A REPORT ON THE 8TH ASIAN FISHERIES FORUM, 2007

LE MERIDIEN, KOCHI, 20 – 23 NOVEMBER, 2007

PREPARED BY

ASIAN FISHERIES SOCIETY INDIAN BRANCH

The 8th Asian Fisheries Forum was conducted in Le Meridian Resorts & International Convention Centre, Kochi, during November 20-23, 2007. The forum was organized by Asian Fisheries Society (AFS). The AFS, established in 1984, is the largest fisheries non-governmental organization in the Asian region with a membership of over 3000 scientists, technocrats, fish farmers, administrators and activists. The AFS has been holding the Asian Fisheries Forum once in every 3 years since its inception. The 8th AFF was co-sponsored by Asian Fisheries Society Indian Branch, World Fish Center, Government of India, Indian Council of Agricultural Research, AARM/AIT, Intervet, Australian Centre for International Agriculture Research and Aquaculture CRSP. The Food and Agriculture Organization, Network of Aquaculture Centers in Asia-Pacific and the Marine Products Export Development Authority co-sponsored the Special Symposium on Shrimp Aquaculture. Prof. Mohan Joseph Modayil, Director, Central Marine Fisheries Research Institute, Kochi was the convener of the 8AFF.

Ever since the announcement of the 8th Asian Fisheries Forum by the Asian Fisheries Society, there has been an overwhelming response globally. Totally, 895 abstracts from 33 countries were accepted for presentation during the Forum. The event at Kochi turned out to be the largest fisheries gathering in the Asian region.

INAUGURAL FUNCTION

The inaugural function of the 8th AFF was held between 5 pm and 9 pm on 20.11.2007. Dr. S.Ayyappan, Deputy Director General (Fisheries), ICAR, & Chairman, Asian Fisheries Society Indian Branch welcomed the gathering. Presiding over the function, Dr.Chan Lui-Lee, President, Asian Fisheries Society highlighted the role of Asian Fisheries Forum in the past as well as in the future for developing fisheries as a source of food and employment. He also called upon the members of the AFS to work jointly to make Asia the source of fish, a source of all nutrients for the whole world. The 8th AFF was inaugurated by Dr.Mangala Rai, Secretary, DARE, Govt. of India & Director General, ICAR. In his inaugural address, he highlighted the need for generating scientific methods for producing more fish based on modern food safety concepts to address the problems of nutritive food security, employment and export earnings. To achieve these objectives, he called for wholehearted co-operation among all the Asian countries. He also exalted the researchers in the field of fisheries and aquaculture to address problems such as climate change, disease control, sustainability, food safety and quality. Dr. Abdul Aziz, Vice Chancellor, Aligarh Muslim University in his felicitation address told that there is need for more meaningful co-operation between Asian countries in the wake of globalization. In this respect Asian Fisheries Forum and the deliberations in the coming three days have a major role to play in the development of fisheries sector in Asia. Shri. Ajay Bhattacharya, IAS, Joint Secretary (Fisheries), DAHDF, Govt. of India, Shri. G. Mohan Kumar, IAS, Chairman, MPEDA and Dr. K. Devadasan, Director, CIFT addressed the gathering. Dr. Meryl J.Williams, Former Director General, WorldFish Center, Dr. M.V.Gupta, World Food Prize Laureate, Dr. Stephen Hall, Director General, WorldFish Center, Penang and Dr. Sena De Silva, Director General, NACA, Bangkok felicitated the event. Dr. Mohan Joseph Modayil, Director, CMFRI & Convener, 8th AFF 2007 proposed the vote of thanks. The inaugural function was followed by a cultural programme.

SYMPOSIA AND TECHNICAL SESSIONS

The symposia and technical sessions of the 8th AFF were held for three days on November 21,22 & 23, 2007 on the theme " Fisheries and Aquaculture: Strategic Outlook for Asia". Two symposia on "Gender and Fisheries: Solutions through Gender Research" and "Shrimp Aquaculture in Asia: Current Status and Future Prospects" and one special session on "Fish Health" were held. These are in addition to 19 technical sessions on the following areas: Living Aquatic Resources: Capture Fisheries; Living Aquatic Resources: Management; Aquaculture: Production System and Management; Aquaculture: Productivity Enhancement; Fishing Technology; Post-harvest Technology; Harvest and Post-harvest Technology; Food Safety & Quality Assurance; Economics and Marketing; Exports, Trade and Globalization; Valuing

Aquatic Biodiversity: Conservation, Use and Human Nutrition; Environment, Pollution, Impacts; Genetics and Molecular Biology; Applied Biotechnology; Biotechnology: Nutrition; Fisheries and Society; Socio-economics and Livelihood; Fisheries Education; Human Resources; and Policy and Governance. The symposia, special session and technical sessions were held in five parallel sessions.

In addition to the oral presentations, poster presentations on the following 11 areas were held on November 21 & 22, 2007: Capture Fisheries and Management; Aquatic Biodiversity; Post-harvest Technology and value Addition; Food Safety and Quality Assurance; Genetics and Molecular Biology; Applied Biotechnology; Aquaculture; Fish Health; Fish Nutrition; Environment, Pollution and Impacts; and Fisheries and Society.

In all, 606 presentations were made, which included 398 oral and 208 poster presentations.

Special Symposium I

Gender and Fisheries: Solutions through Gender Research

The 2nd Global Symposium on Gender and Fisheries, organized during the 8th Asian Fisheries Forum, 20 -23 November 2007 at Kochi, India, sought 'solutions through research' by looking at fisheries and aquaculture through the gender lens, which gives a better, more complete picture – one that is better focused and provides the basis for understanding fisheries issues and taking more appropriate action.

The meet was chaired by Dr. Meryl Williams, Former Director General, WorldFish Center, Penang and Chairperson, Australian Centre for International Agriculture Research; and co-chaired by Dr. M.C. Nandeesha, Dean Fisheries College, Tripura. Dr Deboral Vimala, Central Institute of Brackishwater Aquaculture, Chennai was the rapporteur. The meet saw 29 presentations from 14 countries in Asia, Australia, Europe and North America. Participants and chairs included all those coordinating key gender and social action networks for fisheries.

The symposium continued the trend towards presentation of new and original research looking at significant fisheries and aquaculture issues through the gender lens. It covered inland and coastal resource management and aquaculture, income, fish processing, trade, and globalization, nutrition and human health, gender mainstreaming in fisheries projects and models for successful fishing/fish-farming families/communities. Discussion was lively and presenters' research conclusions were tested for their applicability to policy and practice.

Dr. Meryl Williams, Chairperson, Australian Centre for International Agriculture Research, Australia, explored when a gendered analysis of fisheries makes sense and why. She used three examples, namely, globalization impacts in fisheries, fisheries in transition due to the state of the fish stocks, and HIV/AIDS in fishing communities. Globalization is bringing major changes in the distribution of labour and benefits along the whole fish supply chain. Many of these changes are gendered and consequent on larger events in markets and in the world economy. Each of the three examples individually and together, makes a strong case for the need to look at fisheries through a gender lens.

Dr. Charlotte Howard, Marine Resources Assessment Group, London, presented a paper on gender vulnerabilities throughout the fisheries chain. This paper provides evidence of the effectiveness of gender analysis in leading to community change and reduced gender inequities based on a case study carried out within fishing communities in Lake Selingue, Mali. The analysis provides insight into issues that need to be addressed to move beyond the focus on women to a focus on gender and the achievement of sustainable livelihoods at a community level.

Dr. Holly M. Hapke, East Carolina University, USA presented a paper on engendering globalization in the fisheries. Drawing on recent research in the international political economy of agriculture and field research conducted in Kerala, the paper examines how globalizing trends and processes impact local labour processes, how local norms and ideologies of gender and identity give specific form to such impacts, and how the livelihood opportunities of various groups of individuals and households are thereby affected.

Dr. M.C.Nandeesha, Central Agricultural University, Tripura presented a paper on empowering women with aquaculture knowledge and skill to increase fish production. This study was undertaken in the West Tripura District with a view to understanding the participation of women in aquaculture activities and the level of productivity obtained. The study showed that women's participation helped to increase fish production significantly. These results have been used to influence policies and the field level extension activities to make aquaculture development programmes focused more on women.

Dr. Katia Frangoudes, University of Western Brittany, France presented a paper on women's role in fisheries in Brittany, France. In France, fisher's wives play an important role within the small and medium scale fishing enterprises. They are usually in charge of the administrative work and many other

tasks related to the activity of the enterprises that take place on land. Some of them are involved in marketing activities by selling fish directly to consumers or restaurants. Women's contribution in fisheries has only recently gained some legal recognition, some year later than in other family-based businesses like agriculture or trade. The research addresses also the question of how women manage the multiplicity of their responsibilities when, besides contributing to the family business or having a job outside, they are also in charge of social and family relations, children and other household work.

Dr. Nurunnaher, Bangladesh Agricultural University presented a paper on integrating gender perspectives in aquaculture. The study compared the extension approaches and women's involvement among four different types of aquaculture activities supported by Greater Noakhali Aquaculture Project (GNAEP) in Bangladesh. The study found that the different aquaculture types and approaches for extension did not make much difference in women's involvement especially in the realm of decision making.

Dr. Marieta Banez-Sumagaysay, University of the Philippines presented a paper on enhancing women's role as natural managers of coastal resources. The women along the coasts, mostly housewives, are an untapped group for sustainable coastal resource utilization and management. Extending women's home management to the coastal environment means widening women's access to coastal resources, hence, making them active stakeholders in the utilization and management of their coastal resources. The case of the island-town of Limasawa in Central Philippines is the research locale of this paper.

Dr. Ram C.Bhujel, Asian Institute of Technology, Thailand presented a paper on ethnic women in aquaculture in Nepal. A pilot project in Chitwan District, Central Terai of Nepal was launched jointly by the Asian Institute of Technology and the Institute of Agriculture and Animal Sciences (Nepal). The project provided basic technical support to the women's group, including procuring fish seed and training in fish farming. The project has been considered one of the most successful model projects in Nepal. Some of the members have already expanded their scale to a commercial level, benefiting more from the knowledge /skills gained from the project.

Dr. C. Ramachandran, CMFRI, presented a paper on gendered spaces, technological change and fisheries sustainability and comparative analysis of women in tuna fisheries in Lakshadeep and bivalve fisheries in Kerala. The paper, largely done as case studies, not only reveals new insights into the way technological change, brought about by two interventions (namely introduction of canning factory in the first case and estuarine mussel culture in the second one), characterizes the dynamic interplay of different factors, gender-related and others, but also poses new challenges to a feminist epistemology in the discourse on fisheries sustainability.

Dr. V. Kripa, CMFRI, presented a paper on social impact and women empowerment through mussel farming. A socioeconomic impact survey was conducted in the major mussel production areas of Kerala, *viz.*, Kasaragod, Kozhikode and Malappuram, and the reasons for the continued increase in adoption rate. The impact of this technology adoption in the country was assessed. The survey indicated that training alone was not sufficient to motivate villagers to adopt a new technology, but visual observations of the success of the technology were essential in removing the common 'risk aversion' attitude and for propagating new technologies in rural areas.

Dr. V. P. Vipinkumar, CMFRI presented a paper on dynamics of women's self help groups in Malabar fisheries sector. The study was undertaken in 4 districts in Kerala State, namely Kasaragod, Kannur, Kozhikode and Malappuram. The group dynamics of each SHG was quantified by developing Group Dynamics Effectiveness Index (GDEI), consisting of 12 sub-dimensions. The results showed significant variation in Group Dynamics and revealed that all 12 dimensions were positively and significantly associated with GDEI. The most important dimensions affecting GDE are group atmosphere, participation and achievements of SHG.

Some of the highlights of the Symposium were summarized by Dr Meryl Williams:

1. As a result of the 2001 Women in Fisheries Symposium at the 6th AFF where we reported of the problems of HIV/AIDS and fisheries, Uganda, and the other Lake Victoria countries now have specific strategies and actions for overcoming the problem in fishing communities;

2. Gender research in Tripura state, India influenced the Government to consider a family approach to all aquaculture support programs. India is very active in analyzing and improving its models of extension to reach women and men;

3. Hard data were reported from many studies on the full extent of unpaid and under recognized work that

women do in the fish supply chain. However, legal and technical difficulties persist when countries formally recognize women's contributions in their welfare systems, even in Europe.

4. Options for coastal resource access and income diversification from aquatic resources have declined for all the small scale fishing communities studied, whether in Malaysia, India or Africa. Fishing communities typically have missed the economic miracles of otherwise successful human development, such as the Kerala Model and Malaysia.

5. Studying the whole fish supply chain through a gender lens can provide much greater clarity of where and how to make successful interventions to remove small scale household vulnerabilities.

6. Booming fish trade has created many opportunities for women's labour but these are often exploitative. Trade has also created greater competition for fish and taken much access to the product away from women small scale processors and vendors. Trade has also rushed ahead in many countries without due regard to the sustainability of the fisheries.

7. Data mining techniques can provide fruitful insights into many dimensions of fisheries and aquaculture participation when gender-disaggregated statistics are available.

Special Symposium II
Shrimp Aquaculture in Asia: Current Status and Future Prospects

The special symposium was chaired by Prof. Sena De Silva, Director General, Network of Aquaculture Centers in Asia-Pacific, Bangkok; and co-chaired by Shri G. Mohan Kumar, IAS, Chairman, MPEDA and Dr. Rohana Subasinghe, FAO, Rome. Twelve invited papers were presented in this symposium.

Pham Ba Va Tung, Research Institute for Aquaculture, Vietnam presented his four years' experience in strengthening participatory water management for rice-shrimp farming in the Mekong Delta, Vietnam. The paper stressed a) training in techniques, organizational skills and environmental management, b) strengthening awareness on environmental issues and co-management, c) consensus among stakeholders, and d) need for shrimp co- ordination between researchers and government at district level.

The findings of the paper "Prevalence of virus (WSSV, MBV and IHHNV) in the wild shrimps caught from disturbed and pristine mangrove areas along the west coast of peninsular Malaysia" by Mohamed Fouzi, University of Putra Malaysia showed that the prevalence of virus was low during high tide compared to low tide in the 11 species screened. There was no correlation with rainfall. Seven species were found to be positive to WSSV in Kuala Selengor, but no virus was found in any species caught in Matang. The coastal waters were higher in nitrogenous pollutants in Kuala Selangor than in Matang. Environmental pollution might have predisposed the WSSV infection among shrimp population in the wild.

A.K.Panda, Rajiv Gandhi Centre for Aquaculture, Sirkali, Tamilnadu, India reported that prevalence of MBV and WSSV in wild caught *Penaeus monodon* broodstock along the eastcoast of India was significantly high during January and February, but gradually decreased during summer months. When the prevalence of MBV is high, the WSV is less and vice versa.

Dr. G.P. Reddy, National Academy of Agricultural Research and Management, Hyderabad presented an impact analysis of shrimp farming in east Godavari District of Andhra Pradesh. The survey of 467 farmers indicated that majority of the shrimp farmers (69.8%) operated at more than 90% efficiency implying that the farmers are highly efficient in practices as well as in production.

Dr. Rohana Subasinghe, FAO, Rome, presented a paper "Aquaculture certification: challenges and opportunities for sustainable shrimp aquaculture". He said that aquaculture certification of especially high value species such as shrimp has recently been introduced and is seen as one tool that can be used to develop shrimp aquaculture in a sustainable way. Certification schemes can potentially help raise the standards for the whole industry and act as a link between consumers, retailers, processors and producers to increase information flow and understanding among different stakeholders in the production chain. There is a need to focus on the social, economical and environmental advantages from involving small-scale producers in certification schemes and positive efforts made to encourage and support their participation. In order to achieve higher standards and a more sustainable aquaculture production, the use of Better Management Practices (BMP) should be used.

Hassanai Kongkeo, NACA, presented a paper on shrimp farming development and challenges in Thailand. He told that world shrimp production from aquaculture rose strongly about 25% per year on an average in the last decade due mainly to shifting of problematic species *Penaeus monodon* and *P.chinensis* to *P.vannamei* in Asia. Therefore, *P.vannamei* production dramatically increased by 100% per year while *P.monodon* production was nearly stable at 5% per year. *P.vannamei* broodstock can be easily domesticated and commercially developed as specific pathogen-free (SPF). It can tolerate wider ranges of salinity, temperature and poor bottom conditions. Meanwhile, its hatchery and growout techniques are also relatively simple and production costs, particularly seed and feed, are lower than tiger prawn. In fact, it is good for shrimp farmers to have an alternate species for next stocking if there have been some problems on culture and market of the existing species.

Peter J.Walker, CSIRO Livestock Industries, Australian Animal Health Laboratory, Victoria presented a paper on shrimp disease and health management. He pointed out that disease has been a serious concern for the shrimp farming industry since devastating pathogen such as white spot syndrome virus (WSSV), yellow head virus (YHV) and Taura syndrome virus (TSV) first emerged some 15 years ago. The first key principle is the critical need to implement effective strategies for pathogen exclusion from farmed stock. The second principle is the need to limit the expansion of undetected or acquired infections that lead to disease outbreaks by minimizing physiological stress in farmed stock during grow-out. The third key principle is the need to prevent the local spread of pathogens when an outbreak does occur.

N.R. Umesh, National Centre for Sustainable Aquaculture, Kakinada, India presented a paper on promoting adoption of Better Management Practices (BMPs) in aquaculture. He said that the Marine Products Export Development Authority (MPEDA), in association with the Network of Aquaculture Centers in Asia-Pacific (NACA), Bangkok, Thailand, has implemented a cooperative project for the last four years to support shrimp farmers in India to adopt BMPs for disease control, food safety, coastal management and sustainable farming. This programme, which was started in 2002, has been highly successful in forming a participatory movement of farmers across the country through a "bottom up" approach. From a mere 5 farmers who adopted the cluster farm approach and BMPS in 2002, it swelled to more than 100 farmers in 30 aquaculture societies in 5 coastal states in 2007.

P.A.Padiyar, Fish Health Section of the Asian Fisheries Society, Manila, The Philippines, presented a paper on Better Management Practices (BMPs) and cluster management in shrimp farming. Over the last decade shrimp farming has been scientifically developed, disseminated and implemented in various centres in the Asia-Pacific region to reduce the challenges. Initially, farmer interest in BMPs and cluster management was oriented around achieving primarily disease prevention, but the outcomes have clearly shown significant improvements in food safety, improved yields and overall environmental protection and coastal management. This approach can be extended further to achieve quality improvements and linked to product and process certification, traceability, improved access to markets, finance, and potentially, for crop insurance.

John A.H.Benzie, Moana Technologies, Hawaii, reviewed today's situation in genetic improvement in shrimp. He said that some success has been achieved in selection for Taura virus resistance, but heritability for other diseases is low (<0.1), questioning the economic viability of breeding programs to provide shrimp strains resistant to those diseases. These findings raise the question of which strategies are the most sensible to pursue: the development of specific pathogen resistant strains (SPR), or specific pathogen free resistant strains (SPR), or specific pathogen free populations with genetic improvement for growth. The data suggest that the SPR strategy is the best solution available today, or in the near future, that will provide practical solutions for shrimp farmers.

Melanie Siggs, Seafood Choices Alliance, UK presented a paper on shrimp on the international market: retail trends and implications for shrimp producing countries. She said that farmed shrimp sales are worth US$50-60 billion of retail sales, and nearly half of shrimp produced are consumed in Europe and the USA and just selling shrimp is not enough in itself and value addition is very important. One European retailer reckons to sell shrimp in 'at least' 42 different ways.

Eric Bernard, WWF, Washington DC presented a paper on development of standards for responsible shrimp farming. He mentioned that for the past decade, WWF has been working on a range of aquaculture issues in priority areas worldwide, focusing on the culture of shrimp, salmon, catfish, tilapia, *Pangasius*, trout, yellow tail and mollusks (including oysters, clams, mussels and scallops). WWF has been working closely with the shrimp industry in Belize and Madagascar to begin to identify indicators and standards that seek to achieve the International Principles for Responsible Shrimp Farming. Understanding

the variety in scale of operations, there are large differences in how maneuverable the different regions can adopt shrimp farming standards.

Special Session: Fish Health

This session was chaired by Dr.Brian Sheehan, Intervet Singapore, and co-chaired by Dr. C.V. Mohan, NACA. Dr Rajendran, Central Institute of Fisheries Education, Mumbai and Dr. K. Riji John, Fisheries College, Tuticorin were the rapporteurs.

There were 25 presentations by various researchers from six countries in the session on diverse aspects of fish health. The subject of the presentations ranged from characterization of pathogens, incidence of emerging new diseases in south-east Asia and characterization of WSSV infecting wild and cultured shrimp of Iran using histopathology and PCR. There were 3 presentations on parasites infecting fishes such as crustacean parasite causing large scale mortality in cage cultured seabass, metazoan parasites, especially monogneans and other ectoparasites of freshwater fishes of north-eastern India and nematode parasite, *Anguillicola carassus* infecting yellow tail from Taiwan.

In one of the papers in this session, the author had discussed about the bacterial flora associated with different organs and life stages of *Macrobrachium rosenbergii*, and its potential use as probiotics in aquaculture. Few papers (5 presentations) were also presented on the potential use of probiotics and feed additives in health management in aquaculture. These presentations included the use of feed additive such as ascorbic acid, herbal preparation from I-Tiao-Gung (from Taiwan), impact of cyanobacterium as a feed additive for its anti-oxidant properties, use of Bacillus as probiotics and artemia bioencapsulation. A paper was also presented on the effect of seed extract of *Cotton offcianalis* for its potential as a biotoxin.

Three papers were presented on the topic of characterization of various bacterial pathogens of fish using molecular tools. The pathogens dealt with included *Vibrio harveyi, V. cholera* and different strains of *Aeromonas*. The tools used in these studies were RAPD, cloning and sequencing of a virulent gene, RtX-A. Characterization of fish antibody molecules was presented by two authors. There was also a presentation on the detection of hypoxia inducible factor in catla, a surface feeder.

Development and application of rapid, specific and sensitive diagnostics for fish diseases was also presented in this session. Three papers were presented on this subject and this included a dot blot assay for *Macrobrachium rosenbergii* nodavirus, flow through assay kit using monoclonal antibodies for WSSV, and a DNA microarray-based chip for detection of multiple pathogens such as WSSV, MBV and KHV.

Two authors presented papers on the successes of attenuated vaccines for *Streptococcosis* and *Pasteurellosis*. One of the presentations in this session discussed about the successful use of a DNA vaccine against amoebic gill disease from Australia. A paper also dealt with the need of development of cell lines from indigenous fishes of India and successful use of retrovirus as a transformation agent.

Dr.L.Labrie, Intervet Singapore presented a paper on emerging diseases of finfish in the southeast Asian region. He said that fish mortality associated with infectious diseases remains high in southeast Asia. Often mortality over a typical production cycle ranges between 20% and 80%. Infections with bacterial pathogens such as *Edwardsiella tarda* and *Streptococcus dysgalactiae* are emerging in several countries. Moreover, a previously unrecognized disease named potbelly or big belly caused by a facultative intracellular gram-negative bacterium was identified.

Dr.K.K.Vijayan, CMFRI, Kochi, presented the development of diagnostic DNA microarray for simultaneous detection of multiple viral pathogens. He told that low-density DNA arrays are increasingly being used in routine diagnosis of a selected group of targeted pathogens in areas of health management. Compared to the conventional high density microarrays, low density microarrays are of preference due to the simple format, easy to use high reproducibility, user-friendly data management and low cost.

Dr. A. Palavesam, Centre for Marine Science and Technology, M.S.University Tamilnadu, presented a paper on mutagenic and RAPD-PCR analysis of opportunisitic pathogen *Vibrio harveyi* isolated from estuarine fishes. The results on antibiotic sensitivity inferred that mutagenesis altered the sensitivity pattern form sensitive to resistance and vice versa to a specific antibiotic.

Dr. K. Riji John, Department of Aquaculture, Fisheries College and Research Institute, Tuticorin presented a paper on retroviral transformation results in reduced population doubling time in *Lates calcarifer* cell lines. He said that cell cultures (SBCP) were developed from the caudal peduncle of the seabass (*Lates calcarifer*) juveniles following enzymatic digestion method. An attempt was made to transform the cell culture using C type snakehead retrovirus. Transmission electron microscopic analysis showed the presence of virus-like particles in the transformed cell lines but not the typical C type retrovirus particles.

Dr.N.K.Sanil, CMFRI, Kochi, presented a paper on infestation of the crustacean isopod in the cage farm of Asian sea bass in Southern India. He told that mortalities were observed in the young ones of the Asian seabass, *Lates calcarifer* stocked in cage farm located off Sattar Island in the Vembanad Lake, Kerala. Detailed investigations revealed the presence of heavy infestation by a crustacean isopod in the cage system, traditionally called as '*arippen*' by the local fishermen. The parasite was identified as *Cirolana fluviatilis*, an isopod belonging to the class Crustacea, order Isopoda and family Cirolanidae, which has been widely prevalent in the Cochin backwaters.

Technical Session: Living Aquatic Resources: Capture Fisheries

The session was chaired by Dr.E.G.Silas, Former Vice-Chancellor, Kerala Agricultural University and co-chaired by Dr.M.Y.Kamal, Former Vice-Chancellor and Dr. V.S.R. Murty, Former Principal Scientist, Central Marine Fisheries Research Institute. Dr. H.M.Kasim, CMFRI and Dr. P.S. Krishna Rao, CIFRI were the rapporteurs. In this session, 26 papers were presented.

P.S.B.R.James, Former Director, CMFRI presented a paper "On the need for climate change response program for the Indian fisheries" in which he said that the single major factor that could affect the seas is temperature, which in turn affects the abundance and distribution of fish with far reaching consequences for commercial fish production. He also called for application of precautionary principle and development of adaptation plans to meet the challenges of climate changes by establishing a monitoring and coordination cell for the Indian fisheries sector.

Dr. S. Sivakami, CMFRI, Cochin presented a paper on the marine fisheries of Orissa. Marine fish landings of Orissa has increased from 16,804 t in 1975 to 1,01,500 t in 2005 contributing to an average of 3% of the all India marine fish landings. The long term potential yield (LTPY) is estimated as 1,01,500 tonnes and the average potential yield as 83,184 tonnes.

Dr.R.C. Srivastava, Director, Central Agricultural Research Institute, Port Blair delivered a talk on the marine fishery resources in the seas around Andaman and Nicobar islands. He told that the latest estimate of fishery potential of Andaman and Nicobar Islands projected by Fishery Survey of India is 1.48 lakh tonnes. The average annual fish landing for the last decade (1993-2005) was 26,419 tonnes.

Dr. Grinson George, Central Agricultural Research Institute, Port Blair reported that about 205 species of corals have been recorded from the Andaman and Nicobar islands while 103 species belonging to 39 genera have been recorded from Nicobar alone. The fish fauna of Andaman and Nicobar islands contributes more than 1200 species of which over 250 species are of ornamental in nature.

Dr. H.M.Kasim, Central Marine Fisheries Research Institute, presented a paper on tuna fishery and stock assessment of component species off Chennai. He said that three species of tunas studied are under marginally higher fishing pressure by the mechanized drift gillnets.

Dr. Marcus Emmett Miller, Cronulla Fisheries Research Institute of Excellence, Australia told that ocean leatherjackets showed a geographical preference for spawning along the coast of New South Wales. This research has provided a comprehensive understanding on the biological characteristics of ocean leatherjackets. In addition, it has provided appropriate management strategies to enhance the sustainability and longevity of ocean leatherjackets captured off New South Wales.

Dr. Stephen Dadzie, Department of Biological Sciences, Faculty of Science, Kuwait University, delivered a talk on the reproductive aspects of the black pomfret, *Parastromateus niger* in the Kuwaiti Waters of the Arabian Gulf. Positive correlations were found between fecundity and ovary-free body weight, standard length and ovary weight, and a negative one with egg size.

M. Sivadas, CMFRI, presented a paper on the oil sardine fishery of Malabar region for the period 2001-2005 and evaluation of the spawning stock biomass. He has studied the annual changes in the biological characteristics such as growth, mortality, and condition factor, size at first maturity, total biomass, spawning stock biomass and recruitment of oil sardine.

Dr. Mary K. Manisseri, CMFRI, presented the seasonal fishery for the Indian white shrimp along the southwest and southeast coasts of India. She said that the commencement of the season during May-June coincided with the onset of the southwest monsoon. Appearance of *Fenneropenaeus indicus* population in the subsequent months in the fishing grounds up to Manapadu, contributing to a seasonal but rich fishery, suggests migration of the species from the southwest to the southeast coast.

S.Lakshmi Pillai, CMFRI, presented a paper on the crab resources of the Chennai coast. She said that crabs have emerged as an important fishery over the years due to the expansion of trawl fisheries. Although crabs are not targeted and form only a by catch in the trawls, they are a potential resource having high consumer demand.

Dr. P.P.Manoj Kumar, CMFRI, presented a paper on the fishery of sciaenids with some observations on the biology and stock assessment. Sciaenids form an important demersal finfish resource along the Malabar coast. The stock is exploited marginally below the optimum level at present.

Dr. K.D.Joshi, Central Inland Fisheries Research Institute, presented a paper on the status of fishery, its management and scope for enhancement in Terai wetland of Uttar Pradesh. There is possibility of significant enhancement in fish yield from the wetland by converting it from capture to culture based capture fishery through appropriate management interventions viz., weed control, stocking enhancement, species enhancement, proper harvesting and by use of pen and cage culture systems.

Dr. P.S. Krishna Rao, CIFRI, presented a paper on the fisheries of Manchanabele reservoir. The predicted potential fish yield, based on 0.5% conversion efficiency from gross primary production to fish, is 347 kg/ha/year.

Dr.V.R.Suresh, CIFRI, presented a paper on population dynamics and fishery of the barred spiny eel in floodplain wetland in Ganga river basin. The barred spiny eel has high food and ornamental value. About 42% of the fishes in the catch were smaller than length at first maturity, an indication of growth overfishing, which needs to be reduced for conservation of the stock.

Dr.Prathibha Rohit, CMFRI, presented a paper on the newly emerged fishery of yellowfin tuna along the Andhra Pradesh coast. A potentially rich fishing ground for yellowfin tuna has been discovered off northern Andhra Pradesh along the east coast of India. The resource is being gainfully exploited by the local fisherfolk since the past five years. Fishing for this species is in the oceanic waters beyond 200m depth. Tuna fishing, which started as a small artisanal fishery in this region, has now grown into a large industry and is indeed a boon to the local fisherfolk. . The fishery is still in its infancy but proper management measures need to be evolved to optimize this fishery.

Technical Session: Living Aquatic Resources: Management

The session was chaired by Dr. D.Staples, Consultant, FAO and co-chaired by Dr.P.S.B.R. James, Former Director, CMFRI. Dr. Utpal Bhowmick, CIFRI and Dr. Prathiba Rohit, CMFRI were the rapporteurs. In this session 24 papers were presented.

Christopher G. Barlow, Fisheries Programmer, Mekong River Commission, Vientiane, Lao PDR presented a paper on "Estimating the value of a fisheries resource in the absence of hard data-an example from the Mekong". He said that determining the best use of water in a river requires tradeoffs between different sectors- what benefits one sector may negatively impact the other. For instance, dams for hydropower of irrigation may impact on fisheries resources, through impeding fish migration, altering hydrology, or changing floodplain inundation. Tradeoffs involve assessing economic, social and environmental costs and benefits. In many instances, the traditional uses of a river, including fisheries, are poorly understood in economic terms especially when compared with the more easily quantified economic benefits of dams. As a result, fisheries may not be given proper consideration in assessing development options.

K.Khim, Fisheries Management and Governance, Mekong River Commission Cambodia presented a paper on 'The effectiveness of fish sanctuaries in community fisheries in Cambodia'. He told that the establishment of fish sanctuaries in areas of Community Fisheries (CFs) was initiated and implemented by CF members with support from technical agencies, such as the MRC Fisheries Programme. At present, the setting up of a fish sanctuary figures as a priority activity in the CF area management plan of each target CF. The purpose of having a fish sanctuary is to protect aquatic resources by providing an appropriate habitat for breeding and broodstock conservation within the natural water body. Nobody is allowed to fish in the CF fish sanctuary or to carry out any other activity, which may harm the local fish resources. Results showed that there has been an increase in CF catch of 20-30% from year to year.

Ashley S.Halls, Mekong River Commission Secretariat, Cambodia presented a paper "Towards a model to predict the response of fish resources to development in the lower Mekong Basin". He said that the Mekong River Commission (MRC) is pursuing an integrated water resource management (IWRM) approach to plan and coordinate the sustainable, equitable and efficient pro-poor development of the water and fisheries resources in the lower Mekong Basin. The MRC's Fisheries Programme has been attempting to develop a model to make such predictions based upon observations of annual flooding patterns and the landings of a large stationary trawl fishery, which targets species of cyprinids as they migrate from the Tonle Sap Lake to the mainstream of the Mekong River with receding floodwaters.

Roger Mollot, Greater Mekong Programme, Vientiane, Lao PDR, presented a paper "Fishery Citizenship: The Emergence of Networked Co-Mangement across River Basins in Lao PDR". He said that

spread across complex physical, cultural and political landscapes riverine fisheries have become highly contested resources in the Mekong Basin. In Lao PDR the diversity of cultures, spread across mountainous and floodplain habitats have developed a range of techniques for both exploitation and management of fishery resources. Critical habitats for fish migration, feeding and spawning are also nested within upstream and downstream areas, as well as seasonally flooded and perennial areas of river basins. The Lao government had success in implementing 'vertical' fishery co-management arrangements with various communities across a river basin. In response to the limitations of vertical co-management arrangements, he proposed the horizontal challenge of fishery citizenship as a means of advocating equitable sharing and effective networked management of fisheries resources within and between communities, in upstream and downstream areas, independent of location and ethnicity.

Technical Session: Aquaculture Production and Management

The Session was chaired by Dr. M.V. Gupta, Former Assistant Director General, WorldFish Center, Penang and co-chaired by Dr. A. G. Ponniah, Director, Central Institute of Brackishwater Aquaculture, Chennai and Dr. Fathima Yusoff, University Malaysia Putra, Malaysia. Dr. S. Adhikari, Central Institute of Freshwater Aquaculture, Bhubaneswar and Dr. S. Felix, Fisheries College, Tuticorin were the rapporteurs. In this Session, 35 papers were presented.
The main outcomes of these papers are as follows.

Marine finfish culture:

The constraints of marine finfish culture in Asia-Pacific region could be addressed by the development of Better Management Practices. European countries made a significant progress in the industrial farming of sea bass and sea bream and these technologies could be adopted in Asia also.

Development of inland saline aquaculture:

Inland saline water is deficient in potassium and thus, addition of potassium is very much helpful in production of *Penaeus monodon* and mulloway in Australia. In India, *Macrobrachium rosenbergii* could be cultured in inland saline water belt. Here, in addition to potassium deficiency, the inland saline water contains higher calcium and magnesium, which should be mitigated for successful giant freshwater prawn culture.

Cobia aquaculture:

With the success of cobia aquaculture in Taiwan, research and development for mass propagation, nursery rearing, grow-out, nutrition and commercial production potential of this species have been initiated in Indonesia, Japan, France, USA and the Caribbean.

Effluent treatment:

Aquaculture effluent could be managed effectively by treatment systems. The sludge produced by the treatment could be used in agricultural crop production.

Small Indigenous fish culture (SIS):

Small indigenous species culture (SIS) which are high in vitamin A are recommended for paddy-cum-fish culture in Bangladesh. The integration of cage-cum-pond culture system with high-valued climbing perch and low-valued Tilapia in open ponds is a good option in Bangladesh. Blackear catfish *Pangasius larnaudii* culture was also discussed. The stocking density of 400 fish per m^3 was the most appropriate for cage nursing of this species.

Fishery extension:

Rural population needs support financially and socially to take up aquaculture as vocation by integrating with their life style.

Site selection criteria:

Importance on the farm level site selection criteria are based on quantitative analysis of physical, biochemical and chemical parameters for pond and sea-based culture. GIS based identification of potential mariculture sites along the east coast of India was also discussed.

Management of fish ponds and nutrient budgets:

Fish pond management should be done on the basis of productivity limiting soil factors for increasing fish yields. Nutrient budgets are required for quantification of nitrogen, phosphorous and carbon residuals in pond mud and discharged effluents.

Biosecured raceways prototyped:

High shrimp yield can be achieved in indoor, intensive, closed recirculation production systems with zero/limited water exchange.

Bio–remediation:

Total ammonia nitrogen (TAN) can be reduced in shrimp larval tanks by marine *Bacillus* spp. and periphytic *Oscillatoria* spp. Also, indigenous *Pencillium* species can be utilized for this purpose.

Shrimp farming in Bay Islands (Andaman) can be an alternative source of livelihood.

Breakeven analysis and productivity of aquaculture practices were discussed.

Mass scale seed production of mud crab, open water culture of pearlspot, milkfish production in Kolleru Lake was discussed.

Integrated farming system (IFS) has been developed for mid-Himalayas.

WWF experiences in regional coordination in responsible aquaculture and the role of Asian region in identifying principles, criteria and standards for the certification of aquaculture commodities were also discussed.

Technical Session: Aquaculture: Productivity Enhancement

The session was chaired by Dr. Michael Rimmer, James Cook University and co-chaired by Dr. Chan L. Lee, ACIAR, Melbourne, Australia and Jae-Yoon Jo, Pukyong National University, Busan, Korea. Dr.J.K.Jana, CIFA, Bhubaneswar and Dr. G.Venugopal, CIFE were the rapporteurs.

Dr.C.L.Lee, ACIAR *Trochus* Project, Australia reviewed the aquaculture and stock enhancement of the marine topshell. He said that the Australian Centre for International Agricultural Research (ACIAR) funded the *Trochus* hatchery and stock enhancement project involving four countries. The project investigated the feasibility of hatchery production of juveniles, aquaculture of *Trochus* and the potential of stocking enhancement by seeding suitable reefs with both hatchery produced juveniles and broodstock.

Dr. Sunila Rai, Aquaculture and Aquatic Resources Management, Thailand, presented a paper on the effects of substrate in carp polyculture ponds with supplemental on-farm feed on growth. She reported that an experiment was carried to determine the effects of added substrates and supplementary feeding on carp growth and production in fertilized polyculture ponds ($40m^2$). Based on fish production and gross margin analysis, the rice straw and feed treatment seemed better for marginalized farmers.

Dr.S.Raizada, Central Institute of Fisheries Education, presented a paper on the growth and survival of giant freshwater prawn *Macrobrachium rosenbergii* in potassium amended inland saline water. He told that the prawn has been identified as one of the most suitable farming species for inland saline ecosystem in the northwestern parts of India. The study thus confirmed that amendment of potassium could enhance survival and growth of prawn at salinities higher than 4.

Dr.Sulaiman Almatar, Kuwait Institute for Scientific Research, Kuwait presented a paper on prospects of silver pomfret, *Pampus argenteus* as a new candidate species for aquaculture. He said that the silver pomfret is one of the prime fish species that has a global market demand and high price. Research initiated at the Mariculture and Fisheries Department of KISR during 1998 has succeeded in the hatchery production of this species from the eggs collected from the wild spawners. After 20 months of culture period, the fish size ranged from 86 to 431g.

Dr. G. Gopakumar, Mandapam Regional Centre of CMFRI, Tamilnadu presented a paper on breeding and seed production techniques of damsel fishes for marine ornamental fish trade. He told that the techniques for broodstock development, breeding and seed production of three species of damselfishes *viz.* the three spot damsel, *Dascyllus trimaculatus,* the humbug damsel, *Dascyllus aruanus* and the blue damsel, *Pomacentrus caeruleus* have been developed and standardized. Several batches of the three species were produced and the technique can be scaled up for commercial production for ornamental fish trade.

Joe K. Kizhakudan, Madras Research Centre of CMFRI presented a paper on research advances in juvenile and seed production of the sand lobster *Thenus orientalis*. He also highlighted the habitat

enhancement, high density grow out and nutrition. He has observed the preference of the sand lobster nisto towards different grain size and sediment texture in the wild. Experiments to test the suitability of different grow-out systems for rearing *T. orientalis* revealed that the animals showed a preference for soft sandy substrates, while the adults tend to prefer fine textured clayey sediments.

Dr.A.Vennila, Central Institute of Fisheries Education, Mumbai presented a paper on phosphorus mobilization potential of bacteria in inland salt-affected areas. She told that the number of phosphatase-producing bacterial colonies was higher than the number of phosphate-solubilizing bacterial colonies in both cultured and fallow ponds.

Dr.G.Maheswarudu, CMFRI presented a paper on seed production and grow-out culture of green tiger prawn. He reported that in view of evaluating the suitability of green tiger prawn for commercial application in grow-out sector, an experimental study on seed production and grow-out culture was designed and carried out for three consecutive years. The cost of production for low ($5/m^2$) and high ($10/m^2$) density trial was Rs.130/kg and Rs.175/kg, respectively.

Dr. O. Meunpol, National Center for Genetic Engineering and Biotechnology, Thailand, has studies the effects of progesterone in chitosan/maltodextrin micro-encapsulation on ovarian development of Pacific white shrimp. He told that progesterone is a vertebrate steroid hormone capable of enhancing ovarian maturation in the penaeid shrimp. In this study, progesterone was encapsulated in chitosan and maltodextrin mixture by spray-drying technique.

Dr.U. Rajkumar, Regional Centre of CMFRI, Visakapatanam, presented a paper on the effect of testosterone hormone on the performance of male broodstock of black tiger prawn. He said that in domestication and development of captive broodstock of *P. monodon,* the major bottleneck was mating failure due to poor performance of males. The present study shows that testosterone induces molting and enhances reproductive performance in males particularly during the first 60 days.

Technical Session: Harvest and Post Harvest Technology, Value Addition: Fishing Technology

The session was chaired by Dr. V.S.Somavanshi, Director General, Fishery Survey of India, Mumbai and co-chaired by Shri J.V.H. Dixitulu, Editor, Fishing chimes. Dr. Leela Edwin and Dr. P. Pravin, CIFT were the rapporteurs. Eight papers were presented in this session.

Dr. M.R. Boopendranath, CIFT, presented a paper on fish production and energy requirement during demersal and aimed midwater trawling by intermediate range freezer trawler. The mean daily landings rose from an average of 5.66t, during bottom trawling to 22.84 t, during midwater trawling. Overall fuel consumption per kg fish landed by bottom trawling and midwater trawling worked to be 1.34 and 0.33kg, showing a four-fold difference. As there is intense concentration of effort in the bottom trawl fisheries, it could be advantageous from the resource management perspective and also from the energy conservation point of view, to encourage diversification to midwater trawling.

Dr. Leela Edwin, CIFT presented a paper on utilization of coconut wood for fishing boat construction. Coconut wood with a density of more than $600kg/m^3$ can be used for boat building. The price of coconut wood is less than half that of the conventional boat building timber *viz., aini* (*Artocarpus hirsute*).

Dr. Facunda B. Asia, Mariano Marcos State University presented a paper on catching efficiency of multiple handline operated in Payaw areas off the Northwestern Ilocos coast. Cost and return analysis show that the 100cm hook distance gear baited with red lure had the highest net income. Three pelagic species of fish, *Thunnus albacares, Decapterus macarellus* and *Katsuwonus pelamis* comprised the catch.

Mr. Gipson Edappazham, CIFT, presented a paper on the effect of snood wire on corrosion rate of fishing hooks. Stainless steel snood wires are often used to connect the fishing hook to the fishing line as it prevents large voracious fishes from biting off the hook. The corrosion rate of hooks with and without snood wire was evaluated by exposing them to salt spray as per ASTM B117 standard. It was found that rigging snood wires to the fishing hooks significantly increase the corrosion rate of fishing hooks.

Technical Session: Harvest and Post Harvest Technology, Value Addition: Post Harvest Technology and Value Addition

The session was chaired by Dr. K. Devadasan, Director, CIFT and co-chaired by Dr. S.Ayyappan, DDG (Fisheries), ICAR and Dr. C.S. Purushothaman, CIFE,Mumbai. Dr. D.Venkateswarulu and Dr. S.Basu, CIFE were the rapporteurs. In this session 12 papers were presented.

Dr. T.V. Sankar, CIFT, presented a paper on the physicochemical characteristics of muscle proteins from selected marine fishes. Sarcoplasmic proteins (SPP) were found to be higher in pelagic fishes

compared to the demersal species, the highest in the Indian mackerel *Rastrelliger kanagurta.* The myofibrillar protein content was also found to be highest in *R. kanagurta*. It could be noted that species inhabiting similar environment have many similarities in the properties for their proteins.

Dr. R. Ramesh, CIFT, presented a paper on differentiation of pelagic and demersal fishes by chemometry of the fatty acid profiles. The chemometric method, consisting of esterification with BF_3-methanol, gas chromatography of the resulting fatty acid methyl esters, and multivariate statistical treatment of the analytical data could differentiate the selected fishes into pelagic and demersal groups.

Dr. Yoshihiro Ochiai, University of Tokyo, presented a paper on the characterization of molluscan muscles based on the properties of myofibrillar proteins (tropomyosin and myosin heavy chain). The sequence identities of these proteins were found to be higher than 70%. Myosin heavy chains of mollusks, in general, possess peculiar sequences in the rod region, affecting the coiled-coil formation propensity. Such specificity could give these myosins typical filament-forming ability allowing them to construct obliquely striated muscle.

Dr.P.T.Mathew, CIFT, presented a paper on conversion of fish processing waste into ecofriendly products. About 1.25 lakh tons of prawn shell and head are available as waste after processing of shrimp. Advent of the processes for extraction of chitin and its conversion to several derivatives, which are of high value, provide solution to this problem to a certain extent. Production of fishmeal is an alternate method for the utilization of the waste.

Dr. M.D.Kamal, Bangladesh Agricultural University, presented a paper on improvement of food qualities of traditional dried small indigenous fish products using a low cost solar drier. Detailed survey of various marketing chains revealed that considerable post-harvest losses occur both qualitatively and quantitatively through spoilage and insect infestation, which account for 10-35% of the total dry fish production. The study revealed that moisture content, peroxide value, total volatile base and aerobic plate counts in traditional dried products available in the markets were much higher than those produced in the solar drier.

Technical Session: Harvest and Post Harvest Technology, Value Addition: Food Safety and Quality Assurance

The session was chaired by Prof. Mohammed Shariff, University of Putra Malaysia, Selangor and co-chaired by Mr. Vishnu Bhat, Director, MPEDA. Dr. T.V.Sankar and Dr. P.K.Vijayan, CIFT were the rapporteurs. Eleven papers were presented in this session.

Dr. Cheng-Sheng Lee, Oceanic institute, Hawaii, presented a paper on the quality of farmed seafood products. Anecdotal evidence suggests that there are differences in flavor and food safety between wild and cultured fish. The quality of aquaculture products can be controlled from the production phase to the dinner table. Many factors, such as pond management, feeding and post-harvest handling, may affect seafood quality.

Dr. Yong Zhao, Shanghai Fisheries University, presented a paper on aquatic food quality and safety in China. There are quite a number of factors related to the problems about quality and safety of aquatic food products, such as environmental pollution, laws and rules, monitoring methods, governmental administration, and so on. The main hazard factors in aquatic food products in China are: drug residues, hormones, antibiotics, heavy metals, pesticide residues, additives pathogenic microorganisms, parasites, inorganic and organic poisonous matter and shellfish poisons. China has made conscious efforts to improve the safety and quality of aquatic products. The main two efforts are to perfect the management systems, and to establish technical support systems.

Dr. M.K.Mukundan, CIFT, presented a paper on aquaculture and food safety standards. In view of the strict quality criteria adopted by the importing countries, there is need for more food safety oriented approach to aquaculture.

Dr. L.N. Murthy, CIFT, presented a paper on monitoring of cadmium accumulation in cephalopods in Gujarat coast. In recent years, many export consignments of cephalopods processed in Gujarat region were rejected on account of high levels of cadmium. In order to find the source of Cd, simulation studies were carried out by soaking squid muscle in ink, signifying the fact that poor post-harvest handling and consequent rupture of ink sac followed by soaking in ink-mixed water could be a reason behind the high levels of Cd accumulation in cephalopods.

Dr. K.M.Swapna, Export Inspection Agency, Chennai, presented a paper on the incidence of antibiotics residues in farmed shrimps. Antibiotics are widely used in aquaculture as a prophylactic agent or to treat disease outbreaks. None of the antibiotics tested, exceeded the permissible limits in farmed shrimp or fish. Streptomycin could not be detected in any of the samples from aquaculture.

Dr. Ning Xibin, Shanghai Fisheries University, presented a paper on rapid detection of *Vibrio parahaemolyticus* in seafood using an indirect ELISA. *Vibrio parahaemolyticus* is a halophilic bacterium widely distributed in marine areas, a common cause of seafood gastroenteritis worldwide and the most prevalent food-borne pathogen in China. In this study, an indirect ELISA for the detection of V. *parahaemolyticus* has been established. Using this method, upto 10^4 CFU m/L can be detected in just 8 hours in the seafood infected artificially and naturally.

Dr P.S. Jayasinghe, National Aquatic Resource Research and Development Agency, Sri Lanka, presented a paper on evaluation of the quality of agarophytes available in Sri Lanka for utilization in the food processing industry. An evaluation of quality of three commercially important agarophytes was carried out. *Gelidiella acerosa* had the best quality index than other two varieties.

Dr. A.C. Joseph, CIFT presented a paper on the frozen storage characteristics of coated edible oyster. He told that the storage characteristics of coated edible oyster at
–20°C can be increased to10 months by removing the gut.

The major conclusions that emerged from the session are given below:

- Strict quality management system for aquaculture products to tackle chemical and microbiological contaminants, especially the antibiotics, is needed.
- Exclusive standards for microbiological and chemical contaminants taking into consideration the environmental and aquaculture practices in tropics are needed.
- Effective enforcement of quality standards to improve the quality of dry fish is needed.
- Halophilic pathogenic vibrios in fish products need to be tackled.
- Considering the production of large quantity of fish and fishery products in the tropical Asian region, there is need for evolving different standards for this region for various quality parameters.

Technical Session: Economics and Marketing

The session was chaired by Dr.S.A.H.Abidi, Former Member, Agricultural Scientists Recruitment Board, New Delhi. Dr.R. Narayanakumar, CMFRI and Ms.N.Aswathy, CMFRI were the rapporteurs.

In this session, eight papers were presented. The salient findings of the presentations are given below:

The financial aspects of small-scale grouper hatchery operations and bio economic model were analyzed by Sih Yang Sim, Deakin University, Victoria, Australia and Sena S.De Silva, Network of Aquaculture Centres in Asia-Pacific (NACA). They examined the investment cost, operating cost and non-operating expenses. The study reported that grouper hatchery business is relatively risky but can provide Internal Rate of Return at 154%. Price and survival rate are the two important factors that determine the profitability and sustainability of grouper hatchery business in India.

In another study on grouper feed, the above authors informed that the trash fish component in feed for the groupers is better than the artificial feed component. Trash fish accounted for 32.2% of the cost of production and commercial feed 40.2%.

The returns to investment on genetic research in aquaculture was estimated by N.K.Barik, Central Inland Fisheries Research Institute, Barrackpore, West Bengal. The outcome of research was computed as the sum of fish, farm, household and national level impacts. It was found that the scenario with 50% adoption of genetic research yielded the highest IRR of 51.7%, which increased from 32.8% at 10% level of adoption. Under this scenario, both the producer and consumer shared the gain in the ratio of 57.5% and 49.0% respectively.

The capital formation in fisheries sector was analyzed by A.K. Vasisht and D.R. Singh, Division of Econometrics, IASRI, New Delhi. The authors found that the growth rate of fisheries fund outlay as a percentage of total outlay and outlay for agriculture increased over the plan periods. The share of fisheries GDP to total GDP increased from 0.62% to 1.0%. The growth in fisheries capital formation maintained a uniform trend of 9.5% during 1970-1971 to 2003-04 though that of agriculture declined since 1990-91.

In their demand and supply analysis of fish in India, N. Aswathy and T.R.Shanmugam, Central Marine Fisheries Research Institute found that the demand is expenditure elastic with elasticity of demand 1.07 and supply elasticity as 0.38. The projections on demand and supply for the year 2020 showed at GDP growth levels of 5%, 7% and 9% that there will be demand deficits of 0.14, 5.38 and 11.68 million tonnes, respectively. Scope for increase in fish production is 10.1 million tonnes only with the existing levels of production technology and estimated potential for area expansion. Without concerted efforts to increase the production from aquaculture, the prices in the domestic markets will be increasing with economic growth.

The reasons for the seasonal price fluctuations of Indian shrimps in U.S. markets were identified by Dr.V.Geethalakshmi, Central Institute of Fisheries Technology, Kochi. She found that for popular grades of black tiger shrimp, the seasonal indices were high in the third quarter of 2006 year and lowest in the first quarter.

In the study on economic aspects of marine fish marketing in Kanyakumari District, A.Venkateswaran, Scott Christian College, Nagercoil, Kanyakumari, Tamilnadu, reported that fishermen received only a third of the price paid by the consumer. The low value fish incur higher marketing cost.

Dr.K.J.Chaudhary, College of Fisheries, Shirgaon, Maharashtra, India, analysed the economic performance of shrimp farming in Raigad District of Maharashtra and found it to be profitable with a annual net income of Rs.2,17,342, NPV of Rs.4,10,798, BCR of 2.64 and IRR of 52%. The shrimp farming was found to be economically profitable even at risk-adjusted discount rates of 16 and 20 percent.

Technical Session: Exports, Trade and Globalization

The session was chaired by Mr. Kuruvilla Thomas, Director, MPEDA and co-chaired by Dr.K.R.Prasad, Fisheries entrepreneur, Visakhapatnam. Dr.R.S.Biradar, CIFE and Dr.G.R.Unnithan, CIFT were the rapporteurs. Seven papers were presented in this session.

Dr.Chen Sun, Shanghai University, Shanghai, presented a paper on seashell production and its world trade and export prospects in China. Production and trade of seashell shows an increasing trend in recent years contributing significantly to the export. The three characteristics of seashell trade are 1) the production and trade of seashell relies on aquaculture, 2) the main varieties of production are oysters and clams whereas the main varieties of trade are mussels and scallops, and 3) the concentrated region both of production and trade are Asia, Europe and North America.

Dr.Shyam.S.Salim, CIFE, Mumbai presented a paper "Indian shrimp trade: reflection and prospects in the post-WTO era". The results of the study indicated that the trade liberalization initiated during 1991 had embarked improvement in the Indian shrimp export. But, recently there is erosion in the competitiveness of Indian shrimp trade. Nevertheless, there are issues of concern due to the competitiveness, instability and rejections on quality grounds.

Dr.R.Sathiadhas, CMFRI presented a paper on economic efficiency of domestic fish marketing in India. The gross earnings from marine fisheries at first sales in India recorded an increase of 48% between 1995 (Rs.7409 crores) and 2005 (Rs.11, 007 crores). The fishing industry in India is still depending on the export markets as 50% of the gross earnings at landing center level is contributed by exportable varieties like crustaceans and cephalopods which hardly constitute about 20% of the total landings. The average landing center price of different varieties ranged from Rs.11 per kg for silverbellies to Rs.596 per kg for lobsters in 2005. Although the share of producers increased over the years for high quality fishes, there is enormous scope to enhance the marketing efficiency of low quality fishes such as silverbellies and lizardfishes in the internal markets.

Dr.Nikita Gopal, CIFT, Kochi, reported that the export of finfish from India has been rising over the years, having touched 1.86 lakh tonnes in 2005, which accounted for 37% of the total seafood export. In value terms, however, its contribution is only16%. The unit value realization for finfish exports, excluding ribbonfish, was $ 1.92 per kg in 2005, which was not significantly different from what it realized in 1991 at $ 1.56 per kg, an increase of 23% in 15 years. This unit value realization of finfish is low in comparison with the domestic prices.

The following conclusions were made in this session:

- Good model on export and trade that can be adopted by developing countries has to be evolved.
- There is need for promoting rural fish markets.
- Since there is a demand, farming of mussels and oysters should be intensified.
- Fish in frozen and chilled forms need to be promoted.
- There should be value addition for shrimp and promotion of black tiger shrimp produced in India through brand names.
- There is huge potential for ornamental fishes for employment generation and all the policy interventions, which hamper the growth of the sector, need to be revised, and lack of quarantine facility has to be addressed.
- Aggressive marketing for Indian products is essential. Commercialization through advertisements needs to be encouraged.

- Export of finfish in raw forms should be discouraged, and export in value added forms should be encouraged.
- Cold-chain for fish should be taken up on a priority.

Technical Session: Valuing Aquatic Biodiversity: Conservation, Use and Human Nutrition

The Session was chaired by Dr. Matthias Halwart, Fisheries and Aquaculture Department, FAO and co-chaired by Dr. Shakuntala Thilsted, Department of Human Nutrition, University of Copenhagen. Dr R. Soundararajan, NBFGR, Lucknow, Dr K. Vijayakumaran, CMFRI and Dr. K. Dinesh, Fisheries College, Kerala Agricultural University were the rapporteurs. The Session was conducted for two days. A total of 37 papers were presented over the two days. The following provides the summary that was presented by the Chair at the end of the Session and the salient points as recorded by the rapporteurs for each presentation.

Conservation

Studies on the diversity of fish and other aquatic species are an integral part of conservation and management strategies. Several papers on this subject were presented in this session; the ichthyofaunal diversity in Nandhini river in Karnataka; species diversity of finfishes in trawl landings along the west coast of India; and the diversity of zooplankton, to name just a few. Findings from these studies provide insight into the aquatic diversity at species and ecosystem levels, often indicating the rapid decline of indigenous aquatic biodiversity, but also sometimes resulting in the identification of new or rare species.

The issue of exotic introduced species was the subject of several papers. The impacts of introductions are often not fully understood or foreseen. It is imperative that economic and environmental impact analyses are done before introductions take place, following internationally accepted agreements, such as the FAO Code of Conduct for Responsible Fisheries. Databases such as the Database on Introductions of Aquatic Species (DIAS) can be useful for information and communication of impacts, threats, and benefits of introduced species.

It was pointed out that, in light of the high growth rate of aquaculture, farming practices where wild seed is collected, as in the case of the giant freshwater prawn, will need to become more sustainable (e.g. in terms of use of fishing gear). It is important that regulatory efforts are put in place and enforced. At the same time, efforts need to be made to provide incentives to fisherfolk and farmers to follow better management practices.

We heard about various efforts to conserve species, particularly through breeding programmes such as in Nepal or Malaysia. The use of the bred fish can be varied, from enhancing wild stocks to the aquaculture of food and ornamental species. The research community needs to continue and enhance its efforts to get the maximum benefit out of these approaches.

Use

Many of the papers showed that aquatic biodiversity has many uses, and as such, values. Uses of aquatic organisms include for human medicinal use, animal feeds, ornamental use, house building, and many others. Importantly it was highlighted that not only do values include the economic value of particular species for sale, but also the economic value of ecosystems and habitats, as in the case of mangroves in the Philippines, or rice fields in Laos. Yet, despite its importance, economic valuation of direct and indirect uses remains a difficult task and we keep struggling with answers to questions like: What is the economic value of a *Probarbus jullieni* in Malaysia? What is the value of a particular coral reef off the Indian coast? How can we adequately define the value of aquatic plants from floodplains in Bangladesh? The need to improve the tools for valuation and their cost-effective application became obvious from a number of presentations.

Another important lesson learnt is that when thinking about use of aquatic biodiversity and improving the livelihoods of the poor we should include an ecosystem evaluation in the planning process. The Ecosystem Approach to Fisheries and the Ecosystem Approach to Aquaculture provide useful frameworks for this purpose, but require a great deal of mediation among stakeholders and need to be further elaborated and applied to local circumstances.

Human nutrition

Several papers focused on the role of fish in human nutrition and health. The value of fish for human nutrition is a subject which we have not recognized in its full dimension. We heard an interesting

presentation on grey whales and movement between feeding grounds in Russian waters, but it is the small and unspectacular fish that have caught our particular attention with regard to human nutrition. Several papers focused on these small fish and their important role for rural household members. We have heard particularly about the important micronutrients, about vitamin A, zinc, iron and calcium. It is often ONLY the small indigenous fish which provide the necessary amounts of these nutrients to people who have no access to markets. It is these people whom we need to consider most as they can be destructive in their practices, but with the right research, development and communication efforts they can also be the responsible custodians of biodiversity!

What strikes me as important is that there can be a significant difference between wild and cultured fish. Bioavailability is a key issue when considering the effects of fish on human health, and not only the nutrient composition in a fish species but also local catching, preparation and cooking methods need to be taken into consideration. A case in point was made in a study from Bangladesh which showed that the content in vitamin A that a household member obtains from eating fish can differ by several orders of magnitude, depending on the species and the way the fish is prepared. In this respect, it was highlighted in several presentations that the value of small indigenous species for human nutrition must be better researched and understood, communicated and mainstreamed into fisheries and aquaculture policies. It was also noted that catch and consumption surveys could be made more useful if information was collected on preparation and cooking methods, thereby making data more relevant for nutritional study.

Cross-cutting issues

Illegal, unregulated and unreported fishing, particularly the use of destructive fishing gear leading to indiscriminate catches of all sizes and significant amounts of unwanted by-catch, and prohibited substances such as dynamite fishing and poisoning, and moreover even taking place in protected areas, has severe negative impacts on aquatic biodiversity. Several papers including those from the Sunderbans highlighted this issue and the need for sound regulations and environmental management plans that are properly enforced. In severe cases, banning of fishing activities was advocated. However this comes at a price and the need to ensure that fisherfolk have adequate opportunities to make a living was similarly called for.

Sampling methodology was a subject of intense discussion. Where possible, researchers should try to standardize their methods not only to ensure that scientific standards are adhered to, but also that comparability of spatial and seasonal differences becomes possible among different studies. The standardization issue is considered important both for general methodology and sampling methods but also for the statistical analysis of data. Adequate funding for research is an important issue and more funding for research is called for.

We need to keep in mind that research is not an end in itself. Research plays a very important role in informing policy makers. This was highlighted from examples on the spread of African catfish in Bangladesh or India and the importance of ricefield habitats for aquatic biodiversity in Laos. Solid and reliable research data need to be used to inform and advise policy that aim at promoting fisheries and aquaculture following sound resource management practices.

Finally, the incredible value of working together is a call we have heard in this Session. We need to work together beyond our disciplinary boundaries, and researchers, development practitioners and policy makers need to join hands in finding adequate solutions for maintaining and enhancing aquatic biodiversity for the benefit of humankind. In the same vein, one of the key lessons we should take home from this wonderful session is that we need to keep local people at the center of our attention; we need to make them part of our efforts in maintaining and enhancing aquatic biodiversity. Whether we think about the protection of coral reefs, the valuation of mangroves, or the importance of fish, frogs and snails from rice fields, it is the local fisherfolk, the coastal communities, the farmers and the landless who depend on these resources. Including them in the environmental monitoring and decision-making process can make the difference between failure and success. In this respect, many examples showed us how traditional knowledge and working with people can help us to understand and improve both environmental conditions and people's livelihoods.

Technical Session: Environment, Pollution, Impacts

The session was chaired by Dr. Christopher G. Barlow, Mekong River Commission, Vientiane, Lao PDR, and co-chaired by Dr.Yang Yi, Asian Institute of Technology, Thailand and Dr. K.K. Vass, Director, CIFRI, Barrackpore. Dr. P.K.Krishnakumar, CMFRI and Dr. S.N.Singh, CIFRI were the rapporteurs. In the session 23 papers were presented.

Dr. Ron Szymczak, ANSTO Marine Systems Analysis Task, Australia presented a paper on improving regional capacity for assessment, planning, and response to aquatic environmental emergencies. He said that the growth of mining and other industry-related activities in the Asia-Pacific region has increased the level of contamination in receiving waters, leading to reduced populations of the flora and fauna through direct toxic effects, as well as increasing the concentrations of non-radioactive pollutants in staple aquatic foods. The accumulation of contaminants in water, flora and fauna can impact local communities' sources of food supply as well as their sources of livelihood.

Dr. Ron Szymczak presented another paper on nuclear and isotopic techniques for improved management of contaminants impacting aquaculture. He told that predictive ecological risk assessment requires bioaccumulation and trophic transfer models using keystone species (or critical prey-predator groups) identified by models elucidating trophic structure. Stable isotope studies replace visual observations of prey-predator interactions with statistically interpretable chemical data. Radiotracers provide real time kinetic data on uptake and transfer of specific contaminants and environmental transport processes.

Dr. Raffaele Acierno, Universita del Salento, Italy presented a paper on environmental management reform for sustainable farming, fisheries and aquaculture: the AQUAGRIS coordination action. He said that the extensive use of pesticides, fertilizers and significant energy inputs to maximize production results in considerable waste release and a variety of related environmental problems. Twenty-six organizations from 15 countries united their efforts, in the context of the AQUAGRIS Coordination Action, in order to reform environmental management for improved sustainability in the farming, fisheries and aquaculture (FFA) industries. AQUAGRIS is developing new strategies for environmental management in order to produce sustainable systems. Such systems are designed to imitate natural systems to maximize existing soil nutrient and water cycles, energy flows and soil organisms. The ultimate goal is to coordinate processes so that waste from one process or system becomes input for another.

Dr.F.Y.Al-Yamani, Institute for Scientific Research, Kuwait presented a paper on assessment of the effects of the river diversion, Mesopotamian marsh drainage and restoration and river damming on the marine environment of the North Western Arabian Gulf. The study assessed the impact of river diversion, marsh drainage, and marsh restoration on Kuwait's marine environment. It is exposed that recent and planned river basin modifications in Turkey, Iran and Iraq will significantly reduce river discharge, permanently remove seasonal flooding, and will impact the northern Gulf's marine environment, with serious implications for fisheries.

Dr.Wei Hua, College of Aqua-life Science and Technology, Shanghai presented a paper on endocrine disruption effects of 4-Nonylphenol and Estradiol on vitellogenin gene expression *in vivo* in *Macrobrachium rosenbergii*. He said that the induction of the female-specific protein, vitellogenin (VTG) in male fish is a well-established endpoint to assess exposure to oestrogen-like chemicals. The use of VTG as a biomarker for xenobiotic exposure in egg-laying invertebrates, however, is still relatively unexplored. Recently, RT-PCR assay for VTG has been developed in *M. rosenbergii* to study its potential disruption by nonylphenol (NP) and estrodial (E_2). It is indicated that NP had endocrine disruption effects in *M. rosenbergii* as in egg-laying vertebrates. He speculated that the strong estrogenic effects of E_2 discovered in this experiment might illuminate a hormone regulation mechanism in crustacean vitellogenesis similar to that of egg-laying vertebrates.

Dr.K.K.Krishnani, Central Institute of Brackishwater Aquaculture, Chennai presented a paper on characterization of nitrifying bacteria in coastal aquaculture. He said that nitrification is an essential functional group for the removal of nitrogenous metabolites. In the present study, ammonia monooxygenase (*amo*A) gene is chosen to detect nitrifiers in 50 different environmental samples collected from various coastal aquaculture systems in Tamil Nadu. The study has potential for making bioremediation strategies for ammonia removal from brackishwater aquaculture systems.

Dr.Subhendu Datta, Central Institute of Fisheries Education presented a paper on influence of dissolved organic carbon in modifying the toxic effect of xenobiotics on plasma glucose, alkaline phosphatase, LDH, total protein and liver glycogen of common carp. He said that dissolved organic carbon is an indication of organic fertilization level of pond. Dissolved organic carbon when combined with test chemicals was able to restore almost the normal level of all biochemical parameters mainly due to their influence in reducing the chronic toxic effect of test chemicals on scale carp. It is concluded from this study that organic matter (either raw or partially decomposed cow dung, humus), have good potential to protect the fish from lethal and sub-lethal effects of inorganic (e.g. metals) and organic (pesticides) xenobiotics.

Technical Session: Biotechnology: Genetics and Molecular Biology

The session was chaired by Dr. George John, Advisor, Department of Biotechnology, Govt. of India and co-chaired by Dr.W.S. Lakra, Director, National Bureau of Fish Genetic Resources, Lucknow. Dr. S.D.Singh, CIFE, Mumbai and Dr.P.Jayasankar, CMFRI were the rapporteurs. In this session 16 papers were presented.

Dr. Maria R. Menezes, NIO, Goa, presented a paper on mitochondrial control region variability and population structure in the skipjack tuna *Katsuwonus pelamis*. Samples were collected from the east coast of India and from the Japanese coast. Genomic DNA was extracted from finclip. Three composite haplotypes were commonly observed in the samples from India and those from Japan. The other haplotypes were specific to either the samples from India or those from Japan. As mtDNA has maternal-only inheritance, patterns in mtDNA differentiation reflect mainly the female-mediated dispersal processes. It was, therefore, found necessary to investigate further the population genetics of skipjack tuna using nuclear gene markers (microsatellites).

Dr. P.Jayasankar, CMFRI, presented a paper on the inventorization of marine mammals in the Indian Seas based on molecular taxonomy. Molecular taxonomic identification of the cetaceans and dugong was possible from carcasses of stranded ambiguous specimens or even from tissues of unknown samples. Mitochondrial DNA partial sequencing of two loci (control region and cytochrome *b* gene) was carried out from tissues of accidantly caught/stranded specimens. A total of 63 mtDNA sequences from 40 individuals of eleven species have been deposited in the GenBank. Phylogenetic analysis of the *Sousa-Stenella-Tursiops-Delphinus* complex indicated more or less robust monophyletic in all species except in *Delphinus capensis*.

Dr.S.D.Singh, CIFE, presented a paper on microsatellite-based DNA fingerprinting of seabass populations from Indian coasts. Genomic DNA extracted from fish fins of five populations of *Lates calcarifer* of east (Kolkata, Paradeep, Chilka), west (Mumbai) and south (Chennai) coasts of India were used for DNA fingerprinting which indicated significant genetic diversity of about 9 to 15 alleles of varying sizes with each microsatellite loci. Resolution of microsatellite DNA bands was much improved by PAGE in comparison to AGE for better interpretation and correlation results.

Dr. A. Gopalakrishnan, NBFGR, Kochi, presented a paper on low genetic differentiation in the populations of the malabar carp as revealed by allozymes, RAPD and microsatellites. To explore the genetic variation in natural populations of this species in Meenachil and Manimala rivers allozymes, microsatellites and RAPD markers were employed. The study has indicated low genetic differentiation in natural populations of *Labeo dussumieri* in the two river systems. Free mixing of the populations, leading to high gene flow across the rivers is suspected to cause genetic homogeneity. The stocks need not require different management strategies and for propagation assisted river ranching programme of this species, large effective breeding population can be developed by mixing individuals from both the rivers.

Dr. Alok Patel, CIFA, presented a paper on the development and linkage relationship of a new set of microsatellite markers in *Labeo rohita*. The study was undertaken to develop a new set of microsatellite markers and an experimental population for mapping. An inter-species (rohu x kalbasu) back cross population was generated to serve as the mapping panel. PCR amplification of these microsatellite loci in kalbasu indicated 12 loci to be cross amplifying. This shows that about 60% of the rohu markers can be mapped using the current inter-species panel. All the loci are being PCR genotyped using the entire mapping panel for data analysis in CRIMAP software.

Dr. Rakesh Kumar, CIFT has attempted to characterize the virulence factors of lac^+ and lac^- *Salmonella* serotypes by PCR based assay. The study indicated the presence of virulence genes in lac^+ *Salmonella* strains from seafood and these strains could pose a serious health threat to consumers.

Technical Session: Biotechnology: Applied Biotechnology

The session was chaired by Dr. Martin Kumar, South Australian Research and Development Institute and co-chaired by Dr. N. Sarangi, Director, Central Institute of Freshwater Aquaculture. Dr. Kajal Chakraborty, CMFRI and Dr Devika Pillai, Fisheries College, Kerala Agricultural University were the rapporteurs. In this session, 15 papers were presented.

Dr. N.Sarangi, CIFA, Bhubaneswar presented a paper on on-farm field trial of genetically improved rohu 'Jayanti' *vis-à-vis* two selected varieties of catla-rohu backcross generations B3. The performance was compared with that of catla and mrigal in four different places of Orissa. The improved 'Jayanti' rohu exhibited higher growth efficiency over local rohu (98-128%), and catla/mrigal. Dr. Sarangi proposed that if 30% of the total rohu, can be replaced with Jayanti rohu it will give a better production.

Dr. S. Nandi, CIFA, presented a paper on "Cloning and characterization of GnRH encoding cDNA in rohu". The brain tissues were collected during spawning to isolate RNA. The PCR product has been developed for rohu brain cDNA amplified with sGnRH specific primer (186 6p), that showed similarity between salmon GnRH precursors at nucleotide and protein level.

Dr. M.M. Emhemed, University of Putra Malaysia, Selangor delivered a talk on physical characterization of cryopreserved sperm of *Puntius daruphani* and its effect on fertilization and hatching rate. He suggested that 15% dimethyl sulphoxide is a better cryoprotectant of milt and fertilization. Hatching rate are higher using the frozen thawed sperm.

Dr. Tick Nuanthavong, Living Aquatic Resource Research Center, Vientiane, presented a paper on artifical reproduction of the catfish *Hemibagrus wyckioides* in the Champassak Province of China. Dry fertilization was performed by using sperm collected from wild males. Two kinds of hormonal treatment were tested to trigger ovulations in females. After fertilization, the eggs were incubated and the hatching rate was 66%.

Dr. W.L. Chuang, Department of Food Science, National Taiwan Ocean University, presented a paper on effects of dimethyl sulfoxide (DMSO) on pro-inflammatory gene expressions and cytotoxicity to salmonid cell line. He told that if DMSO is applied to TO cells of salmonoid at less than 4%, the viability of cells is higher. The DMSO has proved to have mild inhibitory effect on pro-inflammatory genes like COX-2.

Dr.Chen, Department of Aquaculture, Shaghai Fisheries University, presented a paper on components of pigments in the chromatophores of discus fish. He pointed out that melanophore, erythrophore, xanthophore and iridophore are the major chromatophores.

Dr. K. Kesavan, Deprtment of Marine Biology, Cochin University of Science and Technology, presented a paper on ethological aspects of chromatophore distribution in *Oreochromis mossambicus*. He delineated that chromatophore concentration is a guiding factor at behavioral responses of the fish. This application is important to study the chromatophores as biomarkers for stress.

Dr. Manush Mohammed, National Research Institute for Fisheries Science, Yokohama, Japan, presented a paper on thermal acclimatory cellular responses in zebrafish. He pointed out that glucose regulatory proteins are important thermal stress markers. He apprised that gradual rise in temperature elicits hsc70 protein expression which affects in negatively modulating the transcriptional expression of hsp70 in zebrafish. He also explained the cellular mechanisms governing apoptosis during thermal acclimation. He delineated the pathways leading to apoptosis in a "cell-death module" in zebrafish.

Dr. Rosalind George, Fisheries College and Research Institute, Tuticorin delivered a talk on genomic plasticity of *Vibrio alginolyticus* subjected to environmental stress. She documented variation of this bacteria in different shrimp farming systems by using conventional microbiological and modern biotechnological tools like PCR. Dendrogram of various isolate has been drawn to delineate the similarities between different strains. She pointed out that high level of genetic variation allows the bacteria to survive under stress condition.

Dr. Mathen Mathew, Central Institute of Fisheries Technology, Kochi has studies the analgesic and anti-inflammatory activities of shark liver oil. He pointed out that shark liver oil is a rich source of alkyl glycerols (AKG), which are natural substances of human body's immune system. The shark liver oil administered at 2.6g/kg body weight was found to have significant analgesic activity against acetic acid induced writhing and hot plate reaction in mice.

Dr. Anuar Bin Hassan, Institute of Tropical aquaculture, University Malaysia Terengganu, presented a paper on studies on the induced breeding of *Pangasius sutch* using pituitary extract. The brooders were injected with pituitary extract of African catfish, *Clarius gariepinus* at different doses with ovaprim as control. The results are similar to that of the control. He told that this method can be used to reduce cost of production in aquaculture.

Dr. Liping Wang, Shanghai Fisheries University, Shanghai appraised that increasing the amount of mannooligosaccharides (MOS) of yeast cell wall results in its better physiological function. By using the methods of enriching culture, isolation and selective plate culture, α-mannanse productivity strains were selected which was identified by 16S rDNA BLAST in GenBank morphological and physiological analysis. He also described the optimal fermentation conditions to increase enzyme activity.

Dr. J.H. Hwang, Division of Food Science and Aqualife medicine, Chonnam University, Korea presented a paper on expression and induction of organic solute transporter α/β in a skate embryo-derived cell line. He opined that chemically defined lipids in a medium supplement OST β in the embryo cell-line suggesting that cell culture model could be promoted as a good model for *in vitro* studies.

Dr. Yang Li, College of Fishery, Huazhong Agricultural University,Wuhan, Hubei, China presented a paper on "Effects of busulfan on primoridal germ cells (PGC) and sex differentiation in zebrafish". Busulfan is currently the most widely used myeloablative regimen to treat malignancies with allogeneic stem cell transplantation. The results revealed that busulfan can significantly suppress PGCs and it was concluded that 20μg/ml is the safe dose that doesn't have bad effect.

Tapas Chakraborty, CIFE, Mumbai, presented a paper on "Development of stable GFP expressing lead biosensor to measure aquatic lead contamination". To increase the stability of the biosensor, the sensor-reporter construct was integrated into the *E.coli* genome using the λ-phage recombination sites. The biosensor was induced by Pb^{2+} ions and GFP expression and cell density at each concentration was quantified. The study allowed the detection of biosensor for determining the lead toxicity levels, which is a simple and quick method of detection of lead in the aquatic environment.

Technical Session: Biotechnology: Nutrition

The session was chaired by Dr. Shian Shiyen, Taiwan National University and co-chaired by Dr.K.V.Devaraj, Former Vice-Chancellor, Karnataka Agricultural University. Dr. Mukhtar Khan, Aligarh Muslim University was the rapporteur. In this session 27 papers were presented.

Dr. Sharifah Rahmah Syed Muhammad, University Sains Malaysia, Penang presented a paper on *in vitro* methods to estimate dietary protein digestibility in bagrid catfish *Mystus nemurus.* The *in vitro* protein digestibility of seven diets containing 0, 10, 20, 30, 40, 50 and 60% substitution of fish meal protein with soybean protein were examined using 4 enzyme systems. Results showed that the pH-stat method using fish enzyme is a better alternative to *in vivo* digestibility approach. SDS-PAGE zymogram revealed that a higher inclusion of soybean meal in the diets gradually inhibited the proteases from fish enzyme evident from the slightly reduced intensity of the bands compared with the diet without soybean meal.

Dr.M.N.Afini, University Sains Malaysia, Penang presented evaluated the utilization of lipid as dietary energy by the young catfish *Mystus nemurus* by manipulating the n-3 and n-6 ratio. The study indicated that catfish required higher n-3 fatty acids content than n-6 fatty acids for growth, which differed from most freshwater fish species.

Dr.Giovanni M.Turchini, Deakin University, Australia presented a paper on increasing efficiency of fish oil replacement and the effects of dietary lipid source and
ad hoc feeding schedules on the murray cod *Maccullochella peelii peelii.* The objectives of the present study were to evaluate the effects of alternating feeding schedules using fish oil (FO) and vegetable oil (VO) based diets on the growth and fatty acid make up of the consumable product. Fish receiving the VO treatment in the morning showed an increased deposition of n-3 HUFA compared to fish on VO treatment in the evening. Therefore, dietary lipid intake in the evening seems to be preferentially deposited while dietary lipid intake in the morning seems to be preferentially utilized for energy production.

Dr.M.Anbarasu, National Institute of Ocean Technology, Chennai presented a paper on acceptability of formulated diets and its effect on the fatty acids profile in the Indian spiny lobster, *Panulirus homarus*. Formulated diets also increase PUFA level in the muscle of the lobster and thereby adding the nutritive value of the lobster. Significant differences were also observed in meat flavor and color.

Dr. Nyoman Adiasmara Giri, Gondol Research Institute for Mariculture, Bali presented a paper on the effect of dietary protein and lipid level on growth performance of the tiger grouper *Epinephelus fuscoguttatus* during late-stage grow-out. Juvenile tiger grouper (11 to 100g) requires diet containing 47 to 50% crude protein and 9% lipid for its good growth. Result of the experiment showed there was no interaction effect between the protein and lipid content of diet for weight gain, survival and FCR. Increasing protein levels in the diet from 38% to 54% did not significantly improve weight gain indicating lower (38%) dietary protein requirement for larger tiger grouper.

Dr. Biswajit Kumar Biswas, Kinki University, Wakayama, Japan, presented a paper on sustainability of formulated diet instead of traditionally used raw sandlance for juvenile Pacific bluefin tuna *Thunnus orientalis*. The Pacific bluefin tuna is regarded as one of the most valuable fish in the world market. The full life cycle under captivity has recently been established by the Fisheries Laboratory, Kinki University. Early stage feeding usually starts with rotifer, *Artemia*, stripped knife-jaw larvae and later solely on raw sand lance.

Dr. R.Ramya, Fisheries College, Thoothukudi, presented a paper on bioprocessed feed formulation, its dietary characteristics and its scope for utilization in shrimp larval rearing. Replacement of live feeds fully or partially in shrimp hatcheries with value-added marine single cell detritus (MSCD) could be a viable option. MSCD, a seaweed based silage was prepared using a bioreactor (Applicon, Holland)

through enzymatic and microbial fermentation processes. Trails conducted to test its nutritive efficiency have confirmed that MSCD has superior biogrowth performance.

Dr. Xu- Xiong Huang, Shanghai Fisheries University, Shanghai presented a paper on the effects of feeding regimen and starvation on the innate immune activities of the shrimp *Fenneropenaeus chinensis*. The results showed that 10% body weight diet daily would meet the well-fed requirement of the shrimp under experimental conditions, 5% body weight diet daily would meet their normal requirement whilst 2.5% body weight diet daily could not meet the normal requirement of the shrimp in a chronic starvation state due to inadequate food.

Technical Session: Fisheries and Society

The session was chaired by Prof.P.Sorgeloos, Ghent University, Ghent, Belgium and co-chaired by Dr.S.P.Tripathi, Former Director, CIFE and Dr.V.V.Sugunan, Assistant Director General, ICAR. Dr.R.Narayanakumar, CMFRI and Dr.Femeena Hassan, CIFT were the rapporteurs.

Dr. Alice Joan, University of Philippines presented the factors influencing the entry of young people into the fishery sector in the Visayan Sea, Philippines. Only few of them compared to non-fisher-respondents were hopeful of a better future. Majority of them plan to leave fishing. In general, they did not differ with the non-fisher-participants in terms of life goals and aspirations.

Dr. R. Sathiadhas, CMFRI, presented a paper on inter-sectoral disparity and marginalization in marine fisheries in India. There has been a sizable growth of mechanized fishing units (70 percent over the last 12 years) that are technically efficient. However, there was a downtrend in non-mechanized units (reduction of 43 percent) denoting gradual phasing out of less efficient units. The fishermen involved in active fishing are more than the absorbing capacity of the fisheries sector leading to disguised unemployment, which has led to lower per capita production. The analysis indicates that there is high incidence of poverty in the coastal rural sector explicitly revealing that majority of these people still could not get much of the benefits of the economic development taking place.

Dr. Roitana Buoy, Inland Fisheries Research and Development Institute, Cambodia presented a paper on fish consumption in Cambodia. Fish and other aquatic animals play the next role after rice and vegetables in-terms of quantity and frequency in poor, rural households in Cambodia.. Rural poor people consume low value fish and other aquatic animals, which are accessible from the local market and wild.

Technical Session: Socio-Economics and Livelihoods

The session was chaired by Dr. Ida M. Siason, University of Phillipines, Iloilo and co-chaired by Dr. Kurokura, Tokyo University of Fisheries. Dr.Pradeep Katiha, CIFRI and Dr.Mahalakshmi, CIBA were the rapporteurs. In this session, 10 papers were presented.

Dr.Loureeda C.Darvin, Philippine Council for Aquatic and Marine Research and Development, Laguna, Philippines presented "Fish for Every Family Project" through introducing Tilapia in backyard rising in the Philippines. The project has been implemented in clusters. It impacted positively with increase in savings of fishers by 80%. The adaptive strategies suited to fishers and development of micro-enterprises for Tilapia production was suggested. The project was found to be sustainable and has been transferred to State Department for implementation with people participation.

Shri. J.V.H. Dixitulu, Fishing Chimes, Visakhapatnam presented a paper on empowering Indian marine fishers. He advocated for integrating fish production with fish marketing and value addition activities. He suggested i) formation of district level Coastal Marine Fisheries Development Authority (CMFDA), ii) Setting up of Fisheries Value Addition Plant (FVAP) in vicinity of landing centers, iii) Integration of FVAP under supervision of CMFDA with state, national and international markets, iv) Possible linkages for integration, v) Use of by catch for processing using technologies developed by CIFT, vi) involvement of fisher at each stage of integration and passing on the benefits to them, and vii) constituting national level task force for preparation of framework for this linkage involving concerned representative from centre, state and NFDB. According to him it will benefit larger number of coastal fisher families.

Shri K.P.Said Koya, Central Marine Fisheries Research Institute made a presentation on socio-biological perspective of Lakshadweep fisheries. He highlighted the fisheries resources, fishing practices and the available efficiency for fisheries exploitation in the region. He suggested improved storage and marketing facilities, and increased use of hand line instead of poll & line.

Dr.P.A.Dissanayake, Ministry of Fisheries Northwestern Province, Chilaw, Sri Lanka highlighted the fisheries activities in Thoduwawa village in NW province of Sri Lanka. He mentioned about the success story of a co-operative bank which was providing short term loan to fishers during the lean fishing period with higher interest rate, but working for welfare of the local fishers. The discussion of the paper highlighted that any institution working for the people with involvement of the people will be a success.

Dr.P.C.Mahapatra, Central Institute of Freshwater Aquaculture made a presentation on the livelihood development of rural poor through aquaculture in Orissa. He highlighted the findings of a project on transfer of carp seed production and culture technologies in remote areas of Orissa including provision of inputs, plastic hatchery and relevant trainings.

Dr.Pradeep Katiha, Central Inland Fisheries Research Institute made a presentation on socio-ecnonomic and institutional settings for estuarine, wetland, and sewage-fed and freshwater fisheries in West Bengal. He highlighted the importance of these fisheries in fish supply to Kolkata; socio-economic status of the fishers and institutional settings, and economics of fish production under different salinity regimes. He also narrated the problems, and suggested the remedial measures.

Dr A.K.Roy, Central Institute of Freshwater Aquaculture has estimated the impact of socio-economic and farm specific variables on technical efficiency of carp culture farms of Kolleru Lake. The subject matter of the paper was the methodologies for estimation of technical efficiency and factors effecting carp culture in Kolleru Lake. The study utilized Stochastic Frontier and production function approaches. It concluded that although the technical efficiency of fish farmers was high, there is further scope for improvement. It also accented many farm and non-farm factors affecting the carp culture.

Dr. R. Sathiadhas, Central Marine Fisheries Research Institute made a presentation on impact of monsoon trawl ban in Kerala. He concluded that there is a short run economic loss due to non-fishing in the monsoon seasons, but the loss was compensated in the ensuing fishing seasons.

Dr.M.A.Kabir Chowdhury, WorldFish Center, Penang presented a paper on the perspective of tilapia culture in changing people's livelihood in Malaysia. He found that the Tilapia farmers had a voice in Tilapia market, but small farmers are not benefited substantially from Tilapia culture in Malaysia.

Technical Session: Fisheries Education

The session was chaired by Dr. Yingqi Zhou, Shanghai Fisheries University and co-chaired by Prof. Roshada Hashim, University Sains Malaysia, Penang and Dr.S.C.Mukherji, CIFE, Mumbai. Dr.V.P.Vipin Kumar was the rapporteur.

Dr. Ram C. Bhujel, Asian Institute of Technology, Thailand presented a paper on meeting the needs for higher education and research in aquaculture and fisheries in less developed countries. It is imperative to ensure the quality of education that focuses not only in technological development, but also on the curricula and delivery methods if we are to improve human capacity within this region. He found that most curricula in various institutions were from texts written out-of-context. University lecturers educated in foreign universities tended to deliver lecture notes that they acquired while they were students. Field experiences and laboratory exercises were minimal or non-existent in several courses.

Dr. M.C.Nandeesha, College of Fisheries, Tripura presented a paper on the topic of investment in Indian fisheries education. To improve the quality of teaching, faculty strength and appropriate research support are necessary. As many countries in the region have fisheries educational programs, it is suggested to establish a regional network with a view to exchange information and provide support for the improvement in the quality of education.

Dr.Le Thanh Hung, University of Agriculture and Forestry, Vietnam presented a paper on the development of aquaculture education system in Vietnam for aquaculture. Fish farming in Vietnam has rapidly increased in the past resulting in aquaculture production higher than the catch from the wild. This paper reviews the development of aquaculture education systems in Vietnam in the last 40 years. Initially, there was only one programme for specialization in aquaculture in the 60's but now there are at least nine faculties in different universities offering bachelor degrees to 500-600 students annually, specializing in aquaculture/fisheries.

Technical Session: Human Resources

The session was chaired by Dr. Barney Smith, Australian Centre for International Agriculture Research, Australia and co-chaired by Dr. Dilip Kumar, Director, CIFE, Mumbai. Dr.Archana Sinha, CIFE was the rapporteur.

Dr. R.Sathiadhas, CMFRI presented a paper on the employment scenario and labour migration in marine fisheries. Macro-level employment status has been worked out based on the well-established

assumption that every 5 kg of fish produce provides employment to one person in harvesting and another 12 persons in the post-harvest sector. The study indicates that about 12,50,000 people are involved in active fishing in India while post-harvest sector including export and domestic marketing employs about 15,00,000 and in tertiary sector there are around 2,00,000 people.

Dr.A.K.Reddy, CIFE presented a paper on extension service delivery system in aquaculture and fisheries. The paper describes the experience and learning from pilot scale application of two extension approaches- one for aquaculture and the other for openwater fisheries in two northeast States of India. Farmer-to-farmer Trickle Down System (TDS) of aquaculture extension approach is being employed in over 200 blocks of Assam. On the other hand fisheries co-management approach has been introduced in a 100 ha segment of Loktak Lake of Manipur, where over 40 fishing families have been empowered to manage the lake as management partner with the state government.

Dr. Archana Singh, CIFE presented a paper on HRD for ornamental fish trade through community based participation model for rural women. Although women have proved to be competent in adopting new aquaculture technologies, their role is very much restricted and often ignored. One of the major reasons is location of aquaculture sites and several socio-cultural taboos against women who strive to earn for their family's subsistence in rural areas.

Technical Session: Policy and Governance

The session was chaired by Dr. Stephen Hall, Director General, WorldFish Center, Penang. Dr. G. Mohanraj, CMFRI was the rapporteur. Nine papers were presented in this session.

Dr. Pedro B Bueno, NACA, Bangkok, presented a paper on organizing fish farmers for better governance and adoption of responsible practices in the aquaculture sector. Poor farmers, and users and gatherers of aquatic resources, being organized into either a formal association or self-help group is a way to collectively achieve a strong capacity to enter and stay in aquaculture, effectively demand and absorb institutional services and technical assistance, cope with natural hazards and economic risks, address barriers to property and financial access, and acquire and use capital and operating assets. Strong and active as well as independent farmer associations could provide non-political positions based on science and/or good sense, which support the management sector and its development.

Dr. Patrick Sorgeloos, Ghent University, Ghent, Belgium, presented a paper on ASEM aquaculture platform. ASEM (Asia-Europe Meeting) is an informal dialogue process initiated in 1996. Now, 27 EU Member States, the European Commission, 16 Asian countries and the ASEAN Secretariat participate in the process. All activities are catering to three societal concerns: a) fair trade, food security & safety; b) environmental sustainability; and c) social equitability.

Dr. Wei Yang, Shanghai Fisheries University, Shanghai, presented a paper on the current state of capture fisheries insurance in China. Fisheries are assigned to agriculture in China, so fisheries insurance is historically regarded as one part of agricultural insurance. There are three kinds of companies operating fisheries insurance, that is, commercial insurance company, policy-related regional agricultural insurance company and cooperative society. Although insurance plays a positive role in the development of fisheries capture and strengths fisherfolk's sense of safety, the capture fisheries insurance is still in its infancy.

Dr. Pradeep K. Katiha, CIFRI, Barrackpore presented a paper on socio-institutional aspects effecting reservoir fisheries in Rajasthan. Average yield rate (1604 kg/ha/yr) was found to be maximum for those having area within the range of 50-100 ha whereas minimum average yield rate (50 kg/ha/yr) was found for the reservoir having area above 5000ha. Poor management and absence of proper stocking were the main reasons for low fish yield in large reservoirs.

Dr. Mai Thi Truc Chi, Research institute for Aquaculture, Ho Chi Minh City, Vietnam, presented a paper on outcome mapping in the SOC Trang co-management project". Outcome mapping, as a participative method, is applied in order to enable the project to cope with the difficult challenges of valuing different stakeholders' beliefs and judgments when assessing co-management progresses. As a preliminary step, a task group, with the district leader as the chairman, was established. The respective commune leaders then supported the implementation activities according to the project goal. Over 80% of farmers changed from shrimp monoculture to an alternate rice-shrimp culture system, which is one of the project's main outcomes with regard to sustainable development.

VALEDICTORY FUNCTION

The Valedictory Function of the 8th AFF was held on November 23, 2007 at 5 p.m. Dr. S. Ayyappan, DDG (Fisheries), ICAR & Chairman, Asian Fisheries Society Indian Branch welcomed the

gathering and presented the draft Recommendation of the 8th AFF. Dr. Stephen Hall, Director General, WorldFish Center, Penang, Dr.Sena De Silva, Director General, NACA, Bangkok, Dr.Meryl J. Williams, Former Director General, WorldFish Center, Penang, Dr.S.N.Dwivedi, Former Director General, Madhya Pradesh Council for Science & Technology, Dr. Brian Sheehan, Intervet Norbio Singapore shared their views about the 8th AFF.

Dr. Meryl Williams announced awards to the following papers presented in the Symposium on Gender and Fisheries:

1. "Empower women with aquaculture knowledge and skill to increase fish production" by M.C.Nandeesha and Manojit Debnath, College of Fisheries, Central Agricultural University, Agartala, Tripura.
2. "Gendered spaces, technological change and fisheries sustainability: A comparative analysis of women in tuna fisheries in Lakshadweep and bivalve fisheries in Kerala" by C. Ramachandran, R. Sathiadhas, Said Koya and A.I. Muhasin, Central Marine Fisheries Research Institute, Cochin.
3. "Social impact and women empowerment through mussel farming" by V. Kripa and V.G. Surendrananth, Central Marine Fisheries Research Institute, Cochin.
4. "Dynamics of women's self help groups in Malabar fisheries sector: a case study" by V.P.Vipinkumar, Central Marine Fisheries Research Institute, Cochin.

Dr.Chan-Lui Lee, Asian Fisheries Society introduced the newly elected President and Councilors of the 9th Council of AFS. Dr Yang Yi, Shanghai Fisheries University, China has been elected as the President of the 9th Council of AFS. Dr. Lee informed that the next Forum will be held in Shanghai in 2010. Following this, a brief presentation on the proposed 9th Asian Fisheries & Aquaculture Forum was made.

The 8th AFF concluded after vote of thanks by Prof. Mohan Joseph Modayil, Convener of the 8th AFF.

8th ASIAN FISHERIES FORUM
DRAFT RECOMMENDATIONS

1. Considering the depletion of several fish stocks in the Asia-Pacific region, responsible fisheries management and co-management practices need to be implemented for sustainable fisheries. Optimum fleet size and capacity assessment based on fish stock estimates need to be quantified for different regions.

2. Taking into account the inadequacies of single species management programmmes, the thrust on fisheries management has to shift towards ecosystem-based approach.

3. In the context of increasing concerns on the impact of climate change on fisheries, vulnerability and adaptive capacity of fish and fishing communities have to be assessed to develop mitigation measures.

4. Researches on straddling and migratory fish stocks need to be taken up on a regional basis for optimum utilization of the resources.

5. In view of the increasing environmental degradation of the water bodies including major river systems in the Asia- Pacific region, the experience of Mekong River Commission may be emulated for improving the health of the ecosystems and fisheries in these waters.

6. Considering the growing concern on the decline of biodiversity in the aquatic ecosystems, programmes on conservation and restoration of endangered species and habitats should be strengthened with regional co-operation. New tools of molecular taxonomy and DNA bar-coding need to be employed for this purpose.

7. In view of increasing costs of fishing and to reduce greenhouse gas emission by fishing boats, greater research efforts are recommended at developing innovative, fuel-efficient fishing methods.

8. Loss reduction at both harvest and post-harvest stages that are significant need to be reduced through suitable interventions of juvenile escape devices and techniques of waste recycling and value addition.

9. Globalization, location-specific transition in fisheries and prevalence of HIV/AIDS among fishing communities make a strong case for the need to look at fisheries through gender lens.
10. Taking into account the disease and other problems in shrimp farms, there is an immediate need for species diversification in aquaculture with consideration to environmental sustainability and market potential.
11. In view of the increasing cost and competition for feed ingredients, it is recommended that cost-effective feeds and improved feeding strategies are developed for enhancing production efficiency of aquaculture systems.
12. Increasing incidences and cross border transmittance of diseases and weak quarantine in the region call for development of novel and new generation cost-effective diagnostic tools and certification mechanisms.
13. Considering the low value realized for fish and fishery products, a value chain approach from production-to-consumption system with food safety needs to be adopted for better returns to the stakeholders.
14. In view of the emerging issues related to trade barriers and globalization, establishing stronger partnerships among the countries in the region has become a necessity for harnessing mutual strengths for collective benefits.

A salient feature of the 8th AFF was the preparation of a draft Resolution, which was circulated to all the delegates who attended the Forum. The draft Kochi Resolution 2007 is given below:

KOCHI RESOLUTION, 2007

Preamble

Asian countries derive substantial economic, social and nutritional benefits from fisheries, with significance for rural development and poverty alleviation. However, several issues such as coastal

overfishing, depletion of fish stocks, impact of climate change on biodiversity and abundance, disease in aquaculture and trade–related issues have emerged in recent years. These call for an integrated action and strategy at the regional level.

The Resolution

The 8th Asian Fisheries Forum hereby resolves to request the National Governments to form a strategic alliance of fish producing Asia-Pacific countries that are net exporters in global market with the objectives of enhancing fish production in a sustainable manner, promote quality of produce, improve the livelihood of fishers and other stakeholders and encourage regional cooperation.

The Alliance will strive for:

- value chain approach from production to consumption system;
- evolving standards based on scientific facts for fish and fishery products by participation in meetings of Codex Alimentarius Commission, International Standards Organizations, etc.;
- identifying uniform quality criteria for all aquaculture inputs with emphasis on food safety, *viz.*, without contaminants, hormones and antibiotics;
- evolving a mechanism for ecolabeling and certification;
- jointly addressing trade-related issues;
- sharing the straddling and migratory fish stocks for optimum utilization;
- conserving and managing endangered species; and
- strengthening capacity building by exchange of expertise and data among the countries in mutually agreed areas of research and development.

It is also resolved that a **Steering Committee** shall be formed to mobilize the National Governments in Asia-Pacific countries for formation and organization of Asia-Pacific Regional Alliance for Fisheries (APRAF).

…….End of Report……