Book of Abstracts

International Symposium on Aquaculture and Fisheries Education

(ISAFE)

27 - 30 November 2009
AIT Conference Center
Pathumthani, Thailand

Organizers:

Asian Institute of Technology
Shanghai Ocean University
Asian Fisheries Society

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Publication sponsored by:

Aqua-Internship
EU Asia-Link Program at AARM, AIT

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1.1 A systems approach for aquaculture/ fisheries education

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Curricula need to be relevant to the developmental needs of an increasingly sophisticated commercial sector as well as to those of marginalized communities. A systems approach is required for aquaculture education to complement the traditional reductionist approaches of conventional science to ensure that graduates promote development that is both socially and environmentally sustainable. Philosophy should also be taught because it determines our world view and way of thinking to lead to ethical behaviour towards both humanity and nature.

A systems approach comprises the concept of holism, a study of the whole system rather than component part in isolation; a physical system such as an aquaculture system located in a hierarchy of systems from organism, through enterprise and farm, to community, region, nation and the world with diverse stakeholders; and methods for identifying and solving problems or identifying and exploiting opportunities.

It is hardly possible to become a specialist in more than one subject but curricula should comprise a range of subjects to develop broad minds that appreciate the complexity of interactions between various factors affecting aquaculture systems. An interdisciplinary mix of at least the following is needed: biology (production technology), social sciences (people and money), and environment.

Besides multi- or rather inter-disciplinarily, there is a need to teach systems methodologies, either to identify and resolve problems or to identify opportunities for development through aquaculture. A general, seven step systems methodology is outlined: define the problem (or opportunity), identify the system to which the problem (or opportunity) applies, characterize the system, analyze the problem (or opportunity), hypothesize a solution, test the solution, and implement the solution to resolve the original problem (or exploit the identified opportunity).

Examples of issues that can be addressed through a systems approach are presented: integration of aquaculture into development programs or farming systems research and extension, especially for poverty alleviation to provide alternative livelihoods and increased food security; improved efficiency of production and profitability of aquaculture; life cycle analysis of the environmental effects of aquaculture; and commodity chains from pond to plate with certification of produce.

1.2 A text book for beginners of fisheries science (general view of fisheries science)

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A common problem of educators who teach beginners of fisheries science such as freshmen of department of fisheries is how to teach them the broadness of the field. Especially in Japan, selection of expertise by young people became earlier and earlier. As the result, high school students who select biology do not want to learn chemistry and physics, or who select physics have no interest to sociology and economics. On the other hand, fisheries science is an integrative applied science. For example, the knowledge of social system and legal regulations are required for the solution of epidemics of fish disease as well as biology and biochemistry of pathogen and pathologies of targeted fish, and information of social and economical backgrounds is necessary for the establishment of resource management system of fish as well as population dynamics of fish. This problem is strongly recognized by the designers of curriculum and balance among classes of humanity, social science and natural science is considered in curriculum planning. However, most of students cannot actuary understand the importance of sociology, economics, mathematics, physics and etc. as the base of fisheries science. One of the solutions to the problem is to teach them advanced topics and very basic knowledge and topics of different research fields such as fisheries sociology, resource management, biology, biochemistry, ecology, physiology of aquatic in a class using a short text book. Student cannot obtain detailed mechanism of the phenomena, though they will notice relation between each topics and existence of common backgrounds of the topics and can obtain the general view of fisheries science. They can get incentive for leaning fundamental science which they did not have interest. A text book for this purpose was published in last April. The authors of the text book are mainly professors in Graduate School of Agricultural and Life Sciences, The University of Tokyo. The contents of the text book will be introduced in the presentation.

1.3 Fisheries education in the Philippines: status, problems and recommendations

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The first academic program related to fisheries started in the Philippines when the College of Agriculture of the University of Philippines (UP) offered in 1927 the Bachelor of Science in Agriculture, major in Fisheries. In 1936, the Zoology Department of the College of Liberal Arts, UP Manila offered the Bachelor of Science in Fisheries which was later phased out in 1948. The Republic Act (R.A.) No. 177 in 1947 created the Bureau of Fisheries with the Philippine Institute of Fisheries Technology (PIFT) as one of its divisions. The PIFT offered the Certificate in Fisheries course, a two and a half post secondary program with three majors: Fish Capture, Fish Culture and Fish Preservation. In 1952, R.A. No. 685 established 15 PIFT branches which became fisheries vocational high schools.

In 1957, R.A. 997 transferred the PIFT to UP Diliman which later became the College of Fisheries. The UP College of Fisheries implemented a new BS Fisheries curriculum which added the required G.E. courses to the modified fisheries subjects in the Certificate course. In 1963, R.A. 3742 transferred the vocational fisheries high schools to the Bureau of Vocational Education, Department of Education. Through more legislation, many fisheries schools were created and existing fisheries high schools elevated to state colleges or become colleges of state universities.

In 1981, the national government pursued the development of fisheries education through a World Bank project which identified the College of Fisheries of UP Visayas as the lead tertiary fisheries educational institution. Seven Regional Institutes of Fisheries Technology (RIFTs) were identified as vocational fisheries educational institutions and seven Regional Fishermen Training Centers (RFTCs) as fisheries training centres for industry practitioners located in the campus of each RIFTs. However, after the end of the Project in 1988, the RIFTs gradually became colleges or institutes of fisheries which offer the BS

Fisheries program. In 1997, R.A. 8435 otherwise as the Agriculture and Fisheries Modernization Act was passed which aimed to modernize and rationalize agriculture and fisheries education in the country.

Fisheries education in the Philippines is beset with numerous problems like proliferation and low standard of fishery schools, declining student enrollment and inadequate training of fishery teachers. The conversion of secondary fishery schools to tertiary education has contributed to proliferation of these schools with 63 higher education institutions presently offering fisheries and related courses. The conversion of these fishery schools resulted in increased budgetary allocation for the upgrading of the salaries of tertiary teachers. However, there were no additional increases for upgrading of facilities and operation of these schools. Santos and Lacanilao (1993) reported that most fishery schools have outdated facilities, inadequately equipped laboratories, few library holdings and the teachers do not have advanced degrees in Fisheries, although some have Masters degree in Education.

There is a declining trend in the student enrollment in fishery schools and colleges in the Philippines and this could be due to various reasons. One is the perception that fisheries are just like any other vocational course and not as glamorous as medicine or law. The presence of many below standard graduates of fisheries who are unemployed contributes to an image of a course with low employability.

The teachers of secondary schools that were converted to tertiary schools are generally graduates of Fisheries Education. This inadequacy is aggravated when these teachers undertake graduate degrees in education and not in fisheries. There are scholarships that are available but some teachers are reluctant to leave their families to pursue graduate degrees in fisheries in another university far from their homes. Due to limited funds, teachers are seldom able to attend further training, conferences and seminars to update their knowledge in fisheries.

The implementation of R.A. 8435 otherwise as the Agriculture and Fisheries Modernization Act could provide solutions to the problems of fisheries education in the Philippines. The aims of this law is to establish and support an integrated system of agriculture and fisheries education relevant to the needs of the country and to modernize and rationalize agriculture and fisheries education from primary to tertiary levels. It provides for a network of National Centers of Excellence (NCEs) in Agriculture and Fisheries Education in which not more than one agriculture and one fishery college shall be established in each of the

16 regions of the Philippines. Those educational institutions not included in this network shall redirect their programs to non-agriculture and/or non-fisheries areas or merge their programs with the NCEs. Through this law, the limited resources of the government can then be focused to these NCEs to be used for upgrading facilities and capacity building of their faculty.

1.4 The reform and development of higher education in fisheries and aquaculture in mainland China

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Fisheries education in China started from the beginning of the 20th century, with a history of more than 100 years. Since the middle of the 20th century, China's education in fisheries and aquaculture, especially higher education, has scored great achievement. Before the 50s of the century, its discipline set-up mainly followed the Japanese model. From the 50s to the 60s, the set-up and teaching plan were set up with reference to that of the former Soviet Union, establishing disciplines according to different lines of business and developing related disciplines according to the industries that needed support. In the beginning of the 80s and 90s, in order to meet the challenges of the new technological revolution and adapt to the needs of local economic development and student employment, the professional coverage of fisheries and aquaculture were broadened adjustments were made in the scope and direction of service, and the requirements for personnel were revised.

Since the mid-90s, a new round of education reforms and discipline adjustments has been conducted, including the revision of the 21st century-oriented catalogue of undergraduate disciplines in fisheries and aquaculture, the content of courses, curricular systems, and the reform of personnel training programs. Majors were increased and credit system promoted. The curricular structure aiming at cultivating compound talent was established. Great emphasis has been put on general education, the nurturing of comprehensive quality, and the infiltration, crossing and expansion of fisheries and aquaculture disciplines and other related disciplines. In order to highlight the nurturing of practical ability and innovative spirit, emphasis was also laid on comprehensive experiments and internship.

Up to date, a multi-layered, multi-disciplinary and multi-typed system of higher education in fisheries and aquaculture has come into being, with junior college students, undergraduate students and postgraduate students. In line with the catalogue of undergraduate disciplines promulgated by the Ministry of Education, three disciplines were established, including aquaculture science, marine fisheries science and technology, aquarium science and technology. At the postgraduate

level, four secondary disciplines were set up; they are aquaculture, fishery resources, fishing science, and fishery economics and management. Under engineering is another secondary discipline, i.e. aquatic products processing and storage engineering. Another two secondary disciplines, aquatic biology and marine biology, are under sciences. At junior college level, we have aquaculture technology, protection of aquatic animals and plants, marine fishing technology, integrated fisheries technology, fishery technology and fisheries administration and management.

Up until the March of 2009, in mainland China, there are more than 60 universities and scientific research institutes with fisheries and aquaculture education (including aquatic products processing and storage engineering) at undergraduate level and above, more than half of which have postgraduate education.

For twenty consecutive years since 1985, China has been number one in terms of output of aquatic products, accounting for one third of the global output. Higher education in fisheries and aquaculture is playing an important role in the nurturing of talent, research in science and technology, and the commercialization of research findings. Through multiple modes of education, including the combination of production, study and research, and the combination of teaching, research and commercialization, higher institutes of fisheries and aquaculture education has become the center of the industry.

1.5 Aquaculture and Aquatic Resources Management curriculum and teaching methods at the Asian Institute of Technology (AIT)

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The Aquaculture and Aquatic Resources Management (AARM) Field of Study and AIT offers post-graduate courses under three areas of specialization, namely 1) Aquaculture Technology (AT), 2) Aquatic Resources Management (ARM), and 3) Integrated Coastal Management (ICM). Aquaculture Business Management program is currently being developed to cater to people who would like to be equipped with both technical and entrepreneurial knowledge and skills for aquaculture business.

Aquaculture Technology (AT) places emphasis on production technology as it relates to seed, seed disease, water quality, system design and economics. Students in this area of specialization apply learned concepts and techniques of experimental design and analysis, production management, and environmental impacts. This enables them to systematically evaluate production and economic efficiency and environmental impacts of existing culture practices. In addition, students acquire the ability to identify opportunities and problems related to production and management practices and to define experiments to formulate solutions aimed at sustainable development.

Aquatic Resources Management (ARM) provides essential knowledge of basic tools of resource assessment, planning and management, i.e. systems modelling, environmental, economic and social analysis, and policy development. Students are able to apply learned concepts and tools to interpret reports of technical investigations and resource management policies. They can also assess aquatic resource utilization systems, identify opportunities as well as problems, and define effective management procedures aimed at sustainable utilization of aquatic resources. This includes the interface between aquaculture and capture fisheries.

Integrated Coastal Management (ICM) aims to build a strong cadre of coastal practitioners and policy makers with the knowledge, skills, and tools to set wise policy and plan, design and implement successful and sustainable integrated coastal management programs for countries in Asia and beyond. Students take core courses such as ICM principles and tools, coastal ecosystems and climate change, and they have the option of choosing courses from a variety of fields that will equip them with necessary knowledge and skills in planning for and management of the coastal zone in a way that integrates across sectors and stakeholders and in consideration of the effects of climate change.

1.6 Leading the way: fisheries program at Kasetsart University, Thailand

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Thailand started its educational program in Fisheries in 1943, one of the first four faculties established under the Kasetsart University Act of 1943. The Faculty of Fisheries at Kasetsart University (KU) is the first degree granting institution in Fisheries in Thailand. KU initially offered a five-year bachelor's degree program and a three-year associate program, with three departments, namely Aquaculture, Fisheries and Fishery Products. More than 60 years later, in 2009, there are around 22 institutions in Thailand offering the Fisheries program at the bachelor level, with a few offering at a graduate level. Less so are institutions offering a truly international graduate program, although there are those which offer a graduate program in English using the Thai curriculum. With the considerable number of degree granting institutions in Fisheries in Thailand, there is an on-going process of standardizing the Fisheries curriculum. This is also timely as KU itself is moving towards a research university status. The Faculty of Fisheries has produced graduates who are now working at different levels of the government, academe, non-governmental organizations, private sector and international organizations. Some are recognized as experts in their field, both in Thailand and abroad. In addition, the Faculty continues to reach out beyond its borders, to share Thailand's rich and vast experiences and dynamism in aquaculture and fisheries, thus an international graduate program in Fisheries has already been designed and is due to open in 2010. This is in response to a number of interested queries and requests from within and outside the country to learn more of Thailand's fisheries and aquaculture industry and expertise. This paper will present the capability and experiences of the Faculty of Fisheries at Kasetsart University in education, research, outreach, local and international collaborations, and in private-public partnerships.

1.7 Key roles of Can Tho University in education and development of aquaculture and fisheries in the Mekong Delta of Vietnam

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Vietnam is currently the third largest world's aquaculture producer (FAO, 2008). The Mekong Delta located in the Southern part of Viet Nam has its rich potential of over 1 million hectares of water surface. This Delta accounts for over 80% of the total country aquaculture production. In 2008, this region produced over 1.2 million tons of catfish and nearly 300,000 tons of shrimp, which contributes significantly to export value as well as labor markets of the country.

Located in the center of the Mekong Delta region, Can Tho University (CTU) has been playing key roles in education and development of aquaculture and fisheries in the region. The college of Aquaculture and Fisheries (CAF) was first found in 1976 as the Department of Fisheries in Can Tho University. With time, CAF has been innovating and strengthening itself to meet the increasing demands for the development of aquaculture and fisheries in the Mekong Delta. CAF has now a strong team of worldwide-graduated staff of 40 lectures and over 40 researchers, and systems of modern laboratories and research stations for basic and applied researches.

Since established, CAF has trained over 2,000 alumni who have been playing key leaders, managers, technicians, lecturers or businessmen in different organizations, colleges, institutes or companies relating to aquaculture and fisheries in the Mekong Delta. Recently, CAF has an enrolment of over 1,500 undergraduates, 100 master students and 10 PhD candidates. From only one study field in aquaculture at the beginning, CAF is now offering 8 study fields for bachelor programs, 2 fields for master programs and 2 fields for PhD programs. Especially, CAF has started an aquaculture bachelor program in English language and is moving forward to having master and PhD training programs in English for local and international students. In addition to diversifying the fields of study, CAF has a significant innovation in academic management, curriculum development and teaching-learning methods with application

of credit systems, informatic technologies, and other academic supporting facilities.

In cooperation with many national and international agencies, organizations and sponsors, CAF has also been carrying out a wide range of basic, applied and developmental researches in fish biology, physiology, toxicology, fish pathology, aquatic resources and environmental management, seed production and farming technologies, and socio-economics in aquaculture and fisheries. The researches do not only focus on targeted species such as Pangasius catfish, freshwater prawn, black tiger shrimp, but also work on many other potentially indigenous species. Findings from these researches have been significantly contributing to education and the activities of aquaculture technology transfer and extension. Annually, CAF organizes over 100 on-farm or in-campus short training courses in different fields for different levels of local or international farmers, technicians and managers. CAF also actively consults in aquaculture technologies through internet, broadcast media, or direct to different companies.

With its strong capacities, CAF–CTU is now readily moving toward international-wide education and training in aquaculture and fisheries.

1.8 Fisheries education – an Indian perspective

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Fisheries Education in the country has evolved considerably from certificate & diploma courses to B.F.Sc., M.F.Sc. and Ph.D. programs undertaken at State Agricultural Universities (SAUs), Central Universities and Deemed University. CIFE has played a very crucial role in Fisheries Education in the country ever since the Deemed University status was conferred to it in 1989.

CIFE is the torch bearer in fisheries education in India and is the hub of Academic activities in the country. IV Deans' Committee (constituted by ICAR) meeting to review and develop the courses for undergraduates across the country was held at CIFE with active contribution of the CIFE faculty. The BSMA committee constituted by ICAR for review, unification and streamlining the courses for MFSc and PhD in fisheries science also got the basic inputs from the courses running at CIFE, because these courses are reviewed and revisited every two years at CIFE to make the relevant and need based changes.

The focus of CIFE is mainly on capacity building of fisheries departments through conducting in-service training to their personnel involved in fisheries development in various states, improve the service delivery system for the benefit of fish farmers and fisher, revenue generation through productivity improvement and sustainable use of resources. A number of academic programs are being offered at masters and doctoral level by CIFE.

Other than the regular academic programs, developing the trained para-fisheries professionals to handle the sector at grass root level is also taken care of by this DU. Professional Development Program (PDP) and Entrepreneurship Development Program (EDP) are such programs offered by CIFE. These are Certificate and Diploma courses meant for either the officials of state fisheries department or for any graduate who wishes to take up fisheries for entrepreneurship development. The course delivery system of these programs is field based.

1.9 Aquaculture education in Taiwan

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Formal aquaculture education in Taiwan has been developing since 1974. There are five public universities and nine vocational high schools which provide aquaculture courses. International Master Program in Marine Sciences and Resources Management, a program training foreign students, sponsored by International Cooperation and Development Fund-Taiwan has been established since 2003. Department of Aquaculture in National Taiwan Ocean University (NTOU) has produced 2030 bachelors, 580 masters, 28 Ph.D. and 28 graduate students having master degree from the Program since 1974. Also, several training courses carried out in the Aquatic Animal Experimental Center of Aquaculture Department of NTOU were operated from 2001 to 2004 to train foreign students coming from all over the world. The status of aquaculture education in Taiwan will be discussed.

1.10 Innovative methods in information gaining, educating, and learning in the frame of platform for fish farming technology development in Hungary

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In 2007, National Office for Research and Technology (NKTH) announced a call for Hungarian Technology Platform projects which was won by the Department of Aquaculture, SZIU with the title of 'Platform for Fish Farming Technology Development in Hungary (PFFH)'. Aims written in the project proposal need to be achieved within 2 years (02/06/2008 - 31/05/2010) with the collaboration of colleagues and partners.

Objectives of our Platform is to involve all members of Hungarian fisheries sector, to invocate each area, to explore problems, to map demands and ideas; furthermore to give answers for questions and suggestions in the area of R&D&I&E (research, development, innovation and education).

Sector stakeholders would validate their interests with serious effects if they could work together in sinergy. This would result in an integrated interest presenting part in international aquaculture.

Four workshops and one closure conference were organized by Platform for Fish Farming Technology Development this year, where participants of fisheries sector and private and public stakeholders were invited. The aim of these meetings was to invocate each area of sector, to explore their demands and problems, to scale which areas and production phases need to be improved; the main objective of our Platform was to collect innovative ideas and material for Strategic Plan. On these workshops, research-developmental, innovation problems, possibilities and solution of fisheries sector has been discussed with the use of modern methods. In sum, it can be stated that "stimulus" and information were collected, which is a good raw material to create short- and medium-term R&D&I&E strategy of sector.

1.11 Aquaculture and fisheries education in Sri Lanka

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Fisheries sector of Sri Lanka contribute nearly 2 % to the GDP with an annual marine and inland fish production of 215000 and 35000 Mt respectively. There is a recent increase in the fishers and individuals depending on the fishery and aquaculture related activities. Weaknesses in fisheries education and lack of opportunities for vocational training have been identified as one main constraint to the development of fisheries and aquaculture sectors in Sri Lanka.

Fisheries and aquaculture has been introduced as a subject in the formal education even at the General Certificate of Education (Ordinary Level) syllabus. But fishers exit from the formal education even before this level. National Institute of Fisheries and Nautical Engineering (NIFNE) under the Ministry of Fisheries and Aquatic Resources provides technical and vocational training through several centers established in coastal areas. This institution is also mandated to offer degree programs in fisheries and related disciplines.

Two national universities offer special degree programs in fishery sciences and majority of the National universities have fisheries and aquaculture course modules for their students following degree programs in biological sciences and agriculture streams. Three national universities offer programs at master's levels and allow students to register for PhD programs.

Universities provide mainly the human resource base for the fisheries management and research and do not provide adequate practical /professional training in aquaculture and fishery production. There is a need for major revisions in curricula and introduction of new course modules to the undergraduate and postgraduate programs to improve the relevance and quality of the degrees offer. Opportunities must to be created for professional education in early exit points in the formal education. Wayamba university of Sri Lanka has introduced a degree program in food production and technology management to promote the fisheries and aquaculture education. Students are expected to cover 120

credits out of which 53% should be from fisheries and aquaculture related disciplines. Course modules to develop skills in research, presentation, IT, marketing, human resources management and implant training are some of the special features. Training human resources and enhancing the skills in sustainable utilization of aquatic resources, sustainable aquaculture production, post harvest management of aquatic resources, Conservation of Biodiversity, Quality Assurance and Product Certification, Management of Aquatic Environment and Health Management in Aquaculture are some of the challenges faced by the fisheries education sector in Sri Lanka. Skill enhancement of fishers and potential fishers through technical training and vocational training has also been identified as a priority area. Assistance in programs to develop low level and medium level professionals in fisheries and aquaculture sector, staff and student exchange and postgraduate training, are some of the areas identified for regional cooperation.

1.12 Fisheries and aquaculture education in Bangladesh with emphasis on BAU's faculty of fisheries – an institution that made a difference

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Bangladesh is a deltaic land of three major rivers, the Ganges, the Brahmaputra and the Meghna along with the Bay of Bengal in the South. These rivers and their tributaries and floodplains were once rich in aquatic biodiversity, and provided abundant harvest from the capture fisheries. This situation reversed with the campaign of 'green revolution' in the early 60's, when floodplains and natural water bodies were brought under massive water development projects to boost up rice production. These measures of HYV rice production and application of pesticides destroyed the rich aquatic heritage of Bengal and resulted in the shortage of fish supply.

Realizing the need for trained manpower for fisheries sector, a distinct discipline of Fisheries Education was introduced in the Bangladesh Agricultural University (BAU), Mymensingh in 1967. The Faculty of Fisheries was established with a mission to develop trained manpower that will manage the open-water capture fisheries, develop culture fisheries through breeding and husbandry, and will take care of post harvest processing and quality control of the aquatic products. It was set up to offer BSc Fisheries (Hons.) degree, a four-year long post HSC course. Three Master's degree programmes in Fisheries Biology and Limnology, Aquaculture and Management, and Fisheries Technology from respective departments were also introduced.

The young recruits in the faculty of fisheries were sent abroad to University of Texas A and M, University of Stirling, UK and some Japanese universities for Ph.D. programme. After their return, some advanced courses like fish genetics, nutrition, fish health management, coastal and marine aquaculture, and fish farm design etc were introduced in early 90s to meet up the emerging needs. This faculty stepped in the international standard in its courses and curricula as well as laboratory facilities through a DFID funded BAU-Stirling Link project during mid 90's. All major courses and curricula have been once again revised and

upgraded, more faculties have been trained up to Ph.D. and post doc levels, four world class laboratories in Fish Genetics and Breeding, Fish Nutrition, Water Quality and Pond Dynamics, and Fish Health Management have been set up. In its continuation, another DFID funded SUFER project (Strengthening of University Fisheries Education and Research), also assisted the Bangladeshi University teachers in Fisheries and Aquaculture in developing teaching and research capacities with the assistance of AIT. Faculty of Fisheries have been successful in attracting the research grants from the major donors such as USAID, USDA, DFID, EU, DANIDA, NORAD, FAO, IFS, WorldFish Center and World Bank through BARC.

Faculty of Fisheries at BAU completed its metamorphosis in 1996 and finally evolved with its four constituent departments like Fisheries Biology and Genetics, Aquaculture, Fisheries Management, Fisheries Technology, and with a fish farm and a field laboratory complex – a unique and modern institution for fisheries and aquaculture education in Asia. It has been able to establish collaboration with most of the renowned institutions of fisheries and aquaculture institutions of Europe, USA and neighbouring Asian countries. Besides all these success stories, there are still weakness in practical aspects of its education, exists overlapping of courses, lack of emphasis in coastal and marine sciences, lack of social and economic elements, and lack of industry-academia linkages. These will be addressed in future through further up-gradation of the courses and curricula, and introduction of aqua-internship.

1.13 Status of aquaculture/fisheries education in India

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The food requirement of millions of people around the world, to a great extent, depends on protein and other nutritional requirements, which can be derived from fisheries resources. Sustainable development of aquaculture/fisheries is an integral part of government policy plan to address the issues of food security and malnutrition among rural populations in India. In the last three decades both national as well as state governments have placed greater emphasis on establishment of institutions dedicated to promote education, research and extension activities in fisheries sector. In India, the first "College of Fisheries" was started in Karnataka in 1969 on an experimental basis. The college has been a great success and has attracted graduate students from all over the country; and thus, triggering demands for more such institutions to cater the needs of the country. At present, there are 16 Fisheries Colleges in the country established by the state governments under the agricultural universities, on under central university and one under deemed university. To date fisheries colleges have produced 5238 fisheries graduates all together. The eligibility criteria for admission in the bachelor degree in fisheries science is completing XII standard from sate board of higher secondary education or an equivalent examination with physics, chemistry, biology/mathematics and English. In addition to this several general universities in India have been offering fisheries as a special paper at the post graduate level in the department of zoology. Recently, some state government introduced fisheries as a vocational course at 10+2 level with assistance from NCERT. Also some of coastal districts have fisheries schools at fishermen's dominating villages under the department of fisheries. Some general universities have started three year degree program in fisheries science. In order to meet the growing education needs of the country in Aquaculture/ Fisheries the Central Institute of Fisheries Education (CIFE) has been accorded university status under the ICAR system. Hence this institution is the country's first fully-fledged national university for fisheries offering post-graduate and

doctoral programs in all major disciplines of aquaculture/fisheries. In addition to CIFE there are seven fisheries colleges in the country which offers post-graduate and doctoral degree programs. Evidently, there is increased attention of government on aquaculture/fisheries education much would be required in order to develop and sustain a critical mass of graduates with doctoral level degree, which at present stands at low. Moreover, in general professional status of bachelor degree holders in fisheries is yet to reach the similar level as to that of from other fields such as engineering, agriculture and management, particularly the job conditions in the private sector. The employability of fisheries graduates in India it appears that public sector remains the primary employer and eventually, the most desired sector for graduates to seek employment.

1.14 Aquaculture and fisheries education program in Institute of Agriculture and Animal Science Nepal

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Institute of Agriculture and Animal Science (IAAS), is the only Institute of Tribhuvan University responsible for higher level education for Agriculture, Animal Science, Aquaculture and Veterinary Science. It is full-fledged government-run institute located in Chitwan district and was established in 1972. It started academic programs such as Intermediate in Science (I Sc) in Agriculture to produce junior technicians and B Sc Agriculture Education which was later converted to B Sc Agriculture program in 1977. These mid-level Agriculture graduates became the main technical manpower for the aquaculture/fisheries sector. First batch of B Sc agriculture were produced in 1980. For the past many years, fisheries professionals/officers for government mostly were from the field of Zoology with master's degree from Tribhuvan University or other university and from B Sc Agriculture degree from outside country. At the beginning, "Fish Culture" was a part of course within "Introduction to Animal Science". From 1987, three elective courses, such as Fish Breeding, Fish Disease, River and Lake Fishery were developed and incorporated in B Sc Agriculture curriculum to provide basic knowledge and skills in fisheries/aquaculture. After that the Ministry changed in policy for the government service in fisheries sector making only these B Sc Agriculture graduates eligible, not allowing the graduates from the field of zoology. Currently, Aquaculture Department runs 2 general courses and 4 elective courses in B Sc Agriculture program and 3 general courses in BVSc & AH program.

Realizing the need of high quality research scientists and managers for the country, the Institute started master program in Aquaculture in 1999 and till now 19 students have already graduated. Among them, nine are government extension/development officials; one researcher; two Agriculture Bank staff, one officer from the Council for Technical Education and Vocational Training (CTEVT) and six others were fresh students. Now Aquaculture Department of IAAS is the sole institute to produce master level graduates in aquaculture and fisheries

field for the country with a degree of M Sc Aquaculture. The 2-year program consists of 2-semester course work and 2-semester research. Aquaculture Department of IAAS is going to start Ph D Aquaculture program from 2010 January session.

As other 18 Departments of IAAS, the Department of Aquaculture is trying to be well-established by linking with local as well as international organizations. It has recently completed curriculum development project under the Asia-Link Program led by the Asian Institute of Technology (AIT), Thailand. The other involved institutions were: Royal University of Agriculture, Cambodia; Research Institute for aquaculture No. 1, Hanoi, Vietnam; University of Agriculture and Forestry Ho Chi Minh City, Vietnam; University of Stirling, UK; and University of Aveiro, Portugal. This project has standardized the curriculum of Master level Aquaculture courses of the involved Asian universities using the experiences and expertise of European universities. In addition to standardization of the curriculum, 2nd project on Aqua Internship under the Asia-Link Program led by the AIT is ongoing for the further strengthening of the Master level Aquaculture program of the institute. Aquaculture department is involved in several research projects funded by national and international organizations.

1.15 Education and training programmes for human resource development in aquaculture projects in Malaysia

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Aquaculture development in Malaysia is discussed with 36.4% increased in aquaculture production to 243,066 tones in 2008 as compared to in 2007. Aquaculture and training programmes for Human Resource Development (HRD) is further discussed with HRD as a priority area for the development aquaculture projects in Malaysia. The aquaculture and training programmes for HRD requirement in the aquaculture sector has to have a more holistic approach which involves cooperation amongst related aquaculture institutions and agencies and the need to increase the research capabilities at the government institutions involved in aquaculture. The government institutions providing aquaculture education and training are divided into three broad categories and these are discussed. The technical training and the academic and professional training involved in aquaculture are also discussed. Direction and strategy in aquaculture education and training programmes for HRD are to rationalize and further improve the extension system with emphasis on upgrading of expertise and on specialization and enhancing communication and extension methodologies. The improved extension services will ensure a more effective use of resources. The government needs to consider providing appropriate incentives to the private sector to encourage it to invest in research. It is proposed that donor agencies must encourage capacity building in emerging aquaculture sector through on-site or regionally-based training. For the sustainable aquaculture projects are to be developed further in future, there has to be more emphasis on aquaculture education and training programmes for HRD in Malaysia.

Theme 2: Curriculum Development and Training

2.1 Do current fisheries curricula play a role in improving marine fisheries management?

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Fisheries resource assessment and the science that provides its methodology have long been accepted as the central 'brain' of marine fisheries management. Therefore, fisheries education would be expected to be the pedagogical nucleus of capacity building for fisheries management.

Many of the world's fisheries are in crisis. Is the crisis linked to failures of knowledge for management or of governance? This topic has been explored in depth for many temperate fisheries, but not to the same extent for tropical fisheries for which the challenges are even more numerous. For example, tropical fisheries management must deal with how to set catch limits for highly multi-species resources harvested by different gear types, how to implement ecosystem based fisheries management and what challenges does climate change bring?

The typical teacher in a fisheries faculty is thoroughly confused. She will likely feel ignorant over the veracity of what she teaches and the uncertain over its utility as a solution for the management ills. Added to this is the fact that the education and research system and the fisheries management systems run parallel with few linkages.

In this paper we examine the situation existing in Australia, where fisheries management has achieved some success, and India, where success appears more problematic.

The questions we seek to answer are:

1. How is fisheries education conducted in each country?
2. What are the pedagogical remedies to fisheries management ills in each country?
3. The role of social sciences, for example, whether the special soft skills essential for initiatives like co management, fisheries extension are being imparted.
4. The link between fisheries education as a capacity provider and fisheries management success in each country (the structure and functions of the fisheries management systems and how it

receives stock assessment advice, the human resources contributions of the educational systems, the perceived problems of the functionaries, gender issues).

2.2 Improving aquaculture and fisheries education through curriculum development and Aqua-Internship

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Shortage of skilled human resource has hampered management of fisheries and the promotion of sustainable aquaculture, especially in developing countries. Higher education plays a crucial role in meeting such human resource needs. However, most post-graduate curricula in aquaculture/fisheries offered are either traditional or very new and immature. Most of their graduates possess limited knowledge and practical skills. This makes landing suitable jobs difficult. Those who do find jobs, face problems while at work. There is a need to make curricula and teaching/learning more applied to real field and industry conditions. Realizing it, we initiated a curriculum development program since September 2005 funded by EC under Asia-Link program with the purpose of improving post-graduate curricula. AIT played coordinating role while two EU partners (University of Stirling, UK and Universidade de Aveiro, Portugal) along with AIT instructors, provided expertise to make sure the quality of the curricula were high. Twenty instructors from four Asian partners (IAAS-Nepal, RUA-Cambodia, RIA-1-Hanoi and UAF-HCM City) were actively involved in developing curricula and case studies specific to their own institutions. Syllabi of six core courses, (Aquaculture Systems, Fish Nutrition, Fish Reproduction/Breeding, Fisheries Management, Water Quality Management, and Fish Health Management) were revised/improved which are now being used by the instructors. Review of this program has been positive. Students and alumni found new curricula to be better than the older ones because they are well-organized, up to date and practical.

While testing the new curricula, we quickly realized that students still lack application skills. Building from this we designed and launched an 'Aqua-Internship Program' funded again by EC under Asia Link program working with the same partners. Under this program, Asian partner institutions explore and select potential host organizations e.g., community groups, private farms, NGOs, and research and extension offices of the government in their respective countries/locations. Upon completion of course work, selected students from respective institutions

are placed in those host organizations for 2-6 months. The selected students and the Country Coordinators in consultation with the students' advisors select host organizations and make the necessary arrangements. Students serve as their staff on a day-to-day basis during the internship period. At the same time, they identify researchable problems, develop research plans for their thesis and carry-out field-based research to address real problems and recommend practical solutions. The program has arranged internships for 30 post-graduate students of Asian partners and five of European partners. The European students work either independently or together with Asian students. The internship is often a part of student thesis or credits for community work depending upon their University systems and requirements. All interns are required to give public seminars of their work at the Asian partner institutions, AIT and/or their own institutions. They are also encouraged to publish their work in local magazines or newsletters. The uniqueness of this project is that partners are committed to continue the internship programs in the long-run even after the project ends on the basis of cost sharing among the parties involved. For example, students would bare cost of food, host organizations offer accommodation for interns and either Universities or students shoulder the transportation cost. Efforts are underway to expand the network for internship.

Innovative and practical solutions to education of aquaculture such as this is needed to not only improve teaching at a modern graduate institution, but also to ensure that the graduates are employable after completion of their degree. The model developed through EU supported Asia-link could be replicated in more locations and in other agricultural sectors.

2.3 Aquaculture education in Vietnam: adaptation in relation to the production development

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In recent years, aquaculture in Vietnam has rapidly developed mainly in shrimp and catfish farming. The development is based on the intensification that results in diseases outbreak and needs some changes in education program to adapt to the new challenge.

Aquaculture education system has increased in number of education institutions from 3 to 7 and the student number has also doubled in five year period. In parallel, specialized programs have designed in the curriculum such as the diagnostic program and aqua veterinary program have been developed in five instructions. The curriculum also changed the content so as to add more courses linked to industry such as course on feed nutrition and production, medicines and chemicals for aquaculture, aqua-veterinary.. Aquaculture text books also changed the content and published.

Graduated students often looks for jobs in industry and large scale farms; therefore, the aquaculture program also modified the curriculum so as to help students can work in the new environment.

2.4 Need for inland fisheries management training in Southeast Asia

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Freshwater fisheries in the lower Mekong basin (LMB) are large, even by global standards. The capture fish harvest has been estimated to be 2.2 million tonnes per annum, which is approximately 2% of the total world marine and freshwater capture fishery. It is worth US$2.2-3.9 billion at first sale and twice that on retail markets. Consumption of fish and other aquatic animals in the lower basin ranges from 29-39 kg of flesh eaten per person per annum, equivalent to 48-79% of dietary animal protein intake. Aquaculture in the region is expanding particularly in the Vietnamese delta, but it is still of less importance than the capture fishery. In other SEA nations (e.g., Myanmar and Indonesia), inland fisheries are similarly important.

Despite the significance of inland fisheries in economic and nutritional terms, there is no targeted tertiary-level training on inland fisheries management available in the Mekong region, and very little elsewhere in SE Asia. However, there is a plethora of courses available on aquaculture. Consequently, virtually all fisheries professionals in the area are trained in aquaculture, but have received no training or exposure to the ecological principles underlying river fisheries production. This situation is not conducive to good management of the resource, and contributes to neglect of inland fisheries in water management planning.

I propose consideration of the development and delivery of an inland fisheries management syllabus to address this concern. Such a course could be easily developed using readily available in materials, but specifically adapted to focus Mekong and south-east Asian information. Design of the syllabus should be flexible, to allow delivery as discrete units during undergraduate degrees, or as a stand-alone post-graduate diploma or Masters course. Funding the development and initial delivery of the course to universities in the region would require dedicated development partner support. It is recognised that demand and need for the course are separate identities.

2.5 Fisheries curriculum that caters to both entrepreneurship and research

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The College of Fisheries of the Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines was established in 1976 to fill the need for trained manpower vital to the development of the country's inland fishery resources. It offered a work-oriented curriculum leading to the degree B.Sc. in Inland Fisheries. In 1987, the college revised the curriculum and offered B.Sc. in Fisheries (BSF) to provide the students a well-rounded training on inland and marine fisheries, the two major areas of the country's fishing industry.

In June 2006, the college offered a revised BSF curriculum focused on aquaculture, capture fisheries, aquatic resources and ecology, and aquatic post harvest. These four areas are the subject areas required by the Philippine Professional Regulation Commission licensure examination for Fisheries Technologists. The unique feature of this revised curriculum is that students are required to undergo apprenticeship, in mostly private enterprise, for one and a half month during the summer term after their third year. After the apprenticeship, they are also required to conduct thesis research in the area of their interest during their fourth year. This curriculum exposes the students to the principles and practices of managing fisheries and aquaculture enterprises which are very important if they wanted to be engaged in aquaculture/fisheries business after graduation. Their exposure to experimental research, on the other hand, boosts their interest in developing technologies which are very important in aquaculture and fisheries development.

Assessing the curriculum, however, indicates that there are still some aspects that need to be addressed. To catch up with the recent trends in fisheries and aquaculture research, there is a need to offer subjects like for example fisheries biotechnology. On the other hand, students who wish to be engaged in entrepreneurship in the future should be given longer opportunity to actually manage an aquaculture/fisheries enterprise to enhance their managerial capability.

2.6 Development and reform of postgraduate education based on aquaculture

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One of the roles of applied university based on applied science such as aquaculture is to bring up senior technicians and researchers to meet the economic development. Aquaculture has developed quickly in China and around the globe. The more and more technicians and scientist are needed in aquaculture industry.

College of Fisheries and Life Science (CFLS) in Shanghai Ocean University (SHOU) develop and strengthen the graduate education in aquaculture and related academic disciplines, developing several new majors in master's and doctoral degrees from the past 15 years. In 1983 CFLS could only award one master degree in Aquaculture and no any doctor degree offered before 1998. From 1983 to 1996, CFLS only offered master degree in aquaculture with average 30 postgraduate students each year. After 1996, master degrees offered by CFLS increased sharply. At present, eight master degrees can be offered. Two doctor degrees also have been offered since 1998. In 2008, CFLS accepted 272 postgraduate students for master degree and 16 for doctor degree, including 2 international students. Now, there are 2 doctoral degrees offered, Aquaculture and Hydrobiology and 8 master degrees offered, Aquaculture, Hydrobiology, Animal Genetic Breeding, Marine Biology, Animal Nutrition and Feed Science, Biochemistry and Molecular Biology, Clinical Veterinary Medicine and Environmental Science.

In order to increase the innovation and mobility of postgraduate students and to meet the aquaculture science development, CFLS has done much in postgraduate reformation recently. First, it reformed the postgraduate curriculum. An advance-course program has been set up since 2005. Under this program, some famous scientists, domestic and overseas, are invited to lecture a set of the courses regarding to progress in aquaculture to the postgraduate students every year. All students could get more practical knowledge and realize aquaculture development in the

world. Second, CFLS provides a special scholarship for excellent postgraduate students (2~4%) for their high level research and support them to publish high quality papers. Third, CFLS also pursues the postgraduate cooperation in China and abroad. It has set up 1+2 cooperation program with Chinese Academy Fishery Sciences (CAFS) which leads 9 fishery institutes and 4 fishery work stations in China. According to this program, students have their courses in CFLS at first year, and then work in the institutes for their research in next two years to get their diploma offered by Shanghai Ocean University. Every year, around 100 students join this program.

Two years ago, SHOU began to join the Asia-Europe Meeting (ASEM) Aquaculture Platform. Based on the platform, the students from SHOU are encouraged to apply for the MSc and Ph.D in the Universities listed on the platform, and host Universities can provide a special scholarship for the students. However, the program just is at beginning, only one student from SHOU begin to study in Gent University on the list in Belgium. SHOU will send more students to study in the universities on the platform in coming year.

2.7 The Philippine fisheries higher education program: a threatened species?

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The present Fisheries Higher Education Program in the Philippines as it continuous to survive the prevalent educational landscape is like a threatened species which is seen as vulnerable to extinction in the near future. This prognosis of the current state of Fisheries Higher Education Program in the country despite the efforts and the investments of the Philippine government to sustain quality manpower in fisheries is attributed to the multifaceted forces and perturbations in the Philippine educational setting that are waiting to devour and cannibalized a potential "prey species." Telltale signs and available data are declining enrolment, few or no takers of choice scholarships in this field of expertise offered by various organizations through land grant academic institutions, declining investments, and seeming lack of motivation to do research in spite of available funds. The sharp decline in Fisheries enrolment is attributed by some people to the perceived greater attractiveness of traditional and emerging professions with greater job opportunities. Younger workers prefer a life of ease and comfort.

Some important indicators for knowing why this is so, data on which are scarce, are creation of data base, availability of strong organizational and policy support to this curricular program, match between available fisheries manpower and resources on the one hand, and dissemination and promotion of the Fisheries Higher Education Program. The usual prejudice against agriculture and related courses like Fisheries as being laborious, less dignified, and in the low income bracket may be the culprit. But it may be possible that parents and peers who are influential in the choice of their children's and friends careers may communicate the poor or wrong notion about the future. In this regard, it is suggested that there be a hard look on the state of the art of the Fisheries Higher Education Program implementation and evaluation using the cues from this report to save this from extinction.

2.8 Experiential learning and book development: the case of SEAFDEC Aquaculture Department

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How does one convey learning, and develop and strengthen the capacities of aquaculture stakeholders? For SEAFDEC Aquaculture Department (SEAFDEC/AQD), a research and development institution based in the Philippines, it is through experiential training courses and provision of take-home reading materials that are the results of its own research program and technology generation efforts for the past 36 years. To date (1975 to 2008), SEAFDEC/AQD has trained and transferred technology to 12,106 stakeholders in 365 training sessions that are a few days to a month to season long. The training courses are conducted at AQD's four stations, on-site at the stakeholders' facilities or through the internet as distance learning courses. AQD's most attended courses before 1992 have been tiger shrimp hatchery–nursery operations and brackish water pond culture. After that, the most attended are abalone, mudcrab and milkfish mariculture. Except the online courses (principles of fish health management and fish nutrition), the courses are 80% practical sessions. Courses in 1987-2008 (total trainees = 3,697) have been attended by 71% male and 29% female who are from national government agencies of SEAFDEC Member Countries (41%), private sector (18%), academe (17%), research & development sector (10%), local government units in the Philippines (6%) and others. Making up the bulk of trainees are Filipinos (57%) as AQD is hosted by the Government of the Philippines, followed by Thais (8%) and Malaysians (8%). Trainees also come from Vietnam (6%), Myanmar (4%), Cambodia (4%), Indonesia (3%) and 32 other countries.

AQD by itself does not decide the courses to offer as the priorities of its training program have been the results of consultations with regional experts and stakeholders in Southeast Asia, including ADSEA (Aquaculture development in Southeast Asia workshop

series) in 1987, 1991, 1994 and 1999; and from then on, through the yearly SEAFDEC Program Committee and SEAFDEC Council Meetings that are attended by representatives of the eleven SEAFDEC Member Countries. Funding for the courses has come from the Government of Japan Trust Fund and/or the stakeholders themselves.

AQD also assesses all its courses by post-training questionnaire (rating by trainees is highly satisfactory to excellent), by a tracer study of its 1985-1993 training alumni, by gathering its training alumni in 1992 for an aquaculture workshop, and by a training needs survey in 1997. All of which are made the basis for the improvement of the training program.

In terms of book development, AQD has so far written and published two textbooks on fish health and fish nutrition, and a 2009 training handbook on rural aquaculture. All of its hatchery and culture technologies -- abalone, bighead carp, catfish, freshwater prawn, grouper, milkfish, mudcrab, sea bass, seaweeds, tiger shrimp, tilapia and more –are compiled in 2008 in a DVD (digital video disc) entitled Compendium of aquaculture technologies. The DVD includes technology summaries, 20 training & institutional videos, and PDF files of AQD's 720 newsletter issues, 35 annual institutional reports, 40 manuals, 60 flyers, 15 posters, press coverage, among others. It also contains a topical list of AQD's over 1,200 research papers that are the backbone of AQD's technologies and that have been published in Current Contents-covered and other journals or publications. More recent updates of AQD's research, technology verification & demonstration, and training & information dissemination activities are found in its website www.seafdec.org.ph.

2.9 The International Tilapia and Aquaponics Course at the University of the Virgin Islands

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For nearly 3 decades the Aquaculture Program at UVI has focused on the development of two intensive tilapia production systems that conserve and reuse water and recycle nutrients. Dry conditions and limited arable land in the Virgin Islands provided the impetus for this research. A commercial-sized aquaponic system was developed. This system can annually produce 5 mt of tilapia and 8-13 mt of hydroponic vegetables on 0.05 ha of land. A 0.02-ha biofloc system was developed which can produce 7 mt of tilapia annually. The biofloc system could be scaled up to a larger size. Using geotextile technology, solid waste from the biofloc system can be recovered, dewatered and used as a soil amendment for field crops, replacing the need for inorganic fertilizers.

After 19 years of research and development, the aquaculture program started a phase of promotion and training of these technologies while continuing to conduct research. In 1999, the First Annual Aquaponics and Tilapia Aquaculture Short Course was held and attended by 17 students. Advertising for the 1-week course was conducted mainly by sending out flyers and placing ads in aquaculture publications. As the Internet became widely used, most attendees learned of the course through the Internet and the use of flyers was discontinued. Attendance gradually increased until the capacity of the lecture room (33) was consistently reached and exceeded, resulting in the rejection of many applicants. During the last 3 years, a new conference room became available with a capacity of 74 students, and attendance in 2007, 2008 and 2009 was 63, 73 and 56 students, respectively. In 2008, the 10th anniversary of the course, its name was changed to the International Aquaponics and Tilapia Aquaculture Course. During that year students came from all seven continents, including a researcher from Antarctica.

A team of four aquaculturists teaches the course which is divided into 26 hours of classroom instruction and 22 hours of hands-on field exercises. During the last 3 years, two lectures were delivered by an aquaponics researcher from Australia over the phone while his PowerPoint slides were shown in the conference room.

Total course attendance to date has been 418 students from 42 U.S states and territories and 47 other countries. Four former students have offered their own short courses in Mexico, Florida, Illinois and Hawaii and have attracted hundreds of students. As a result of the UVI course and the efforts of many others, aquaponics is becoming remarkably popular, but mainly at the hobby level so far. Biofloc system adoption is slower, but its potential in dry tropical areas is great. Biofloc technology training should be conducted in a separate course for a different audience.

Theme 3: Innovative Teaching / Learning

3.1 Opportunities and challenges for distance learning programmes supporting aquatic resource development

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The demand for postgraduate-level capacity building to support the challenges facing organisations spanning the aquatic sector in the coming decades should be enormous. The emerging need to meet growing food security needs in the face of climate change will be testing and require well trained people equipped to work as specialists but also able to bridge disciplines to be effective team members on real problems. A unique programme delivered through a hybrid distance learning format has been developed to better equip mid-career professionals working in the sector to upgrade their skills and develop such interdisciplinary capacity. Piloted extensively in Bangladesh over the last five years with students from a variety of backgrounds the programme will be available in 2010 throughout Asia enabling professionals working in the sector to study part-time while continuing to work The part-time, action learning approach used for the programme results in a certificate qualification after the first year, diploma after a second successful year and full MSc after completion of a project based around the needs of the workplace.

This paper reviews the challenges and opportunities to teachers in the programme's design and implementation on the one hand and to the students' participation on the other. A key issue is the motivation and time organisation of both teachers and students given the programme duration and part-time format.

3.2 The practice of open fisheries education mode based on fisheries industries website

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It is a rising kind of open education mode based on fisheries industries website to propagate fisheries knowledge and information.

The education form reflects the open character. Internet has open, interconnected and shared features. Fisheries industries website could be a mutual gathering platform to achieve consciously and self-help learning. Combined by the experts' lectures, the education method would be multidimensional.

The education content would be wide-ranging. The website could select some hot and concern topics to discuss. At the same time, the reviewers would also be the information providers. So the website would be at contending and debating atmosphere to acquire different perspective and ideas communication.

The education audience is widespread. The public who interesting in fishery could learn some basic reading. The fisheries practitioners could solve practice troubles, get professional assistant and grasp scientific knowledge. As for technicians, the network classroom and network courses would provide systematic training.

China-Fishery Net, launched in Internet on Oct. 98, was constructed by shanghai ocean university. China-Fishery.net is an extensive fisheries discipline-specific website that provides high quality online services to the fisheries community and propagates fisheries knowledge to the public. Now China-Fishery.net has formed its own open education system with four interwoven layers based on its own key knowledge database.

1) Fisheries topic database and professional channels focusing on basic knowledge & popular science characters of open education. Such as LieYu CiBa (fishery webdictionary), LieYu search engine, LieYu database, ornamental fishery and fishery culture channel.
2) Fisheries application system focusing on practicing & implicating characters of open education. On the "Remote Fisheries Disease

diagnostics system", practitioners can self- help to disease diagnose relied on the knowledge system. When on some sudden or significant circumstances, the experts can real-time video consultation by the platform.

3) Interactive online platform focusing on opening & self-help characters of open education. Lieyu Forum is a free professional exchanging place.
4) Network classroom integrated graphics, audio, video media focusing on systemic & professional characters of open education. It could share some quality courses of shanghai ocean university and invite many experts to fulfill remote training.

3.3 Innovation in aquaculture education by AQUA-TNET, Europe's thematic network on aquaculture

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AQUA-TNET is a multidisciplinary Thematic Network that unites the academic and vocational aspects of the establishment of the European Higher Education Area in the field of Aquaculture, Fisheries and Aquatic Resources Management. The network currently consists of 109 partners, representing universities, training organisations, associations and research performers working in aquaculture, fisheries and aquatic resource management. Innovation in aquaculture education is one of the thematic activities. The main focus of this activity is to identify the key technologies and trends affecting higher education in Europe and potential responses by the aquaculture and to provide guidance in applying innovative education tools.

The increasing power of computers and particularly their interconnections through the Internet, is changing the social and economic landscape and presenting new opportunities and challenges for learners, educators and academic institutions. Globalisation is one of the dominant economic trends, impacting massively on the European manufacturing industry, and transforming many types of primary production. It is also changing markets and the relative value of many goods and services. The European Union response is encapsulated in the Lisbon Strategy, formulated in 2000 with the aim of turning Europe into the most competitive and dynamic knowledge economy by 2010. Reform and development of the education and training sector forms a central part of this strategy. Indeed, the higher education sector itself is globalising with greater mobility of students and many universities establishing overseas campuses. Of particular relevance to Aqua-TNET activities in this field is the way in which education is now framed within a wider policy of support for lifelong learning. This encourages wider access to education and places new emphasis on the value and role of informal and non-formal learning, especially in the context of continuing adult

education. Informal learning is generally understood as the day to day accumulation of knowledge from diffuse sources, whilst non-formal learning is through structured learning activities that are not certificated in any way.

At the technology level, it is the continuing development of information and communications technologies that underpin the changes and challenges identified. The AquaTNET group on innovation in education has therefore focused attention both on how the technologies work, and how they can be best employed to further the aims of aquaculture teaching and learning. Ongoing initiatives aim to:

- Develop user-friendly guides for tutors to encourage and enable better use of ICT resources
- Encourage greater sharing of learning objects through formal and informal repositories
- Help bring together individual tutors and institutions with shared interests and complementary skills or resources
- Pursue opportunities to develop open resources particularly case studies and simulations
- Help develop stronger links between industry, research and teaching, through collaborative lifelong learning

3.4 Talent fostering pattern and course system for speciality of Marine Fisheries Science and Technology

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The speciality of Marine Fisheries Science and Technology in Shanghai Ocean University (SOU) was established in 1950s. Fostering objective has experienced three stages: (1) Technical Professional talent; (2) Versatile talent; (3) Creative Talent. Before 1990s, the course system followed Ex-Soviet's 5-year pattern with the course of engineer design, marine environment and marine biology in order to foster technical professional talent. With the fishery development in later 1990s and required talents, versatile talents are urged. They should possess comprehensive knowledge of fishery such as fishing gears and methods, fishery resources and fishery laws. Therefore, A National Education Reform Program for Fostering Fishery Talent Pattern was launched since mid-1990s. The Program has achieved following results:

Firstly, Merging two specialities (Fishery Resource and Management speciality, Marine Fishery speciality) to new one (Marine Fishery Science and Technology). This reform is adapted to the China marine fishery change and development of distant water fishery, emphasizing on fishery sustainable development, environment and resources harmonization as well as food safe assurance.

Secondly, Course system is divided by groups. Each group consist of several courses, which assure the systematic knowledge learning and make the favourable situation for multi- discipline exchange.

Third, the reform aims at strengthening practice ability. In addition, more free time for students is arranged by aiming at fishery survey and fishing gear design practices, which makes the students to know fishery industry and fishery research for conservation of aquatic animal in the ocean.

Fourth, Four-year-undergraduate stages are divided to 1+2+1 model. Fresh students in the first year are pooled to consolidate basic knowledge. Sophomore and junior students are arranged to enter different

colleges and specialities. Senior students are required to conduct research under the supervisor guidance.

In the 21st century, reforms are made to foster high level talents with international views, initiative ability etc. Six-Year Education Program for graduate students (master degree) are launched. The first four year is to finish undergraduate course and the left two year is for graduate course. Furthermore, some new programs are added including Special Technique Training and International Fishery Observers etc. Because marine fishery industry has expanded from fishing technology to comprehensive sector such as trade, processing, culture and education and leisure etc., the high quality talent are urged for this adaptation.

But some problems still existed. It is great challenge to adjust the course system for the speciality of Marine Science and Technology adapting to the rapid development of fishery and fishery resource decline. Broad basic knowledge requirement and solid fishery technical professional and ability should be mastered in the course system. Graduated students are reluctant to enter fishery industry due to hardship.

3.5 Evaluation of biology teaching in the fisheries colleges in Region I, Philippines

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The study evaluated biology teaching in the four fisheries colleges in Region I in terms of objectives, curriculum, instruction, faculty and equipment, including issues and concerns of biology and biology-related teaching in the colleges. The study was first conducted in 2002 and a follow-up study this year 2009. A descriptive design was used in the study and data gathered were analyzed using frequency distribution, mean and percentages. Using a questionnaire, sources of data were faculty members teaching biology and biology-related subjects and department chairs/deans. Unstructured interviews, observations and analysis of official documents were employed to validate data gathered through questionnaire. A very high adaptability (4.65) rating on the goals and objectives of biology teaching in fisheries colleges in Region I indicate that they are in line with the national, regional and local goals and mission of the institution and conforms to Commission on Higher Education (CHED) and the Professional Regulation Commission (PRC) requirements on policies for fisheries education.

A very good (4.17) perception and high adaptability (4.41) were obtained on the use of instructional materials and processes. However, results of personal interviews revealed that students were not even provided a copy of the course syllabus. In 2002, the most common method used to enrich instruction in biology and biology-related subjects were field trips, projects and seminars. This year a follow-up study shows that experiments, case studies, group discussions are the common methods used. Faculty members teaching biology and biology-related subjects in 2002 have high academic ranks (Asst. and Assoc. Professors), and academically prepared, hence, they were highly qualified to teach the subjects. Majority of the respondents in 2002 rendered 16-20 years of service which implies that they are seasoned, adept and well-versed in biological concepts related to fisheries but now a slight change has been noted, that majority are rendering 1-5 years in service and they are given a lower rank (Instructor). They are newly hired as replacement of those who early retired from the service and for those who are on study leave.

Faculty teaching biology and biology-related subjects manifested good performance in their classes through varied and appropriate instructional materials to facilitate learning. In 2002, the teaching assignments are not limited to their specific training and professional experiences. Some faculty members were given teaching loads outside their major fields and now some faculty teaching biology and bio-related subjects are not major in biology or bio-related subjects. Some faculty members have overloaded teaching assignments, even rendering more than 24 hours/week with five to six preparations in 2002 but at present, policies on the number of preparation is a maximum of three but should not exceed fifteen lecture hours a week is now strongly adapted. The classrooms were adequate to meet the needs of the college students, conformed to acceptable standards, with good lighting, proper ventilation, clean and well-kept. Conditions of laboratory rooms were commendable except for the inadequacy of equipment in 2002 but now equipments for laboratory use are moderately adequate. Some which were identified as immediate needs were repaired, improvised and purchased such as microscopes and plankton net.

The general concerns of respondents from the colleges of fisheries in Region I in 2002 was on the provision/purchase of adequate facilities and equipment for a better-teaching learning process and still their concern today. The very low number of students taking fisheries course was the greatest problem encountered by the two colleges in Region I in 2002 and still the same today however, a slight increase is noted for majority of the enrolled student are scholarship grantees of the provincial, municipal and other government and private scholarship grants.

3.6 Incorporating local knowledge into education for the management of nearshore capture fisheries

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Alternative models that generally include "Adaptive Management" and "The Ecosystem Approach" have been advocated to replace "standard" Western models and approaches for managing tropical nearshore fisheries. However, they remain generally unfamiliar. As a result, "Local Ecological Knowledge" or LEK (also known as "Traditional" [TEK] or "Indigenous Ecological Knowledge" [IEK]) is widely promoted as a source of data on these alternatives, in order that the best of non-Western pre-existing models and Western approaches could be blended to provide acceptable and sustainable solutions. This would require Tertiary Level training on LEK. Before that occurs, however, the limitations of LEK research must be recognized. A recently completed study by Davis and Ruddle demonstrated that the basic problems characterizing social research on LEK are the use of unsophisticated theories or concepts with often undocumented and nonsystematic research designs and methodologies, which, in turn, give rise to unwarranted or indefensible outcomes. Social science research of LEK has much to contribute to framing and understanding an alternative approach to resource management. However, given the trends evident in the most cited literature, it is far from obvious that current social research is following a path to fulfill that important mandate. Supporting documentation is, at best, based on unsystematic study, thus much is unrepresentative and unreliable, producing data and outcomes that do not permit comparisons and generalizations. Consequently, it is ill-suited for sustainable resource management policy recommendations. Standards of accountability and transparency need to be raised, beginning with the elementary requirement that researchers provide descriptions of research designs and methodologies sufficient to enable assessment of the reliability and representativeness of findings, and to facilitate comparison,

generalization and evidence-based conclusions. Only then will LEK be suitable for inclusion in Fisheries Social Science instruction at any level.

Theme 4: Partnership / Collaboration

4.1 Fisheries and aquaculture education – need for regional co-operation

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Globally, fisheries and aquaculture contribute significantly towards food security, poverty alleviation, economic development and supporting livelihoods, and the sectors are particularly of fundamental importance to Asia-pacific region. Fish, probably being the only affordable source of animal protein available to the millions of poor in developing nations, and since the capture fishery is dwindling fast, aquaculture would play a crucial role in health and livelihood of nutritionally challenged people in the developing world. In addition, there is a critical need for rehabilitation of capture fisheries through implementation of responsible fisheries regime for food and protecting fishing-based livelihoods. Further, to meet the demand of the growing population and to maintain the per capita fish consumption at current levels world will need another 40-60 million tonnes of fish by 2025.

In any country/region, industry/sectoral development plan is inseparably linked with the human resources development programmes. And, educational plan need to be closely allied with the contribution the sector makes to the development of the country/region in terms of economic growth, livelihood and employment opportunities. In this regard, Asian region has a unique stature. Asia which hosts 60% of the world's current human population, also leads the food production table, as the region contributes more than 90% of the world aquaculture production and 52% of the global capture fisheries production. Contribution of fisheries and aquaculture to the gross domestic product (GDP) of majority of the countries in the Asian region is substantial (>1%). Further, there is a tremendous employment opportunities the Asian Fisheries sector provides. It accounts for 87% of global employment of fishworkers with a total of 41.4 million full-time employment, apart from a huge number of part-time employment. According to Asia-pacific Fishery Commission, 'aquaculture production in the region is still considered to be grossly underestimated because of the large number of small-scale producers and remains difficult to

assess'. This significant contribution of the region was possible due to many factors of which fisheries and aquaculture research, education and training programmes have played key roles. Another significant factor is the inseparable association of fisheries and aquaculture with the Asian social set up. Fisheries and aquaculture is a traditional wisdom for local Asian communities which are still being sustainably practiced. Such traditional knowledge and social orientation have provided critical ingredients to the development of modern and commercial aquaculture in Asia, thus, making the region the biggest contributor to global aquaculture. The traditional knowledge resources still have vast potential for the enhancement of aquaculture in the region and, therefore, it is necessary to make the traditional, local knowledge available throughout Asia through networking and integrating into the fisheries education system. Further, in Asia, human resource development plan assumes utmost significance as the region's stature in the world economy is growing. This is particularly significant to India, the second largest fish producer in the world, where fisheries and aquaculture sector is playing a pivotal role in the nutritional security and livelihood. Accordingly, the subject of fisheries occupies a prominent position in the Indian education system and today the programme has moved from its training-oriented system to a diversified and highly specialized education system.

4.2 Aqua-TNET, Europe's thematic network on aquaculture

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AQUA-TNET is a multidisciplinary Thematic Network that unites the academic and vocational aspects of the establishment of the European Higher Education Area in the field of Aquaculture, Fisheries and Aquatic Resources Management. The network currently consists of 109 partners, representing universities, training organisations, associations and research performers working in aquaculture, fisheries and aquatic resource management.

AQUA-TNET, originally founded in 1996 as a SOCRATES Thematic Network, took on to assess and analyse the aquaculture higher education sector and to identify key curriculum development and assessment objectives, publishing its "Higher Education in Aquaculture and Related Sciences - Guide to Courses within Europe" (1998), updated and uploaded to the internet in 2001 (PiscesTT). AQUA-TNET also published the "White Paper on Education and Training in Aquaculture for the New Millennium" (2000), addressing the long-term education and training needs of the European industry for the new millennium. Its formal recommendations on geographic and functional mobility, trans-national placements, delivery of specialised and advanced education and training, joint development of specific courses, and accreditation and mutual recognition of qualifications were actually ahead of trends that are now becoming common practice in European education.

In 2008, the network received funding from the EC for another 3-year programme. Main activities are clustered in 6 thematic work packages:

- Masters and Masters of Science curriculum development and assessment
- PhD curriculum development and assessment
- Proposed transparency measures (including Qualifications Frameworks) and quality assurance
- Measures to improve student mobility

- Innovation in teaching (e-learning and ICT technologies and their role in joint degrees)
- New methods of language training and promoting language diversity

Network deliverables are to the benefit of the entire sector, involving the production sector, consumers, educationists, researchers and NGOs. Three over-arching work packages are dedicated to the needs of industry, academia and society. Deliverables include a PhD web portal, student conferences, publications and online self-tuition language learning modules all geared towards the promotion of life-long learning in its many aspects.

4.3 National and international aquaculture networks and opportunities for mobility across Europe

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Aquaculture is the fastest growing sector among agroindustries and it may be one of the priority areas of public and private investments in different countries. This is the case of Spain, as it is one of the European countries in which there is a high demand of consumers for aquatic products and also there is a long tradition of fisheries and fish and seafood consumption.

The situation of the Spanish aquaculture research and education is presented including the following resources: Research Centers, Educational Centers offering aquaculture Masters and Ph.D. degrees or professional opportunities, and technological centers for common initiatives between researchers, educators, industry and administration. Public Applied Research Centers are located mainly in the coastal areas where there is an activity in fisheries, seafood production or aquaculture placements, either in the Mediterranean coast, Atlantic coast or in the Spanish Canary islands close to the African coast. Basic Research activities in the area of aquatic sciences are developed in universities regardless their geographic situation. Technological or Network centers are located in the regions where most of the aquaculture takes place and they depend on the regional administrations. Most of these centers for research, education or technology offer programs for education or training in aquaculture and it becomes increasingly easier to obtain an official acknowledgement of this training in the framework of the European Higher Education Area that involves all European countries.

The opportunities for mobility are also presented in relation with European aquaculture networks, and in particular with AquaTnet, the European multidisciplinary Thematic Network related to the establishment of the European Higher Education Area in the field of Aquaculture, Fisheries and Aquatic Resources Management. One of the areas of work is the promotion of mobility through a web portal that allows to identify academic or vocational courses and training, access of

informations about eventual opportunities for funding and recommendations and best practices in mobility among European countries.

4.4 Building human capital in fisheries – Southern Africa

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There is a general decline in capture fisheries in the Southern African Development Community (SADC) region (FAO, 2002). In Malawi for example, the capture fisheries is estimated at about 40,000 metric tonnes per year against the potential volume of more than 100,000 metric tonnes. Fish consumption has also declined from 14.7 kg/capita/year in 1970 to less than 7.0 kg/capita/year in 2004 according to recent statistics. The decline has been attributed to a number of reasons including over fishing, climate change and lack of a critical human resource in conservation and sustainable utilization to reverse the decline.

Governments in Southern Africa are pursuing policies to improve agricultural productivity, enhance sustainable use of natural resources and increase incomes. However, even if development capital is made available, the missing link is availability of qualified human resource that can undertake activities that will provide solutions to many of the region's problems which include decline in capture fisheries and low aquaculture production. The New Partnership for Africa's Development (NEPAD)-Fish for All" Summit held in Abuja, Nigeria in 2005, emphasized the need to increase fish production from aquaculture and the region is taking this initiative seriously. However, all these interventions require well-trained and qualified staff to address various problems.

Due to demand in the region for capacity building in aquaculture, a regional program was launched for BSc in Aquaculture and Fisheries Science in 1991. The program was hosted by Bunda College, University of Malawi, because of comparative advantages and through the mandate by Malawi Government as the technical coordinator for inland fisheries in the SADC at that time. A program in MSc in Aquaculture and Fisheries Science begun in 2001 and to date more than 30 students from almost all countries in the SADC have successfully been trained to MSc level.

A regional strategic planning process undertaken by the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), a consortium of 12 universities in east and southern Africa, mandated

Bunda College to host and coordinate a joint Regional PhD training Programme in Aquaculture and Fisheries Science, and has since started in September, 2009.

The uniqueness of the programs is that the human capital to be developed will be trained within the regional environment and will most likely remain in the region and contribute to the development of aquaculture and sustaining fisheries biodiversity in the region.

4.5 Improving sustainable aquaculture technologies: research – education linkages at the WorldFish Center

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Aquaculture, one of the fastest growing food production sectors, currently supplies nearly half of global fish consumption. Whilst global demand for fish continues to grow, aquaculture too must grow substantially if projected shortfalls are to be met. The social and economic benefits from aquaculture are increasingly being recognized, from international to household levels. Household food and nutrition security and income augmentation from the sale of production surplus to improve rural livelihoods has being increasingly realized in Asia and parts of Africa. Developing sustainable aquaculture is one of the two "Development Challenges" for the WorldFish Center. The emphasis of aquaculture research at the Center is on developing international public goods (IPGs) to support national, regional and global efforts to develop the aquaculture sector in a sustainable manner, to achieve human development goals as outlined in the Millennium Development Goals.

The development of aquaculture technology is a key area of research at the WorldFish Center. Realizing the limited availability of quality seed and feed as a widespread constraint to the development of smallholder and SME-based aquaculture, WorldFish aquaculture research has focused on:

- designing and implementing aquaculture technologies to maximize development impact;
- developing ecologically responsible technologies to improve and disseminate quality seed for selected aquaculture species (for example GIFT); and
- developing low-cost fertilization and feeding systems that maximize profitability without compromising the quality of the product, and that are consistent with the Ecosystem-Based Approach to aquaculture development.

The WorldFish Center adopts a participatory action research approach to the development and validation of sustainable aquaculture

technologies, ensuring that technologies match the natural, capital and educational assets and the aspirations of the farmers. Whilst development and sustained uptake of aquaculture technologies that impact on poverty require a wide range of technological and socioeconomic skills, the center works in partnership with National Agricultural Research and Extension Systems (NARES), other CGIAR Centers, Advanced Research Institutes (ARIs), Aquaculture Networks, UN organizations, Non-governmental Organizations (NGOs) and private sectors for effective dissemination and advocacy of promising technologies. Further, the center provides a wide range of capacity building opportunities (Master's, Doctoral and Post-doctoral research; short-term trainings; and internships) to its partners that foster research – education linkages. We believe that capacity building among our partners, and more widely among stakeholders in aquaculture development, is a cornerstone of future sustainable development of aquaculture. The paper highlights our key current and planned future areas of research, provides examples of current linkages between research and education, and makes suggestions on future opportunities for improving linkages for the benefit of sustainable development of aquaculture.

4.6 Networking, partnership and communications in Asian aquaculture training – the NACA experience

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For decades, aquaculture development in the region has been characterized by rapid advances in production technology, diversification and specialization of production systems, gradual standardization of production processes and adaptation to emerging issues such as food safety and quality, international trade, environmental concerns, climate change etc. Consequently aquaculture training has also been challenged to keep up with and adapt to these rapidly changing mix of issues. These include the increasingly diverse training needs; for instance the increasing demands and diversity of backgrounds of the candidates for such training. Overall we seek to meet these demands with innovative training approaches that optimize the increasingly constrained training resources. This paper will review the Network of Aquaculture Centres in Asia-Pacific (NACA) experiences to date in conducting training in aquaculture for more than the past decade. About 3,000 professionals from 30 countries and xx backgrounds/organizations have been trained in a wide variety of training courses and study tours and have been playing important roles in aquaculture development in the region. In addition this paper will seek to review some of the history of these training approaches and then examine the lessons learned from the training experiences. The authors suggest that networking and partnerships that encourage continued shared learning mechanisms to utilize the diversity of knowledge and training experiences of NACA and its partners has provided a valuable resource to date. This paper then seeks to look at the past supply of training and relate this to our evolving measurement of demand including an initial examination of what mechanisms might be put in place to further develop and strengthen these efforts around optimization of our regional aquaculture training resources, improvement in training efficiency and enhancement of the capacity of training institutions to cope with new challenges. Redesigned evaluation and other

feedback mechanisms need to be developed that can be used in the continued improvement of such training efforts.

4.7 Education and capacity building for sustainable aquatics resources management and poverty alleviation beyond the campus: the Wetlands Alliance

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To achieve sustainable development, poverty alleviation and the responsible use of natural resources, capacity is needed. Individuals, communities, businesses and governments need competencies and skills to take charge of the change processes that impact and determine local development.

Teaching and learning in an academic setting conventionally focuses on individual capacity building by focusing on the transfer of knowledge and technical skills from teachers to students. Graduates are expected to be able to meaningfully contribute these skills and knowledge to the organization, institution or enterprise that will employ them. However, besides 'hard' technical skills and expert knowledge that are required to fulfill particular tasks, relevant skills also include 'soft' ones such as the ability to build relationships and trust.

The Wetland Alliance links this individual competency development with capacity development of local actors and communities, government and private sector organizations and institutions, through outreach research and outreach education. This engagement of faculty, researchers and students with off-campus audiences creates a dialogical learning environment, in which academia, governments and civil society develop the capacity to transform unsustainable development practices and create public value.

Theme 5: Future Strategy

5.1 Overview of aquaculture and fisheries education from Asia Pacific perspectives

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5.2 Future education initiatives by the ASEM Aquaculture Platform

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The ASEM Aquaculture Platform, established in 2003, is an Asian-European multi-stakeholder forum that aims to reconcile ecological, social and economic demands and introduce or consolidate practical concepts of sustainability in the sector in both regions. The platform brings together experts from both regions to formulate recommendations on future directions in research, production and trade, including key areas of BMPs (Better Management Practices), integrated ecosystem based production (Integrated Multi-Trophic Aquaculture), community engagement, certification, and aquatic health management, together with education, training and communication. This network is and has been funded by the European Commission and the Flemish Government.

One of the tasks of the ASEM Aquaculture Platform is to support Asian aquaculture education and interactions with European aquaculture education. Aquaculture education in the Asian region is still very unharmonised and does hardly permit credit transfers between institutions. As a consequence, the prospective student wishing to develop his/her competences at another university has nearly always to leave his/her work place. In essence, only "face to face" learning in aquaculture is available in Asia. This situation has hampered continuous upgrading of knowledge of the personnel working in the sector, and with the increasing competitiveness and demands on quality of aquaculture produce; this will restrain creative innovations in the sector and in the region.

An earlier ASEM workshop on Education in the Philippines in 2005 recognized the fragmentation amongst the different Asian education and training providers. This leads to duplication of effort but most of all, it hinders prospective learners, particularly the mature and/or employed learners, to access the opportunities available to upgrade themselves. The workshop stressed the need to explore potential rationalization of aquaculture education in Asia, with a corresponding increase in the use of

open and distant learning. In this process much can be learned from experiences and initiatives in Europe and Australia.

The objective of the education workpackage in this project is to make an active contribution to the harmonisation of European and Asian aquaculture education in order to assess strengths and gaps in aquaculture education against the sectors' research needs. This includes following activities:

- Establish an Asian-EU working group including AquaTNET workpackage leaders
- Develop a joint agenda for collaboration between AquaTNET and the Asian higher aquaculture education initiative launched by AFS/AIT (transfer European expertise; represent European higher education institutes)
- Further support the China AquaFishNet and VIFINET initiatives that fosters the harmonisation of resp. Chinese and Vietnamese higher aquaculture education between the major universities and research centers
- Establish workable exchange schemes of educational modules between Europe and Asia.
- Create an online inventory of higher aquaculture education in Asia

5.3 Aquaculture and fisheries education at AIT – past, present and future

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5.4 Graduate education to match the changing needs of aquaculture sector in Vietnam

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Aquaculture in the last decade, has been one of Vietnam's fastest growing industries. Today, Vietnam ranks sixth among the ten major exporters of aquaculture products and the third largest fish producers behind only to China and India. Vietnam confidently expects to produce 6.5 million tons from aquaculture by 2020 (worth US$7 billion) – over $3 billion increase since 2008.

Serious concerns have been raised on whether Vietnam can sustain this growth; thus, the theme of 2010 Vietnam Aquaculture Conference in Saigon, 'sustainable development of the aquaculture industry'. Rapidly increasing industry needs capable human capacity in both, the technical and management areas to sustain this industry. Technical Capacity is needed in production optimization, traceability, HACCP standards, state of the art farms- processing (packaging, labeling, certification)-feed manufacturing etc. Human capacity to sustain this burgeoning industry is also in need of excellent managers and executives to not only to manage this industry but also to make strategic decisions for growth and sustainability.

A number of research and educational institutions in Vietnam are offering degrees in fisheries and aquaculture, and they have taken cues from traditional aquaculture education system developed at AIT and other similar aquaculture pioneering institutions established in the 70s, some 40 years ago. While industry has evolved from small-scale, waste-fed systems to now highly intensive system of multi billion $ output (see figure below) the education and training has seen limited progress.

5.5 Fisheries education in India – issues and challenges

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Over the past four decades, Indian fisheries education has evolved from its training-oriented structure to a diversified and highly specialized education system. Fisheries education in the country has its actual launching after the establishment of the first College of Fisheries in 1969. This was followed by the establishment of a chain of Fisheries Colleges under the 16 State Agricultural Universities, one Central Agricultural University and one Deemed University. The country has a 4-year Bachelors Degree in Fisheries Science (B.F.Sc.) and a Two-year postgraduate course, Masters in Fisheries Science (M.F.Sc.) and Three-year Ph.D programmes in fisheries and aquaculture. Further, as with other disciplines of science, the subject has diversified into advanced specializations at post-graduate level. However, fisheries and aquaculture education system faces varied challenges.

Although there are no scientific studies conducted to prove the fact, it is firmly believed that the Indian fisheries graduates are exposed to a highly theory-oriented curriculum rather than skill-based one. At the same time, the industry considers that the present day curriculum does not produce project-ready graduates for the industry. In this background, there is a strong argument that fishery being a skill-based profession, unlike general university education, the skill rather than the knowledge a pupil acquires is more important in fishery education. In India, the students appear to be losing interest in taking up education in life sciences in general, and fisheries science in particular. More over, one of the problems the fisheries education system in India faces is the drop-outs at the post-graduate level. In this background, a careful look at the requirements for the graduates is imperative in India. It is not the number of graduates which are produced every year but the quality and their acceptability that are paramount. Increasing the relevance and enhancing the acceptability of fisheries graduates is an issue which the Indian fisheries education system faces. In this, bridging the knowledge-skill gap in fisheries education system is the key. However, active participation of industry/private sector in curriculum development and implementation would help in making the courses more relevant and acceptable. Industry involvement can be extended to the level that the

experts from the sector can participate as a part-time faculty, and the industry providing on-the-job practical training to the students. Further, an academia-industry interface will help in bringing a constant dialogue between the two players that would help the faculty in updating the field-level information.

5.6 JABEE accreditation and fisheries education in Japan

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Japan Accreditation Board for Engineering Education (JABEE) is a nongovernmental organization, established in 1999, that examines and accredits programs in engineering education conducted by institutions of higher education such as universities reach the levels expected by society and accredit those programs, in close cooperation with engineering associations and societies. In 2005, JABEE was admitted as a signatory to the Washington Accord, which is an international agreement among bodies responsible for accrediting engineering degree programs. JABEE has accredited 409 education programs (leading to bachelor's degree) at 158 institutions, and among them 8 fisheries education programs are included. Each education programs need to suffice strict criteria for accreditation, and by the end of 2008, more than 95,000 undergraduate students finished Those who graduate from JABEE-accredited programs are granted an exemption by the government from the primary examination of Professional Engineer (PE). Human welfare and mutualism with environment is a primary issue in the world, and PE are required to ethical beings who are responsible in applying science to technology. Faculty of Fisheries, Nagasaki University is one of the accredited programs (since 2003) in Fisheries Education, with 120 students and 56 teaching staffs. I will present the detail of the education program, especially in the area of education of field survey, design, engineering ethics and international relation.

5.7 Towards multi-disciplinary approach in fisheries graduate studies: the master of marine affairs program of the College of Fisheries and Ocean Sciences, University of the Philippines Visayas

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In cognizance of the archipelagic nature of the Philippines whereby 60% of the population are coastal, 80% of the municipalities are coastal and 26.6 million hectares of ocean and marine areas, IFPDS-CFOS have embarked on a graduate program that tackles the multi-disciplinary nature of managing such resources. The Master of Marine Affairs Program aims to provide students with holistic perspective in the management of ocean and coastal resources through the courses on various areas of knowledge in both natural and social sciences.

This paper traces the history and the context of the development of the degree program, analyses the trend by which it has taken in terms of student enrolment, research undertaken, and possible directions in the future. It analyzes the multi-disciplinary nature of the fisheries and coastal resources and juxtaposes how the program can offer possible insights and inputs to coastal resource governance management.

5.8 Professional fisheries education in India – an analysis and exploration of partnerships in Asia

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India started professional fisheries education after independence in 1947 and established the undergraduate level degree programme in 1969. Currently, there are 17 Fisheries Colleges that offer undergraduate degree program and nine colleges offer also postgraduate level education. In addition, a National University of Fisheries has been established to provide the required manpower for the fisheries sector. Over 5000 fisheries professionals passed out from these institutions contribute in various ways for the development of fisheries and aquaculture in India.

The professional fisheries education system has made positive impact in improving the fisheries and aquaculture production in India. However, maximization of the impact has not been possible because of the lack of facilities provided to the fisheries educational institutions that can help the students to acquire the level of skills and knowledge needed. To deal with the issues related to Animal husbandry and Fisheries with more focus, Agricultural Universities have been bifurcated into Animal hubandry and Fisheries Universities and Agriculture Universities. Though such bifurcation from Agriculture has helped in providing additional resources to the fisheries sector, it has not yet addressed adequately, the problem of facilities and manpower needed to provide quality fisheries education.

Several other State Agricultural Universities are now taking up the initiative to establish professional fisheries education. While it is heartening to see these initiatives, poor investment of resources to build the institutions and development of practical plans to address the problems are contributing to the declining quality of education. As the inadequate staff, thin infrastructure facilities, poor access to communication and information have already been affecting the established institutions, it is necessary to address these problems in the existing as well as upcoming institutions to attract the best students to the courses. As the demand for fish is increasing in the country, there is a

need to enhance the availability of human resource with entrepreneurial attitude.

The issues confronting Indian professional fisheries education system are examined and suggestions are made to explore alternate ways to increase the quality and productivity of the institutions. Fisheries education systems impact in China at various levels in improving production and create food security for people in terms of fish availability are examined. With the improvements in information and communication technology, it is hoped that good partnerships between the countries can help in improving the quality of the human resource and thereby improvements in fish production.

5.9 Today and tomorrow — education in fisheries sciences in SOU

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Shanghai Ocean University, which was formerly Jiangsu Provincial Fisheries School established in 1912, is a university with 97-year history and glorious tradition. Since 2000, it has been jointly constructed by the Ministry of Agriculture and Shanghai government but administered by Shanghai Education Commission. It has developed into a multi-disciplinary university focusing on the coordinated development in agriculture, science, engineering, economics, arts and management, among which fisheries science has always been the most significant and preponderant field. Nowadays, SOU has constituted a complete academic educational system covering Bachelor, Master, Doctoral degrees and Postdoctoral programs.

2008 was really a special year for SOU since she moved to Lingang New City according to the overall layout and planning of Shanghai universities. Located in Shanghai, one of the most modern cities in China, next to the shore of the East Sea, with a totally new campus and advanced facilities, SOU is facing unprecedented challenge. We are eager to expanding the extension of fisheries science and to put new meanings in traditional disciplines so that we can serve the national or local economy development and provide excellent scientific researchers and skilled technician.

On one hand, SOU keeps on strengthening the construction of traditional graduate and undergraduate programs through reforming the curriculum structure, improving the hardware and introducing or training high-quality teachers. For example, courses belonging to the four proportions, which are water quality, aquatic genetic resources, nutrition and feed, aquatic disease respectively, have been emphasized to support the key of aquaculture research and technology. Courses in aquatic biology and ichthyology contribute a lot to the deep understanding of aquaculture. The Experimental Teaching Demonstration Center of Aqua-life gives students an experimental platform. Bases have also been constructed for students undergoing practice and research.

On the other hand, SOU are putting forward new directions, such as Aquaria Science & Technology, Water Landscape Ecology and so on. In the major of Aquaria Science & Technology, we provide the courses covering basic biology, aquarium design, circulating system design, water quality control, ornament fish culture and practice in aquariums. It is significant that new majors should be adapted to the demand of society and economy and correspondingly the curriculum should be timely and applicable. SOU has made tremendous contribution to the education in fisheries science in China and she will continue to play an important role in it.

5.10 Gender mainstreaming in fisheries education

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Contribution of women in agriculture, who constitute about half of humanity, is increasingly realized. It is estimated that women contribute up to 70% of income from agriculture related operations. Studies in this regard clearly indicate that contribution of women in agriculture is of great significance and by empowering them with knowledge and skill it is possible to enhance food production and making optimum use of food. Somehow the contribution of women in fisheries and aquaculture is not adequately reflected. It is mainly because harvesting operations, which are more visible, are conducted by men, although many other critically important operations are the domain of women. In the context of Asian region it is more important as fisheries and aquaculture is not only an important livelihood and income generating options but it is a part of regional culture. However, because of prevalent social taboos in several rural societies their contribution is ignored and underrated but also we have not been able to harness their potential.

Recent trend indicate that women are also coming forward to accept fisheries and aquaculture as profession related to education, research and extension. The time has come to realize their potential and contribution and attempt be made to make fuller use of their potential. It calls of mainstreaming of gender issues in fisheries education. More so would be to encourage women participation in fisheries education.

The paper highlights contribution of women in fisheries and aquaculture, underlines potential areas of their participation and emphasizes gender mainstreaming in fisheries education programmes.

B: POSTERS

1. Validation of all lifelong learning in aquaculture

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European aquaculture is a fast-growing innovative industry, its success relying on a joint practical and theoretical knowledge base, whose personnel regularly require specialised training. Yet training such as work placements, on-the-job training, and short-term learning courses, regarded as essential in today's competitive business, falls outside current credit systems. The European Qualifications Framework (EQF) links national qualifications systems, acting as a translation device to make qualifications more readable, with the aim to promote mobility between countries and to facilitate lifelong learning. The EQF encompasses general and adult education, vocational education and training, as well as higher education, and applies to all types of qualifications. A key challenge for the EQF is the status of unaccredited short-term sectoral and professional training courses.

The VALLA project, funded by the European Commission, will test how some types of lifelong learning fit into the EQF, targeting the aquaculture sector as a pilot case study. VALLA will develop and pilot methods of recognising and accrediting lifelong learning in the aquaculture sector via the European Qualifications Framework.

VALLA will contribute towards the aims of the EQF:

- by developing competence-based learning outcomes for a specific sector
- by providing a reference for the validation of non-formally acquired competences by linking such reference points to established sectoral standards

VALLA builds on the results of WAVE, a pan-European project that identified the skills and knowledge needed to work in aquaculture across Europe. WAVE produced a "Master List of Competencies" (248 descriptors in 16 categories), which are descriptors of the competencies used in primary production in aquaculture. VALLA takes WAVE one step further, with tools and protocols to move from the competency list to

actual validation of the diverse types of formal and informal training in the aquaculture sector.

VALLA Tools and Protocols will benefit:

- Providers of training and education: describe short training courses in terms of competence-based learning outcomes and credit points with VALLA tools and protocols
- Employees: substantiate skills and competences learned through on-the-job experience
- Job market entrants: add relevant but previously unaccredited study stays, student jobs, and other useful experience to CVs to reflect the complete extent of job qualifications

2. Reducing the impacts of fishing on coastal and marine environments in the Southeast Asian waters: a regional synthesis

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Many traditional fishing gears have been found to induce negative impacts on the coastal and marine environments and resources. In an effort to assess the extent of such impacts, SEAFDEC convened in January 2009 a workshop to address the concerns on the need to improve the designs and use of fishing gear in order to mitigate the impacts of such gear on the coastal and marine environments as well as mitigate sea turtle by-catch in fisheries. This article includes the initiatives of the Southeast Asian countries in reducing the impacts of fishing gears and practices on the marine environments and resources.

3. Effect of dietary Spirulina level on growth and chemical composition of carcass in rohu, *Labeo rohita* (Hamilton)

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An experiment was conducted in three different tanks for 45 days (T1, T2 and T3) to investigate the effect of dietary Spirulina level on growth and chemical composition of carcass in rohu, Labeo rohita. A diet having deoiled rice bran(30%), rice polish (15%), deoiled mustard oil cake(25%), mustard oil cake(10%) and deoiled groundnut cake(20%) was provided to the control (with 100% formulated feed), in T2 95% formulated feed with 5% Spirulina and in T3 90% formulated feed with 10% Spirulina. The physico-chemical and biological parameters and their fluctuations were evaluated throughout the experimental period. In general the water quality varied in the following range; temperature from 20 to 27oC, while DO from 8.2 to 9.1 ppm, free carbon-dioxide recorded 0.4 to 0.8 ppm, pH from 6.5 to 6.9 and total alkalinity from 160 to 190 ppm. Almost similar status of all physico-chemical parameters was found and not affected by the Spirulina application. There was significant difference in the average final weight of the fish among treatments with highest in the T3 (11.28g) followed by T2 (8.32g) and T1 (7.51g). It indicates that the Spirulina along with supplementary feed gave better performance as feed for overall development of fingerlings of rohu during investigation. The higher SGR was recorded in T3 (2.17) followed by T2 (1.52) and T1 (1.28). The experiment clearly indicates the usefulness of Spirulina as feed supplement in fish production. There was significant difference in the average carcass composition of the fish among treatments with highest level in T3 followed by T¬2 and T1.

4. Impacts of integrated fish farming system on the rural economy of India

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The Integrated Fish Farming System is one of the means of sustainable-aquaculture technology, is being practiced especially in India, China and South East Asian countries of the world. This technology has offered the economic improvements and benefits in the field of fisheries, within a shorter time, to the rural fish farmers of India. It has also reduced the adverse aquatic environmental impacts on fish farming, up to 50%. In this system, there is a combination of different species of fishes, under composite fish culture, along with, integration of agricultural production. (Livestock and crops), with aquaculture, and also the farm waste recycling. being practiced in the rural parts of India, for the three fold increase in the economic benefits, in comparison to earlier fish farming practices Though , it requires continuous effective management to maintain a sustainable and productive integrated system. In this system, one can get maximum aqua cultural production, from a single unit area, through, the optimum utilization of all the possible resources of the system.

During the last two decades, the rural fish farmers of India, including the Haryana state, have been trained to understand the techniques of integrated farming system, to maximize the production of the entire associated sister farming units, through the recycling of organic wastes. In one way or the other, to get the maximum economic benefits individually. This is the reason that India has shown a gradual, but a steady enhancement in fish production, followed by, elivation in the national economy, since last two decades. Therefore, a significant contribution has also been marked at the international level, towards the total fish production of the world.

The fish farming communities from the rural part of India are continuously been trained, educated and have also been exposed through practical demonstrations in the Integrated –Fish Farming System, at the

government and at the private fish farms, since more than two decades. This has resulted in:

i) Provision of 70-80 % technical and financial assistance to fish farmers, through Fish Farmer's Development Agencies (FFDA) of India
ii) Different ways to create a class of trained fish farmers in the field of Integrated Fish Farming Units and their Economics
iii) Provision of additional employment opportunity in the rural areas and Management training in "Integrated Fish Farming System"
iv) Utilization of more than 70% available village ponds and tanks for the Integrated fish farming System.

Significant achievements and impacts have been brought, in the form of, increased fish, milk, meat, poultry, vegetables, agricultural crops and fish seed production in carps and cat fishes, at the national level. These impacts are due to the regular fisheries education, fish farm's demonstrations and extension education training programmes, being organized from time to time, by the different States Department of fisheries of India, in collaboration with, Agricultural Universities of the states, for the rural farming communities, fish farmers, rural women of agriculture and extension fisheries workers.

5. Improvement of collaboration possibilities within research and business sector in Central and Eastern European countries

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In the beginning of 2000, the Department of Aquaculture, SZIU had noticed those trends which greatly determined success of conversation between teachers, researchers working on scientific areas, and entrepreneurs working in practice, and economical sphere.

However, colleagues of the department kept traditional educational and research methods, they has developed a new direction: innovation management and technology transfer effectively collect information with modern tools from practical areas; then educational and research focus points are going to be changed by the use of new methods.

The basis of this method is recognition of participants of fisheries sector, business area; reveal of any problems; to get familiar with unexploited opportunities; and by utilizing these information; the main basis is to reform educational system and research strategy.

Due to new education-research approach, the staff of the department has become a determinative participant of national (Hungarian), and international area (Central and Eastern Europe) in forming education materials and research methods.

6. Phytochemical analysis and antibacterial activity of *Carica papaya* and *Azadirachta indica* leaves against *Aeromonas hydrophila*

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Phytochemical screening of the dried leaves of papaya, Carica papaya and neem tree, Azadichta indica revealed the presence of bioactive compounds – flavonoids, saponins, tannins and antraquinones, which have been linked to antibacterial properties. The antibacterial activity of the aqueous and ethanolic extracts of plant materials was tested by disc diffusion method against fish pathogenic bateria Aeromonas hydrophila. Zones of inhibition produced by plant extracts in concentrations of 100, 75, 50 and 25% against the bacteria was measured and compared with those of positive control – antibiotic oxytetracycline (30ug). All pure extracts exhibited antibacterial activity. Results showed that ethanolic extracts were more active compared to aqueous. Growth of inhibition also decreases with decreasing concentration. Statistical analysis of data using ANOVA and DMRT ($p>0.05$), showed that pure ethanolic extracts of A. indica is significantly higher than its reconstituted concentrations while there is no significant difference with pure ethanolic extract of C. papaya compred with its 75% concentration. Although antibiotic OTC displayed a superior potency, results of this study can be used as preliminary basis for further isolation of the therapeutic antibacterial and pharmacological evaluation of plant materials for use in fish health management.

7. Self help groups in fisheries – an impact study

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Degree of visibility of women's participation in fishery activities varies from country to country and within a country from region to region. It is often reported that fishing communities are amongst poorest and most vulnerable. An effective way to tackle poverty is through social mobilization of people, into Self Help Groups (SHGs). Recognising the importance of SHGs, a study was undertaken with the objectives of studying impact of SHG on its members as regards to selected social and economic parameters in Madhubani district, Bihar. To assess performance of SHGs, checklist method of National Bank for Agriculture and Rural Development (NABARD) was used. Data was collected from interview method, focused group discussion, meetings with SHG and NGO staff, personal narrative method, scoring method and assessment of performance of SHG by checklist method. Appropriate statistical methods were used. Paired t-test was performed for impact assessment. Profile of village revealed that area of study lacked basic facilities. A total of 80.9% of SHG members were married and were between18-60 years. Positive impact was found for social parameters namely political participation, mobility, access to different organization, access to Govt./Non Govt. organization, health care and sanitation and decision making ability regarding savings, taking loan and repayment, expenditure and work. Similarly, positive impact was reported towards economic parameters namely employment status, work participation, income, family expenditure, saving pattern and life style. Paired t-test showed that the difference was significant ($t>0.8$). But checklist method for performance assessment of SHG revealed that performance of SHGs was not up to the mark and required improvement on many factors. Accordingly, recommendations were suggested.

8. Sustainable development and potential utilization of waste wetlands for integrated aquaculture system on fish-crop diversity for productivity and economic stability of fish-farm families in Indian sub-continent

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Wetland ecosystem including coastal biosphere comprises of 25-30% that intersected with the main river system (The Ganges, Brahmaputa, Padma, Mahanadi, Mahananda, Rupnarayan etc.) and it's so many tributaries like oxbow lakes (mauns, chaurs, jheels, beels, baors, nayanjali etc.) predominant in Indian subtropics, mostly in Indo-Bangladesh regions. These are immense valuable, resourceful for integrated aquaculture system for fish variables [major and minor carps (rohu, catla, mrigal), live-fishes snakehead & air-breathing catfishes (shoil, gajer, singhi, magur, lata, cheng etc.), edible shellfish, perch, murrels etc.], adaptable for nutrient-rich aquatic food, food-cum-ornamental, non-food commercial wetland crops (Trapa bispinosa Roxb., Euryale ferox Salisb., Nymphaea spp., Colocasia, Aeschynomene aspera, Typha elephantina etc.) either as sole or integrated with fish-crop diversity, as these have out-yielding ability, productive in nature and remunerative as well, mostly preferred by the common urban and rural people and ultimately, sustained for economic stability to millions of people.

This paper deals with development of number of case studies on aquaculture system in utilizing divergence 'Tal' wetland ecosystem (deep, semi-deep, temporary in NAZ, OAZ and Coastal Zone of the regions) for wide sector of downtrodden resource-poor to marginal fish-farming communities through the implementation of TOT based research projects (Transfer of technology, the updating technological improvised demonstration-cum-field trials financed by State Government, ICAR, NWDPRA, DoLR, Department of Land Resources, Ministry of Rural

Development, Govt. of India sources etc.) on the development of integrated fish-crop management programmes suited to zone-specific.

These were launched and formulated through following the (i) System approach (need-based excavation & renovation, methodological approach on waste or unused water body), (ii) Management (all sorts of fish-crop management), (iii) INM utilizing organic as well inorganic sources of plant nutrients, including (iii) Low-cost fish-feed, effectively utilized on fish-crop diversification to a great extent. The unique approach of fish-crop diversity implemented in watershed basins (bherri system), effectively for upright and increased total production system, exhibited economic outturn due to wide use of natural resources as well. Comparative advantages significantly exhibited with mixed farming system [GMR, NP & B-C ratio (even up to 2.70) over subtracting the cost of production] than monoculture, which was economically viable, even to the resource poor fish-farm families, gained to its sustainable level of the regions. From studies it concludes, it is thus imperative to utilize this vast wetland ecosystem, particularly north-eastern part of the country with impetuously for food, livelihood, engagement of household labours and ultimately, economic stability that are inextricably linked with rural economy and sustainability as well, as 'Aquaculture is one of the fastest growing food production systems in the world, with the bulk of its output currently being produced within developing countries, and with expectations for aquaculture to continue its contributions to food security and poverty alleviation'. However, it is essential for current efforts aiming at the future success of aquaculture in both developing and developed countries, that potential social and environmental problems are duly addressed in order to ensure that aquaculture develops sustainably (FAO).

9. The reform and practice of inter-disciplinary talent cultivation mode in Agricultural Resources and Environment (Fishery Resources and Environment) undergraduate

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According to the problems in marine fishery, such as decline of marine fishery resource and environment deterioration, and new demand for talent, we proposed the new talent cultivation mode in Agricultural Resources and Environment (Fishery Resources and Environment) undergraduate. Agricultural Resources and Environment (Fishery Resources and Environment) undergraduate aims at cultivating students with integration of arts, science and engineering, and mastering modern fishery management techniques and deep ecology theory knowledge. We want to reform teaching plans and curriculum system, practice teaching, teaching means, teaching methods and teaching contents, and strengthen the construction of faculty, internship base and laboratory in order to form talent cultivation characteristics in Agricultural Resources and Environment undergraduate in local colleges.

10. The status of silver pomfret *Pampus argenteus* population after exposed to ecological consequences during 1980 to 2005 in Iraq marine waters, northwest Arabian Gulf

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The status of silver pomfret *Pampus argenteus* population in Iraq marine waters, north-west of the Arabian Gulf was assessed from March 2004 to July 2005 and compared with the status of this species during the periods of 1989-1990 and 1997-1998. A total of 1929 specimens of P. argenteus were collected, their lengths ranged from 10 to 36cm. Length-weight relationship was obtained as W= 0.0466 L^ 3.0725. The relative condition factor ranged from 0.95 in September to 1.05 in April. Growth and mortality parameters estimated were: L∞= 42.4cm, K= 0.53, Z= 2.15, M= 1.25 and F= 0.9. The current exploitation rate (0.42) of P. argenteus was lower than the optimum level (0.5). A bimodal recruitment pattern of unequal strength was observed. The maximum yield per recruitment could achieved at Emax= 0.50. The study reveal that the total and natural mortality rates were higher than that for the same population during the last two decades, and the exploitation rate was lower than that of the late of ninetieths.

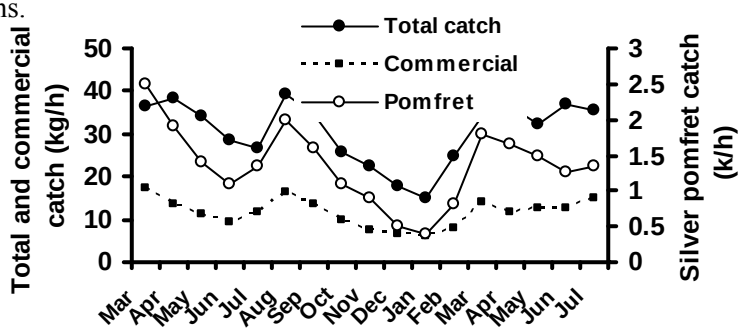

Fig. 2. Monthly variations in the total catch, commercial and silver pomfret

11. Is there gender equity in organized Indian fish retail markets?

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Retailing is final step in the distribution of produce. It is last link in the supply chain connecting the bulk produces of commodities to the final consumers. Fish finds its place in the diversity of products retailed in the market. Structure of fish marketing has been changing considerably since the days of technological improvements of fishing industry. In the recent years, transformation of unorganized fish retail marketing in to organized fish retailing has been noticed in India through entry of private retailer giants such as Spencer's, Starbazar, More, etc. organized system demands the professionals for operation of the system. It is perceived, that it gives equal opportunity for both the gender to work in the system, the reality may be otherwise. With this background a study was done to analyze gender equity in terms of participation, in organized retail fish market vis a vis traditional fish market. Study was performed in one of the important metros, Mumbai India. It was found that women's participation in the organized retail market (Spinach, Spencer, Foodland, Star bazaar) was limited to as fish cutter and fish dresser and only few women were involved in this work. This was compared as to the traditional fish marketing in two main fish markets namely versova fish market and Savarkar fish market, Mumbai. It was found that in these two markets, majority of fish cutters and fish dressers were females. It was interesting to find that more than half of the women working in the traditional fish markets were ready to work in organized fish retail outlets. Women who did not show interest in working in organized retail markets owned their own stall in the fish markets and performed the work of cutter and fish dresser and they earn reasonable profit. The study has revealed that participation of women in the organized fish retail outlet was very limited and interventions should be made to increase their participation so as to ensure gender equity.

12. Impacts of fisheries education and training on fish farming practices/community set up in the rural part of Haryana state, India

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Fish culture is an age-old practice in the many states of India, adapted by the people, as a source of food. Fish netting was even depicted on the rock walls, found in that era, during the excavation of Mohanjodaro & Harappa civilization (350-BC). Aquaculture and fisheries of India is an important sector of aqua- food production. It also provides the sustained nutritional surety and security to the national food stock

At present, India has shown a sustained enhancement in fish production from the Marine and Fresh water Fisheries sectors thus has a significant contribution towards the total fish production of the world The Fish Farming adoption in the state of Haryana is of recent origin. Less than 5 per cent people of the total population in the state are fish eater, which include, local as well as immigrant population from the neighbouring fish eating states. Even than, more than 95 per cent agricultural farmers are profitably engaged in fish farming, along with agricultural and other allied farming works. Resulted in a big benefit in a shorter period .The increasing interest in fish farming in the Haryana state, has clearly been observed science last 3 decades. It is due to the regular fisheries education and training programmes, being organised from time to time for the rural farming communities, fish farmers, unemployed youth, extension fisheries workers and fish dealers in the state. Thus, fish farming in the state has reached to a status of significance at the national and international levels .It has been observe that the interest and awareness in fish farming in the state ,especially in the rural area, has been increased from 5 % to 92 % since last three decades, which is a direct impact of regular fisheries education and training programmes, being run by the State Department of fisheries, Haryana, India and in collaboration with, CCS Haryana Agricultural University, Hisar, for the rural farming communities,

13. A comparison of technical-economic efficiencies of intensive tiger shrimp (*Penaeus monodon*, Fabricius) culture in different cropping calendars of Mekong Delta, Vietnam

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A study assessed the supplied seed quality, technical and economic characteristics of intensive Penaeus monodon (Fabricius) culture in different time cropping. In shrimp seed market, there were 53% of shrimp seed batch was infected by pathogens mainly about 37% of white spot syndrome virus (WSSV), 19% of monodon baculovirus (MBV) and 4% of Yellow head virus (YHV). The average percentage of non pathogen seed from December to next May was 52% higher than 42% of June to November.

The average stocking density was 17 PL m-2 leading to an average of 55% survival rate, 2,470 kg ha-1 crop-1 yield, 1.6 feed conversion ratio, US$6,768 ha-1 crop-1 net income. The average production cost was US$3.4 kg-1, shared mostly 58% by feed cost. The shrimp survival rate of shrimp farm stocking from December to nest May (dry crop) was significant higher than that of from June to November (wet crop) ($p<0.05$) (59% and 49%, respectively). However, the ratio of net income per total cost of two crops was the same because the average marketable farm-shrimp price of dry crop (US$5.5 kg-1) was cheaper than that of wet crop (US$6.0 kg-1) ($p>0.05$).

Approximately 21% of shrimp farms reduced income because of expense cost, caused by 16% of WSSV and 5% of poor water quality management. Almost the main failure in shrimp-farm yield was caused by WSSV. The odd of being lost yield farm was 15.55 times of wet crop higher than that of dry crop. The positive net income of shrimp-farm was dominant in dry crop, new pond, and applied test pathogen seed at laboratory before stocking of shrimp farmer group.

14. Fisheries education in Sri Lanka

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University of Ceylon was established in 1942 and at its inception it had four faculties, Arts, Oriental Studies, Science and Medicine. Since then, university education has become a medium for upward social mobility and is of public concern. Now, annually around 180,000 candidates sit the GCE (A/L) Examination seeking admission to universities in Sri Lanka but only 1/3 of the number qualify. University curricula and teaching programmes were developed over the last few decades without concerning the exact needs of the country. Until very recent, those who followed the biological science courses had no alternative but to offer the three subjects, botany, chemistry and zoology. Ruhuna University College was established in 1978 and the Faculty of Science at Ruhuna followed the other sister science faculties in the university system.

Basics of fisheries science has been included into the curriculum of A/L Biology for more than twenty years, education in fisheries at university level was identified only few years back. At present, there are 15 national universities but fisheries subject is taught under agriculture or biological streams in 13 universities. University of Ruhuna started aquaculture & fisheries into the curriculum of Fisheries Biology in the year 1998 as an optional course under the subject of zoology and then this optional course was upgraded to a department, Department of Fisheries Biology in year 2000 and offered Fisheries Biology as a separate subject. Faculty of Fisheries and Marine Sciences & Technology (FMST) was established in the year 2005 with three academic departments

Department of Fisheries & Aquaculture, Department of Limnology and Department of Oceanography & Marine Geology, Wayamba, Sabaragamuwa, Eastern and Uva-Wellassa universities are also offering fisheries and aquaculture as separate subjects. The degree programme conducted by the Faculty of FMST is unique among other universities in terms of aquaculture & fisheries education as it completely devoted to research and teaching in this particular subject. The Faculty

offers Bachelor of Science in Fisheries and Marine Sciences Degree after successful completion of the four year programme. Undergraduates get the opportunity to specialize in any out of four areas, Aquaculture, Fisheries, Limnology or Oceanography. Three universities, University of Kelaniya, Peradeniya and Sri Jayawardanapura provide the opportunity for postgraduate studies in the field of fisheries and aquaculture in Sri Lanka.

15. Comparison between monovalent vaccine and bivalent vaccine of *Streptococcus agalactiae* and *Aeromonas hydrophila*, on antibody production and survival rate of Nile tilapia, *Oreochromis niloticus*

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Effects of monovalent vaccine and bivalent vaccine of Streptococcus agalactiae and Aeromonas hydrophila in Nile tilapia were evaluated in view of antibody production and survival rate. Both vaccine types were attenuated using 2.0% formaldehyde. Experimental fish with 137.1+ 10.8 g BW were vaccinated by intraperitoneal (ip) injection at a dosage of 0.1 ml/100 g fish and booster vaccination was manipulated 17 days after the first vaccination. Antibody production was investigated by indirect agglutination test.

Twenty-eight days after booster vaccination, all experimental fish were challenged with S. agalactiae KKU 07025 and/or A. hydrophila KKU 08008 to examine survival rate comparing with non-vaccinated controls. From the results, all vaccinated groups, both monovalent and bivalent vaccinations displayed significantly higher antibody production and survival rate than non-vaccinated controls. Monovalent vaccine was more effective to increase antibody productionin comparison with bivalent vaccination ($p<0.05$). Nevertheless, there had any difference in survival rate between the fish administered with monovalent vaccine and bivalent vaccine. Also, booster vaccination exhibited significantly higher antibody production than single vaccination both in monovalent and bivalent vaccination.

16. The need for fish health education to support sustainable aquaculture in Asia

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Expertise in fish health has generally been gained through short-term training courses or through post-graduate degree programs because the discipline has not been strongly incorporated into the academic programs for fisheries or veterinary degrees. A big gap in the supply of fish health care specialists exists in aquaculture because the available expertise has not kept in pace with the phenomenal growth of the industry. Trainings in Fish Health at SEAFDEC Aquaculture Department has spanned more than two decades and has evolved into various modes of delivery to tailor-fit and suit the requirements of various stakeholders. Training courses have ranged from face-to-face and hands-on training to online delivery and short-term internships. Resource materials that have been published and used for these various programs include a comprehensive textbook, highly illustrated manuals and CD. This experience has taught us that, notwithstanding decades of training delivery. The need for basic fish health knowledge remains. SEAFDEC answers this by being flexible with the contents, delivery mode, duration of training, and availability of funds from donor agencies.

17. Determination some educational characteristics of the academic education in compare with vocational education and modified vocational education in aquaculture in Iran

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This article is the result of the field study to determine some educational characteristics of the academic education in compare with vocational ones. The Fisheries academic education has been being going on for the last four decades in Iran. In last twenty years, the role and situation of educated experts has been characterized but as matter of fact, educated people always face to problems to enter new industries. On the basis of private opinion, Academic education has failed to obviate the need of aquaculture industries and it's infra structures should be changed. It seems the private sector comments are rather right. One of the reasons that can be pointed for denial of graduates by sector is the type of training.

According to our research, the percent of the volume of the theoretical and field courses in different educational systems respectively arranges as following:

- Academic Education> Vocational Education> Modified Vocational Education
- Modified Vocational Education> Vocational Education> Academic Education

So, it seems the percent of the volume of the theoretical courses is more than other systems but contrary to the previous result the satisfaction and capability of the students in modified Vocational Education are further than other systems.

18. Experiential learning and book development: the case of SEAFDEC Aquaculture Department

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How does one convey learning, and develop and strengthen the capacities of aquaculture stakeholders? For SEAFDEC Aquaculture Department (SEAFDEC/AQD), a research and development institution based in the Philippines, it is through experiential training courses and provision of take-home reading materials that are the results of its own research program and technology generation efforts for the past 36 years. To date (1975 to 2008), SEAFDEC/AQD has trained and transferred technology to 12,106 stakeholders in 365 training sessions that are a few days to a month to season long. The training courses are conducted at AQD's four stations, on-site at the stakeholders' facilities or through the internet as distance learning courses. AQD's most attended courses before 1992 have been tiger shrimp hatchery–nursery operations and brackish water pond culture. After that, the most attended are abalone, mudcrab and milkfish mariculture. Except the online courses (principles of fish health management and fish nutrition), the courses are 80% practical sessions. Courses in 1987-2008 (total trainees = 3,697) have been attended by 71% male and 29% female who are from national government agencies of SEAFDEC Member Countries (41%), private sector (18%), academe (17%), research & development sector (10%), local government units in the Philippines (6%) and others. Making up the bulk of trainees are Filipinos (57%) as AQD is hosted by the Government of the Philippines, followed by Thais (8%) and Malaysians (8%). Trainees also come from Vietnam (6%), Myanmar (4%), Cambodia (4%), Indonesia (3%) and 32 other countries.

AQD by itself does not decide the courses to offer as the priorities of its training program have been the results of consultations with regional experts and stakeholders in Southeast Asia, including ADSEA (Aquaculture development in Southeast Asia workshop series) in 1987, 1991, 1994 and 1999; and from then on, through the yearly SEAFDEC Program Committee and SEAFDEC Council Meetings that are attended by representatives of the eleven SEAFDEC Member

Countries. Funding for the courses has come from the Government of Japan Trust Fund and/or the stakeholders themselves.

AQD also assesses all its courses by post-training questionnaire (rating by trainees is highly satisfactory to excellent) by a tracer study of its 1985-1993 training alumni, by gathering its training alumni in 1992 for an aquaculture workshop, and by a training needs survey in 1997. All of which are made the basis for the improvement of the training program.

In terms of book development, AQD has so far written and published two textbooks on fish health and fish nutrition, and a 2009 training handbook on rural aquaculture. All of its hatchery and culture technologies -- abalone, bighead carp, catfish, freshwater prawn, grouper, milkfish, mudcrab, sea bass, seaweeds, tiger shrimp, tilapia and more -- are compiled in 2008 in a DVD (digital video disc) entitled Compendium of aquaculture technologies. The DVD includes technology summaries, 20 training & institutional videos, and PDF files of AQD's 720 newsletter issues, 35 annual institutional reports, 40 manuals, 60 flyers, 15 posters, press coverage, among others. It also contains a topical list of AQD's over 1,200 research papers that are the backbone of AQD's technologies and that have been published in Current Contents-covered and other journals or publications. More recent updates of AQD's research, technology verification & demonstration, and training & information dissemination activities are found in its website www.seafdec.org.ph.

19. Curriculum design system in Shanghai Ocean University

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Shanghai Ocean University (SHOU) has strengthened the construction of connotation aimed at improving quality, optimizing structure, highlighting characteristics, coordinating development, and enhancing the quality of education from 2004 when the university had gone through the National Undergraduate Teaching Assessment, which was widely embodied by the talent cultivation plan of the university.

Guidelines

Based on the perception of strengthening general education, broadening disciplinary foundation, condensing specialty characteristics, and optimizing curriculum, the university works out scientifically the goal and standard of talent cultivation, combines effectively the program of strengthening solid foundation with that of emphasizing adaptability, links request of broadening specialty to flexible disciplinary setting, promotes integration of science and humanistic education, and handles the relationship between general education and disciplinary education well.

Principle

- to foster the all- round development students in ethics, intellect, aesthetics and social skills
- to advocate unity in diversity
- to plan global optimization of curriculum system
- to urge practical education, reinforce the ability of applying knowledge practically
- to deepen comprehensive reform, strengthen the education construction and administration

Implementation

- redesigned curricular model, construct overall disciplinary system

- rationalized the standard of course option by providing less compulsory courses but more optional courses
- constructed continuous educating system for the skill-oriented course such as foreign language and computer
- promoted reform on laboratory education system, foster science literacy

20. On the cultivation of the practical abilities of public administration students

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Students' practical ability is one of the most important abilities in cultivating Public Administration professionals. Starting from the existing problems and practical needs of professional training in public administration, this paper elaborates on the students' creative thinking and ability-cultivating from the angles of teaching concepts, teaching system, practice base construction and construction of double-qualified teachers, so as to find the approach and ways to cultivate the practical abilities of Public Administration Students.

21. College adult education in Chinese aquatic universities: present status, problems and solution

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Adult continuing education occupies an important place in Chinese Agricultural Education System and plays a key role in agricultural economy development. As an effective education approach, it contributes a lot in fishery to promoting the human resource exploration, improving specialty capability, developing farmer quality, increasing international competitive ability, and enhancing the transfer from traditional mechanism to modern one. Chinese aquatic colleges have made great contribution as the lead and main force in aquatic continuing education. Facing the promising opportunity and fierce challenge under the new circumstance, aquatic educators need to explore the problems of aquatic adult continuing education within Chinese context, which is significant for expecting a more healthy and sustainable development.

Present Status

- explicit university orientation
- a nearly complete pattern of college running system
- high qualified full time/part time teachers
- outstanding achievement and distinctive features

Existing Problems

As one of the disadvantaged businesses in China, fishery adult education has encountered various difficulties as follows:

- lack of government support on policy
- lack of government support on finance
- marginalized position caused by the misperception of its education orientation
- lack of autonomy in diploma education, students recruitment, and planning enrolment scale
- obstacles occurred frequently because of the non-diploma education.

Possible Solution

- to accord great importance
- to adapt the new situation, meet request of new task, and promote system reform
- to strengthen exchange and coordination with agricultural sectors, make full use of resource advantages on science and education, reinforce service commitment to new socialist countryside
- to increase government financial input, encourage development
- to intensify academic research on aquatic adult education, increase education quality, especially on the non-diploma education quality

22. The exploration and thinking about the cultivation of postgraduates through production-academy-research alliance

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The cultivation of postgraduates through production-academy-research alliance is an effective way to ensure the high quality of postgraduates under the circumstance that the scale of the postgraduate education is expanding rapidly. SOU, a university characterized by special flavors, has gradually worked out a successful road leading to cultivate postgraduates through production-academy-research alliance in the process of developing postgraduate education. That is to say, to build up an effective alliance-interaction mechanism and a practicable management process and come true the advantages complementation and mutual benefit on the purpose of double win and sustainable development.

23. Shanghai Ocean University aquatic products processing and storage engineering department: the reform and practice of talent training

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Aquatic products processing and storage engineering is a traditionally strong subject in Shanghai Ocean University, which acquired the right to grant Master's degree in 1984, and Doctorate's degree in 2003. Our department has been doing extensively and in-depth research for a long time, in various aspects of aquatic products processing and storage, such as aquatic products keeping, frozen and cold storage, fish waste utilization, extraction of active ingredients, nutritional testing and fish processing machinery and equipment design, etc. China's total aquatic production is as much as 40% of global fisheries production, ranking first in the world for 20 consecutive years; the national aquatic production reached 48.956 million tons in 2008. With the development of modern economy, the content of the processing has been changed entirely. The deep-processing of the aquatic food has been initiated; in addition to the traditional quick-frozen products, canned fish, dry goods and fresh products, it also developed convenient aquatic food, flavor aquatic food and aquatic products beverage; pharmaceutical and biological products have also been developed. With the emergence of a variety of fish processing products, food packaging technology and equipment are facing the new requirements, the accompanying food packaging and food logistics companies are actively exploring aquatic food market changes, to meet the development needs of aquatic food products. These developments contribute to the setting of the professional subject and the adjustments of the professional training goal. In addition of the original professions, our department added the programs of food quality and safety, packaging engineering, food logistics engineering, so that the professional setting can catch up with the trend of technological development, to enhance the quality and raise the level of personnel training.

Teachers play an important role in raising educational levels and the qualities of teaching, by taking the "introduction, training, improvement" steps. First, we took a variety of ways to improve the

teaching force structure, and introducing experts and professors who studying abroad; Second, we took efforts to improve the professions of teachers, and support teachers in curriculum studies and training projects abroad, at the same time invite a number of foreign well-known experts, professors to give lectures on a regular basis, to provide students with high-quality teaching.

Profession Construction is not only an important aspect of colleges and universities education, but also carrying out the personnel training and the foundation of teaching. Shanghai Ocean University conducted a professional training plan revision in 2006. The new talent development program strives to build the training model as the organic combination of the teaching theories, teaching practice, and self-research, emphasizing a flexible setting of professional direction, focusing on the students' development of expertise and personality.

Aquatic Products Processing and Storage Engineering Undergraduate Training Program's overall framework is divided by three levels of classes and focused practice teaching composition of, comprehensive education, academic education and professional education. In the construction of the curriculum system, we introduced a number of optional courses and cutting-edge professional development programs, in addition to meet the basic needs of fundamental knowledge. We encourage emphasizing the core curriculum as a starting point for curriculum construction, and strive to improve the teaching content, teaching methods and tools, teaching force and teaching effects, in order to lead the overall improvement in the quality of teaching. Actively carry out multi-media teaching, and use the multi-media teaching methods more than 90% of time.

In the undergraduate educational plan of Aquatic Products Processing and Storage Engineering, we strengthen the practical aspects of education and practical abilities, which recognizes internships, production internships, graduate internships and other professional practice and integrated practice a large proportion of total credit account, for up to 20 credits. At the same time, our school supports students in science and technology innovation activities; and specially designed course credits recognition plans of the corresponding courses, to support students' enthusiasm to participate in the activities.

24. Thoughts on the innovation of the talent training mode of fishery economics and management specialty

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The new target of the modern fishery development is to present higher and new requirements for the type, knowledge structure and ability of talents cultivated by higher fishery education. The development of talents' type has changed from past focus on natural science knowledge and technology to the balance between natural science knowledge and social science knowledge. Therefore, the talent training of fishery economics and management specialty is becoming an important part of higher education.

The traditional talent training mode requires to establish discipline-based specialties, set up teaching contents around the fundamental theories and methods of the subject and emphasize the disciplinary integrity, curriculum hierarchy and the impart of professional knowledge. However, if experiment, practice and the combination of knowledge with reality are neglected, the students who have been trained will not understand the society and industry, which is unable to meet the social requirement for talents. The talent training mode is the concrete way to realize training target. To be specific, it involves the talent training target, curriculum system construction, the reform of practical teaching links, teaching methods and so on. Thus, the innovation of the talent training mode firstly requires to accurately position the talent training target of fishery economics and management specialty according to the change of the talent demand of the modern fishery economic development.

According to the socio-economic development and the needs of modern fishery industry, the talent training target of fishery economics and management specialty is to make them have systemic economic theories and modern management ideas, grasp advanced management methods, know better of the fishery industry development and become applied talents with good comprehensive quality and specialized skills.

On the basis of knowledge and ability, the educational concept of training applied talents attaches importance to the coordinative

development among knowledge, ability and quality and the cultivation of students' comprehensive quality and specialized skills. The application of knowledge is the main feature of specialty direction, curriculum design, teaching content, teaching method and other aspects. As applied talents are characterized by basic, applied and practice, their training mode may follow the principles of learning to meet practical needs, ability standard and diversification.

In order to implement the innovation of the talent training mode, firstly, measures should be taken to continuously improve the training programs of the talent and construct scientific and rational curriculum system, which could be divided into general education curriculum, core curriculum and professional orientation curriculum to highlight the application of the basic theories and improve students' ability to analyze and solve the problems. Secondly, the strengthening of practical teaching, the construction of close producing-teaching-researching cooperative system and the implementation of diversified cooperative education is the key to shorten the distance between university and society. Thirdly, it is requisite to explore student-centered education teaching mode, change the traditional system-knowledge-centered teaching mode, strongly advocate and promote participatory, heuristics, discussion type and other interactive teaching mode. Also, the combination of the first class with the second class is needed. Through students' self-design and cross-discipline course selection, the implementation of the comprehensive elective system as the core of the credit system promotes students' permeation of the scientific and artistic knowledge. Finally, it is essential to introduce high-quality educational resources and advanced education mode abroad. In order to provide a good platform for cross-training students, we introduce foreign curriculum, teaching materials, teachers, teaching and testing methods, and conduct bilingual teaching through cooperation and study with the experiences of developed countries in training applied talents.

25. A study on general mathematics teaching reform in fisheries colleges

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General mathematics is one of the important public basic theoretical courses in the curriculum of fisheries colleges. It plays an important role in cultivating students' such abilities as creative thinking, abstract thinking and generalizing, logical reasoning, self-studying, analyzing and solving problems. The teaching quality of it will directly affect the whole teaching quality of fisheries colleges. With an increasingly enlarged enrolment of students in China's tertiary schools since 1999, each college or university is confronted with a series of problems: on one hand, the number of students has increased greatly while the number of teachers cannot increase correspondingly; on the other hand, the percentage of new teachers, and the difference of students rise sharply. In addition, the requirements for general mathematics have been improved. Therefore, it is necessary to reform the existing teaching method.

According to an investigation, the present administrative measures for improving the teaching quality mainly include: designating a class advisor and stimulating the student' motivation; reducing the number of students of a class and creating an individual class atmosphere; increasing after-class tutoring, which should be included in the teaching plan, etc.. It has been proved that these measures are effective in improving the teaching quality of general mathematics.

The teaching of general mathematics should focus on disclosing "the burning thinking hiding behind the icy beauty of mathematics". The teachers should strive to explore a students-centered brain-storming-style teaching mode, stimulate the students study motivation, and cultivate their divergent thinking ability and creative spirit. The ideas of stratification teaching, competency-based instruction and students-centeredness should be popularized so that all students can obtain the opportunity to develop themselves. It is necessary to reform the existing teaching contents, which should meet the needs of students in terms of theory and practice, classic and modern, knowledge and capability,

reduce redundant teaching contents and remain the essence, and weaken the calculation skills. Establishing a stage-check-up system, which, by reasonable assessment of students' performance, will transforms the students from passive receivers to active learners, and thus lay a solid foundation for their future specialty study.

26. The exploration of team-learning cultivation modes in fisheries education

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Chinese fisheries have developed rapidly, and the demands of fisheries talents become increasingly urgent, which promotes the rapid development of fisheries education. Meanwhile cultivation modes are also innovative and increasing continuously, which is the opportunity and challenge of fisheries education.

Team-learning cultivation mode brings into playing positive roles in many ways of talents cultivation. This article mainly aims to discuss and analyze the exploration of team-learning cultivation in fisheries education.

Team-learning is the common education mode in management education. Teaching centered on problems is called problem-based teaching (PBT). Students should use problem-based learning (PBL), which is a kind of problem-oriented learning mode, it can set learning to the complicated and significant problem situation. According to some ways, teacher makes up learning team work, which can make the learners work together and solve actual problems, to learning the scientific knowledge implicit in problems, which can cultivate students question consciousness and thinking skills, come into being self-learning, problem solving abilities and improve learning interests.

To rise and enter the simple problems into specific actual task, the students should gain experience in the completed task process, and sum up completed knowledge of the courses, in order to apply to the different situation cases, which is called task-based learning (TBL), it has realistic significance for the exploration of fisheries education.

Team-learning is to take new knowledge, new idea, the experience of success and failure to communicate in the team, forming team knowledge sharing, which can make team knowledge exceed the sum of individual knowledge.

Fisheries education refer to many aquaculture fields and subjects, for the course of aquaculture logistics equipment technology, effectively

organize and enter into team-learning ways will obtain some achievement. Author makes the corresponding exploration in teaching.

27. A study of career orientation and employment psychology of fisheries and aquaculture majors

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Due to the lack of career planning and influenced by the traditional belittling of agriculture, many students majoring in fisheries and aquaculture have misconceptions in their career orientation and employment psychology. The idea of "getting out of agriculture" is deeply rooted and exerts great influence on the ideas of employment of students and their parents. Through the investigation with many employers, students and university authorities, this article summarizes some misconceptions in the career orientation of these students and some adverse attitudes towards employment caused by this orientation. Taking advantage of the theories in career education and psychology, this article tries to come up with a solution to help these students establish correct career orientation and maintain healthy employment psychology.

28. A few reflections on the college foreign language (CFL) teaching reform for the undergraduates in the fisheries discipline

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Fishery has long been one of the dominant disciplines in our university. It ranked second among those universities which received the first level discipline evaluation in the fisheries universities of China. As one of the most important basic courses of unprecedented size in our university, CFL in our university has undergone a great change in both form and content since the first implementation of CET Band-4 examination in 1987, esp. CFL teaching reform in China's universities. Although we have obtained some remarkable achievements so far in CFL teaching reform, there are many hard-to-solve problems existing in syllabus, courses, teachers, teaching patterns, etc. Therefore, the present paper tentatively makes a careful analysis of the current situation of CFL teaching reform based on the characteristics of CFL teaching for the undergraduates in the fisheries discipline, affirms the achievements made in the CFL teaching reform, points out some problems to be solved and puts forward corresponding countermeasures so as to improve CFL teaching reform.

Firstly, this paper holds that a clear picture of the characteristics of CFL teaching in the fisheries discipline is a prerequisite to achievement-affirming, the current situation-analyzing, problem-finding and countermeasure-proposing. College English, as one of the most important CFL courses offered to the undergraduates of the fisheries discipline is similar in one way to the other courses but dissimilar in another. And so, only through a better understanding of the developing objective, curriculum requirement, teaching methods and evaluation system, can we implement CFL course teaching. And at the same time, since the students vary from major to major and from learning basis to learning basis, different teaching content and teaching models should be considered so as to meet the specific needs of the individualized teaching. So in terms of CFL teaching reform for the undergraduates in the fisheries discipline of our university, consideration must be given to the characteristics of college foreign language itself as well as the laws of

fisheries discipline itself, and a balance point must be found between general English courses and professional English courses.

Secondly, like other basic courses in our university, the current situations are not optimistic in CFL teaching for fisheries discipline. There has much to be improved and many problems to be solved. First of all, only monolanguage is offered to the undergraduates in the fisheries discipline, So the demands of international exchange and cooperation in fisheries cannot be met; and also, curricula are not well designed so that the requirements of the syllabus can not be satisfied and the developing objectives cannot be attained; And to make things worse, a shortage of teachers in the follow-up CFL teaching prevent students from continuous CFL study after they finish attending all the required comprehensive English of Band 1-4 at the fundamental stage (the 1st and 2nd year in university). They have no choice but to give up the study of some follow-up English courses in the 3rd and fourth year of the university. Over the past decades, overemphasis on language input and over-explanation of grammar in CFL class aggravate "dumb English" and "deaf English" among the undergraduate of fisheries discipline. Finally, because of different teachers' ideas, inappropriate curricula and a shortage of language environment, students' comprehensive ability to use English, esp. the ability to obtain knowledge independently, think independently and create independently, can not be developed.

Thirdly, although CFL teaching is not entirely satisfactory in the last few years, we have made many achievements so far by deepening the teaching reform in fisheries discipline. This mainly lies as follows: Teachers have been greatly improved in professional level by going aboard for further study and studying for doctor degree in TESOL. We have also made a syllabus of our own in the light of the fisheries undergraduates' specific circumstances and set our different objectives in listening, speaking, reading, writing and translation for different majors in fisheries discipline so that it could meet the needs of the students' learning at different level. Textbooks and supplementary teaching material based upon "Curriculum requirements" and "Teaching Syllabus" has been mature recently. Every student can learn what they want to. Diversified teaching methods have been used in CFL class. Traditional explanation, integrated with presentation, discussion, seminar and short movie-watching, arouses great interest of the undergraduates in fisheries discipline. With the development of multimedia and network technology, new teaching models are widely used in CFL class. As a result, CFL

teaching will be free from the constraints of time or place and geared towards students, individualized and autonomous learning.

Finally, the problems existing in CFL teaching reform are obvious, but what matters is how to solve them so as to develop students' comprehensive ability to use foreign language in an all-round way. So this paper believes that it is very important, first and foremost, to improve the current syllabus, including curriculum issued by the State, and especially the teaching syllabus made by our university so as to ensure that the developing objectives and teaching requirements vary from major to major and from student to student. Then, teaching models should be further optimized. Three different teaching models---E Independent Learning, E Cooperative Learning & E Blended learning---should be introduced into alternatively used in the modern CFL class because of different learning basis of students, class size and Language level of teachers. And at the same time, more selective courses, such as language skills, language uses and language & culture courses should be offered to the undergraduates of fisheries discipline to meet the needs of the country and society for qualified personnel in the new era. And finally, in terms of CLF, the extracurricular teaching must be emphasized since students' language skills and creative ability can be developed through such extracurricular teaching activities as various language contests, conference interpretation, social practice, etc.

29. The study of fed-batch control strategies for high-density culture of gene engineering bacteria

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Fed-batch control strategy is one of the key technologies to achieve high-density cultivation of gene engineering bacteria. This review emphatically introduces the current development and trends of microorganisms' fed-batch control strategy and control system at home and abroad, combined with a large number of examples. And this review discusses the application and trends of the pattern recognition technology, artificial neural network, particle swarm optimization algorithm, etc.

30. Cloning and sequencing of partial leptin gene from *Labeo rohita* (Ham.)

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Feed intake regulation and underlying mechanisms is one of the most active areas of research in the nutritional physiology of fish. There are several anorexigenic and orexigenic factors involved in the regulation of feed intake and leptin is one of the most important factors which plays a crucial role in feed intake regulation and energy homeostasis. Leptin is a 16 kDa non-glycosylated peptide hormone encoded by the obese (ob) gene and it is implicated in a wide spectrum of physiological functions including growth in mammals. But, information about the role of leptin in fishes is scanty and obscure and particularly, there is no report about the structure, expression pattern and function of leptin in the Indian major carps.

The present work is probably the first to identify the presence of leptin gene in rohu, Labeo rohita - a significant start for leptin research focusing on Indian major carps. After checking the purity, integrity and quantity of total RNA isolated from the liver tissue of rohu yearlings, first strand cDNA was synthesized by reverse transcription of the rohu mRNA and this first strand cDNA was subjected to PCR with leptin specific primers designed based on reported cyprinid sequences. The amplified cDNA fragment encoding rohu partial leptin was about 450 bp by agarose gel. This partial gene insert was ligated to a plasmid vector pTZ57R/T by T/A cloning and Escherichia coli DH5α strain was transformed with this ligation product. The recombinant clones were screened by blue white colony selection, colony PCR and horizontal slot lysis and finally confirmed by restriction enzyme digestion with Eco RI and HindIII. Rohu partial leptin gene after automatic sequencing revealed the maximum homology (97%) with Cyprinus carpio ob 2 gene, followed by Carassius auratus (89%), Ctenopharyngodon idella (85%) and Danio rerio (72%) on BLAST search in the NCBI GenBank database. The absence of homology with fishes from any other families indicates the low sequence similarity of leptin between the teleostean families and

this implicates that there has been rapid divergence in the evolution of leptin within the teleost lineage. Analysis of the rohu partial leptin gene sequence revealed no homology with mammals or other vertebrates. Characterization of leptin in rohu would have implications for studies that seek to understand feed intake regulation, energy storage and allocation, metabolic rate, reproductive maturity and environmental adaptations.