Abstracts

PAF Congress on Public-Private Partnership
in Aquaculture and Culture Based Fisheries.

9th - 11th February, 2013

Organised by

Pillay Aquaculture Foundation
Inland Fisheries Society of India
Central Inland Fisheries Research Institue

Central Inland Fisheries Research Institute
(Indian Council of Agricultural Research)
Barrackpore, Kolkata - 700 120

PAF Congress on Public-Private Partnership
in Aquaculture and Culture Based Fisheries.

Published by

Dr. A. P. Sharma
Director, Central Inland Fisheries Research Institute, Barrackpore

Contents

AQUACULTURE

PARAPROFESSIONALS FOR AQUACULTURE: CONSTRAINTS, STRATEGIES AND SOLUTIONS

W.S.LAKRA, M.KRISHNAN and P.S.ANANTHAN
Central Institute of Fisheries Education, Mumbai

Increasing demand for India's food basket and concerns over food safety, fish provides the best with a low fat, healthful alternative to many other types of meat. Hence there is a growing interest on fisheries activities particularly aquaculture. It is seen that more than 50 percent of the world's fish consumption would come from aquaculture by 2012. This shows the potential of the sector at present and future. In addition, there is growing importance on environmental sustainability, food safety, certification and eco-labeling by many governments for which skilled professional and paraprofessional manpower is paramount. But unfortunately, there is a severe shortage of staff in the fisheries sector especially in the Department of Fisheries which forms the basis of technology or demonstration transfer to the fishermen. There are also critical gaps between the research and the extension system. A comprehensive study done by NAARM and IAM indicated that more than 95% of the estimated 2,39,186 diploma holders by 2019-20 would be required in Aquaculture sector including seed hatcheries and feed industries. These diploma holders will be ideal candidates for paraprofessionals, the requirements for grass root extension agent for promotion of aquaculture. This has been implemented in agriculture with a management philosophy of Employee First, Consumers also First. Further, issues such as employment of female paraprofessionals for women in aquaculture, pre service and refresher trainings, implementation of service level agreements, performance management and supervisory support for the paraprofessional staff should be considered to strengthen paraprofessional manpower that would help the aquaculture sector emerge as the lead sector in emerging scenario of corporate agriculture.

RESOURCES CONSTRAINTS IN AQUACULTURE AND POSSIBLE SOLUTIONS TO MEET INCREASING FISH DEMAND

P. JAYASANKAR and P.C.DAS
Central Institute of Freshwater Aquaculture, Bhubaneswar

India's expanding population and changing dietary habits of millions have been the major factors for growing fish demands in recent years. The fish production from marine sectors has witnessed stagnation with 3.07 m t since past two decades. To supply this growing fish demand, inland sector particularly aquaculture has taken up a greater responsibility with keeping projection of 15 kg per capita by 2030 with 9.8 kg per capita today. To bridge this gap, this sector has identified several potential challenges that include expansion in demands, increase in farm profit, species diversification under culture practice, priority to small indigenous fish species of local importance, holistic health management, water budgeting and public-private partnership. Besides these challenges, resource wise there is need for both vertical and horizontal expansion of the culture area and intensification of the practice. In addition, input in the form of technology and demonstration would bring great impact in rural aquaculture in terms of efficient utilization of resources and energy resulting in productivity and production in total. Further, from production to an efficient utilization there is a need of intervention with private partnership. The country has seen the involvement of corporate sectors in the aquaculture industry, which has played an important role in expansion of the aquaculture by the principle of seeing is believing for the fish farmers. Hence, corporate investments should be encouraged to increase the fish production in country. Such issues must be given on priority basis to maintain the pace of the fisheries development in the coming years.

STATUS OF COLDWATER FISHERIES IN INDIA: PROSPECTS AND ISSUES

P.C. Mahanta
National Bureau of Fish Genetic Resource, Lucknow

India has vast resources for cold water fisheries which include upland rivers, streams, high and low altitude natural lakes, reservoirs, brackishwater lakes etc. The coldwater fishes of the country harbour 258 species belonging to 76 genera under 21 families, comprising indigenous, exotic, cultivable as well as non-cultivable fishes. The subsistence and commercial fishery of Himalayan waters exploit carps (*Labeo* and *Tor spp*), lesser barils, snow trouts, garrids and sisorids. *Salmo trutta*, the exotic brown trout, has established in some areas of Himalayas. *Tor putitora*, golden mahseer, is the most important sport fish of which the breeding and seed rearing technology has been perfected by DCFR, Bhimtal. Hill aquaculture is an area of immense scope to provide a source of livelihood to the hill people. With the commendable help and guidance of DCFR, Bhimtal, many hill states particularly Himachal Pradesh have taken up trout farming and carp farming in commercial scale. New candidate species are being identified and introduced for the diversification of hill aquaculture. Fishery based ecotourism, fish watching and ornamental fish trade are the potential sectors for coldwater fisheries livelihood security. There are serious management issues in coldwater fisheries, the most dominant being indiscriminate fishing and habitat destruction. Use of modern techniques such as molecular and biotechnological intervention, selective breeding programme for improvement of strains and resource assessment using GIS and remote sensing can improve the potential of these vast resources.

INTRODUCTION OF EXOTIC AQUATIC SPECIES FOR AQUACULTURE IN INDIA-SOME PERSPECTIVES

B.VISHNU BHAT AND T.K.SINGH
Department of Animal Husbandry and Fisheries, Govt. India

Globally, aquaculture is leading as the fastest food producing sector in recent years. The growth and trade in aquaculture products show that aquaculture is gaining expansion, intensification and diversification as a result of which movements of live aquatic animals and its products have heavily increased. The motives and reasons for trade of exotic aquatic species and the introduction into different water ecosystems vary from country with time, space and requirements. The world has witnessed both sweet and bitter taste of the introduction of these alien species. In India, introduction of species such as rainbow trouts, silver carp, grass carp, common carp and most recently *Litopenaeus vannamei* have been contributing significantly both for production and value. However, there is a growing concern over high risk of introduction of diseases, genetic degradation, alteration of habitat and its socio-economic impacts. In this connection, World trade organization has taken a vital role in facilitating trade particularly focusing on sanitary and phyto-sanitary issues. This has opened up of new vistas and doors for the introduction of alien aquatic organisms world over. In this article, the authors have expressed their personal opinion on the introduction of alien species in aquaculture sector. The authors have underlined the research needs on environmental, socio-economic and biodiversity issues and their impact assessment to mitigate the damage if any due to introduction of these exotic aquatic species.

RECENT ADVANCES IN ENCLOSURE AND RACEWAY SYSTEMS OF AQUACULTURE-PROSPECTS AND CONSTRAINTS

P.Jayasankar and D.N.Chattopadhyay
Central Institute of Freshwater Aquaculture, Bhubaneswar

Fish culture in enclosures and raceways are diversified production systems where fish culture can be done intensively. 'Enclosure is a confined bay, where the shoreline is closed-off by a net or screen on all but one side. 'Pen' is enclosed at all sides by bamboo matting, netting or screening. 'Cages' are also enclosed by bamboo matting, netting or screening at the bottom and sides whereas the top may or may not be enclosed. Cage and pen culture has advantages like utilization of large water bodies, raising of large sized fingerlings, culture of different sizes of desired species, low maintenance cost, fish stock protection from predators and permits high stocking density with easy harvesting. The main constraints are strong water current, wind, clogging and cutting of screen by crabs, fouling, feed loss through cage walls, poaching, pollution and disease infections. Site selected for cages and pens need adequate water circulation, desirable water qualities and shore facilities. Cage types are floating and fixed in which the former is suitable for fish culture. Designing of pen is easy and simple than cages. Modern cages consist of collar (outside frame), screens (net), floats and mooring (anchors and ropes). Pen construction requires fencing screen, poles, ropes and twines. More than 70 species of fishes have so far been experimented in cages. Stocking density in cages is high and requires artificial feeding according to nutritional requirement of fishes. Cage management requires appropriate initial size of fish, mechanical aeration, control of plankton growth, proper repairing etc. Raceway culture where there is continuous water flow with inlet-outlet arrangement, are constructed using reinforced concrete, earthen stone and FRP. High quality balanced diet is most important in raceway culture. Water quality management is most important in raceways. Concerns for expansion of enclosure culture are disturbance of soil water qualities and natural fishery, disease outbreaks, chemical usage for control of disease etc. Technological advancement of enclosure and raceway system developed in other countries can be tested in our country through R&D efforts with foreign collaboration. Popularization of enclosure culture among farmers are required for production of advanced fingerlings and table sized fishes.

MODERN GENETIC TOOLS AND THEIR APPLICATION IN ENHANCING AQUACULTURE PRODUCTIVITY

J. K. Jena and A. Gopalakrishnan

National Bureau of Fish Genetic Resources, Lucknow

World aquaculture production continues to grow rapidly and the introduction of modern molecular techniques in addition to the traditional methods has helped in significantly increasing aquaculture productivity. Rapid advances in the genomics, proteomic and bioinformatic sciences have made the improvement programmes feasible in a wider range of species and this has opened up vast possibilities for speedy genetic gains in aquaculture. This communication reviews the application of a wide range of techniques, many unique to aquatic organisms, and their potential to secure and enhance the aquaculture production in the future.

RECENT ADVANCES IN CRUSTACEAN AQUACULTURE

T.Rajyalakshmi
6-2/1 2214 ABC Apartments, Sriramnagar, Kakinada

One of the greatest achievements of India since attaining Independence is the tremendous increase in Research-based Agricultural and, the Aquaculture productivity This approach has served to attain an economic transformation in not only India but many of the poorer countries of the Asian sub-continent, self-sufficient in food-production. It has in fact ushered in the first “Green Revolution”. followed a short period later, by the ‘Blue Revolution”. At that time both ‘revolutions’ were environmentally sustainable preventing famine and death. Both were made possible by the new technologies of seed production and induced confidence in the rural farmers to take up the farming in a more sustained way, as a means of livelihood and employment.

The next paradigm shift in aquaculture took place some 4 decades later when a single species of shrimp, the tiger prawn, *Penaeus monodon* stormed the Aquaculture sector shifting the location also to coastal/estuarine regions, thus freshwaters to brackish waters. Until then unused coastal derelict water bodies found new life. Communications to coastal neglected rural areas, motorable roadways, electrification, marketing channels, imports and exports of not only aquaculture products but all marketing products, employment to many a rural youth opened up. Well-designed seed production hatcheries came up adjacent to the coast with seed producion capacities ranging from 5 million to 50 million PL 20. In course of time this also led to the banning of natural seed harvesting from creeks and estuarine inlets (exception is West Bengal in India). Even the Marine capture fisheries prospects improved because of the *P.monodon* brood stock requirement by hatchery operators. Fishermen ventured out to distant fishing zones for brood stock capture. Thus, the tiger shrimp production gave a wide ranging, all-comprehensive impact, after the year 1990 and reached a peak between 1993-’95; This all comprehensive impact, particularly by way of awareness of manifold opportunities in shrimp aquaculture, among rural farmers and, corporate bodies, remains even today.

RECENT ADVANCES IN SEAWEED CULTURE PROSPECTS AND CONSTRAINTS

Reeta Jayasankar and Syda Rao
Central Marine Fisheries Research Institute, Kochi

Indian coastal waters are endowed with huge biomass of different varieties of seaweeds, comprising alginophytes, carragenophytes, agarophytes and other non-commercial algae. The phycocolloids obtained from seaweeds are widely employed as gelling, stabilising and thickening agents in various industries. In India, seaweeds are exploited from the nature as well as cultivated. The major species cultivated are *Gracilaria edulis, Hypnia muciformes, Kappaphycus alvarezi, Enteromorpha flexuosa* etc. The high production cost and less profit lead the folk to depend on sea for production. Overharvesting and lack of crop management resulted in the depletion of natural stock of sea weeds. In India, there are lot of R&D initiatives on seaweed farming and successful experimental trials with encouraging results have been carried out for many seaweed species. With the entry of companies like PFL into the large scale farming, seaweed farming is opened up as a diversification activity in mariculture and has tremendous potential all along the Indian coast.

EARLY MORTALITY SYNDROME (EMS) / ACUTE HEPATOPANCREATIC NECROSIS SYNDROME (AHPNS) IN SHRIMP – AN EMERGING AQUATIC ANIMAL DISEASE IN ASIA-PACIFIC.

C.V. Mohan and Eduardo Leano
Network of Aquaculture Centres in Asis-Pacific, bangkok, Thailand

Aquaculture systems are vulnerable to infectious trans-boundary diseases which is also a major hurdle in the sector. Disease occurrences in Asia-Pacific region have increased with aquaculture intensification and increase in global trade. Besides earlier known diseases, a new and poorly characterized disease, Early Mortality Syndrome (EMS), or more appropriately, Acute Hepatopancreatic Necrosis Syndrome (AHPNS), affecting *P. monodon* and *P. vannamei*, has caused great loss in China, Malaysia, Malaysia etc. very recently. The disease is characterized by acute progressive degeneration and dysfunction of central hepatopancreatic B, F and R cells with ultimate necrosis, sloughing off HP tubule cells and atrophy of the organ. High density cultures closer to the sea and outsourced seed are potential risk factors for the disease. The causative agent is still unknown. Increased surveillance, restriction in seed and broodstock movement from affected countries, rapid contingency plans and good pond health management practices are suggested management plans to prevent or circumvent the disease problem.

SNAKEHEAD FISHES: ALTERNATIVE CANDIDATE FISH FOR DIVERSIFICATION OF AQUACULTURE

Kuldeep kumar, Rajesh Kumar, U. L. Mohanty, Shailesh Saurabh, B. B. Sahu, Minakshi Sahoo, Amita Mohanty, A. K. Sahu and P. Jayasankar
Central Institute of Freshwater Aquaculture, Kausalyaganga, Bhubaneswar

Murrels are well known food fishes with high therapeutic value, mostly marketed live in several parts of the country as well as abroad. These fishes are highly preferred by the consumers due to its flavor, meaty flesh with less intra muscular bones and other curative properties. Hence, seed production, aquaculture practices and development of appropriate feed are main issues to fulfill the growing demands of consumers. Breeding biology and maturation, induced breeding, seed raising studies are being conducted in murrel fish farm in CIFA. Study reveals that concrete tanks can be maintained for high recovery and easy routine management and harvesting. Segregation of bigger seed during larval rearing period is considered to be the critical stage in entire seed raising practice. Scientific culture of snakeheads in community ponds have been initiated by various self help group with the technical support of CIFA. Thus, murrel culture has become a source of farm income and foreign exchange by improving nutritional requirements and also helps in generating adequate means of livelihood for a socio-economically self sufficient community.

NEW AGE TECHNOLOGICAL INNOVATIONS FOR DISEASE MANAGEMENT IN AQUACULTURE

P.K. Sahoo, Banya Kar and P. Jayasankar
Central Institute of Freshwater Aquaculture, Bhubaneswar

Fish diseases are one of the major constraints for aquaculture production in India, as well as, throughout the globe. A wide range of viral, bacterial, fungal and parasitic pathogens infect cultured animal species and cause substantial losses to the farmers. Prominent examples of devastating diseases are epizootic ulcerative syndrome, white spot disease, yellow head virus infection, yellow head virus infection etc. New approaches to (i) pathogen detection using serological and molecular techniques like ELISPOT, FAT, PCR, RT-PCR, loop mediated isothermal amplification (LAMP), DNA microarrays, SELEX aptamers, Luminex assays etc., (ii) fish health management by use of probiotics and prebiotics, immunostimulants, (iii) use of vaccines and reverse vaccinology RNA interference and nanomedicines are required to be developed and applied in aquaculture for better animal health management, reduction in disease prevalence and thereby better profitability and sustenance of the sector.

CULTURE-BASED FISHERIES

FISH SEED PRODUCTION IN CAGES AND PENS FOR STOCKING IN RESERVOIRS AND WETLANDS AND ITS ECONOMICS

A. K. Das and M. K. Bandhyopadhyaya
Central Inland Fisheries Research Institute, Barrackpore

Cage culture of fingerlings for stocking has been successfully demonstrated in the reservoirs of Madhya Pradesh (Dahod and Raisen reservoirs) and Uttar Pradesh (Pahuj reservoir) as well as in the floodplain wetlands of Assam (Kumri, Samaguri and Haribhanga beels). Pen culture for production of fingerlings and table-size fish has also been conducted in the beels of Assam. Criteria for site selection, materials used for cage and pen construction have been discussed along with the economics of production.

STRATEGIES FOR INLAND FISHERIES RESOURCES ENHANCEMENT IN INDIA AND THEIR IMPACTS: A REVIEW

A. P. Sharma and V. R. Suresh
Central Inland Fisheries Research Institute, Barrackpore

Importance of the inland fisheries resources of India for livelihood and nutritional security of India has been highlighted. Reservoirs and floodplain wetlands offer ample scope for developing culture-based fisheries in the country. Various technologies developed and demonstrated by the Central Inland Fisheries Research Institute (CIFRI) for effective utilization of the inland fisheries resources have been described. Inadequate stocking is a major factor that retarded the production in culture-based fisheries. Efforts made by the National Fisheries Development Board (NFDB) under the advice and guidance of CIFRI have resulted in enhanced yield from Indian reservoirs. Importance of governance and institutional arrangements for the success of culture-based fisheries has been discussed.

STATUS, SCOPE AND POTENTIAL OF ENCLOSURE (CAGE AND PEN) FISH FARMING IN RESERVOIRS AND FLOODPLAIN WETLANDS

B. C. Jha, A. P. Sharma and A. K. Das
Central Inland Fisheries Research Institute, Barrackpore

In recent years, enclosure fish farming in reservoirs and wetlands, either for raising stocking materials or for the production of table-sized fish has attracted the attention of researchers, developmental agencies, entrepreneurs and policy makers. Growth of cage fish farming in reservoirs has gained further momentum during 2010-12 with the funding support from National Fisheries Development Board (NFDB), Government of India. The pen fish farming now remains restricted to the States of Assam, Bihar and West Bengal. The practice still remains as a low key activity in spite of its tremendous potential to scale up, both for raising of stocking materials (fingerlings) and production of table fish, especially in the Ganga and Brahmaputra river basins, where floodplain wetlands are in abundance. The main reason for its relatively poor adoption is the poor flow of funds and non-availability of ready-made cages and cage materials. Technologies of pen and cage farming including site selection, structure, construction material, design, installation, stocking, feeding and harvesting have been detailed.

SUCCESS STORIES OF STOCK ENHANCEMENT IN FLOODPLAIN WETLANDS IN ASSAM, BIHAR AND WEST BENGAL AND THEIR ECONOMIC, ENVIRONMENTAL AND SOCIAL IMPLICATIONS

B. C. Jha, B. K. Bhattacharya, V. R. Suresh and Ganesh Chandra

Central Inland Fisheries Research Institute, Barrackpore

Success stories of Central Inland Fisheries Research Institute in enhancing the fish production and productivity of floodplain wetlands in Assam, Bihar and West Bengal have been described. The fishery management of floodplain wetlands and reservoirs is a challenging task on account of its nature of multiple resources use and increased man-induced environmental perturbations. A two-pronged approach consisting of (i) conservation and restoration of ecosystems, including the fish stock and biodiversity, and (ii) increasing the production and productivity in participatory mode is needed for sustainable utilization of reservoirs and floodplain wetlands through culture-based fisheries. Forging cooperation and tradeoff among various stakeholders would also be essential to minimize conflicts and to ensure sustainable fisheries, to ensure livelihood support and nutritional security to target groups in general and fishing community in particular. Ecosystem-based fisheries management needs to be popularized for sustainability in fisheries and conservation of biodiversity.

ENVIRONMENT AND BIODIVERSITY CONCERNS IN RELATION TO FISHERIES ENHANCEMENTS IN FLOODPLAIN WETLANDS

B. K. Bhattacharjya[1], B. C. Jha[2] and A. P. Sharma[2]

1Central Inland Fisheries Research Institute, Regional Centre, Guwahati
2Central Inland Fisheries Research Institute, Barrackpore

It is well recognized that the floodplain wetlands are one of the most important inland fisheries resources of India considering their resource size, high fish production potential and rich aquatic biodiversity. Implications of various forms of enhancement on the environment and biodiversity of floodplain wetlands have been discussed. Negative impact nutrient and chemical inputs on the water and sediment quality as well as the impact of species enhancement and introductions on the biodiversity need serious considerations. It is obvious that various forms of fisheries enhancements including culture-based fisheries will increasingly be utilized for enhancing fish production from floodplain wetlands of the country in the coming years. Therefore, environment and biodiversity concerns related to fisheries enhancements in these potential, yet sensitive, resources should be immediately addressed for realizing optimal fish production from them on one hand and ensuring their long-term environmental sustainability on the other.

RECENT TRENDS IN MANAGEMENT OF CULTURE-BASED FISHERIES IN RESERVOIRS: INDIAN EXPERIENCE

D. S. Krishna Rao and Preetha Panikkar

Research Centre of Central Inland Fisheries Research Institute, Bangalore

With the declining catch from rivers and other natural water bodies, reservoir fisheries are destined to become the prime source of inland fisheries. This can be attained through culture-based fisheries, which has several advantages over most other conventional forms of inland fisheries. Culture-based fisheries is the most suitable fisheries management practice for reservoirs in India. The small reservoirs in India exhibit wide variations in size, water quality, catchment, fish fauna and fishery management practices. The present status of culture-based fisheries operation in these water bodies is discussed.

MODELLING APPROACH IN FISH STOCK MANAGEMENT IN RESERVOIRS

M. Feroz Khan, M. Karthikeyan and Preetha Panikkar

Research Centre, Central Inland Fisheries Research Institute,Bangalore

There are various methods to assess the fish stocks in different aquatic ecosystems. The basic techniques of fish stock management in reservoirs using the process of stock assessment are detailed. The fish populations are always dynamic and such studies help in assessing the condition of the stock from time to time for judicious management of their fishery for maintaining a sustainable stock. The shift of fisheries research from single-species analysis towards an ecosystem-based approach using ecosystem modeling techniques can be very useful for addressing issues of environmental and anthropogenic perturbations.

SUCCESSFUL INTRODUCTION OF SEA CAGE FARMING IN INDIA

G. Syda Rao

Central Marine Fisheries Research Institute, Cochin

Central Marine Fisheries Research Institute (CMFRI) has developed a cage culture technology and demonstrated it at different places. The technology involves site selection, cage shape and design, cage material, stocking, feeding and harvesting. The economics of cage culture operations have been worked out. CMFRI has Initiated the cage culture in 2006-07 and over the years, the Institute has perfected the technology. Recently, a 6 m diameter cages was designed to cater to the needs of small farmers with suitably designed moorings. The volume of each cage is about 170 m3 with a production potential of 4 to 5 tonnes of fish. Apart from the 14 cages sponsored by the NFDB, the Institute has twelve cages installed in different stations all along the east and west coast of India. In the mariculture farm at Karwar has at present there are 23 cages of different dimensions stocked with different species of fish as a model farm in India. CMFRI has also successfully demonstrated the cage culture in open backwaters in Kerala and brackishwater riverine systems in Andhra Pradesh using the 6 m diameter cages.

MODERN GENETIC TOOLS AND THEIR APPLICATION IN ENHANCING AQUACULTURE PRODUCTIVITY

J. K. Jena and A. Gopalakrishnan

National Bureau of Fish Genetic Resources, Lucknow

World aquaculture production continues to grow rapidly and the introduction of modern molecular techniques in addition to the traditional methods has helped in significantly increasing aquaculture productivity. Rapid advances in the genomics, proteomic and bioinformatic sciences have made the improvement programmes feasible in a wider range of species and this has opened up vast possibilities for speedy genetic gains in aquaculture. This communication reviews the application of a wide range of techniques, many unique to aquatic organisms, and their potential to secure and enhance the aquaculture production in the future.

ENVIRONMENTAL ISSUES ASSOCIATED WITH CAGE CULTURE IN RESERVOIRS AND WETLANDS

M. A. Hassan and Md. Aftabuddin

Central Inland Fisheries Research Institute, Barrackpore

The organic matter input in the form of unutilized feed and fecal matters is the main environmental hazard of enclosure farming which vary depending on the scale and intensity of operations. Fish species used in India for cage fish farming, except few, are generally either herbivore or omnivore with low protein requirement and these will contribute less nitrogen as metabolic waste. Therefore, if practiced in low intensity and in limited to a restricted percentage of the lake area, cage farming of these fishes do not pose an environmental threat of great magnitude. Water from intensive cage farming systems primarily consists of uneaten food, metabolic waste and chemical wastes. Dissolved wastes include nitrogen, phosphorus and organic compounds. Oils from the diet may form a film on the water surface in the vicinity of the cages prevents gas exchange. Other negative impacts include chemical contamination, accidental introduction of fish and pathogens and physical obstruction limiting access to other water users. Indian reservoirs being mostly oligotrophic/mesotrophic, the threat perception from cage farming for causing eutrophication appears less. However, the intensification of such culture practices needs careful assessment of trophic state of the water body for sustainability. Similarly, application of this technology in floodplain wetlands should be practiced at a low scale, considering its hydrological limitations.

FISH HEALTH MANAGEMENT IN INLAND CULTURE BASED FISHERY IN INDIA: AN OVERVIEW

Manas Kumar Das and Sanjib Kumar Manna

Central inland Fisheries Research Institute, Barrackpore

Most of the natural water bodies in India such as rivers, floodplain wetlands and reservoirs have sub-optimal water habitat quality that limits their production potential. Various factors that cause stress in the aquatic environments are chemical, physical, procedural and biological stressors. Physiological impact of these stressors on fishes and the stress-mediated diseases have been discussed in detail.Infectious diseases caused by bacterial, fungal, Protozoan, Helminth, Acanthocephalan and Crustacean pathogens have been described. The common non-infectious diseases are also evaluated which are hypoxia, gill disease, algal toxicosis, and nutritional diseases. Management guidelines to avoid fish health problems have been provided that include selection of good fish stock, handling, minimization of stress, maintenance of water quality in pens and cages, and feeding with good quality feeds.Some key issues pertinent to fish health management in India have been identified including excessive feeding and fertilizations of ponds; aquaculture products and public health; use of durgs, chemicals and antibiotics in aquaculture;impact of new culture practices; introduction of exotic species; national-level planning; and programme on disease surveillance and quarantine mechanisms; disease management at hatchery level; and organic aquaculture.

IMPACT, VULNERABILITY AND ADAPTATION OF INLAND CULTURE-BASED FISHERY TO CLIMATE CHANGE IN INDIA

Manas Kr. Das

Central inland Fisheries Research Institute, Barrackpore

Inland culture-based fisheries is vulnerable to climate change in India through surface air temperature, rainfall, extreme weather events, rise in sea level and changes in Himalayan glaciers. Impact on the environment and fish populations of rivers systems, reservoirs and floodplain wetlands has been assessed, with special emphasis on breeding, reproductive integrity and recruitment of fishes. Predictions on the breeding periodicity, growth and health of fishes have been made. Potential impacts of climate change on the cage culture in wetlands and reservoirs have been evaluated. Number of measures have been suggested on how would Inland fisheries cope with climate change. Specific mitigation and adaptation strategies to deal with high temperature, flood, intense storm surges and sea level rise, drought, water stress and carbon sequestration have been suggested. A unified strategy for mitigation including GIS mapping for vulnerability assessment has been suggested.

SOCIO-INSTITUTIONAL ISSUES IN DEVELOPING CULTURE-BASED FISHERIES IN RESERVOIRS AND FLOODPLAIN WETLANDS MANAGED ON A COMMUNITY-BASED APPROACH

Pradeep K. Katiha

Central Inland Fisheries Research Institute, Barrackpore, Kolkata

The socio-economic traits of a community directly impact the performance of a community and adoption of particular production/technical activity. This is increasingly relevant in case of culture-based fisheries community, which consists of downtrodden, poor inland fishers with low income, employment and nutritional and food security levels. The demographic pattern, literacy rate and income of inland fisher households, enumerated based on the primary data collected during 2010-11 from 575 households (415 from reservoirs and 160 from floodplain wetlands) from the states of Andhra Pradesh, Kerala, Tamil Nadu, Jharkhand, Bihar, West Bengal, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, and Assam have been presented and discussed. For an efficient uplift of poor fisher community, their capacities should go up in terms of socio-economic characteristics and institutional arrangements along with rules and regulations. Over past few Five Year Plans, emphasis has been given to address these issues. These efforts resulted in development of CBF in reservoirs and wetlands in India.

INLAND FISHERIES ENHANCEMENTS: EMERGING OPPORTUNITIES AND CHALLENGES

V.V.Sugunan

10A, Mather Green Hills
Kunnumpuram Kakkanad PO
Kochi, Kerala

Enhancement is a process by which qualitative and quantitative improvement is achieved from open water systems through exercising a range of specific management options. It provides opportunities for increasing fish yields with relatively lesser environmental degradation. Being effective in common pool and co-management environments, it becomes relevant to the needs of resource-poor sections of inland and coastal aquatic resource users. The common forms of enhancement which are relevant to inland water bodies are culture-based fisheries, stock enhancement, species enhancement, environmental enhancement, habitat enhancement and enhancement through new culture systems. The negative impacts of stocked fish on the ecosystem through competition, predation, diseases and genetic contamination are serious threats, which have not been assessed adequately. Enhancements, being operated essentially in common pool resource regimes, require conducive institutional arrangements to be sustainable. Maximum advantages from enhancements can be achieved by creating conducive institutional arrangements to enable and sustain investment in common pool resources.

COMMUNITY INVOLVEMENT AND ITS MOBILIZATION FOR SUSTAINABLE FISHERIES MANAGEMENT OF OPEN WATER FISHERIES RESOURCES

Utpal Bhaumik and Ganesh Chandra

Central Inland Fisheries Research Institute, Barrackpore

The open water fisheries resources are dynamic resources where a large numbers of actors operate for gaining access and livelihood. Understanding various stakeholders and their involvement in the management is important for bringing them into governance. The inclusion of the entire actor group and the presence of active linkages within and among them will strengthen governability. Community based fisheries management is the way to involve and mobilize fishers to think, work collectively and bring cohesiveness to larger public goods.

CULTURE-BASED FISHERIES: SUCCESSFUL CASE STUDIES FOR ENHANCING FISH PRODUCTION FROM INLAND OPEN WATERS ON SUSTAINABLE BASIS

V. R. Suresh, B. C. Jha and A. P. Sharma

Central Inland Fisheries Research Institute, Barrackpore

Examples of enhanced fish yields from reservoirs through adopting culture-based fisheries involving tilapia, grass carp, silver carp, common carp, bighead carp, and Indian major carps have been described by citing examples from Sri Lanka, Vietnam, China and India. Of these, performance of Chinese (150 to 750 kg/ha/year) and Sri Lankan (220 to 2300 kg/ha; mean 892 kg/ha) reservoirs has been particularly impressive. Similar success stories in respect of floodplain wetlands from India and Bangladesh have been presented. National Fisheries Development Board's stocking support programme has made a positive impact on fish yield. Small reservoirs under NFDB's assistance recorded yield increase from 50 kg/ha to 174 kg/ha, while medium and large reservoirs recorded increase 30 kg/ha to 94 kg/ha and 12 kg/ha to 33 kg/ha respectively. Success stories of species enhancement (giant freshwater prawn in Malampuzha reservoir, Kerala), and yield enhancement from a number of reservoirs and floodplain wetlands in India have been illustrated.

CULTURE-BASED FISHERIES IN INLAND OPEN WATERS: SOME RECENT INITIATIVES TO INCREASE PRODUCTION, FUTURE PLANS AND MAJOR CONSTRAINTS

C. Vasudevappa and Salim Sultan

National Fisheries Development Board, Hyderabad

The Fingerlings Stocking Programme of National Fisheries Development Board (NFDB) made a positive impact on the fish yield of reservoirs across the country. In small reservoirs, the yield increased from 50 to 174 kg/ha/year, while the increases in respect of medium and large reservoirs were 12 to 94 and 11 to 33 respectively. The mean yield increase across the three categories was from 30 to 110 kg/ha/year. The paper also describes the Government of India's National Mission for Protein Supplements (NMPS) that assists12 states to undertake cage and pen culture in reservoirs as well as intensive aquaculture in ponds. The component of cage and pen culture, envisages to install 864 cages in 18 reservoirs to produce 4320 tonnes of fish @ 5 tonnes per cage. The intensive aquaculture component of the programme will cover 3500 ha of ponds in seven states to produce 17,500 tonnes of fish. The NMPS scheme will continue during 2012-13 with an outlay of Rs. 200 crore, covering 28 states involving 1872 cages in 39 reservoirs anticipating a production of 9360 tonnes. From the aquaculture development component, an estimated additional fish production of 5600 tonnes per annum @ 5 tonnes per hectare is expected to be harvested from 28 states. There will be an additional component of open sea cage culture wherever feasible with end to end approach.

GENERAL

OPPORTUNITIES FOR IMPLEMENTING PPP FOR SUSTAINABLE AQUACULTURE AT KOLLERU LAKE – THE CARP POCKET OF INDIA.

Ajit.Kumar Roy

College of Fisheries, Central Agricultural University, Lembucherra, Agartala,

Kolleru Lake is ecologically a wetland of international importance, located in between the Krishna and Godavari river deltas in Andhra Pradesh, India. It is basically a freshwater lake but has a connection to the sea through a 51 km long channel known as Upputeru. Three rivulets, viz., Budameru, Ramuleru and Tammileru and 15 irrigation channels and an equal number of major drains coming from extensive catchments join the lake. There are 50 island villages, which are called as bed villages and 98 other habitations around the lake, called as belt villages. The lake bed is highly fertile with alluvial deposits and nutrients enriched from the run-off of agricultural lands and other catchments. The lake is rich with fishery resource of considerable economic importance. All the 50 bed habitations in the lake can be considered as fishing villages as a significant area of the lake bed used to be under aquaculture. According to a report about 3 lakh people get their livelihood from the lake which is considered a world heritage having an important habitat for an estimated 20 million resident and migratory birds, including the Grey or Spot-billed Pelican (Pelecanus philippensis). The lake was notified as a wildlife sanctuary under India's Wild Life (Protection) Act, 1972, and designated a wetland of international importance under the international Ramsar Convention. The wildlife sanctuary covers an area of 308 km².Satellite images by the Indian remote sensing satellite IRS-1D found that approximately 42 per cent of the 245 Km² Lake was occupied by aquaculture, while agriculture had encroached on another 8.5 percent. The area under aquaculture consisted of 1050 fishponds within the lake and 38 dried-up fish ponds, which together covered an area of 103 km². Further demand from different groups is there to reduce the protected sanctuary area for aquaculture. An extensive socio and techno economic survey was conducted by CIFA. Details of culture fishery operations, species composition, productivity, marketing channels, storage, transportation, foreword and backward industries associated with aquacul-

ture operations at Kolleru lake is well documented. The reported production of carps from aquaculture ponds range from 8-12 t/ha/year and is marketed almost throughout the whole country including neighbouring Bangladesh. A lot of gap in price has been observed between farm site and retail market. Price per kilogram of carp is too low compared to equivalent quantity of chicken and mutton. Under the above circumstances there exists a lot of scope in taking appropriate policy decisions to offer public private (PPP) to achieve sustainable fisheries and aquaculture involving the areas of post harvest, marketing, export, storage and transportation besides restoration of wildlife sanctuary and ecological balance.. PPP will ensure increasing financial services and investment, improving capacity building, developing well established marketing infrastructure, cost-effective culture operations, facilitating access to national and international markets, improving information and communication, and privatizing government owned facilities and services to the underutilised vast aquaculture potential of Kolleru Lake known as Carp Pocket of India. A real picture of Kolleru Lake is presented in this communication with live and unique illustrations.

INTEGRATED DEVELOPMENT OF WETLANDS USING INTEGRATED FISHERY-ANIMAL HUSBANDRY FOR SUSTAINABLE ECONOMIC DEVELOPMENT

S.S. Mishra[1], K.D. Joshi[1], B.K. Singh[1], M. Dhiman[2] and B.K. Dwivedi[2]

1. Regional Centre, Central Inland Fisheries Research Institute, Allahabad
2. Bioved Research Institute on Agriculture & Technology, Allahabad

Freshwater habitats play a very important role in sustaining human activities. Natural functions of wetlands, and other freshwater habitats, generate a wide array of resources that directly or indirectly support the economic and social welfare of diverse groups of people. Natural functions of wetlands, and other freshwater habitats, generate a wide array of resources that directly or indirectly support the economic and social welfare of diverse groups of people. This role is being seriously weakened as a result of inappropriate planning and management approaches which fail to maintain the functional integrity of the freshwater ecosystems with the result that the flow and quality of resources is degraded. One of the major constraints to the integrated development of wetlands is lack of knowledge by planners and natural resource managers on the benefits that they provide and techniques by which they can be utilised in a sustainable manner. Sustained and enhanced fish productivity using integrated farming approach has been the point of focus for wetland development for fisheries and aquaculture sector. Integrated wetland development is a sustainable-agricultural technology practiced widely in Asia and other regions of the world. This integrated technology can offer farmers economic improvements while lessening the adverse environmental impacts of farming. Integration of livestock farming with fisheries and horticulture is an excellent method of recycling organic wastes for the production of highly digestible proteins at low cost and also serve as model of water recycling. Various studies on integrated farming system have revealed that integration of two or more components ensured sustainability in production, economic return, recycling of wastes and livelihood improvement to the farming community over any single component. The main conclusion is that sustainable livelihood development of wetland communities requires multidisciplinary and integrated efforts in addressing constraints in the various sectors such as agriculture, natural vegetation use, water resources and fishing, which have been elaborated in the present paper

OPPORTUNITIES AND CHALLENGES IN RESPECT OF AQUACULTURE DEVELOPMENT: THE ROLE OF PPP IN ARUNACHAL PRADESH

P.Nath & S.C.Dey

1st Lane, Bidhan Pally Sporting Club, Nona Chandanpukur, Barrackpore.

In N.E Region, particularly Arunachal Pradesh more than 90% of the people depend on fish as their main source of protein. The region produces more than 3500 MT of fish annually with almost 75 % of this production coming from Aquaculture. Capture fisheries production has almost stabilized and it is believed that there is no scope to increase production from capture fisheries sector. Though the region has enormous potential to increase fish production, due to uncoordinated and unplanned effort; a deficit state thereby huge gap of demand-supply and continues to import fish annually to the tune of 3-4 crores worth fish from the main land. At this backdrop, yet the Govt. recognizes the growing importance of fish culture in the State and identify this as an area where more Research and development efforts should be focused. Further, the State has also begun to recognize the potentials of people organizations like SHG and NGOs in aquaculture and fisheries. Cold water is another area for culture of Trouts as well as ornamental fish and forms an important export items.

The present paper discusses the issues identified and intervention areas for working in PPP (Partnership mode) focusing heavily on privation of development through people base organizations would be Education(value based and gender focused education system); Research (assessment of fish and fisheries, refinement of pond culture, gentic improvement of cultivable spp.,running water fish culture, cage culture, studies and social issues etc.); and promote development to ensure sustainability.

AN ANALYSIS OF GROWTH TREND OF FISH PRODUCTION IN WORLD AND INDIA

Arun Pandit, Anjana Ekka and Pradeep K. Katiha

Central Inland Fisheries Research Institute, Barrackpore, Kolkata

Fisheries sector has been recognized as a significant income and employment generator as it stimulates growth of a number of subsidiary industries and is a cheap source of nutritious food to a large section of downtrodden people. In India this sector contributes to the livelihood of a large section of economically underprivileged population, besides being a foreign exchange earner. More than 200 million people worldwide are fish workers, which is just under 3 per cent of the global agricultural labour force. Of this over 90 per cent live in developing countries, working in small-scale, household based or artisanal fishing enterprises. In India, about 14 million people are employed in this sector either directly or indirectly. Therefore this sector has to grow consistently to ensure the livelihood of a large section of population. This paper analyses the growth of fish production in world and India level. The secondary data were collected from FAO Year Book of Fishery and Aquaculture Statistics and Department of Animal Husbandry and Dairying, Ministry of Agriculture, Govt. of India. Exponential growth model was employed to estimate the growth rates. Based on 11 years average data it was found that China, Peru and USA occupied first three positions in world captured fish production which also includes crustaceans, molluscs etc. Among these three countries, China alone contributes more than 16% of world production. Though India occupied third position during 2010, due to fluctuations in production India could claim only 7th position based on average of 11 years data. Among the top seven producers none of them except Indonesia and India achieved appreciable growth. In fact majority for them, the growth rates were negative. However, as far as aquaculture is concerned it was found that all the 15 top producers, except only Japan the growth were positive and significantly higher than the captured production. In aquaculture sector China produced almost three-fourth of world production during the last 11 years. India is in distant second position which possesses about 7% of world production followed by Indonesia (2.9%). The annual compound growth rates for these

top three producers were 5.5, 8.6 and 10.4%, respectively. It has also been seen that both in the world fisheries and aquaculture production the share of Africa and Asia has increased during 2010 as compared to 2003 at the expense of Americas and Europe.

The decadal growth rate analysis of India finds that the growth rate in marine sector has been decreasing consistently since 1980-81 and during 2000s it has become 0.53% only. In aquaculture the decadal growth rates has always been above 5% and in the last decade India could achieve about 6% annual compound growth rate. As a result the combined growth of marine and inland sectors for the last 30 years was 4.4%. Analysis of 8 years state level data of India reveals that Andhra Pradesh achieved highest growth rates in both marine (5.1%) as well as inland sectors (12.3%). However, no other states, except West Bengal, among the other 7 top fish producers could achieve even 1% growth rates in marine sector. As a result at national level Indian marine fish production growth rate was a meager 0.65%. Of course the poor growth of marine sector has been compensated by inland sector which grew at the rate of 5.7% thereby the total fish production growth was elevated to 3.2% during the last 8 years at national level.

SOCIO-ECONOMIC ASPECTS OF THE FISHERS ENGAGED IN HILSA FISHERIES IN HOOGHLY-ESTUARINE SYSTEM OF WEST BENGAL, INDIA

Bidita Banerjee and Ashim Kumar Nath

Aquatic Ecology and Fisheries Laboratory Post Graduate Department of Zoology, West Bengal

In India it is important to analyze socio-economic and cultural structure of the fishermen for the development of aquaculture in the long run. The fishers are the backbone of this large fishing oriented business and only they can play the most important role for the conservation and development of fishery. A large no. of fishers is engaged in fishing activities in the States of Gangetic plain. Among them highest number of fishermen are from West Bengal (28.71%) (Das and Samanta, 2010). Hilsa (Tenualosa ilisha), on the other hand accounts for 15-20% of the total fish landing of Hooghly estuary. Therefore, it is clear from these facts a large no. of fishermen are associated with hilsa fish catch. Studied area includes three upstream stations (Tribeny, Barrack pore and Ariadaha) and one downstream (Kakdwip) station. Study was conducted from March, 2010 to February, 2012. In most cases the Government rules are violated. Mesh size is found below 90 mm range. The juveniles are randomly caught. For the analysis of these high rates of exploitation level when a glance is thrown to their social structure the wretched condition is expressed.

Present study reveals that more than 90% of the fishermen have kaccha houses. Most of the cases they have either illegal connections or no electricity. Only 40% of the population has high school education. From upper to lower stretch the social structure takes a little change as fishermen at least get some alternative job options. But only 10-20% has such constructive alternate livelihood options. In most of the cases they have to depend upon lenders for livelihood. There are some lending societies namely 'Bandhan'etc.

Most of the fishermen formerly depend upon hilsa catch as this is a highly profitable business and they are in this profession generation after generation. In upstream a large no. of fishermen (50%) have their own net and boat. The share is done in such a way the boat owners get high percentage of the profit.

In downstream though the fish catching centers are formed and they do it in an orderly manner still the grass root level fishermen are facing many problems. They are paid Rs. 1000 in a trip and also a small amount of profit percentage. The boat owners have very large maintenance cost. There are some associations and they are fighting for the improvement of fishermen's social condition.

During last few decades' hilsa catch has depleted in the Hooghly stretches. Moreover, the fish caught is passing between many marketing channels. Thus though the fish is sold at market about Rs. 1000 per kg, the fishermen get a small amount of that in both up and downstream.

Thus they are facing many problems to maintain their livelihood. Government or Non Government Organizations or any fishing related organization, nobody is working for their socio-economic-cultural development. Already hilsa catch per unit effort (CPUE) is decreasing in large scale in Hooghly. Now, if nothing is done for the betterment of hilsa fishermen they will continue to catch juveniles and brooders.

CULTURE-BASED ECO-ENHANCEMENT FOR OPTIMIZING FISH PRODUCTION IN UKAI RESERVOIR, DISTRICT TAPTI, GUJARAT

S. N. Singh, A. P. Sharma, Ritesh Saha, Sameer Patel and Prashant Joshi

Research Centre of Central Inland Fisheries Research Institute, Vadodara, Gujarat

Ukai reservoir having an area of 60,095 ha at FRL is situated in Taluka Songadh, District Tapti and has been created by impounding river Tapti at latitude 210 15' N and longitude 730 35' E. This is a multi-purpose reservoir specially meant to cater to the needs of irrigation and power generation. This artificial lake has unique morphometry and looks elongated in shape with its tail resembling slight horizontal expansion of the original river. The shore development index (DL) value of 2.15 denoted moderate irregularity of the shore and is indicative of medium biological productivity. The volume development index (DV) of 0.524 indicated the reservoir basin being convex towards water. The water reaction (pH 7.07 to 8.28) and D.O (4.76 to 7.30 ppm) were congenial. Specific conductance (0.197 to 0.359 mSm-1) and T.D.S levels (0.114 to 0.225 ppt) reflected high biological productivity. Total alkalinity (114.0 to 225.0 ppm) corroborated the above inference. The nutrient's status (nitrate- 0.05 to 0.263 ppm, phosphate – Tr. to 0.012 ppm) portrayed the reservoir being medium productive. However, the silicate level (3.52 to 9.80 ppm) was highly conducive for the biotic communities requiring silica for their propagation.

Phytoplankton (90.91%) excelled as mainstay of planktonic community and blooms of blue-greens (56.92%) mainly represented by Microcystis aeruginosa were recorded. Other planktonic assemblages of secondary importance were Bacillariophyceaea (20.82%) and Chlorophyceae (13.17%). Zooplankton community was comprised of copepods (6.22%) and rotifers (1.99%). Dipterans (43.75%) and molluscans (37.75%) shared bulk of macro-benthic community of this reservoir. Fisheries spectrum of the reservoir revealed high hold of minor carps (10.38 to 28.86%) and the contribution of cat fishes mainly represented by Wallago attu and Aorichthys seenghala have considerably increased from 27.30 to 42.13%. The fish yield

potential has been computed being 208.28 kg ha-1 yr-1 and a stocking rate of 458 nos. ha-1 has been reached after considering 15% mortality allowance. With the view to target grazing and detritus food chain, culture-based eco-enhancement in the form of fish species-mix in the ratio of 4 Catla: 2 Rohu: 2 Mrigala: 1.5 Calbasu: 0.5 Pangasius is recommended for optimizing fish production of this reservoir. Staggered stocking by 100 mm size fingerlings is suggested. The exploitation prescription should be in consonance to MSY/ MEY criteria. The impact of the proposed culture-based eco-enhancement will form the basis for future management interventions.

HAEMATOLOGICAL RESPONSE OF LABEO ROHITA (HAMILTON) FINGERLINGS EXPOSED TO LOW SALINITIES

Supriya Rani, T.S. Nagesh*, S. Behera, G Dash and Chitra Pakhira

Department of Fisheries Resource Management
Faculty of Fishery Sciences, W.B.U.A.F.S.,
Kolkata

The present study was carried out for a period of 42 days to find out the effect of different acclimation salinities (0 ppt-control, 2 ppt, 4 ppt, 6 ppt and 8 ppt) on the haematology of Labeo rohita fingerlings (9.1 - 12.7 cm). The fishes were active and showed normal feeding and swimming behavior upto 4 ppt salinity level; however, they were stressed but could survive at 6 ppt and 8 ppt. There was no significant ($P>0.05$) difference in hamematological parameters among control, 2 ppt and 4 ppt. However, it was significantly ($P<0.05$) differed both in 6 and 8 ppt with that of other treatments. The haematocrti (Ht%) was maximum (28.75) in control and minimum (20.43) at 8 ppt. The Ht% values were within the optimum range at 0, 2 and 4 ppt salinity. The highest mean total haemoglobin was observed at 0 ppt (7.52 g/dl) and it was lowest at 8 ppt salinity (4.57 g/dl) at the day of termination of the experiment. There was a clear cut increase in the Total Erythrocyte Count (TEC) up to 2 ppt salinity with the highest counts recorded at 2 ppt salinity (2.11 million/mm3) and the lowest was at 8 ppt salinity (1.52 million/mm3). The overall mean Total Leukocyte Count (TLC) was highest at 8 ppt (5.04 thousand/mm3) and the lowest value was recorded at 0 ppt (4.30 thousand/mm3). The TLC values decreased up to 4 ppt salinity and increased at higher levels. The mean plasma glucose at 8 ppt (76.100 mg/dl) was highest than all other salinities followed by 6 ppt (51.000 mg/dl). The lowest mean glucose content was found at control (0 ppt) (44.500 mg/dl).

HARNESSING THE POWER OF PUBLIC-PRIVATE PARTNERSHIPS (PPPS): FOR SUSTAINABLE AQUACULTURE DEVELOPMENT OF RUDRASAGAR LAKE (RAMSAR SITE) IN TRIPURA, INDIA.

Debtanu Barman and Pampa Bhattacharjee

Department of Fisheries Resource Management, Central Agricultural University, College of Fisheries, Lembucherra, Tripura

Rudrasagar Lake is a lowland deep and extensive lake/wetland in the northeast hills. Rudrasagar Lake is declared as National Lake No.13 and also it is declared as an International Lake numbered 1572 as a Ramsar site. The Lake holds 240 ha; situated between Latitude 23°29'N & Longitude 90°01'E; with water depth varies from 2 to 9 m. This lake has the perennial connection with one of the major rivers (Gomati) of the state facilitating the natural breeding ground of the valuable indigenous endemic fishes. The lake is abundant in commercially important freshwater fishes like Botia spp, Notopterus Chitala, Mystus spp., Ompok pabda, Labeo bata and freshwater scampi and an ideal habitat for IUCN Red listed Three-striped Roof Turtle Kachuga dhongka. However, the lake at present is under threat from a variety of human induced changes to their hydrology. To minimize threats and restore wetlands degraded by past human activity or to enhance biodiversity, an inventory study was carried out by the authors in the Rudrasagar Lake at 6 different sampling sites to understand the Hydro-Biological Parameters, Natural Productivity, Fish species diversity etc. It was observed that lake water ph range between 6.2-6.9, Dissolved Oxygen level (mg/l) 5.2-7.1, Total Hardness (mg/l) 124-151, Total Alkalinity (mg/l) 104-123, PO4-P (mg/l) 0.024-0.042, NO2-N (mg/l) 0.063-0.085 etc. Whereas Soil Ph lies between 6.4-6.6, Organic Carbon (%) 2.4-2.6, Available Phosphorus (mg/100gm) 3.5-3.8 , Available Nitrogen (mg/100gm) 8.5-9.3 etc was estimated .It has been also reported that fish production in the lake is decreasing drastically almost every year from 48 tonnes to 29 tonnes. Fish species diversity in the lake was recorded 52 nos of species which is under great threat now with a rapid declined of the species varieties. New and innovative approaches to the management of lakes and their basins are urgently needed to ensure

that this precious freshwater ecosystem continue to deliver their services. Public-Private Partnership (PPPs) participation lies at the heart of the new policy approaches for sustainable management of this lake where they can do intervention likes enhance fish production through innovative approaches with community participation, Eco-tourism, Conservation of Endemic fish species with promotion of Native Ornamental Fish Trade etc. PPPs can be useful in effective technology dissiminetation along with the improved the biological system and service quality, better equipped to deliver on design innovation, timeframe and operation flexibility etc. Thus, it is the high time to understand the value of wetland ecosystem and their role that their sustainable utilization can play in achieving social and economical goals.

PPP IN DECENTRALIZED AQUACULTURE EXTENSION THROUGH AQUACULTURE FIELD SCHOOL IN RURAL AREA

Radheyshyam, H.K.De, G.S.Saha, Lekha Safui and S. Chandra

Central Institute of Freshwater Aquaculture,
Bhubaneswar

Country is endowed with diversified freshwater resources (ponds, tanks, lakes, reservoirs, bheels, oxbow-lakes, rivers and canals) with immense potential of fish production. There are 2.414 million hectares freshwater ponds and tanks. Further, more area is added through National Rural Employment Guaranty Scheme (NREGS). Of which merely 46% ponds and tanks are used for fish culture. Little is known about the rest 54% freshwater ponds and tanks. Fish production in these areas is unreported, locally consumed and ignored in the policy domain. While national average fish production from freshwater ponds and tanks is 2.9t/ha/yr, the institute based researches made it possible to produce 10-15 t/ha/yr. This indicates ample scope of vertical and horizontal aquaculture expansion in the country. The state line departments and its extension machinery responsible for fisheries development are over-stressed and unable to meet the requirements of fish farming community. It is therefore, worthwhile to decentralize aquaculture extension in public-private partnership mode through establishing aquaculture field schools (AFSs) in different agro-climatic condition for enterprise-specific cost effective technology transfer. With this view attempts have been made to establish two freshwater aquaculture filed schools (Maharatha's Aquavariant Estate, Banpur block and Sarakana Fish Farm, Balianta block) in district Khurda, Odisha for the first time by the CIFA in 2009. AFSs are "schools without walls" for improving the decision making capacity of the rural fish farming community through discovery based learning approach. Here the fish farmers are experts, their fish farm is a practical ground for learning skills and aquaculture extension worker serves as facilitator. In Sarakana AFS, the rural farmers in 1986 emerged to entrepreneurial aquaculturist during 2004-08 and knowledge disseminator farmers from 2009 onward in stages. The farmer of Banpur AFS with their higher educational and entrepreneurial background, became "aquaculture know-how and do-how disseminator"

within ten years of mentoring. However, both of them have been mentored by the scientist of CIFA technically through participatory capacity building and helped financially by the commercial bank for the development of foundation activities and relevant infrastructure for implementing and demonstrating different aspects of aquaculture. Both AFSs were developed and operationalized by the experts of the institute. The two AFS piloted by CIFA is the first of its kind in freshwater aquaculture. It is an example of private-public partnership in aquaculture extension. AFSs, besides providing fish seed are actively helping other farmers to learn scientific aquaculture. A number of training programmes, exposure visits, workshops and field days were organized by AFSs. State line departments (Agriculture, ATMA, RKVY etc) are also sponsoring training programmes at AFSs to avail the skill/knowledge/guidance of the facilitator farmers. AFSs served as an innovative and efficient cost effective aquaculture technology dissemination tool for building fish farmers' capacity in analyzing their production systems, identifying problems, testing possible solutions and making appropriate improvements in the fish farming practices of the fish farmers. Thus it provided an account of need-based technical literacy and developed confidence in fellow farmers about fish farming practices and profitability. However, private run AFS needs technical and financial public support and coordination of the local farmers in order to maintain sustainability.

INTERVENTION OF CIFA FOR SUSTAINING FISH PRODUCTION IN SEWAGE-FED AQUACULTURE – AN IMPORTANT SUCCESS STORY

R.N.Mandal[1], D. N. Chattopadhyay[2], B. K. Pandey[1], B. N. Paul[1], P. P. Chakraborti[2], P. K. Mukhopadhyay[1] and P. Jayasankar*

1Regional Research Center, Central Institute of Freshwater Aquaculture, Rahara, Kolkata
2Field Station of Central Institute of Freshwater Aquaculture, Kalyani,
*Central Institute of Freshwater Aquaculture, Bhubaneswar

Central institute of Freshwater Aquaculture (CIFA) has been striving to extend its technologies in freshwater aquaculture to farmers' fields to increase fish production and farm income of the farmer, as well as to add cheap source of protein to the food baskets of the country. One technological intervention of CIFA has witnessed enhanced production of consumable fish in sewage-fed aquaculture, with the evidence of uplift of a financially depressed man becoming progressive fish farmer having a strong economic benefit. With long experience in sewage-fed aquaculture field, Regional Research center, CIFA has been rendering technical know-how to this farmer to utilize domestic sewage emanating from KMDA (Kolkata Municipal Development Authority) in his farm after the process of bioremediation with aquatic macrophytes (Colocasia esculanta, Typha angustata, and finally Eichhornia crassipes) through a series of treatments. This 'Biological Treatment System' had been potentially efficient in reducing drastically the levels (%) of physico-chemical parameters of domestic waste: BOD5 by 96%, Total solids by 61%, Total alkalinity by 48%, Total N2 by 80% and P2O5 by 40%; on the other hand, pH and DO increased about 5% and 100% respectively. Therefore, intake of such sewage water into ponds maintained vibrant ecosystem functioning of pond water favourable for fish production. Density of phytoplankton increased in the range of 65,000-1- 20,000 nos/l while zooplankton in the range of 20,000-45,000 nos/l. These parameters were found suitable to facilitate the efficacy of pond water to have increased gross primary productivity in the range between 650-850 mg C/l/h and net primary productivity in the range between 250-450 mg C/l/h. Besides, analyses of sewage fed pond water showed that the amount of heavy metals was found to be minimal in the following

range (ppm): Cr, 2.3; Pb, 1.02; Cu, 0.05 and Zn, 1.02. Fishes (Labeo rohita, Cirrhinus mrigala and Tilapia nilotica) released @ 20,000 numbers/ha with the ratio as 1:1:2 in such waste fed pond showed production of 6810 kg/ha/6 months, with 87% survival. Recycling of domestic sewage through resource recovery system has been long term objective of CIFA to enhance freshwater fish production as a means of low external input sustainable aquaculture (LEISA). The present paper highlights the potentials and effectiveness of using domestic sewage water under controlled manner in freshwater ponds for increasing fish production, considering the inevitable scarcity of clean water.

DIVERSITY AND DISTRIBUTION OF FISHES IN RIVER WAINGANGA, MADHYA PRADESH, INDIA

A.K. Bose, B. C. Jha, A. K. Das and Ridhi

Central Inland Fisheries Research Institute
Barrackpore,

The River Wainganga (19°38′N and 79°48′E) originates about 12 km from Mundara village of Seoni district in the southern slopes of the Satpura Range of Madhya Pradesh, and flows south through Madhya Pradesh and Maharastra in a very winding course of approximately 360 miles. After joining the Wardha, the united stream, known as the Pranahita, ultimately falls into the R. Godavari. The river has developed extensive Floodplains with sweeping graceful meanders and low alluvial flats and meander terraces. The R. Wainganga an important river in India, supports rich fish faunistic diversity, a major source of livelihood and food. Present communication deals with the diversity and distribution pattern of fishes in R. Wainganga, Madhya Pradesh. The result reveals the occurrence of 45 species belonging to 28 genera, 6 orders and 12 families. The family Cyprinidae found dominant. The distribution pattern of fish showed variability and some species were common to all the seasons and sites. Fish diversity was assessed by calculating the various diversity indices such as Shannon – Weaver (H), Simpson's Dominance index (D), Simpson's index of diversity (1- D), Evenness index (J) etc. This record will be beneficial for further studies being the base line data of fish fauna of the R. Wainganga.

UNSCRUPULOUS FISHING IN MAITHON RESERVOIR, JHARKHAND AND ITS IMPACT

Akanksha Singh[2], Sagar Agrawal[2], A. K. Das[1], B. C. Jha[1] and S. Das[2]

2 Deptt. of Zoology, Bundelkhand University, Jhansi 284 001, U.P
1 Central Inland Fisheries Research Institute
Barrackpore,

Maithon reservoir (23047′ N, 86049′ E) was impounded on river Barakar-the main tributary to river Damodar, having waterspread 10,716 ha, mean depth: 9.1 m with productive area 6,680 ha sprawling over West Bengal and Jharkhand. The catchment (C: 6267 km2) comprises moderately fertile river valley including deciduous forest cover. It is the second largest reservoir after Panchet under Damodar Valley Corporation (DVC), impounded to serve the very purposes of flood control, irrigation, water supply and hydel.

The fish production was estimated at 250 kg/ha/y while the actual yield realized was only 4-6 kg in 2004 which was enhanced to 85 kg during 2010-11. To sustain this production, a regular stocking programme with stocking of fingerlings around 80-100 mm size @ 300 Numbers fingerlings/ha/y with a total of 19.2 lakh numbers for the Maithon reservoir will be required in every year. DVC authority through its Aquatic Resource Division has been regularly stocking the reservoir keeping this in view. Unfortunately, some of the fishers especially in the intermediate and lentic sectors have been engaged themselves in unscrupulous fishing using zero meshed long drag nets with 6-8 m height, sieving out all stocked fingerlings including juveniles (auto stocked) immediately after stocking and afterwards thereby jeopardizing all the efforts of the well wishers involved in stocking program targeting towards up-liftment of socio-economic status of the poor fishers thriving in- and around Maithon. An immediate stringent action against those involved in such type of destructive fishing activities is the need of hours which would be resolved through co-participatory management with the active involvements of all the fishers fishing in this reservoir under different active fishery co-operative societies recorded under DVC authority.

ROLE OF PUBLIC-PRIVATE PARTNERSHIP IN FISH FOOD SAFETY ASSURANCE AND QUALITY MANAGEMENT

Arabinda Mahanty[1], Sudhir Kumar Barik[1,2], Sudeshna Banerjee[1], Sasmita Mohanty[2] and Bimal Prasanna Mohanty[1]

[1]ICAR- Central Inland Fisheries Research Institute, Barrackpore, Kolkata;
[2]KIIT School of Biotechnology, KIIT University, Bhubaneswar

Fish and aquaculture products are among the highly exportable agricultural commodities. Consumer demands for fish have increased in recent years and this situation has underlined the need to guarantee the safety, traceability, authenticity and health benefits of such products. Identification of fish has gained increased importance in the aquaculture and seafood industries because of the labeling regulation imposed by many countries all over the world. In addition to this, the handling of fillets or minced fish as raw material instead of whole fish specimen in global fish markets has complicated the process of identification of fish. Fishery in India is a major industry and it exports over 600,000 metric tons of fish, to about 90 countries, earning over US$1.8 billion. Almost every country throughout the world has a government-connected authority to monitor food safety issues from production to sale. Therefore, to safeguard the forex earnings, issues concerned with safety, authenticity and labeling regulations are to be addressed carefully. Public-Private Partnership (PPP) can play a major role in assuring food safety as well as management of food quality. As fish food export is a multi-step process including fish production, collection and processing and it is necessary to the maintain food hygiene in each of the steps and PPP can play major role in each of the steps. Maintenance of food hygiene should follow a bottom-up approach i. e. it should start from the fisherman level, followed by supplier and exporter which requires training and creation of awareness among all groups of peoples associated with the industry. Training programmes can be organized by PPPs to generate skilled human resources which can maintain all necessary elements of food safety and hygiene. Transportation of fish

and fish products requires their proper storage during the process. Store houses can be constructed on PPP mode to decrease the instances of food spoilage and the resulting financial losses. R & D initiatives can also be taken up by PPP mode to develop technology capable of detecting unwanted food adulterations which can lead to cancellation of export consignments and cause huge amount of financial loss.

EFFECT OF MARIGOLD OLEORESIN ON GROWTH, SURVIVAL AND PIGMENTATION IN ORANGE CHROMIDE, *ETROPLUS MACULATUS*

Jagadish.T.D, H.Shivananda Murthy, Himanshu.S.Swain, S.J.Meshram, Ali. H

Department of Aquaculture
College of Fisheries, Mangalore

The study was conducted in 12 fibre glass aquarium tanks (20L capacity) to evaluate the effect of Marigold oleoresin, is the hexane extract of the dehydrated marigold flowers (Tagestes erecta) on growth, survival and total carotenoid content in muscle tissue of Etroplus maculatus. The uniform size group (0.60g) of orange chromides (Etroplus maculatus) were used for the study. The study was carried out in triplicate for a period of 45 days. Fishes were stocked at the rate of 15 per tank. Three test diets namely T1, T2 and T3 with 30% protein content were formulated. Diet T1 had 60ppm, T2 had 120ppm and T3 had 180ppm marigold oleoresin, and diet without marigold oleoresin supplementation served as a control (T0). Significant differences were evident between treatment groups ($P<0.05$) in growth parameters with 60ppm marigold oleoresin fed fishes showing higher mean weight gain of 1.04±0.08g, specific growth rate (SGR) of 1.36±0.21, lower feed conversion ratio (FCR) of 1.53±0.05 and higher survival rate (82.14%) of fish between the treatments. The body colouration and total carotenoid concentration of muscle tissue (4.62±0.02 µg/g) was significantly higher in fish fed with 60ppm marigold oleoresin diet. Among the tested doses 60ppm marigold oleoresin showed better results than 120ppm and 180ppm marigold oleoresin inclusion in the fish diet. The study showed that 60ppm marigold oleoresin is better to enhance the growth and colouration in Etroplus maculatus

IMPACT OF STOCKING IN A SOUTH INDIAN RESERVOIR

D.N. Singh[1], A. K. Das[2] and D. S. K. Rao[2]

1 Regional Centre, CIFRI, Allahabad
3 Research Centre CIFRI, Hessaraghatta, Bangalore
2 Central Inland Fisheries Research Institute, Barrackpore

Manchanbele reservoir-MBR (latitude 12052′, 736 m asl) was impounded on river Arkavathi- a tributary to river Cauvery, having watershed FRL: 329 ha, catchment: 1590 km2, mean depth: 9.5 m, maximum depth: 24.4 m, shore development: 2.9. MBR being located in a valley is sheltered. The shoreline is even and the banks are steep limiting the extent of littoral zone. MBR region, characterized by low rainfall (annual ranging 679-889 mm). MBR receives much of the inflow from its independent catchment, most of which is under forest cover mostly rocky and denuded.

The MBR had not been brought under scientific fisheries management till 1998 and the fishery was dominated overwhelmingly by a single species, Oreochromis mossambicus, which contributed 95% to the total catches. Other species in the fishery were Punitius sarana, Ompok bimaculatus, Mystus cavasius and Etroplus suratensis and miscellaneous small species. The estimated fish catch was 32.15 t during 1997-98 and 22.36 t during the following year. The mean fish yield was 118 kg/ha. The reservoir was stocked following CIFRI principles through sound stocking program with Indian major carps predominantly L. rohita and C. catla by Department of Fisheries, Bangalore, Karnataka from and onwards 1999. The impact of stocking was overwhelming; tilapia population was drastically reduced and confined to 46-58% in the 2nd year of stocking. The growth and stand of C. catla and L. rohita had been reflected in the catch composition with enhanced income of the fishers of MBR manifolds. Being a small category reservoir, it was advised to maintain stocking program on a regular basis so as to enable the fishers to catch priced IMC sustainably rendering their socio-economic status uplifted.

IMPACT OF GLOBAL WARMING ON FISH DISEASE OUTBREAKS AND FUTURE CHALLENGES

S.S. Mishra[1], B.P. Mohanty[2], M. Dhiman[3] and B.K. Dwivedi[3]

1. Regional Centre, Central Inland Fisheries Research Institute, Allahabad
2. Central Inland Fisheries Research Institute, Barrackpore,
3. Bioved Research Institute on Agriculture & Technology, Allahabad

Disease dynamics in the aquatic environment are influenced by climate change‐driven alterations of the physical, chemical and biological properties of ecosystems. Global warming acts in synergy with other anthropogenic factors, such as pollution and over‐exploitation, to negatively impact upon these complex ecosystems driving changes in the aquatic environments. The sustainable provision of these aquatic environments is determined by a diversity of complex ecological interactions between a variety of different living and non‐living factors. Infectious diseases can cause rapid population declines or species extinctions. Many inland fisheries are threatened by alterations to water regimes (Ficke et al., 2007; Marcos et al., 2010; Roessig et al., 2004). The possible threats to inland fisheries and aquaculture would arise from, stress due to increased temperature and oxygen demand and decreased pH, extreme weather events, increased frequency of diseases and toxic events, and sea level rise and conflict of interest with coastal defenses. Many pathogens of terrestrial and marine taxa are sensitive to temperature, rainfall, and humidity, creating synergisms that could affect biodiversity Roessig et al., 2004). Climate warming can increase pathogen development and survival rates, disease transmission, and host susceptibility. Although most host-parasite systems are predicted to experience more frequent or severe disease impacts with warming, a subset of pathogens might decline with warming, releasing hosts from disease. Parasites, including bacteria and viruses, and biotoxins compromise the health of aquatic organisms and therefore are key regulators of fish populations in aquatic ecosystems.

The fish immune response and the replication of pathogens are often correlated with water temperature, which manifest as temperature ranges for infection and clinical diseases. Increasing water temperatures can shift the balance in favour of either the host or pathogen, changing the frequency and

distribution of disease (Marcos et al., 2010). Increasing water temperatures and the negative effects of extreme weather events (e.g. storms) are likely to alter the freshwater environment adversely for both wild and farmed fish populations, increasing their susceptibility to disease and the likelihood of disease emergence. Since millions of people around the world depend upon the aquatic resource for a diverse array of activities and services, the impacts of climate change will may have significant socio‐economic implications. The possible implications of global warming on fish health and on socioeconomics of fishers have been discussed in the present paper.

BREEDING BIOLOGY OF RAINBOW-TROUT: A SENSITIVE SPECIES TO CLIMATE CHANGES

K.D. Joshi, M.K. Das, A. U. Khan, R. K. Pathak and R. Singh

Allahabad Regional Centre,
Central Inland Fisheries Research Institute, Allahabad
Central Inland Fisheries Research Institute, Barrackpore

Rainbow trout (Oncorhynchusmykiss) a native fish species to Pacific drainages of North America, ranging from Alaska, is the world's most widely transplanted fish species. Since 1874 it has been introduced over 70 countries of the world including India. Breeding aspects of rainbow trout were investigated under the present study during April 2011 to March 2012. Fish samples were collected from trout hatcheries and farms situated in Uttarakhand and Himachal Pradesh. Rainbow-trout stocks in the above farms breed during mid-November to January, when water temperature ranged from 4.0 to 6.5 0C. The body weight of the female and male brooders collected during the study were in the range of 140-750g and 150-800g, respectively. The maturity stages of both the sexes were observed in gradual development from stage III (September) to Stage VII (December). The fecundity varied from 666 to 2674 in different sized females. Few male trout were observed in oozing stage during the month of November'11. Most of the female brooders showed maximum gonado-somatic indices (GSI) during December to February while the peak (25.08) values were observed in the month of February. GSI in male trouts showed higher values during October to January while peak (5.32) value was observed in November. The details of the above information will be discussed in the paper.

ANALYSIS OF LIVELIHOOD DIVERSIFICATION OF FISHERS OF HOOGHLY ESTUARY

Aparna Roy and Utpal Bhaumik

Central Inland Fisheries Research Institute
Barrackpore

The paper depicts an extended analysis of livelihood diversification among the fishers of Hooghly estuary. The livelihood issues of fishers of Hooghly estuary are very distinctive and it portrays adjustment strategies. The income and expenditure pattern of fishermen in upper stretch(fresh water gradient) of Hooghly estuary is quite different than that of lower stretch(marine). In upper stretch, the main income source is other activities (42%) where in lower stretch it is maximum income comes from fishery (63%). In upper and lower stretch there is significant difference between the socio-economical variables. Except age, all the socio-economic variables viz. education, family type, family size, family income, social participation, extension contact, mass media exposure, indebtedness and the risk bearing ability has better performance in lower stretch of the Hooghly estuary. Livelihood diversification is a major livelihood issue in upper stretch. Less fish catch in upper stretch leads to large scale forced migration. A range of diversification activities undertaken in the study area, namely, wage labour, agricultural labour, handicraft(spinning), rickshow puller, vendors etc. Simpson index has been used to determine the extent of livelihood diversification in Hooghly estuary. The majority of the fishers (68.4%) had medium level of Diversification Index i.e.0.35 to0.69 as against only 16.8 per cent of fishers were under high level(>0.69) of Diversification Index.

EVALUATION OF BREWERY WASTE AS PROTEIN SOURCE FOR REPLACEMENT OF SOYBEAN OIL CAKE IN DIETS FOR LABEO ROHITA (HAMILTON) FINGERLINGS

Sayanti Saha and M.A. Hassan.

Central Inland Fisheries Research Institute, Barrackpore

Brewery waste (BW) is one of the increasingly abundant agro-industrial wastes with high nutritive value that remains almost underexploited. Therefore, an attempt was made to evaluate its quality as protein source for utilization in fish feed formulation. Soybean oil cake (SOC) has been conventionally used in fish feed as plant protein source. The cost escalation, in recent days, of this ingredient has inspired the nutritionists to look for its cheaper alternative. An experiment was conducted to evaluate the utilization of BW to replace SOC in diets for Labeo rohita fingerlings. Four iso-nitrogenous (% CP = 36.71±0.45) and iso-caloric (18.73±0.11 KJ/g) diets were prepared replacing SOC at 0% (RD), 50% (D1), 70% (D2) and 100% (D3) with BW respectively and fed twice daily to Labeo rohita fingerlings (5.79±0.004 g) for 60 days. The result indicated that the live weight gain (%) of fish showed an ascending trend with increasing replacement of SOC in diets, the highest being for diet D3 with 100% substitution. Specific growth rate (SGR) also showed the similar trend. On the contrary, the fish group fed with the diet D1 (50% substitution of SOC with BW) indicated the best feed conversion ratio (FCR), protein efficiency ratio (PER) and protein productive value (PPV) that differed significantly from that of other three diets including RD. Carcass composition revealed highest protein content for the fish group fed with diet D1 that differed significantly from that of RD, and D2, D3. There was higher accumulation of body fat for all the four diets including RD which differed significantly from that of initial. Tissue mineral content showed the inverse trend with body fat. Statistical analysis of the data indicated that SOC can be replaced up to 50% with BW in diet for Labeo rohita fingerlings without any adverse effect on its growth and feed utilization efficiencies.

STRESS LEADS TO MORTALITY IN SEMI-INTENSIVE BRACKISH WATER SHRIMP (*PENAEUS MONODON*) DUE TO IMPROPER POND MANAGEMENT.

Samarendra Behera, T.S.Nagesh, Sudhir Kumar Das & Sanjeev Kumar

Faculty of Fishery Sciences, WBUAFS, Kolkata

A study on brackish water pond management was conducted in the semi intensive shrimp (Penaeus monodon) farming ponds in three different zones of Baloaore districts of Odisha. Five ponds from each zone (brackish water shrimps cultivated sites along cricks of Subarnarekha, Budhabalonga and Baitarani) were selected randomly. The pond management that includes water quality parameters (colour, depth, temperature, transparency, pH, Dissolved Oxygen, salinity, alkalinity, amonia-N, nitrate-N and nitrite-N), feeding management (daily ration and FCR, feeding rate and unconsumed feed accumulated in soil) and soil parameters (colour, texture, pH and organic carbon) of cultivated pond were studied for a complete culture period. From this study it was found that the water quality parameters particularly amonia-N, nitrate-N and nitrite-N are found significant ($P \leq 0.01$) with mortality when compared location wise. In the soil load of organic carbon increased with the cropping time and found significant ($P \leq 0.01$) with mortality when compared due to location and crop. The FCR of the cultured pond is reduced to 25.1 and found significant ($P \leq 0.01$) when the animals were in stress condition. The load of unconsumed feed increased with the culture duration. These feed get putrefied at the soil bottom and increased the organic carbon level to 42.26 and found significant ($P \leq 0.01$). improper management of ponds developed unbearable ranges of parameters. Which in turn put the shrimps into different kinds of stress. Prevailing of such stress for long time or beyond tolerance limit lead the shrimps to mortality. The analytical statistics like ANOVA and DMRT test were done to co-relate the percentage of mortality with different parameters and also themselves and found significant and found significant ($P \leq 0.01$).

WATER STRESS ON INDIAN AQUACULTURE AND CAPTURE BASED FISHERIES: NEEDS HOLISTIC MANAGEMENT UNDER GLOBAL WARMING

A.K.Sahoo , A.P.Sharma and Utpal Bhaumik

Central Inland Fisheries Research Institute, Barrackpore

Groundwater and Surface runoff resources have been the mainstay for Inland fish production in India. Over two decades, the country has witnessed a ten-fold growth in fish production through aquaculture covering more than 1 million ha of ponds and through various Inland resources including rivers, reservoirs and wetlands. In India, major river basins such as the Ganga-Brahmaputra, Mahanadi, Godavari, Krishna and Narmada are the drivers for both culture and capture fisheries. Fish production uses no more water than the production of other animal foods but needs quantity, quality and timing of water. In aquaculture, water estimation is expressed in terms of precipitation, evaporation and seepage. While in open water resources it is the flows which determine the quantity and quality of waters. However due to the changing climate, water resources are undergoing stress in the Indian subcontinent resulting in increased water temperature, decreased oxygen level and increased toxicity of pollutants. Global warming is a major impact of climate change facilitating change in hydrology and hydrography of water bodies. In addition, it is predicated that global warming will directly alter hydrological regimes of major river basins resulting in change in food webs, habitat destruction and ultimately native fish community structure and production. Water stress, one of the major components under global warming may also directly impact on saline intrusion in coastal aquifers and extreme events such as droughts and floods. Time series data analysis showed as many as 99 districts spread over 14 states including Andhra Pradesh which is second fish producer state has been identified as drought prone in the country. It is suggested that an average drop in groundwater level by one meter would increase India's total carbon emissions by over 1% because the time of withdrawal of the same amount of water will increase fuel consumption. Further, it is estimated that both groundwater and surface runoff resources will decrease to about 68% by 2050. With keeping target of achieving 11.8 mt of fish by 2020, an immediate holistic approach must be adopted between public and private partners to secure the water resources for sustainable fish production under the global warming.

IDENTIFICATION OF CONSTRAINTS IN FISHERIES DEVELOPMENT OF FLOODPLAIN WETLANDS IN ASSAM

R. K. Manna and Md. Aftabuddin

Central Inland Fisheries Research Institute
Barrackpore, Kolkata

East and northeast India is blessed with more than 2 lakh ha of wetlands with a major share of about 1 lakh ha in the state of Assam. Wetlands can be a significant contributor in meeting the ever-increasing demand of fish of the region considering their high production potential. Accordingly planners and policy makers have given more attention in the recent past for promoting different management measures to augment the fish production from those wetlands. Success of any management measure depends on identification of real constraints for development. A rapid survey was conducted in various beels of lower and upper districts of Assam to understand the constraints behind development of beel fisheries in Assam. In 33 beels surveyed in Bongaigaon district, out of total 10 identified constraints, weed infestation (especially floating type) has occupied first rank (55%) followed by lack of sufficient fund (52%), siltation (39%) and lack of supplementary stocking (33%). Out of total 61 surveyed beels in Dhubri district, flood was the highest ranked problem (64%) among 12 constraints identified. Other constraints were weed infestation (59%), no proper demarcation (59%), lack of sufficient fund (42%), etc. In Dibrugarh district of upper Assam, fish disease occupied the highest rank (38%) along with weed infestation (38%) followed by siltation (25%). In Golaghat district, weed infestation has the highest impact (76%) followed by no proper demarcation (30%), flood (24%) and siltation (21%). In Jorhat district, again weed infestation is the major problem reported from 86% beels followed by siltation (53%) and lack of river connection (30%). In Sonitpur and Tinsukia disctricts, the problems are similar, weed infestation and siltation is the major constraints reported. Altogether weed infestation (especially floating mats) is really a menace in wetland of Assam and needs to be addressed immediately for development of beel fisheries of Assam.

KNOWLEDGE ECONOMY BASED AND INNOVATION CLUSTER ORIENTED FISHERIES HIGHER EDUCATION THROUGH PUBLIC PRIVATE PARTICIPATION

Sudhir K. Das

Department of Fisheries Resource Management, Faculty of Fishery Sciences,
West Bengal University of Animal & Fishery Sciences, Chakgaria, Panchasayer, Kolkata

The twenty first century has emerged as knowledge based society with knowledge revolution becoming the main engine for economic growth. Knowledge economy stands on the foundation of its institutions (Universities), system and culture. Knowledge generation is powered by creative mind of faculty and students of Colleges and Universities. India with more than half of young population has demographic advantage to reap benefits of globalization through its skilled manpower in future. Nurture of their mind in creative thinking is shaped in Higher Education Institutes with appropriate academic environment that needs high investment through Public Private Participation. Quality Fisheries Higher Education has principal components like good faculty, well equipped laboratory, ICT based instruction delivery system, infrastructure and good library. Such institutes can be promoted as regional innovation cluster with membership of broad innovation net work in Fisheries sector. India has emerged as one of major fish producers in global level and has potential to command the world provided its higher Fisheries Education is widely supported with creativity and innovation. Fisheries Colleges of India suffers from fund crunch and other problems which need to be addressed through a new legislative instrument of Fishery Council of India in line with Veterinary Council of India. Considering the expenses of Higher Education sector of India at about one percent of national GDP, provisions need to be made for spending one percent of Fisheries GDP by Fishery Colleges of different states of the country. It will help to promote the colleges as innovation clusters propelling the growth of society. Economies which do not innovate get stagnated and Fisheries Colleges may be oriented accordingly. Public Private Participation had given encouraging results and it needs to be implemented in Fisheries Education and Research in the country. The country can think of an instrument in line of Bayh Dole Act of USA to facilitate technology transfer from academia to industry to develop a culture and system of innovation in University level with Public Private Participation.

ANTIMICROBIAL PEPTIDES: INNATE IMMUNE MECHANISM AGAINST FISH PATHOGENS

PRAVEEN MAURYE AND MANAS KUMAR DAS

Central Inland Fisheries Research Institute, Barrackpore, Kolkata

Antimicrobial peptides are evolutionarily ancient defense factors widespread throughout the animal Kingdom. Their strategic location in phagocytes or mucosal tissues, allied to their powerful broad-spectrum antimicrobial activity, makes them crucial components of the innate immune system. They have been extensively studied in mammals, amphibians and invertebrates, but have received only scant attention in teleosts. The fish skin is covered by epidermal layer and mucus, act as a primary wall between internal and external environment. Due to their less structural complexity, potentially limiting the capability to generate fully functional adaptive immune responses against pathogen invasion. Therefore the fishes are depending on their innate immune mechanism for protection against invading pathogens. The innate immune components include the mucus layer on the skin, gills and Gastrointestinal (GI) tract, constituents of the blood such as natural killer cells and phagocytes. The epidermal mucus contains a key component of innate immunity that protects from the unfavorable conditions and prevents foreign substances from invading. This mucus secretion is thought to perform number of functions including lubricant, mechanical protective function, osmoregulation, locomotion, immunological role and intraspecific chemical communication. A skin secretion contains a wide variety of polypeptides with antimicrobial properties. Proteases are considered to be antimicrobial proteins which involved in the regulatory production of antimicrobial peptides. Antimicrobial activity of epidermal mucus extracts against a broad range of microbial pathogens was observed by many researchers, but those works were focused towards on marine microbial strains and notably there is no information available on the antimicrobial function of epidermal mucus of stingray. The goal of the present study was to investigate the in vitro antimicrobial activity in the epidermal mucus and assessed the presence of protease activity by using gelatin as a substrate and we have also determined the protease classes present in the mucus by using various inhibitor in Indian major carp, *Labeo rohita*.

APPLICATION OF MOBILE TECHNOLOGY FOR ENHANCING FISH MARKET PERFORMANCE THROUGH PUBLIC-PRIVATE PARTNERSHIPS

D. Karunakaran and B. P. Mohanty

Central Inland Fisheries Research Institute
Barrackpore, Kolakta

Information Technology (IT) has now entered into the new era of mobile internet application.. Using web technology on smart phones and other mobile devices to get information, news and data have increased in everyday lives. Introduction of the 3G mobile networks is the beginning of this revolution. In India mobile connections have increased to 921.01 million in April 2012; it is going to increase further. The cell phone application is going to transform the markets and marketing system in the near future. In India about 14 million people are engaged in fisheries, aquaculture and ancillary activities. One of the drawbacks of fish farmers are the lack of timely information to avail the economic and social opportunities. Accessing instant information on prices at different market places is crucial for farmers, traders and consumers to get profit and upscale their business. Mobile application on fish marketing system is required for the farmers and consumers to search information quickly at any time and any location on real-time basis to enable them to market their product at the right time and negotiate with the traders and consumers for better deals. Adoption of such hand held device will increase the welfare of fish farmers in rural areas through close public private partnership. A separate function, exclusively for fish farmers and consumers, can be developed by sending SMS text message to a unique number for getting wholesale and retail prices of fish across markets to compare prices with competitors for quick decision making. Effective and relevant IT solutions can be developed and deployed by combining technical expertise and innovations through public private partnership for enhanced market performance and implementing Integrated Fish Marketing System for guaranting better livelihood support and welfare of those involved in the sector.

PUBLIC-PRIVATE PARTNERSHIPS: SCOPE IN FISHERIES AND AQUACULTURE

Bimal Prasanna Mohanty, Bankim Chandra Jha and Anil Prakash Sharma

Central Inland Fisheries Research Institute, Barrackpore, Kolkata

PPPs (Public-Private Partnerships) can be defined as a cooperative venture between the public and private sectors, built on the expertise of each partner that best meets clearly defined public needs for services or infrastructure through the transfer between partners of resources, risks and rewards. In the present day world PPPs is becoming increasingly important for furthering developmental goals. The aim of PPPs is to structure the relationship between the public and private sectors to serve these two purposes: to allocate the risks to those best able to manage them and to add value to public services by using private sector skills and competencies. PPPs are not incentives or subsidies given by the public sector to attract private investments, rather it is built upon the strength of the two sectors. Like in any other sector, PPPs can play important role in fisheries and aquaculture to meet research and development goals. One typical example of PPP for development is Organic catfish production in Vietnam, where the Fisheries Association, An Giang, producing organic catfish (*Pangasius*) linked up with the German Technical Cooperation Agency (GTZ), The NGO Naturland and the private German fish-importing company Binca Fisch GmBH under the PPP. The private sector partners and GTZ shared both risks and costs; the responsibility for implementing and managing the project was shared by the private partners only. This resulted in better fish quality, with production and processing that met European standards. In India, PPP has not yet come up in fisheries and aquaculture sector excepting partnership between fisheries cooperatives, government agencies like NFDB for fisheries management in reservoirs. Some success stories of PPPs development in fisheries sector are coming up where the NFDB, CIFRI and state-owned reservoirs involving local fisher folks and fisheries cooperatives are working in close cooperation for increasing the fish production from the reservoirs. Some of the important areas in fisheries sector where PPPs can be of much significance are: Supply-chain management and market access; Food safety and quality; Management and business development; Infrastructure services; Information and communication services; Resource and environment management; Product development and R&D; Seed dissemination; Consultancy and business development; Technological development; Fishery and aquaculture production; Capacity building; Financial services etc.

PUBLIC-PRIVATE PARTNERSHIP FOR THE SUPPLY OF QUALITY SEED OF SCAMPI: AN EXPERIENCE IN NELLORE DISTRICT

O. Sudhakar[1], Bindu R. Pillai[2], T. Venkata Ramana[3], B. Chamundeswari Devi[4], P. V. Rangacharyulu[5], D. Ravindra Kumar Reddy[1], Ramesh Rathod[5].

1 College of Fishery Science, Muthkur, Andhra Pradesh
2 Central Institute of Freshwater Aquaculture, Bhubaneswar,
3 Sri. Venkateswara Veterinary University, Tirupathi
4 Fisheries Research Station, Beach Road, Kakinada
5 Central Institure of Freshwater Aquaculture, Regional Center, Vijayawada

The aquaculture production of giant freshwater prawn Macrobrachium rosenbergii, commercially known as scampi has shown phenomenal increase from mid nineties till 2005, increasing from less than 178 MT in 1996 to 42,870 MT in 2005, however, since 2006 the production started declining. In 2010-11 the production stood at 13,525 MT a reduction of more than 60% when compared to 2005. The state of Andhra Pradesh (AP) was the top producer with a production of 19,887 MT in 2007-08 and accounted for 73% of the production. In AP, Nellore district alone has contributed to about 80% of the production (26,000 MT from a water spread of 22,000 ha in the year 2005). However, culture has virtually collapsed in AP in general and Nellore district in particular due to various reasons. The scampi culture had faced problems like i) Stunted growth of stocked animals, ii) Early maturation of females, iii) Early appearance of blue claws in males, iv) Weak animals with poor disease resistance, v) Low survival rate in hatcheries and grow-out ponds and vi) Inability to complete larval cycle in local hatcheries with local brood stock. Sourcing brood stock from grow-out ponds rather than from the wild and the resulting high levels of inbreeding over time was believed to be the reason for growth decline. Therefore, availability of quality brood-stock is most crucial for the revival of scampi culture.

Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar has developed a technology for raising good quality captive broodstock of giant freshwater prawn M. rosenbergii. A collaborative project was started

in 2010 between CIFA, and College of Fishery Science (CFSc), Muthukur, Nellore with financial support from National Fisheries Development Board (NFDB), Hyderabad. Under this project, quality post larvae (PL) of scampi produced from improved brood stock of CIFA are being supplied to CFSc. These PL are being reared up to brooder stage at Instructional Freshwater Fish Farm (IFFF), Eguvamitta. A public-private partnership was made with the M/s. Sripa Hatchery, Nellore for production of seed from the brooders reared by the CFSc. This public-private partnership has worked well and we could supply 2.5 lakh quality seed of scampi to the farmers of Nellore district during the first year of the project.

NEED FOR PUBLIC PRIVATE PARTNERSHIP IN CONDUCTING CUTTING-EDGE RESEARCH IN BIOLOGICAL SCIENCES IN INDIA

Prasenjit Paria, Arabinda Mahanty and B. P. Mohanty

Biochemistry Laboratory, Central Inland Fisheries Research Institute, Barrackpore, Kolkata

Last 50 years India has grown very rapidly in the field of agriculture, industries and pharmaceuticals. At the same time, research has also got more investigative to support this growth as well as to fight several problems like pollution, food safety, food security and health sector which are serious challenges in present and demands in depth study. The complete sequencing of the human genome has ushered in a new era of systems biology referred to as 'Omics' science. The 'Omics' technology include genomics, proteomics or metabolomics that has driven these new areas of research which consists of DNA and protein microarrays, mass spectrometry and a number of other instruments that enable high-throughput analyses. Omics technology is increasingly used in chemical risk assessment and environmental monitoring that requires an expanded ecotoxicogenomics reference database and a better understanding of the relationships between specific responses and biomarkers to ecological adverse events. Fish aquaculture is considered to be one of the most sustainable sources of proteins for humans. During the last years, an important effort has been directed towards the use of functional genomics, proteomics and metabolomics to better characterize reproduction, development, nutrition, and immunity of fishes. 'Omics' approaches can identify suitable biomarkers to monitor the welfare of cultured fish and the quality of aquaculture products. This modern technology is used by different research institutes all over the world, at the same time, in India it need lots of infrastructure. An important public private partnership had taken place during Human Genome Project. Human Genome Project began in October 1990 and was initially headed by Aristides Patrinos, head of the Office of Biological and Environmental Research in the U.S. Department of Energy's Office of Science. In 1998, a similar privately funded quest was launched by an American researcher Craig Venter, and his firm Celera Genomics. Celera used a technique called whole genome shotgun sequencing, employing pair wise

end sequencing which is a faster and cheaper technology. In 2006, together with Celera Genomics a complete draft of the genome was announced which was completed 2 years earlier than planned. Such collaborations are essential among institutes in India for carrying out cutting-edge research in biological sciences to improving the efficiency and effectiveness of research, extension and education services; enhancing access to new products and services that target the problems like pollution, food safety, food security, health sector and agricultural sector.

AQUACULTURE - NEW POSSIBILITIES AND CONCERNS

T. Rajyalakshmi

G-2/1-22-14 ABC Apartments.,Sriramnagar, Kakinada

Aquaculture is now finding a berth of its own in all the Food production platforms of the country; Though yet to be fully recognized as the prime contributor to the protein food in all the 'Nutritionally balanced food' promotions of the country in the mid-day meals schemes or the pregnant-women food category, it might catch on soon; because at times aquacultured over - produce goes into doldrums with no planned market–the buyers. It happened recently in Andhra Pradesh when the much-hyped Pangas fish Pangasiodon hypophothalmus could not get remunerative prices when all the farms simultaneously brought the product to market; It is happening now in August-September season when the story was duplicated by imported white shrimp, *Litopenaeus vannamei* produce. It might happen soon with *Piaractus brachypomus* (commonly called the Red pacu or Roopchand) being promoted and farmers are rushing in to take up culture- the latter is imported from Bangladesh, at a high cost.This over- produce could have been brought under nutrition schemes of the country under proper support price or whatever and conversion to value-added ready-to-consume or ready-to-cook products. Other issues impacting on the Aquaculture 'industry', if we can term it so, is deficiency or shortage in inputs: the freshwater supply, the energy (electricity and diesel) supply, the rising costs of raw materials such as rice bran, oil cake, fish meal etc., that go into the bulk feed bags of carp culture ponds. The most dominant impact now ,very visible and imminent, is the Climatic changes; the sudden rainfalls; the hot sweltering day-light hours followed by sudden clouds and downpour; the very hot 39-45oC temperatures in 2012 Summer; the extreams of cold temperatures in winter. In fact passing of one climatic condition to another with not much an interval which results in the farmer caught unprepared and helpless. Now the farmer needs to be on his toes all the time fully prepared with emergency measures such as aerators, generators, pumps and extra personnel; in short to keep attuned to changes in water quality parameters such as Dissolved Oxygen, pH, salinity (in coastal shrimp culture). Our entire range of eminently culturable species can be counted on fingers ; Apart from the Indian major carps (only *Catla catla* and Rohu are now preferred) and the imported Chinese *Cyprinus carpio, Heteroneustes fossilis* and *Ctenopharyngodon idella*, the grass carps, the other species are the sea bass, *Lates calcarifer*, Pangas (culture has come down recently), the much-talked about Red pacu *Piaractus brachypomus*, and the not-lawfully cultured Catfish *Clarias gariepinus* among fish species; the others are the indigenous tiger prawn, *Penaeus monodon* (still a

preferred species), the current imported *Litopenaeus vannamei* and the Indian freshwater giant prawn, *Macrobrachium rosenbergii*, the scampi; the tiger and scampi are on the downward spiral. Two species of crabs viz., *Scylla quinquiradiata* and *Scylla serrata* are farmed only for fattening of their soft crabs stage for a niche market only. This number of variety of species is not at all small range if we can only go on improving upon our culture practices, standardize the same, increase research on disease management and post harvest technologies; as well as devise sufficient farmer-oriented strategies for market infrastructure, price controls and attention to domestic market as well as export market. There are other major and minor indigenous species of carps such as *Labeo calbasu, Labeo fimbriatus, Puntius* sp.; Murrels and the anadromous *Tenuolosa ilisha* in freshwater; And species of white shrimp such as *Fenneropenaeus indicus, F.merguiensis*, the river Prawn *M.malcolmsonii* and the milk fish *Chanos chanos* with proven seed production technologies. These surely can be brought in under rural protein food production, nutrition, rural employment schemes being proposed by NABARD. Pond production need not always cater to high returns of commercial ventures. This can enhance local and domestic protein food as is done in the West Bengal's bachyard ponds. The species that are being promoted currently, are the marine varieties : Cobia, *Rachycentron canadum* and the pompano, *Thachynotus blochii*, as suitable species for open sea cage culture. Similarly, two species of Lobsters are under experimental cage culture trials. This means they would be confined to a few enterprising farmers brave enough to take up off shore cage culture. Similar attempts are going on for shore (coastal) culture of sea weeds. Unfortunately proper and firm policy decisions are not yet taken up at administrative level of Government of India. There is a fourth dimension although still not yet confusing the farmer or, in fact , the Scientist. That is What species to choose? Where to culture and how! All though it is not as if we have a wide range to choose from. Still, it is worth the while of all aquaculturists to think seriously about this factor; Genetically modified, selective breeding or induced old technologies or go on importing foreign (exotic) species which require the permission of National Aquaculture Authority and quarantine.

A STUDY ON THE ICTHYOFAUNA OF SHIPRA RIVER

Ridhi, A. K. Das and Arun Kumar Bose
Central Inland Fisheries Research Institute, Barrackpore,

River Shipra is one of the principal tributaries of river Chambal, supporting the livelihood concerns of thousands of traditional fishers. The Shipra starts its journey in the Vindhya range from a hill called Kokri Tekdi situated at a distance of 11km from Ujjain. This river is 195 km long, out of which 93km flow through Ujjain. It then touches Ratlam and Mandsaur, before joining the river Chambal. Unfortunately, however, there is a dearth of authentic database on its biodiversity, specially the fish fauna. The present investigation was, therefore, undertaken to collect fish diversity data over the period 2009 to 2012, covering whole stretches of the river. Fish samples were collected from landing sites, experimental fishing and market surveys. During the present investigation a total of 63 fish species were collected and documented. The Fish faunal diversity of the river indicated the dominance of Cypriniformes (60.31%, 38 species) followed by Siluriformes (20.63%, 13 species), Perciformes (11.11%, 07 species), Anguilliformes (1.58 %, 01 species), Beloniformes (1.58 %, 01 species), Clupeiformes (1.58 %, 01 species) Cyprinodontiformes (1.58 %, 01 species) and Synbranchiformes (1.58 %, 01 species). Majority of the species thus collected have high commercial importance, both as food as well as ornamental.

SIGNIFICANCE OF PUBLIC-PRIVATE PARTNERSHIP IN THE CHANGING CLIMATE OF INDIAN SUNDARBAN

R K TRIVEDI, B K CHAND, S K ROUT AND S K DUBEY

West Bengal University of Animal and Fishery Sciences, Kolkata

The extreme climatic events have impacts on the sustainability of fisheries and aquaculture and on the livelihoods of the communities that depend on fisheries. The Sundarban ecosystem is characterised by a very dynamic environment due to the effect of tide, flooding, salinity and cyclones. The frequency and intensity of extreme weather events like cyclone and storm surge have increased over the period of time, bringing sudden influx of saline water into the aquaculture areas leading to loss of fish crop. A survey on prevailing aquaculture practices, problems faced by the fish farmers of Sundarban due to extreme events and the prevailing coping measures practiced by these farmers to minimize the loss was conducted to understand the situation. Based on these findings, a study is being conducted to develop climate resilient aquaculture strategies for Sundarban region for sustainable production. Further, it is being suggested that in order to transfer the proposed climate resilient package of practices among the farmers, a partnership among all the stake holders is needed. NGOs, government agencies, institutes and local elected bodies shall have to play vital role not only in transferring it among the farmers and entrepreneurs, but to ensure its long term sustainability.

POTENTIAL FOR ENCLOSES CULTURE (PEN AND CAGE) IN PAHUJ RESERVOIR, JHANSI, UTTAR PRADESH, INDIA.

Surajit K. Banik[1]*, A. K. Das[1] and A. Wanganeo[2]

1Central Inland Fisheries Research Institute, Barrackpore,
2Department of Environmental Science and Limnology, Barkatullah University, Bhopal

The exponential growth, in our population and the great pressure on land for habitation and agriculture, the large water resources such as tanks, lakes and reservoirs, which have been hitherto under-exploited, need to be harnessed for augmenting fish production. Because of complex problems of management, aquaculture cannot be undertaken in these water bodies. The best solution seems to be captive, regulated culture of suitable fishes in pens and cages installed in them.

Pahuj a small reservoir (Area: 518 ha, Mean depth: 5 m) located at Jhansi in Uttar Pradesh, India which receives one third Jhansi city sewage annually, including frequent water discharge from upstream reservoirs which enriched the nutrient profile of this reservoir for sustainable aquaculture. The water quality was studied during May 2007 to April 2009 for aquaculture needs. The pH values ranged from 7.48 to 8.68 (avg. 7.92) while the sp. conductivity fluctuated between 220 and 572 µS/cm (avg. 325.81 µS/cm). Dissolved oxygen varied from 6.4 to 10.8 mg/l (avg. 7.8 mg/l) and total alkalinity fluctuated between 96 and 178 mg/l (avg. 134.36 mg/l), total hardness at 78 and 174 mg/l (avg. 115 mg/l) and chloride ranged from 25.56 to 66.74 mg/l (avg. 42 mg/l). The nitrate nitrogen and phosphate phosphorus fluctuated between trace and 198.4 µg/l (avg. 118.25 µg/l) and trace to 186.20 µg/l (avg. 73.53 µg/l) respectively. All the above water quality parameters show the capability of this water body for fish culture practices.

Single time experiments have been conducted on both pen and cage culture in Pahuj reservoir. Both enclose culture was stocked with Indian Major Carps (IMC) in 10-15 mm size. The seed is fed daily artificial, in the presence of natural food in the system; food supplied was low in quantity from outside. After 2 to 3 months the fingerlings, 65-120 mm size, are enumerated and

stocked in Pahuj reservoir batch-wise. It was observed that the growth and survival rate of catla was more comparing to rahu and mrigal. The fish production of Pahuj was increased noticeably in the next year to the enclose culture in both years and it was reached to near the fish production potential of this reservoir. To fulfill our fish production target for the upcoming years in India, we should practiced enclosure culture in potential water bodies, mainly small reservoirs, like Pahuj..

ICHTHYOFAUNAL DIVERSITY OF MAITHON RESERVOIR, JHARKHAND

Sagar Agrawal, Akanksha Singh, A. K. Das*, B. C. Jha* and S. Das

Deptt. of Zoology, Bundelkhand University, Jhansi
*Central Inland Fisheries Research Institute
Barrackpore,

An exploratory survey was conducted in Maithon reservoir (23047' N, 86049' E; A: 10716 haat FRL; m.d: 9.1 m; productive area: 6680 ha) spreading over West Bengal and Jharkhand impounded on the river Barakar, a tributary to river Damodar. The catchment (C: 6267 km2) comprises moderately fertile river valley of Damodar, some part of which is under deciduous forest cover. The very purposes of the reservoir are flood control, irrigation, water supply and hydel.

The present investigation deals with the ichthyofaunal diversity of Maithon reservoir. The result of present investigation confirmed the occurrence of fifty species belonging to nine Orders. Order Cypriniformes was dominant with eighteen species, *Catla catla, Labeo rohita, Cirrhinus cirrhosus, Labeo calbasu, L. bata, L. gonius Hypophthalmichthys molitrix, Arictichthys nobilis, Ctenopharyngodon idella, Cyprinus carpio carpio, Puntius sarana, Amblypharyngodon mola, Devario devario, Puntius ticto, P. sophore, Esomus danricus, Chela bacalia, Lepidocephalichthys guntea,* followed by Siluriformes with twelve species, *Wallago attu, Sperata aor, Sperata seenghala, Mystus vittatus, M. cavasius, M. tengara, Ompok bimaculatus, O. pabo, Heteropneustes fossilis, Clarius batrachus, Eutropiichthys vacha, Pangasius pangasius*. Perciformes with seven species, Channa punctata, Channa gachua, Channa striata, Channa marulius, Oreochromis niloticus niloticus Oreochromis mossambicus, Anabas testudineus and Osteoglossiformes with two species, Chitala chitala, Notopterus notopterus and Angulliformes, Mastacembeliformes (Synbranchiformes), Beloniformes, Cyprinidontiformes and Mugiliformes each with one species, *Anguilla Anguilla, Macrognathus pancalus, Xenentodon cancila, Aplocheilus panchax, Rhinomugil corsula*. A regular stocking program with Indian major carps (IMC) and C. carpio during 2007-10 has impacted positively on the species abundance of Maithon reservoir.

IMPACT OF EXOTIC CAT FISH PRODUCTION ON RURAL ECONOMY OF NORTH 24 PARGANAS, WEST BENGAL

Tapas Paria and Uttam Kr. Panja*

Meen Bhawan
Office of Asst. Director of Fisheries
Govt. of West Bengal, Barasat

The study was conducted during last two years in North 24 Parganas of West Bengal, India. The present investigation reveals that most of the farmers' increased their income by adopting the culture and breeding technology of exotic cat fishes. The rural economy is boosting up in geometrical propagation with the help of exotic fish culture *i.e*. the income varies from 6.5 to 8.5 lac per year/ha. Fish farmers of West Bengal with a view of getting more profit apart from conventional species, tried to import various exotic species from Bangladesh as well as from Nepal. The breeding and culture both are done in unauthorized and illegal manner, which in dangerous for future of aquaculture sector. If the culture can be done in control condition with balance feed, it shows better result without hampering the aquatic environment. Apart from major carps among the freshwater resources, the exotic catfishes namely *Clarias gariepinus* and *Pangasisus sutchi* are being cultured by large section of aquaculturistis and got momentum in the propagation and production system due to its faster growth and market demand. Thus breeding and culture of these specious have been started by a large no of fish farmers of West Bengal. Such activities have become more popular in some part of the district of North 24 Parganas. So, the farmers' should take alternative compatible species for breeding and culture, which are lucrative in fisheries sector and also uplift the rural economy for the backward communities in a sustainable way.

POTENTIALITY OF IRRIGATED CANAL FOR ENHANCEMENT OF FISH PRODUCTION

Tapas Paria and Uttam Kr. Panja*

Meen Bhawan
Office of Assistant Director of Fisheries, Barasat,
*Director of Fisheries (Kolkata Zone)
Kolkata, West Bengal

Paper highlight the enhancement of fish production vis-vis rural economy through irrigated canal fish culture. Canals are designed to carry a specified discharge without erosion and traditionally have a trapezoidal shape. Fish production from irrigation canals can be acquired through aquaculture or capture fisheries. Present study was conducted through a Self Help Group (Mamatamoyee Sanirvar Gostyee) at Gaigata Block, North 24 Parganas. These canals remained mostly unused so far or used only for irrigation purposes in North 24 parganas, West Bengal. But the resources of Canal, which are often a conspicuous feature of agricultural systems throughout the world, can contribute significantly to the overall production of animal protein in the form of fish, especially in developing countries. Because of limited water resources new sources of fish are always under investigation. Irrigation schemes cover extensive, and continuously increasing, areas and the unlined canal is usual in developing countries because this type of canal is easy to build, with low capital costs, and can be easily maintained by unskilled labourers. But the potential of the canals for fish production has so far been largely neglected, and there is consequently very little organized fish production in these systems. The study was conducted in an area of 1 ha (covered by bamboo split pen) in a small irrigation canal during the period of March to September,2012. The productions obtained from the Canal have been estimated as 2,050 kg/ha/6 month. The aquaculture in canals may prove more appropriate, because of the greater control possible over production and the confined nature of the production systems. The aim of this paper is to bring the relevant information together and to outline some of the methods, which may be applied for the production of fish in irrigation waters.

BIOLOGICAL DIVERSITY OF THE WETLANDS, WITH SPECIAL EMPHASIS ON PLANKTON ALONG THE SEWAGE EFFLUENT GRADIENT

DIPANWITA SARKAR (PARIA) AND B. B. JANA

Darjeeling Government College, Darjeeling &
International Centre of Ecological Engineering, University of Kalyani

Direct discharge of much liquid waste into the natural waterways perturbs the homeostasis of aquatic ecosystem causing unacceptable deterioration of water quality either by severe contaminations or eutrophication and therefore pose ecotoxicological threat and health hazards. Recent years have witnessed a major shift in the reclamation strategies for wastewater from high tech to environmentally sound, low cost and effective eco-tech using locally abundant biotic resources and based on ecological principles in the economically less developed countries where sophisticated high techs are hardly affordable due to economic reasons. Eight constructed wetlands in sewage fed fish farm located in Kalyani Township were studied with all the trophic components of the ecosystem provide a holistic approach towards wastewater reclamation. Placement of the open constructed wetlands along the sewage effluent gradient is such that a distinct gradient of the effluent has been formed with high load of organics in the source to the reduced level of organics at the outflow. Among the phytoplankton all the common species belong to Cholorophyceae, Myxophyceae, Euglenophyceae and Chrysophyceae, tended to decline in their numbers along the course of the sewage effluents. The species of Bacillariophyceae tended to rise in numbers as a function of the distance from the source of the sewage effluent. This was also supported by the values of Simpson index of dominance showing rising trend for Bacillariophyceae and downward trend for others with increase in distance of the sewage effluent. Dominance of Bacillariophyceae in the last stocking pond was clear indication of oligotrophic state of the pond. The zooplankton population tended to decrease from the facultative pond to the last stocking pond following the gradient of the sewage effluents. Likewise, the count of benthic invertebrate declined as the distance of sewage effluents increased from the inlet of the facultative pond to the last stocking pond at the outlet. It seems probable that grazing by the fish population in the stocking ponds resulted in decline in the numbers of all the fish food organisms like phytoplankton, zooplankton and benthic animals in the stocking ponds. Absence of fish grazing in the facultative pond seems to be responsible for turning the ecosystem into detritus based ecosystem. The results of the P/R

ratio which remained less than unity in most the times in the facultative pond also led to such conclusion. The specially designed facultative ponds have been proved to be most dynamic in the series because of major reclamation of 42-62% of the total occurred in this subsystem before being passed into the next subsystem of fish growing ponds. The system was primarily responsible for transforming organic wastes into fish biomass through the multichannel grazing-detritus-complex food-chain pathways. It is of considerable significance in tropical developing countries where production of fish protein from such low cost organic wastes is highly promising.

CONDUCTNG HUMAN FEEDING TRIALS FOR ESTABLISHING HEALTH BENEFITS OF FISH CONSUMPTION - NEED FOR PUBLIC PRIVATE PARTNERSHIPS (PPPS)

Satabdi Ganguly, Tandrima Mitra, K. K. Goswami, B. P. Mohanty

Biochemistry Laboratory, Central Inland Fisheries Research Institute, Barrackpore, Kolkata

Fish is a health food owing to its richness in polyunsaturated fatty acids (PUFAs), especially the ω-3 PUFAs EPA and DHA, proteins, vitamins and minerals and the benefits associated with the consumption of small indigenous fishes. Two forms of child under nutrition, marasmus and kwashiorkor often occurring together are world health problems. In this context, fish, being one of the cheapest sources of quality animal proteins is playing a big role and can still play a bigger role in preventing the protein-calorie malnutrition problems. Health benefits of eating fish are being increasingly understood now and human feeding trials are being conducted worldwide to establish the health benefits of fish consumption. Conducting human feeding trial is a talk for public private partnerships as it is a multifaceted task which requires the involvement of physicians, scientists, nutritionists, NGOs of the locality, diagnostic centers, hospitals, and volunteers to successfully conduct the program. Although a difficult job, it is important to conduct such trials to firmly establish the health benefits of fish consumption and public-private partnership is the mode of choice for success of such programme.

SCOPE OF PUBLIC PRIVATE PARTNERSHIP IN MANAGEMENT OF NATURAL WATER RESOURCES OF TRIPURA

Pampa Bhattacharya
Central Agricultural University (Imphal)
Department of Fisheries Resources Management College of Fisheries
Lembucherra, Tripura

The freshwater resources of Tripura state comprises of rivers, reservoirs, lake, minnibarrages charrars etc.The water resource can be broadly be classified into 3 categories viz., capture , culture-based, culture based capture fisheries resources. Out of total natural water area is 133.59 sq. Kms. reservoirs (39.83%) and rivers constitute (25.93%) respectively. Most of the water bodies are common property resourcesl. Generally being the capture fishery people living along these resources are engaged in harvesting only.For this reason, productivity of reservoirs, rivers etc. in terms of species diversity and quantity declined significantly during the last two decades. Intensive survey and study on this areas have revealed that in early 70's Cyprinids and Cat Fishes. (Mystus, Puntius, Glossogobius, Barilius etc). Fishes like Rita rita , Chitala chitala, Hilsa ilisha, Aspidoparia morar, Acanthocobitis botia, Schistura scaturigina, Schistura nagaensis, Chaca chaca,, Rita rita , Pseudeutropius atherinoides , Amblyceps mangois, Bagarius bagarius, Channa orientalis and Tetraodon cutcutia were dominant but these species have become rare presently in the water bodies. Over-exploitation, habitat destruction etc. are some of the causes for the depletion of these species from the water bodies. As the natural water resources are common property, so there are none to control, manage, stocking, feeding and harvesting of these water resources. For management huge investment is required Therefore, public-private partnerships can provide a unique perspective on the collaborative and network aspects of public management. For Tripura scenario, there is a wide scope for improvement of the water resources through public private partnership to enhance the productivity to maintain water quality, control species diversity through gear selectivity for conservation of fish seed, ecological balance resulting in sustainable productivity,. One option may be leasing the water bodies to entrpreneurs,

cooperative societies for implementation of govt.policies under Public Private Partnership model. This can improve the productivity of water bodies and the livelihood of the local fishers residing adjacent to the water bodies which are at present in uncertain condition. In PPP approach both the government and private players can work together for social welfare, eliminating the prime focus of private players on profit.

ASSESSING THE LOSS OF SMALL WATER BODIES USING GEOSPATIAL TOOLS – NADIA AND PURULIA DISTRICTS OVER A PERIOD FROM 1999 TO 2009AND THEIR CAUSATIVE FACTORS

S.K.Sahu*, Manisha Bhor , Sweta Sinha, Brojogopal Ghosh, Saptarshi Sarkar, Samima Islam, Amitangshu Sil and Anirban Goswami

*Central Inland Fisheries Research Institute
Barrackpore, Kolkata

Major challenges to aquaculture and participatory approach to mitigate them. The paper takes up the cause of observing water bodies in Nadia and Purulia districts over a time span of ten years 1999 to 2009 with respect to rainfall and population density initially. The water bodies are an essential resource for fish production. To maintain and sustainably increase fish production, a systematic monitoring and conservation of this resource becomes a primary responsibility of an organization or institute associated with fisheries. The study hopes to find out the number of water bodies that have disappeared over the decade and the decrease in area caused. Remote Sensing and Geographical Information System has been used as tools to support this analysis. The study takes into consideration a rainfall deficient area and a rainfall sufficient area to compare and contrast the above stated variables. Initially Purulia and Nadia were chosen with respect to the prevalent topography. Purulia being situated in the undulating topography areas and Nadia being situated in the plain areas were considered for comparing and analyzing rainfall, water body areas of more than 1 hectare, and population density. The analysis of the study has showed that a decrease in the amount of rainfall has decreased the number ofand area under inland water bodies. Purulia has a greater area under water bodies. With its low population density, the water supply for its population is sufficient. In spite of being situated in the flood plain area of the Bhagirathi, Nadia district is a water scarce district due to a heavy population pressure. The results of the study have raised concern, as a number of water bodies have disappeared over these years while still other have undergone a change in their spatial composition. This study may be a facilitator for reclaiming lost water bodies.

ROLE OF PPPS IN POPULARIZING FARMING AND CONSUMPTION OF SMALL INDIGENOUS FISHES FOR PREVENTING MICRONUTRIENT DEFICIENCY AND MALNUTRITION

Soma Bhattacharjee and Bimal Prasanna Mohanty

Biochemistry Laboratory
Central Inland Fisheries Research Institute, Barrackpore, Kolkata

Malnutrition, especially protein energy malnutrition (PEM) continues to be a significant problem all over the world and occurs in both developing and industrialized nations. In the developing world, it is frequently a result of socioeconomic, political or environmental factors. There are several causes of malnutrition which may results from inadequate or unbalanced diet, problem with digestion or absorption and certain medical conditions. These are silent epidemics of protein, vitamin and mineral deficiencies affecting people of all genders and ages, as well as certain risk groups. They not only cause specific disease, but they act as exacerbating factors in infectious and chronic diseases such as anaemia, osteoporosis, osteomalacia, thyroid deficiency, colorectal cancer, cardiovascular diseases etc. There remains much variations in the criteria used to define malnutrition, with each methods having its own limitations. Early detection, prompt management, and robust follow up are the critical for best outcomes in preventing and treating malnutrition. India, one of the 17 global mega biodiversity hotspots, is native to many freshwater fish species. About 2,246 indigenous finfish species have been recorded from Indian of which 450 species are categorized as small indigenous fish species (SIF). Some freshwater SIF include highly nutritious fish like mola, punti, chanda, chela, tengra, shingi, magur, koi, gute, lata etc and many types of crabs, mollusks, small prawns etc. Small, indigenous fish are particularly important for nutrition because they are eaten whole, with bone, head and eye, thereby providing a source of calcium and other micronutrients. The high quality protein is high in lysine and essential amino acids. Lysine is more than 10 percent of the total protein in fish whereas it is only 2.8 percent in rice. This makes it particularly suitable for complementing the high carbohydrate diets prevailing among the poorer sections. Though

fish is most important as a source of protein, its contribution to energy is also important. The vital role of SIF in nutrition is probably due to its richness in micro-nutrients i.e. manganese, phosphorus and other important trace elements like zinc, iodine, selenium that is generally not found in staple foods. It is a very important source of pre-formed vitamin A, vitamin D and vitamin E and also contains thiamine, riboflavin and niacin (vitamin B1, B2 and B3). The contribution that fish can make to the nutritional status of young children and lactating women is particularly significant. Incorporation of a small quantity of SIF can substantially improve the biological value of the diet and contribute to significant improvements in nutritional security. Therefore, small indigenous fishes can play a big role in malnutrition management as they are cheapest and commonly available source of quality animal protein. These complementary methods, along with food security, education and monitoring are challenges for public health and clinical medicine.

ARSENICOSIS- NEED FOR TACKLING THE PROBLEM THROUGH PUBLIC-PRIVATE PARTNERSHIPS

Sudeshna Banerjee, Sasmita Mohanty*, S. Samanta and B. P. Mohanty

[1]Biochemistry Laboratory, Central Inland Fisheries Research Institute, Barrackpore, Kolkata

*KIIT School of Biotechnology, KIIT University, Bhubhaneswar

Arsenic is a toxic environmental contaminant and a potent human carcinogen. Prolonged drinking of arsenic-contaminated water leads to arsenicosis and it results in pathophysiological changes like alteration of skin colour, hard patches on palms and soles of feet, cancers of the skin, bladder, kidney and lung, and vascular diseases in humans. Widespread use of arsenic-contaminated groundwater for irrigation of rice and other crops has lead to accumulation of arsenic in rice plants, grains and other crops and vegetables. The humans, domestic animals and birds are exposed to arsenic by intake of contaminated foods and feeds, respectively. Fish and other aquatic animals are naturally the worst affected ones as they feed, breed and grow in the contaminated aquatic habitats, thereby getting lifelong exposure. In the World Bank funded NAIP research consortium (www.naip.icar.org.in/downloads/Summary/C-1005.pdf) 'Arsenic in Food Chain: Cause, Effect and Mitigation' involving several state universities: BCKV, UBKV, WBUAFS; ICAR research institutes: IVRI- ERS, CIFRI and NGO (DNGM Research Foundation) has been a successful PPP exercise and has led to better understanding of arsenicosis problem. Our studies have shown that arsenicosis is not only caused by chronic exposure of arsenic-contaminated water but from the food chain also. Arsenicosis has been a great public health problem and there is need for greater partnership and linkage among the government and non-governmental organizations to work for mitigation as arsenic-contamination problem is geogenic and cannot be totally eradicated.

IMPACT OF SEASONAL CHANGE ON MACROBENTHIC COMMUNITY IN OUTER CHANNEL AREA OF CHILIKA LAKE, ODISHA

Suman Mishra, *Md. Razauddin, B. C. Jha, A. K. Das and S. Das

Central Inland Fisheries Research Institute, Barrackpore, Kolkata
*Dept. of Zoology,M.G.College,Gaya, Bihar

Wetlands are the most productive ecosystems in the world. Due to co-existence of different ecosystems it is often regarded as the “biological supermarkets”. The Chilika wetland ecosystem is one of such wetland where unique assemblage of marine, brackish water and fresh water ecosystem is seen. It is located on the east coast of India and regarded as the largest tropical brackish water lagoon in Asia (Panigrahi 2009; CDA 2008). This lagoon is enriched with high fisheries resource that supports the livelihood of fisher folk, for a population more than 2 lakhs (CDA 2008). Due to its vast biodiversity and greater socioeconomic importance this lagoon is regarded as one of the RAMSAR site in 2002 (CDA2008; Mohapatra et al., 2007). Many studies were carried out by different researchers on different aspects of this lagoon. Chilika lake designated Ramsar site of international importance is situated in the humid tropical climatic zone of Odisha, on the east coast of India. It has both marine and freshwater ecological stands being a lagoon. The lagoon has four distinct ecological stands based on salinity profile viz. southern zone, central zone, northern zone, and outer channel. Nayak,(1994) have enumerated the geology, geomorphology and tidal variation in the lagoon. Abundance of macrobenthos in the outer channel area of Chilika lagoon in the east coast of India was studied during 2010 to 2012. In total 27 species of macrobenthic organisms were collected during the study period season. Crustacea was emerged as the most dominate group representing 9 species followed by polychaetes with 8 species while 5 species belonged to bivalvia and 3 species to gastropoda. The result of the study shows that hydrographical parameters like Temperature (°C), pH and Salinity (psu) parameters had modest relationship with population density and biomass. The opening of a new outlet connecting with the sea had good influence on species richness and population density.

USE OF ANTAGONISTIC BACTERIA FOR BETTER DISEASE MANGEMENT IN AQUACULTURE: A NEW HORIZON TO FISH FARMERS

Farhana Hoque

Department of Aquatic Animal Health, Faculty of Fishery Sciences,
West Bengal University of Animal and Fishery Sciences, Kolkata

Extracts and preparations from animal origin are used extensively in folk and modern medicine for treating many diseases since our early ancestors began exploiting natural compounds to improve and enrich their own lives. In spite of modern improvements in chemotherapeutic techniques, infectious diseases are still an increasingly important health issue in aquaculture. In the present study efforts have been made to find a technique for better disease management in aquaculture using scientific advances. Antagonistic effect were confirmed against many human and fish pathogenic bacteria such as *Aeromonas* sp., *Bacillus subtilis, Bacillus amylolequifasciens, Escherichia coli, Edwardsiella tarda , Klebsiella pneumoniae, Enterohaemorrhagic Escherichia coli* (EHEC), *Pseudomonas aeruginosa, Salmonella typhi*, beta haemolytic *Streptococcus, Staphylococcus aureus*(ATCC12598) and *Vibrio cholera*. The result is quite surprising as all the pathogenic bacteria is more or less sensitive to the antibiotics produced as secondary metabolites by the antagonistic bacteria .The purpose of the study will be frustrated if it doesn't lead us to think and highlight about the use of these antagonistic bacteria as a substitute to the commercially available and indiscriminately used common antibiotics to combat infections, overcome problems of developing antibiotic resistant pathogenic strains and other side effects of antibiotics etc.

STATUS OF FISH DISPOSAL SYSTEM IN RESERVOIR FISHERIES: A CASE STUDY IN MADHYA PRADESH

PRADEEP K. KATIHA[2], SANCHITA SARKAR[1], and M. K. Pal[3]

1Central Inland Fisheries Research Institute, Barrackpore – Kolkata
2Directorate of Census Operations, Gandhi Nagar - Gujarat
3Department of Economics with Rural Development,
Vidyasagar University, Paschim Midnapore - West Bengal

The efficiency of fish disposal system from reservoirs in India is seldom questioned due to their location in the remote areas and lack of infrastructural facilities for storage and transportation. Further, high perishability of the product, poverty stricken condition of fishers and poor infrastructural base lead to generation of large number of intermediaries in the system and make fishers dependent upon them who use to extract most of the profits of fish sale due to their solvent economic condition. Present communication was undertaken to i) portray present status of fish disposal system (fish market structure, fish supply chain, fish physical flow, price spread and marketing efficiency) ii) identify major constraints of the system and outline possible focal areas of intervention. The study was done at Dahod reservoir (460ha), a small productive reservoir located in Raisen district of Madhya Pradesh. Results of the study indicated i) market expanded many times in terms of number of market functionaries and volume of fish catch handled whereas market expansion in terms of new buildings, cold storages, ice factory is nil, ii) inverse relationship between length of the supply chain and fisherman return, hence marketing channel with less no. of intermediaries happens to be more efficient, iii) Storage is the most severe constraint for primary markets whereas for terminal and secondary markets unstable quantum of fish catch, low quantity of catch, lack of price control and perishable nature of the product are the major constraints. The study also recommends some suggestions for improving reservoir fish disposal system.

IMPROVING FISH PRODUCTIVITY AND EQUITY IN COMMON PROPERTY WATERS: A STUDY OF INDIAN RESERVOIRS UNDER DIFFERENT FISHING REGIMES

PRADEEP K. KATIHA[1], SANCHITA SARKAR[2], and M. K. Pal[3]

1Central Inland Fisheries Research Institute, Barrackpore – Kolkata
2Directorate of Census Operations, Gandhi Nagar, Gujarat
3Department of Economics with Rural Development,
Vidyasagar University, Paschim Midnapore - West Bengal

The declining trend in fisheries of inland open waters like rivers, estuaries, etc. adversely affected the livelihood of thousands of inland fishers. To sustain their livelihood, reservoirs offer immense potential through increase in production (6.5 times) and employment (0.75 million). The reservoirs are recognised as the 'sleeping giant' for inland fisheries development in India. These are common property multiuse waters utilised primarily for irrigation, hydro-power generation and flood control and secondarily for fisheries, domestic water supply and day to day uses. Different stakeholders with conflicting interests complicate fisheries development process in these waters, which needs to be addressed through appropriate institutional arrangements to increase efficiency of production and equity. The fisheries management practices vary according to the fishing regimes followed in a reservoir. It influences both the productivity and distribution of benefits among various stakeholders and has direct impact on the efficiency and equity. Present paper attempts to analyze reservoir fisheries in India under different fishing regimes towards improving fish productivity and equity.

Pahuj reservoir (518 ha) in Jhansi district of Uttar Pradesh and Dahod reservoir (640 ha) in Raisen district of Madhya Pradesh were purposely selected for the study, as they belong to small category of reservoirs and considered as the representative for the reservoir offering potential for fisheries development. These reservoirs are under the ownership of State Department of Irrigation (DoI). For fisheries purpose, these are managed by State Department of Fisheries (DoF). In Dahod, DoF is responsible for fisheries management including fish seed stocking, and monitoring of fish catch, while lessee and his associates conduct fisheries management, monitoring and fish seed stocking

in Pahuj reservoir. Fishing rights of Dahod reservoir are with the fishers of three co-operative societies, while for Pahuj these are with private contractor (lessee). The fishing in Dahod is on royalty basis Rs/kg of fish biomass harvested, while at Pahuj, the lessee engages fisher parties/ local fishers for fishing on remuneration (Rs/kg) of fish catch. The remunerations for fishers depend on negotiations between the fishers and lessee. Both fishing regimes have advantages and disadvantage. The paper explains these aspects and suggests measures to improve fish productivity, management and equity to uplift the socio-economic status of fisher community.

A PROFILE OF WATERSHEDS OF RIVER KAMENG IN ARUNACHAL PRADESH: A CASE STUDY FOR CONSERVATION MEASURES ALONG WITH AQUACULTURE DEVELOPMENT

P.Nath[1] & S.C.Dey[2]

1 . P. Nath,
2. S.C. Dey, Gauhati University (ex)

The river Kameng (par nee) in Arunachal and Jia Bhorali in Assam and one of the largest Tributaries of R. Brahmaputra is the potential house of Mahseers especially Golden Mahseers and along with other miscellanious spp. (Labeo dero, pangusia, loaches etc.) in the North eastern Region. In view of richness occupies an important place in boosting up local economy, if systematically exploited. Further, the population of Mahseers and its desity was so high in the past led to the establishment of Anglers Association in both the States but “Jia Bhorali Anglers Association” has been operating since many years. The catch of the past records and of; the present day revials the zize, occurrence and distribution of different varieties of Mahseer available in the Region which has gone down drastically to a great extent. The worst experience has been during the international Angling Festival conducted by the Govt. of Arunachal Pradesh in the recent year along the river stretches of the R. Kameng.T he International Tourists remarked while appreciating of the peace and tranquility of the Region that serious thought needs to be pondered on the dwindling size and catch of the Mahseers from the river owing to the environmental stress in the riverine habitat.

The attempt of this paper has been to highlight the major cause of depletion of the fish and fisheries of the river, steps ahead for protection, conservation, observation of breeding grounds and aquaculture development with reference to the R.Kameng.

WETLANDS OF BUNDELKHAND REGION: POTENTIAL RESOURCES FOR FISH PRODUCTION

B.K. Singh and K.D. Joshi

Allahabad Regional Centre,
Central Inland Fisheries Research Institute, Allahabad

The Bundelkhand region of central India spreads over vast geographical area in the states of Uttar Pradesh and Madhya Pradesh. The Region is semi-arid plateau which encompasses 12 districts of northern Madhya Pradesh (MP) and 5 districts of southern Uttar Pradesh (UP). The landscape is rugged, featuring undulating terrain with low rocky outcrops, narrow valleys, and plains. The area is highly drought prone and backward. To maintain potable, irrigation and household needs the rulers of the region had constructed a number of water harvesting units in the form of tals or tanks. Some of these tals are perennial source of water to the peripheral populace. Some of thetals are used for fish farming since long. Eight such tals or wetlands in the region were studied during 2010-12. All the wetlands were closed and the water spread area varied from 14.0 ha to 151.0 ha. Sediments were alkaline in pH, dominated by sand (77.0-98.0 %) and rich in organic carbon (0.2-2.9 %). Moderate to rich values of dissolved oxygen, pH and other water quality parameters indicate considerably productive nature of the wetlands. In general abundance of phytoplankton was higher (61-100 %) with dominance of blue green algae (22.2-100.0 %) followed by green algae (8.2-42.1 %) and diatoms (2.7-30.1 %). The benthic fauna was dominated by insect larvae (34.8-95.1 %) followed by molluscs (1.2-6.1 %) and annelids (4.3-25.6 %). Wetlands were poor in aquatic vegetation. Fish production potential in the wetlands estimated between 800-1000 kg/ha/yr, and 20 % of the potential is being harnessed presently. Wetland specific management protocols will be discussed in the paper.

FISH PRODUCTION POTENTIAL IN GUJAR TAL WET-LAND, JAUNPUR, UTTAR PRADESH

S. C. S DAS, B. K. Singh, V. Kumar, A. Alam and K. D. Joshi

Regional Centre, Central Inland Fisheries Research Institute, Allahabad

Eastern Uttar Pradesh is blessed with rich water resources in the form of river, rivulets, wetlands and ponds. The wetlands in the region are valuable resources for fish production. Gujar tal in the Jaunpur district is studied for its various parameters. Water spread area of wetland is 210 ha and lies in 250 58' 40''N and 820 38' 54''E. The maximum depth of the water is about 2 meter during winter, increases in rainy season and decreases in summer. The periphery of the wetland is infested with the macrophytes like Neumbo sp, Hydrilla sp, Nagas sp Potamogeton sp, Eicchornia sp etc. The centre zone of the lake is free from the surface floating weeds. The water of the wetland is alkaline (pH 7.3) with moderate oxygen content (4.8mg/l). The key water quality parameters like bicarbonate (172 mg/l), Chloride (24.14mg/l), Calcium (32.064 mg/l), Magnesium (7.74 mg/l), Sp. Conductance (305 S/ cm), TDS (171 mg/l), Total Hardness (112mg/l) were found in moderate level. The wetland harbours rich fish diversity comprising Labeo rohita, L calbasu, Catla catla, Cirrhinus mrigala, Wallago attu, Clarius batrachus, Heteropneustes fossilis, Mystus vittatus, Channa marulius, C. striatus, Ctenophyrongodon idella, Cyprinus carpio, Labeo bata, Salmostoma bacaila, S. laubuca, Chanda nama, Nandus nadus, Colisa fasciatus, Cirrhinus reba, Puntius ticto, P. sarana etc. Fish production from Gujar tal is quite low which could be enhanced many folds by control on carnivorous fish, control on aquatic weeds, proper stocking and use of pen culture for seed and yearling raising. The detailed will be discussed in the paper.

IMPACT OF CONSTANT ACCLIMATIZATION TEMPERATURES ON GROWTH, THERMAL TOLERANCE AND OXYGEN CONSUMPTION OF EARLY FRY OF LABEO ROHITA (HAMILTON, 1822)

M P Brahmane, Ajay D Nakhawa, B Sarkar, K K Krishnani

School of Edaphic Stress Management,
National Institute of Abiotic Stress Management (ICAR), Baramati, Pune

Determination of early life stages of fish for thermal tolerance, optimum temperature for growth, rate of oxygen consumption is becoming essential for aquaculture industry in the climate change scenario due to long-term variability in temperature and the seasonal and diurnal variability of temperature. Six hundred early fry stage rohu, Labeo rohita (initial weight 0.097±0.01 g) were equally distributed at four different temperatures (28, 30, 32, 34°C) each with three replicates for a period of 40 days. Highest body weight gain was between 30 and 32°C and lowest feed conversion ratio (FCR) was at 30°C. The percentage weight gain and specific growth rate at 30°C was 382±8.01 and 0.88±0.03 respectively, significantly higher than at other acclimation temperatures. Thermal tolerance and oxygen consumption rate were analyzed to determine the temperature tolerance limits and metabolic activity at four acclimation temperatures. Critical thermal maxima (CTmax) was 42.86±0.04, 43.3±0.02,44.45± 0.02 and 45.42±0.03, critical thermal minima (CTmin) was 13.07±0.04, 14.35±0.02, 14.92±0.04 and 15.64±0.03 at 28, 30, 32, 34°C respectively and increased significantly with increasing acclimation temperatures. Oxygen consumption rate for four acclimatization temperatures increased significantly, 110.75 ±0.44, 126.57±0.60, 146.22±0.68, 166.47±0.86 mgO2 kg-1h-1 at 28, 30, 32, 34°C respectively. Temperature preference of the early fry of rohu was derived from relationship between acclimation temperatures and Q10 values for 28-30°C, 30-32°C, 32-34°C were 1.94, 2.05, and 1.91 respectively. The optimum temperature range for growth was 30-32°C and Q10 value was 32-34°C. Survival at different acclimation temperatures was between 98.7±2.31, 96.0±4.0, 93.3±2.31 and 94.7±4.62, from lower to higher temperatures.

INDIAN FARMED SHRIMP EXPORTS TO EU – AN ANALYSIS OF REJECTIONS AND POLICY MEASURES

V. Geethalakshmi and Femeena Hassan

Central Institute of Fisheries Technology, Kochi

Shrimp has long dominated the seafood exports from India. India's frozen shrimp exports during 2011-12 was 1.89 lakh tonnes fetching a revenue of 1741 US million dollars. The shrimp export has been plagued by a number of issues - the EU ban in 1997, the US threat to ban import for non-compliance on use of TED, antidumping investigations and the subsequent tariff imposition, quality problems in Japan being some of them. India's frozen shrimp exports to EU is on the increase during the past years. The Indian share to the total frozen shrimp imports by EU is around 7%. Out of its total frozen shrimp exports, India exports around 24% to the EU countries. Due to the stringent food safety norms for exports to the European Union countries, the Indian seafood processing industry has incurred huge investment by way of equipments and infrastructure. On the other hand, incidence of rejection of farmed shrimp exports to EU for antibiotic residue occurs very frequently. Approximately 0.75 to 1 lakh tonnes of farmed shrimp exports to EU get rejected which is around 80% of the total export rejections. This paper gives an insight to the farmed shrimp exports from India to the EU, analyses the trend in rejections over the past few years and suggests suitable policy remedies.

A STRATEGY FOR MARKET PRICE STABILIZATION OF INLAND FISHES THROUGH LOW COST PRESERVATION TECHNIQUE

M. Nasser, V. Geethalakshmi and S. Ashaletha

Central Institute of Fisheries Technology, Kochi

Fish is a highly perishable commodity and when not in fresh condition fails to fetch its premium price. Therefore, fishermen has a tendency to sell their catch as early as possible, which is exploited by traders to their advantage often resulting in a low price realisation to the primary producer, especially when the landings are more or the catch reaches late to the market. Aroor market located in Alappuzha district is a major market for inland fishes handling about 750 tonnes of fish annualy. The market caters mainly to around 150 stake net fisherfolk, many of them being women, operating in the inland water bodies in Alleppey district. During the benchmark study conducted under the NAIP project on "Responsible harvesting and utilization of selected small pelagic and fresh water fishes", it was found that fisherfolk who come to the market late are forced to dispose their catch at very low prices. It has been assessed that around 110-130 tonnes of fish are thus disposed off at low prices annually, resulting in loss of revenue to the primary producer which affect their livelihood. Two low cost energy efficient 'chillrooms' developed under the NAIP project were introduced in the market on an experimental basis and the stakeholders were motivated to use the facility to hold their catch when the price fall. An operational protocol for the system was implemented which proved sustainable. The intervention led to 30 to 35% increased price realization for those who were forced to distress sale earlier. This experiment also leads to an overall price stabilisation effect in the market. This paper details the technology, market strategy and the operational protocol of this intervention implemented at Aroor fish market in Alleppey district.

ENHANCING WATER PRODUCTIVITY OF INDIAN RESERVOIRS THROUGH ENCLOSURE CULTURE IN PUBLIC-PRIVATE PARTNERSHIP MODE

Satish K. Bara, A. K. Das and S. K. Banik

Central Inland Fisheries Research Institute,
Barrackpore, Kolkata

Fish enclosure culture is a rapid aquaculture practice of producing fish with more yield compared to traditional pond culture system. Enclosure culture is used widely in fish seed production across the world especially in freshwater bodies. In India, the exponential growth, in our population and the great pressure on land for habitation and agriculture, the large water resources such as tanks, lakes and reservoirs, which have been hitherto under-exploited, need to be harnessed for augmenting fish production. Because of complex problems of management, aquaculture cannot be undertaken in these water bodies. The best solution seems to be captive, regulated culture of suitable fishes in pens and cages installed in them.

Public-private partnership (PPP) describes a government service or private business venture which is funded and operated through a partnership of government and one or more private sector companies. These schemes are sometimes referred to as PPP, P3 or P3. PPP involves a contract between a public sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical and operational skills and risks in the project. In enclosure culture especially cage culture practices are aimed at creating public goods in the infrastructure sectors, the government may provide a capital subsidy in the form of a one-time grant or as negotiated between the two for cage installation and other works, so as to make it more attractive to the private investors. The vast productive water area under reservoirs of India particularly medium and larger ones are so far unexplored as far as fish production is concerned. The techniques of cage culture system for production of fish seeds and table fish through PPP mode will be of immense help not only in sustaining steady supply of fingerlings for the reservoirs to be stocked but also enhance water productivity of the majority of Indian reservoirs, thereby much more protein supplement would be assured for the rural as well as common people and upliftment of socio-economic status of the poor fishers thriving the open water bodies especially reservoirs.

ICHTHYOFAUNAL DIVERSITY OF A CENTRAL INDIAN RESERVOIR, MADHYA PRADESH (INDIA)

Nirmal Biswas[1], Satish Bara[2], A.K.Das[2] and Ashwani Wanganeo[1]

1Department of Environmental Science and Limnology, Barakatullah University, Bhopal
2Central Inland Fisheries Research Institute, Barrackpore, Kolkata

The present study has been undertaken to ascertain the ichthyofaunal diversity of a central Indian reservoir, Dahod, constructed on Bagwani nala and Bithouri nala tributaries of river Betwa. The reservoir is at Goharganj Tehsil, Raisen District, 60 km way from Hoshangabad and 40 km from Bhopal. Dahod reservoir (23 o 2′ N & 77 o 29′30″ E) is an irrigation impoundment in semi-agro fertile land with a waterspread of 459.94 ha at FRL. It has a total catchment of 51.79 Km2 with a gross capacity of 27.75 x 106 m3 at FRL. The study has been carried out during September 2006 to August 2009. The fish species were collected with the help of local fishers at different intervals. During the period of investigation, 44 fish species belonging to 6 orders and 12 families were recorded. The order Cypriniformes was found to be a major one having 50% contribution. Siluriformes with 21%, Perciformes with 14%, Synbranchiformes with 7% and Osteoglossiformes and Beloniformes with 4% contribution as per the order of sequence. Overall, the family Cyprinidae dominates in this reservoir. The stocking of IMC has had moderate influence on the endemic species of this reservoir. It could be concluded that Dahod under small category reservoir was rich in fish diversity.

POTENTIAL UTILIZATION OF RUBBER SEED MEAL AS AN UNCONVENTIONAL FEED SOURCE FOR AQUACULTURE PRACTICES

Biraj Bikash Sharma[2], Gadadhar Dash[1] and Ratan Kumar Saha[2]

1Department of Aquatic Animal Health, Faculty of Fishery Sciences, WBUAFS, Kolkata
2Department of Fish Health and Environment, College of Fisheries, CAU, Tripura

The present study was conducted to review the effective utilization of locally available and cheap nonconventional feed resources in aquaculture practices. The rubber plantation is plenty throughout the country and there is no effective utilization of the seed except some portion is used for natural plantation purpose. The use of rubber seed meal in monogestric has been reported in many tropical countries such as Sri Lanka and Malaysia in Asia. From the study it was found that the meal is useful substitute for coconut meal in broiler rations. There was no significant difference in egg production when feeding layer hens with rations containing rubber seed meal. In a comparative study between the process and raw seed it was found that rubber seed kernel could be incorporated in diets of finishing meat-type chickens. Experimental chicken diets containing 10, 20, 30 and 40% rubber seed meal was conducted in Sri Lanka. However there was a growth depression trend in pigs consuming the meal, though the difference was not significant. An inclusion level in Vietnam at 5, 10 and 15% level in broiler rations found that the chickens grew best when fed 10% supplemented with 0.15% crystalline methionine in the diet. In another study, concerning the aquaculture the seed meal was incorporated in Nile tilapia and it was found that up to 30% level there was no adverse effect concerning FCR, FGR and PER. In case of Indian major carp Labeo rohita there was no significant difference with control in the rubber seed meal formulated diet. The limiting factor for the utilization of higher percentage is the presence of a toxic factor i.e. cyanogenic glycoside that decomposes either as a result of enzyme action or from being in a very slightly acidic medium. Effective processing approach may lead to the full utilization of the seed meal as an efficient protein source.

ENTREPRENEURSHIP DEVELOPMENT MODEL FOR WOMEN IN RESERVOIR FISHERY SECTOR

S. Ashaletha*, M. Nasser and V. Geethalakshmi

Central Institute of Fisheries Technology, Kochi

India has a large spread of fresh water resources in the form of rivers, reservoirs, lakes, ponds. Indian reservoirs, being in the tropics, have high primary productivity and have the capacity to produce more fish than their present low Indian average of 29.7 kg/ha/yr in reservoirs. Though stocking cum capture system exists in reservoir fisheries sector, role of women in this is very minimum or practically nill compared to other fresh water & marine sectors. This is very true among the women in reservoir fishing communities of Kerala, who mostly belong to Scheduled Tribes. The trading system for reservoir fishes is not at all organised or well developed. The fish caught are sold at production site at low price and the trend of value addition is an area which is not given much thought due to many reasons.

In this paper, the success story of moulding women from tribal fishing community of the remote areas of Kerala making use of their basic indigenous knowledge, skill, potential and resources to dynamic entrepreneurs is presented. Under the NAIP project " Responsible harvesting and utilisation of Selected small pelagic and fresh water fishes" operational at CIFT, Cochin, tribal fisherwomen belonging to Chulliyar Tribal Fishermen society, Kerala were empowered through adopting a unique Entrepreneurship development model, "Fisherwomen's Entrepreneurship Capacity building Model" (FECAM)

The participatory development of FECAM model as a full package of solution for entrepreneurial development of women from socio-economically backward sectors as well as the successful implementation of the programme is brought to light in this paper. The FECAM model has got wider applications in State departments, NGOs, District Industrial Centres, MSME, KVKs of all locations where similar situation exists.

DEVELOPMENT OF SOME MODEL CODE FOR ESTABLISHING PUBLIC PRIVATE PARTNERSHIP IN MANAGEMENT OF DIFFERENT ENVIRONMENTAL, DISEASES AND CAPACITY BUILDING ISSUES FOR THE SUSTENANCE OF INLAND FISHERIES

Umesh C.Goswami

Department of Zoology, Fish Biology & Fisheries Sciences, Centre for Aquaculture & Aquatic Resources Monitoring , Biodiversity & Bioinformatics, Gauhati University, Guwahati, Assam

Public private partnership issues are effectively pursuing in several fields and the findings from those implementations would be guidelines for preparing some effective model as per suitability and application in fisheries sectors. In this context an efficient model could be shorted out in the management of various environmental issues related to preparation of quality environment for different sectors of inland and culture fisheries, as well as maintenance of quality of the aqua bodies. Along with the environmental issues, the conservation aspects of the endangered species will be an added issue. Like the environment, the control of diseases and capacity building etc. are issues which could be addressed through public private partnership issues.

In the present communication several such successful issues that have been addressed in different aspects of inland fisheries and aquaculture in North East India be presented for the development of some strategies concerning the needs of different regions.

IMPORTANCE OF ORNAMENTAL FISH CULTURE IN PUBLIC AND PRIVATE SECTOR

Sanjeev Kumar, Kurva Raghu Ramudu, S. Behara and Gadadhar Dash

Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences, Kolkata, West Bengal

Ornamental fishes form an important commercial component of aquaculture providing for aesthetic requirement and upkeep of environment. The farm planning is unique method of brining change in the farmer's life. After independence, the small farmers have been handicapped in having access to the co-operative credit both for current inputs and investments.

Small farmers are stared doing keeping ornamental fishes in aquarium has emerged as the second most popular hobby of people in recent years, next to photography. Ornamental fishes are assuming importance in recent days as stress removers. It has been estimated that 1.5 to 2 million people worldwide keep marine aquaria with 600,000 households in the United States alone.

Keeping ornamental fish, and breeding and culture of ornamental fishes are to earn more income in public and private sector. India is the marginal player in the global trade of ornamental fishes with a market share of 0.07%. It may be possible to raise the share to a level of 0.1% in the next 5 years accounting for exports worth of 30.45 crores rupees. About 80% of ornamental fishes from India to International market are exported via Kolkata Airport, of which the lion's share (more than 80%) is contributed from North Eastern Region.

As far as the export of ornamental fishes from India is concerned, 90% of the total exports are wild caught fishes of fresh water origin and arising from North-Eastern region. The remaining 10% are either tank reared or breed and reared varieties of exotic species of fresh water or marine origin. To improve ornamental breeding and culture we need so many things to improve in between public and private sector. Cooperative society strongly needed loans from government, Production of mono sex population is of great importance in aquaculture, Application of hormones (natural and synthetic) is widely accepted. The hormone is selected an induced to the fishes through different methods (immersion, oral and injection).

Transfer of technology to to public and private sector entrepreneurs who approach is being planned by imparting hands on training through different modes.

ROLE OF PREDATORY BIRDS ON CULTURE BASED FISHERIES IN AQUA FIELD, THEIR PREVENTION AND CONTROL

Kurva Raghu Ramudu, Gadadhar Dash

Department of Aquatic Animal Health
Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences, Kolkata, West Bengal

Several bird species have been identified as “problem species” on culture based fisheries in aqua field. Many species of birds prey on cultivable fishes causing significant losses, predators can kill or wound fish (primary infection), then secondary infection like bacterial, viral and fungal infection starts then cause stress to the fish that results in reductions in appetite that in turn causes poor growth and reduced resistance to disease. This in turn causes poor production and profitability. Records shown that Peligans are the highest predatory fishes, 15kg/month is consumed by this bird. Cormorants, Terns are the lowest predatory fishes, 1.5kg/month consumed by this fishes. Not only that damage equipment and nets, resulting in escape of fishes through damage. Due to predation on fishes by the predatory birds so much economic loss, so it is significantly need the prevention and control of predatory birds in aqua field.

FISH GENOMICS RESEARCH IN INDIA - NEED FOR PUBLIC PRIVATE PARTNERSHIP FOR ITS ADVANCEMENT

Tandrima Mitra, Sudeshna Banerjee, Arabinda Mahanty, Prasenjit Paria, Satabdi Ganguly, Amit Kumar Mukherjee, Soma Bhattacharjee, Sasmita Mohanty* and Bimal Prasanna Mohanty

Biochemistry Laboratory, Central Inland Fisheries Research Institute, Barrackpore, Kolkata *KIIT School of Biotechnology, KIIT University, Bhubaneswar

Genome is an entire set of hereditary instructions for building, running, and maintaining an organism, and passing life on to the next generation. Full genome sequence of a species provides detailed information on gene map, a foundation for the identification of production quantitative trait loci (QTL) that can be exploited in gene-assisted selection for brood stock development; and acts as a reference guide for the genomes of other species. The successful completion of the human genome project marked the beginning of the genomics revolution. First blue print of the human genome sequence was made available in the year of 2003 by the joint collaboration by U.S. federally funded Biological and Environmental Research in the U.S. Department of Energy's Office of Science and Celera genomics (Business unit of the Private organization Applera Corporation). Aquaculture is one of the fastest growing food producing sectors in the world, with in annual average growth rate of 6.9% per year since 1970. Due to the economical and ecological importance of fish, genomic data are eagerly needed for genetic improvement purpose. It indicates each advance study possible by combination the knowledge base and infrastructure of public Research & Development institutes and private Research & Development institutes. In 2009 the genome sequence of the wild strain of zebra fish containing 1.7 billion genetic letters was independently sequenced by Indian research Laboratories (IGIB, New Delhi). This has the potential to impact aquaculture and fisheries production and has implications for the management of fish genetic resources. Zebra fish (*Danio rerio*) is the first vertebrate to have its whole genome sequenced in the year of 2005. Following that genome sequencing of other species like mustard (*Arabidopsis thaliana*), red alga (*Cyanidioschyzon merolae*), rice (*Oryza sativa*), green alga (*Ostreococcus tauri*), black cottonwood (*Populus*

trichocarpa), Pufferfish (*Takifugu rubripes*), Western clawed frog (*Xenopus tropicalis*), chicken (*Gallus gallus*), cattle (*Bos primigenius*) has been completed. For advancement of the fish genomics research in India, there is a need for greater linkage among the public and private research institutions through public private partnership.

MARKETING OF VALUE ADDED FISH PRODUCTS IN PUBLIC PRIVATE PARTNERSHIP MODE

Bahni Dhar[1], Ranendra Kumar Majumdar[1] and Pampa Bhattacharjeee[2]

1 Dept. of Fish Processing Technology,
2 Dept. of Fisher Resource Management
College of Fisheries, CAU, Lembucherra, Tripura

Fisheries play a very important role in the Indian economy. It provides employment opportunities to large sections of the population, supplies rich protein diet at affordable costs and earns foreign exchange. India has a good potential to have favorable financial returns for value-added production of fishery products which indicates encouraging prospects. Less preferred or low cost fishes available are preferentially utilized for preparation of different value added fish products such as fish & prawn pickle, fish finger, fish roll, fish cutlet, fish samosa, sandwich etc. Preparation and marketing of such value added fish products can play a significant role in income generation through employment & small or medium type enterprises can be established for both rural and urban sector of the society. Marketing of value added products is completely different from the traditional seafood trade. It is dynamic, sensitive, complex and very expensive. Marketing surveys, packaging, proper labeling and advertising are few important areas, which ultimately determine the successful movement of a new product. Packaging requirements change with product form, target group, market area, species used and so on. Most of the market channels currently prevailing for raw fishes are not applicable for value added fish products for smooth flow of marketing. A new and an appropriate channel would probably be the super market chain. Designing and market development of ready to eat fish products like fish tikkas, kababs, sausages, salami etc utilizing fishes disposed in fresh form both inland and marine sectors, for the domestic as well as the export market is at infant stage and this sector requires more attention. Moreover, in North-eastern states marketing of such value added ready-to eat products are to be intensified for promotion of already developed products available in different parts of the country. In many parts of the region people are not even aware of such development mainly due to the lack of appropriate marketing for such

products. Public private partnership has important roles to play in marketing of such products. PPP is one of the eight millennium development goals of UN in which India is also a signatory. Therefore, to implement Millennium Development Goal marketing of value added products is need of the hour. Promotion of marketing of value added products requires huge capital, infrastructure and expertise. Under the situation it is expected participation of private agencies under PPP mode in this venture would surely help these products to reach to many consumers in different parts of the country and abroad through appropriate marketing channels.

APPROPROATE POST HARVEST TECHNOLOGIES FOR FRESH WATER AQUACULTURED FISHES – STRATEGGIES FOR PUBLIC – PRIVATE – PARTNERSHIP INITITAVIE

B A Shamasundar

Department Of Fish Processing Technology
Karnataka Veterinary,Animal And Fisheries Sciences University
College Of Fisheries, Mangalore

The demand for fish is increasing world over due to its high nutritive value. However, it has become increasingly difficult to meet the demand due to short supply. Though the world fish production has increased during last decade, this increased supply is not sufficient to meet the demand. In India the fish production from aquaculture practices is contributing to more than 50% of total production. The marine fish production in India has been almost constant for the last 5 years and possibility of increasing fish catch will be small. Any increase in fish production to meet the growing demand has to be met by aquaculture practices. It is expected that by 2020 the production of fish from aquaculture practices may reach 10 million tones. To utilize the farmed fish effectively for food and non food purpose, it is imperative there should be better post harvest management practices. The technology for the production of fillets, various mince based products and neutracticals are available and can be effectively made use of. The processing waste such as skin, bones and entrails can be used for high value products like gelatin and industrial enzymes. The processing of fresh water aquacultured fishes requires capital investment. The investment should flow from public organizations like fisheries development corporations and entrepreneurs for production and marketing of processed fisheries products. This initiative should be looked at providing nutritious food to our larger population than at only profit motive.

THE IMPORTANCE OF SMALL INDIGENOUS FISH SPECIES TO SUSTAINABLE CULTURE-BASED FISHERIES

Sumana Narayanan

International Collective in Support of Fishworkers (ICSF)

Fish has been an integral part of the diet for a large number of people near water bodies. Many of these species, including small and indigenous fish species, are familiar only to the local population. They are either caught from nearby water bodies or cultured in small ponds/paddy fields. Complex patterns of access rights to such indigenous fish species, such as allowing community access to even privately-owned paddy fields, have been documented contributing to food security and poverty alleviation. The health benefits of such indigenous species are also well known to the local population. However, data on capture and consumption of these species is lacking and they often do not get recognition in fisheries and aquaculture development policies. Due to pressures that include growth in capture-based culture fisheries, and the pollution and degradation of water bodies such indigenous species are under threat; a trend with grave import for biodiversity in freshwater ecosystems. Considering the nutritional, food security and poverty alleviation benefits of small indigenous species, it is important to consider promoting conservation and sustainable use of these species, including in culture based capture fisheries in inland water bodies.

PROSPECTS OF OSTEOBRAMA BELANGERI AQUACULTURE IN NORTH EAST INDIA

B. K. Behera, N. Samarjit Singh, Priyanka Das, Asim Jana and A.P.Sharma

Central Inland Fisheries Research Institute
Barrackpore, Kolkata

Osteobrama belangeri (Val.) locally known as 'pengba' in Manipur is a medium carp (Family- Cyprinidae) endemic to Manipur, India. However, the fish has almost disappeared from the Loktak Lake (Menon, 1989) and other water bodies of the central plain of the state. Hence induced breeding and seed production and aquaculture of Osteobrama belangeri are very important for conservation and fish production enhancement in NE India. Osteobrama belangeri is omnivorous in the juvenile stage and herbivorous in adult stage. Therefore, this species can be a candidate fish species in composite fish culture replacing Grass carp, Ctenopharyngodon idella. In addition to that, Osteobrama belangeri has a better consumer preference and market price.

ROLE OF PUBLIC PRIVATE PARTNERSHIP WITH FISH BIODIVERSITY IN AQUATIC RESOURCES OF RAIGARH DISTRICT OF CHHATTISGARH, INDIA

Gourishanker Patel and Dr. M.S. Chari, S.R. Gaur, Pravej Kolhe,

College of Agriculture Raipur, Indira Gandhi Agriculture University Raipur (C.G.) 492001

Freshwater fishes from selected sites of the rivers, reservoirs and ponds were collected during the study period from November, 2011 to May, 2012. Fish biodiversity study was done in three rivers *viz.*(i) Mahanadi (ii) Mand (iii) Kelo and two reserviors namely Chinkari and Kedar along with three village ponds Chhapora, Kodatarai and Pussore in Raigarh district.

A total of 61 species under 41 genera, 22 families and 7 orders were recorded. Five new entrants *Eutropiichthys murius, Gagata gagata*, *Johanius gangaticus, Ompak pabda* and *Tor putitora* were recorded. In this study 54 species were observed in Mahanadi, 30 in Mand, 37 from Kelo, 24 from Chinkari dam, 18 from Kedar dam and 14, 12, 14 from Chhapora, Pussore and Kodatarai ponds respectively.