallel Session 4, 16.30 – 18.00 [MR 215] (resource assessment)	
16.30 – 16.35	**Introduction**
16.35 – 16.50	**Population dynamics and fishery of roughear scad *Decapterus tabl* in Camotes Sea, Central Philippines** Charina Inog Narido, Herminie P. Palla, Francis Albert T. Argente, and Paul John L. Geraldino
16.50 – 17.05	**Assessment of commercially important groupers (Epinephelinae) in Tawi-Tawi, Philippines** Richard Nami Muallil and Ahalnida M. Tambihasan
17.05 – 17.20	**Status of fish biodiversity in Surha Tal: A back water natural lake in the floodplain of River Ganga at Ballia District, Uttar Pradesh, India** Ajey Kumar Pathak, U.K. Sarkar, and Rehana Abidi
17.20 – 17.35	**Trophic flows in the marine ecosystem of an artificial reef zone in the Yellow Sea, China** Zhongxin Wu, Xiumei Zhang, Hector M. Lozano-Montes, and Neil R. Loneragan
17.35 – 17.50	**Tuna long-line fishery in the East Indian Ocean** Sampan Panjarat , Sichon Hoimuk Thumawadee Jaiyen Supachai Rodpradit, and Wanlee Singtongyam
17.50 – 18.00	**Wrap up**

6 August, Parallel Session 5, 08.30 – 10.30 [MR 215] (management)	
08.30 – 08.35	**Introduction**
08.35 – 08.50	**In-situ and ex-situ conservation of sahar (*Tor putitora*) in Nepal** Jay Bista, Narayan P Pandit, Madhav K Shrestha, and James S Diana
08.50 – 09.05	**Role of fish reserves and swamp forests to Sumatra and West Kalimantaan floodplain fisheries** Husnah, Agus Djoko Utomo, and Melfa Marini
09.05 – 09.20	**Establishment of a critical habitat in Hinobaan and Sipalay City, Negros Occidental, Philippines** Farisal U. Bagsit, Armi May T. Guzman, Caridad N. Jimenez, Rikka Reyes, and Raul dela Peña
09.20 – 09.35	**The sustainability of shark finning: Assessing eastern Indonesia's data-poor fisheries** Vanessa Jaiteh, Adrian Hordyk, Matías Braccini, Carol Warren, and Neil Loneragan
09.35 – 09.50	**FAO-SEAFDEC/TD Project on Energy Audits For Thai Trawlers** Khunthawat Manomayidthikarn
09.50 – 10.05	**Comparison on the efficiency of conventional trap and vented trap in ghost fishing experiment in Si Racha Bay, Gulf of Thailand** Santiphong Putsa, A. Boutson, and S. Tunkijjanukit
10.05 – 10.20	**Assessing impacts of fishing gears on marine ecosystems: Expert judgement** Wichin Suebpala, Ratana Chuenpagdee , Charoen Nititamyong, Thamasak Yeemin, and Kungwan Juntarashote
10.20 – 10.30	**Wrap up**

6 August, Parallel Session 6, 11.00 – 13.00 [MR 215] (taxonomy & stocks)	
11.00 – 11.05	**Introduction**
11.05 – 11.20	**Population structure of marine pelagic fish species in waters of Philippines, Indo-Pacific and Western and Central Pacific as inferred through genetic markers** Mudjekeewis Santos, Rey C. Thomas Jr., Ivane Pedrosa-Gerasmio, Altair B. Agmata, Roselyn D. Aquila, Sweedy Kay L. Perez, Billy Joel N. Catacutan, Grace V. Lopez, Noel C. Barut, Demian A. Willette, Duncan Leadbitter, and Minerva Fatimae H. Ventoler

11.20 – 11.35	**How DNA barcoding is used to support fisheries regulation and traceability to combat IUU fishing in the Philippines** Mudjekeewis Santos, Angelli Marie Jacynth M. Asis, Joanne Krisha M. Lacsamana, Benedict A. Maralit, Sweedy Kay L. Perez, Roselyn D. Aguila, Altair B. Agmata, Billy Joel N. Catacutan, Demian A. Willette, and Minerva Fatimae H. Ventolero
11.35 – 11.50	**Stock identification of short mackerel in the Gulf of Thailand: An otolith microchemistry approach** Sontaya Koolkalya, Clive Trueman, and Tuantong Jutagate Stock
11.50 – 12.05	**DNA barcoding of *Setipinna* ecotypes from Indian water reveals single species *Setipinna phasa*** Shardul Sham Gangan, A. Pavan-Kumar, A. K. Jaiswar, Dhaval Bamaniya, S. Jahangeerdar, and W. S. Lakra
12.05 – 12.20	**Genetic variation of wild populations of snow trout (*Schizothorax richardsonii*) from rivers of Nepal revealed by microsatellite DNA** Suresh Kumar Wagle, Madhav Kumar Shrestha, and Neeta Pradhan
12.20 – 12.35	**Genetic and morphological evidences reconcile *Systomus sarana subnasutus* as a distinct valid species** J.R. Biswal, Rajeev K. Singh, Kuldeep K. Lal, and Vindhya
12.35 – 12.50	**Species specific molecular signatures of fishes of genus *Sillago* from Indian waters for fishery management purposes** V.S. Basheer, Elizabeth Jency. P.M., Linu Joy, Divya. P.R., Kathirvelpandian.A., Bineesh. K.K., Charan. R. , Rajeev Kumar, Vindhya Mohindra, and Jena. J.K.
12.50 – 13.00	**Wrap up**

Seafood, post-harvest technology and food safety

4 August, Parallel Session 1, 16.00 - 18.00 [MR 216] (marketing)	
16.00 – 16.05	**Introduction**
16.05 – 16.20	**Processing and marketing of donkeys ear abalone (*Haliotis asinina*): The case of Iloilo, Philippines** Rowena Paz L. Gelvezon, Hanny John P. Mediodia, Alice Prieto-Carolino, Cherry Pilapil-Añasco, and Fe M. Gabunada
16.20 – 16.35	**Meeting customer expectations what does quality look like? A seafood wholesaling context from Sydney Fish Market** Mark Boulter
16.35 – 16.50	**Iloilo Fish Port Complex: Analysis of capacity and utilization, the fish auction system and future prospects** Nelcie Jean Esmero, Jesper Marie Turao, Jan Vincent Ybut, Rachel T. Aguilo, Camille Faye T. Deloria, Fatima Jane S. Dimaala, Rodelio F. Subade
16.50 – 17.05	**Nutritional status and associated factors among fishers in Batan Bay, Aklan, Philippines** Alice Joan Ferrer, Leah Araneta, Gay Defiesta, Cristabel Parcon, Hanny John Mediodia, Marietta Sumagaysay, Jinky Hopanda, and Satoshi Ishikawa
17.05 – 17.20	**Value chain analysis of sergestid shrimp (*Acetes* Spp.) in Oton and Tigbauan, Iloilo Province, Philippines** Junauelle Kyla B. Andres, Myra B. Iguban and Alice Joan G. Ferrer
17.20 – 17.30	**Wrap up**

5 August, Parallel Session 3, 14.00 - 16.00 [MR 216] (food technology)	
14.00 – 14.05	**Introduction**
14.05 – 14.20	**Studies on factors influencing carnosine content in eel *Anguilla* spp.** Chyuan-Yuan Shiau
14.20 – 14.35	**Changes in biochemical compositions of Japanese eel (*Anguilla japonica*) during growth and starvation** Wan-Pin Su and Chyuan-Yuan Shiau
14.35 – 14.50	**Studies on biochemical compositions of cultured freshwater prawn (*Macrobrachium rosenbergii*) and quality changes during storage** Thi Mong Tho Nguyen and Chyuan-Yuan Shiau

14.50 – 15.05	**Nutritional composition and antioxidant properties of dried powder residue, a by-product from oyster (*Crassostrea iredalei*) extract processing** Ernestina M. Peralta, Rhoda Mae C. Simora and Karmelie Jane M. Monaya
15.05 – 15.20	**Development of extruded product from seaweed (*Sargassum tenerrimum*) and its process optimization** Baru Singh Chongtham, K.A. Martin Xavier, Gudipati Venkateshwarlu, and Amjad K. Balange
15.20 – 15.35	**Development of crackers using different levels of gonads of sea urchin (*Tripneustes gratilla*)** Jonita V. Literatus, Cecilia G. Sicadsicad, Serapion N. Tanduyan, and Cecilio G. Baga
15.35 – 15.45	**Wrap up**

5 August, Parallel Session 4, 16.30 - 18.00 [MR 216] (food safety)	
16.30 – 16.35	**Introduction**
16.35 – 16.50	**In vitro antiplasmodial activity of tambelo (*Bactronophorus* sp.) extracts** Lely Okmawaty Anwar, Ary Tamtama, Maulidiyah, and Muhammad Nurdin
16.50 – 17.05	**Parasite infestation on *Oreochromis niloticus* from selected fish farms in Cebu, Philippines** Gloria G. Delan, Raamah C. Rosales, Rachel Luz P. Vivas-Rica, Christine M. Corrales, and Anthony S. Ilano
17.05 – 17.20	**Biosynthesis of Ag/ZnO nanocomposite using chitosan from shell waste of mud crab, *Scylla serrata* and its antibiofilm screening** Vijayakumar Sekar, Thaya Rajagopalan, Malaikozhundan Balasubramanian, and Vaseeharan Baskaralingam
17.20 – 17.35	**The effect of plasticizer on the functional properties of biodegradable protein base film from surimi wash water** Rapeepan Saiwaew, Pawared Inthuserdha, and Chaphaiporn Khuabphimai
17.35 – 17.45	**Wrap up**

6 August, Parallel Session 5, 08.30 – 10.30 [MR 216] (quality assurance)	
08.30 – 08.35	**Introduction**
08.35 – 08.50	**Comparison on transportation, handling and preservation methods of sea lettuce (*Ulva rigida*) and gutweed (*Enteromorpha* sp.) for prolonged shelf-life of chlorophyll** Walai Kleechaya and Somyos Rachniyom
08.50 – 09.05	**Effects of relaying on the quality and safety of green mussels (*Perna Viridis*)** Rose Toledo-Mueda, Mary Ann Serrano, Janice Naquita, and Carlos Baylon

09.05 – 09.20	**Quality and shelf life upscaling on chilled storage of Japanese threadfin bream (*Nemipterus japonicus*) incorporating green tea (*Camellia sinensis*) extract in icing medium** Femeena Hassan, Nija K.V. and Geethalakshmi.V.
09.20 – 09.35	**A shrimp virus, WSSV, changes the balance of host metabolism during infection to complete its replication** Han-Ching Wang
09.35 – 09.45	**Wrap up**

6 August, Parallel Session 6, 11.00 – 13.00 [MR 216] (food safety)	
11.00 – 11.05	**Introduction**
11.05 – 11.20	**Monitoring of mercury, lead and cadmium contamination in imported fishery products for laying down control measures** Pooritat Watcharasin
11.20 – 11.35	**Histamine level and microbiological quality of dried fish products sold at retail markets in Iloilo, Philippines** Rhoda Mae C. Simora and Ernestina M. Peralta
11.35 – 11.50	**Quality degradation of milkfish (*Chanos chanos*) along the food value chain: An assessment in municipalities with high incidence of malnutrition in the province of Iloilo** Reynold D. Tan
11.50 – 12.05	**Verification of ELISA kit for monitoring of leucomalachite green residues in farmed marine fish** Suttinee Limthammahisorn, Chantana Kaewtapee, Patcharee Soonsan, Laddawan Krongppong, and Masashi Maita
12.05 – 12.15	**Wrap up**

Special session schedules

Small-scale Fisheries & Food Security: Cross-pollination and Synthesis

Organised by Too Big To Ignore

5 August, Parallel Session 2, 11.00 – 13.00 [MR 216]	
11.00 – 11.05	**Introduction**
11.05 – 11.20	**Importance of small-scale fisheries to food security: Overview and prospects** Melinda Agapito
11.20 – 11.35	**Inland fisheries based food system for food and nutrition security in Nepal** Tek Bahadur Gurung
11.35 – 11.50	**Does traditional knowledge on the nutritional value of fish play an important role in determining fish allocation for consumption at household level?** Horacio Francisco Gervasio
11.50 – 12.05	**Fish consumption in Myanmar** L. Seng Kham
12.05 – 12.20	**The humble sardine - fish as food or fodder** Moenieba Isaacs
12.20 – 12.35	**Discussant (Ratana Chuenpagdee)**
12.35 – 12.45	**Wrap up**

Current Governance Issues in the Inland Fisheries of Asia-Pacific

Organised by Too Big To Ignore

5 August, Parallel Session 3, 14.00 – 16.00 [MR 211]	
14.00 – 14.05	**Introduction**
14.05 – 14.20	**Aquatic value chain of brackish water shrimp culture in India: Issues and challenges at farm level** Jyothis Sathyapalan
14.20 – 14.35	**Ongoing transformations in inland fisheries and implications for governance on the east coast of India** Prateep Kumar Nayak

14.35 – 14.50	**Aquaculture in transition: land governance and uneven development in Myanmar's Ayeyarwady Delta** Ben Belton, Aung Hein, Kyan Htoo, Seng Kham
14.50 – 15.05	**Freshwater fish trade in Chiangmai, Thailand: Patterns and challenges** Daracha Thiammueang, Yanisa Bangseangon, Chisaphat Tordok, Meranee Inkam
15.05 – 15.20	**Lessons on the development of Lake Chiuta Transboundary Fisheries Co-Management Arrangement** Friday Njaya
15.20 – 15.30	**Wrap up**

5 August, Parallel Session 4, 16.30 – 18.00 [MR 211]	
16.30 – 16.35	**Introduction**
16.35 – 16.50	**Competing claims in a multipurpose recreational lake: Mapping resource conflicts on Lake Kariba, Zambia/Zimbabwe** W. Mhlanga, K. Nyikahadzoi
16.50 – 17.05	**Water-sharers: Inter-sectoral fisheries governance issues and solutions on the Cauvery River, India** Shannon D. Bower, Rajeev Raghavan, Neethi Mahesh, Andy J. Danylchuk, and Steven J. Cooke
17.05 – 17.20	**Understanding fishery conflicts in hilsa sanctuaries of Meghna river system in Bangladesh** Mohammad Mahmudul Islam, Md. Mostafa Shamsuzzaman, Atiqur Rahman Sunny, and Naimul Islam
17.20 – 17.35	**Inter-sectoral governance of inland fisheries: A case study of Badagry Creek, Lagos State, Nigeria** Shehu L. Akintola, K. A. Fakoya
17.35 – 17.50	**Intra- and inter-sectoral governance of inland fisheries – what have we learned?** Andrew M. Song, Shannon D. Bower, Steven J. Cooke, Paul Onyango, Ratana Chuenpagdee
17.50 – 18.00	**Wrap up**

Biofloc Technology

Organised by the Asian Institute of Technology

5 August, Parallel Session 3, 14.00 – 16.00 [MR 212]	
14.00 – 14.05	**Introduction**
14.05 – 14.20	**A simple technical approach for shrimp farmers for sustainable production with biosecure biofloc technology** Nyan Taw
14.20 – 14.35	**Nutritional contribution of bioflocs to cultured aquatic animals** Amara Yakupitiyage and Krishna R. Salin
14.35 – 14.50	**Biofloc aquaculture: sustainable aquaculture development in Thailand** Suchart Ingthamjitr, Nattapong Parnkao and Chayanit Soontara
14.50 – 15.05	**Amino acid and fatty acid profiles of bioflocs obtained from shrimp culture ponds** Phennapa Promthale, Kanokpan Wongprasert, and Boonsirm Withyachumnarnkul
15.05 – 15.20	**Comparative efficacies of tilapia green water and biofloc technology in suppressing population growth of green vibrios and *Vibrio parahaemolyticus* in the intensive tank culture of *Penaeus vannamei*** Rowena E. Cadiz
15.20 – 15.35	**Biofloc in freshwater prawn nursery** Abdullah Abd Rahim
15.35 – 15.50	**Business model for biofloc farming in Thailand** Naret Maidee
15.50 – 16.00	**Wrap up**

Cross-country Studies on Coastal Resource Management

Organised by the WorldFish-EEPSEA Cross-country Project on Coastal Resource Management

5 August, Parallel Session 4, 16.30 – 18.00 [MR 214]	
16.30 - 16.35	**Introduction**
16.35 - 16.50	**Does COREMAP program improve fishers' welfare in Southeast Sulawesi, Indonesia** Sopian Hidayat, Umi Muawanah, and Noor Aini Zakaria
16.50 - 17.05	**The effects of conservation groups and marketing integration on the income of coastal-dependent households in southern Thailand** Kunlayanee Pornpinatepong, Sukampon Chongwilaikasaem, Sinad Treewanchai, Sakchai Kiripat, Sopin Jirakiattikul Papitchaya Saelim, Chalerm Jaitang
17.05 - 17.20	**Assessment of the impact of fishery reform policy and the influence of community fishery on fisher's income in the Tonle Sap Lake in Cambodia** Sopheak Kong and Thol Dina
17.20 - 17.35	**Assessing the impacts of marine protected areas on the welfare of small scale fishers in southern Iloilo, Philippines** Alice Joan G. Ferrer , Herminia A. Francisco, Benedict Mark Carmelita, and Jinky Hopanda
17.35 - 17.45	**Wrap up**

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Co-organisers

- Asian Fisheries Society
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- Food and Agriculture Organization of the United Nations
- GLOBEFISH
- INFOFISH
- Southeast Asian Fisheries Development Center
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Tour: Demonstration Sea Farm, Petchaburi

A one-day post-conference tour to the Demonstration Sea Farm in Petchaburi Province will be offered on Sunday 7 August. The demonstration farm is a model environmentally-friendly and sustainable aquaculture system established under the initiative of Her Majesty the Queen and operated by the Thai Department of Fisheries.

The farm includes a variety of freshwater and marine aquaculture activities and incorporates brine shrimp culture and salt flats in order to recycle wastewater and nutrients as part of a zero waste discharge system.

Location

The Demonstration Sea Farm is located in Banlaem District, Petchaburi Province, approximately 130 km from Bangkok (two and a half hours drive via minibus). The tour will depart from the conference venue in the morning and return in the afternoon (precise timing to be advised).

Cost

The tour costs Baht 1,500 (45 $US/person) inclusive of transport, lunch and drinking water.

Registration

Please reserve a seat at the conference Registration Desk. Places are strictly limited and will be allocated on a first-come basis. Please note that pre-conference tour bookings that must be confirmed and paid by the morning of 5 August or they may be reallocated.

Contacts

Conference

Bangkok International Trade and Exhibition Centre	02 726 1999

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http://www.agoda.com

http://www.booking.com

http://www.hotels.com

http://www.tripadvisor.com

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	1661
	1668
Suvarnabhumi Airport	02 132 1888

http://www.suvarnabhumiairport.com

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Bangkok Hospital	02 310 3000
Samitivej Hospital	02 022 2222
BNH Hospital	02 686 2700

Police

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