Collaborative Aquaculture Education in the Asia-Pacific Region

Report on the Expert Consultation on Aquaculture Education in the Asia-Pacific Region

Hotel Meritus Westlake Hanoi, 11th-15th May 2000

Edited by:

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The Expert Consultation on Aquaculture Education in the Asia-Pacific was held in Hanoi, Vietnam, from 11-15 May 2000. The Expert Consultation was the final activity of APEC project FWG/02/99 "Collaborative Aquaculture Education Program", which was jointly implemented by Deakin University and the Network of Aquaculture Centres in Asia-Pacific (NACA). This report gives the findings and papers presented to the Expert Consultation, including the follow-up recommendations for establishing an **Aquaculture Educational Consortium** (AEC), in the form of a network, comprising academic and training institutions in the Asia and Oceania regions.

Limited copies of the report are also available from NACA Coordinator at the following address:

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Expert Consultation Photos

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Report on the Expert Consultation on Aquaculture Education in the Asia-Pacific

Background

The Expert Consultation (EC) on Aquaculture Education was hosted by the Ministry of Fisheries, Vietnam from the 11th – 15th May 2000 at the Hotel Meritus Westlake Hanoi. The EC was the final activity of the APEC project "Collaborative Aquaculture Education program in the Asia-Pacific Rim Economies of the APEC", being implemented by Deakin University, Australia, in conjunction with the Network of Aquaculture Centres in Asia-Pacific (NACA).

The EC involved 36 persons from APEC economies in the Pacific Rim, NACA member countries, representatives from Fiji and the South Pacific University and regional institutions involved in aquaculture education. The list of participants is attached as **Annex A**.

Objectives of the APEC Project and Expert Consultation (EC)

The long-term objective of the APEC project is to adequately train a critical mass of middle-level managers and technicians in the science of aquaculture so as to:

- develop skills to equip them adequately to meet the challenges of a growing industry in the next millennium;
- maintain environmental integrity within aquaculture industry operations; and
- retain the long-term sustainability of the industry and maintain environmental integrity.

The project is expected to lead to the achievement of this objective by developing a collaborative approach to aquaculture education and training within the APEC region. The immediate objective of the APEC project therefore is to develop a strategy for a cooperative education program in aquaculture in APEC countries, specifically through:

- an assessment of the present availability of aquaculture courses in the region and the perceived impact/ relevance of these to the industry currently and in the future;
- evaluation of the possibilities and mechanisms for networking of national and regional institutes on a regional basis;
- an assessment of needs and building of capacity for skills based education and training; and
- development of an overall strategy for implementation of the regional aquaculture educational program to provide the most efficient and effective method of delivering the complex and multi disciplinary nature of aquaculture education and training that is essential

The Expert Consultation was the final activity of the APEC Project with the following objectives:

- to review the status and activities of different providers of aquaculture education/ training in participating countries;
- to assess the transferability/ adoption of existing material between countries/ institutes;

- to determine the skill base needed to meet regional needs for the new millennium;
- to determine a course content and prioritize training and education in aquaculture for the region, including targets and delivery mechanisms;
- to determine potential twinning/cooperation arrangements between institutes and usability of study materials already available; and
- to develop a framework for a pilot regional aquaculture education program.

The Expert Consultation

The consultation was opened by the Dr Nguyen Viet Thang, Vice-Minister, Ministry of Fisheries, Vietnam and with welcome remarks from Professor Robert Wallis, Deakin University and Hassanai Kongkeo, NACA Coordinator.

The opening session informed the participants of the relevance of this consultation to the recent Bangkok Declaration on Aquaculture Development beyond 2000[1], in which great emphasis was laid on human resources development and capacity building for the sustenance of the sector. In this regard, attention was also drawn to a previous workshop in 1988 on fisheries education in Asia, convened by the Asian Fisheries Society, where again emphasis had been laid on the need for capacity building in aquaculture education.

The detailed workshop program is given as **Annex B**. The program included four **Plenary Sessions**, as summarized below.

Session 1: Introduction and objectives of the workshop
Chairs: *Robert Wallis & Le Thanh Luu*
Rapporteur: *Tim Pickering*

This session introduced the background to the APEC project and the Expert Consultation, provided a brief review of aquaculture in the Asia-Pacific Rim economies of the APEC and a summary on aquaculture education in the APEC economies of the Asia-Pacific Rim, and key findings of the APEC/ NACA project.

Session 2: Presentations of economy experiences
Chairs: *Hassanai Kongkeo & Amararatne Yakupitiyage*
Rapporteur: *Mads Korn*

This session provided a more detailed analyses of aquaculture education in various economies, including Australia, Bangladesh, Cambodia, China, Fiji, India, Malaysia, Pacific Island States, the Philippines, Thailand, Vietnam, and Kasetsart University and the University of the South Pacific.

Session 3: Assessment of requirements for aquaculture education and potential strategies for meeting future needs
Chairs: *Li Sifa & Pedro Bueno*
Rapporteur: *Laurie Laurenson*

[1] NACA/FAO (2000) Aquaculture Development Beyond 2000: Bangkok Declaration and Strategy. Conference on Aquaculture in the Third Millennium, 20-25th February 2000, Bangkok, Thailand. NACA, Bangkok and FAO, Rome, pp. 28.

This session involved more detailed presentations on requirements for aquaculture education, and selected experiences in delivering and developing aquaculture training and education programs.

Session 4: Strategies for meeting future aquaculture education needs
Chairs: *K. Gopakumar & Leonor M.Santos*
Rapporteur: *Robert Gibbons*

This session looked at the use of electronic media in aquaculture education, and the potential role of distance education.

Summary of Major Findings of the Plenary Sessions

In the plenary, 24 presentations were made, of which 19 draft documents were available to the participants. Each presentation was followed with a short discussion, in addition to the general discussion at each of the four plenary sessions.

The following summarizes the major findings and issues raised during the plenary sessions of the Expert Consultation.

It was apparent from most of the presentations and the discussions that followed that in view of the diversity of aquaculture practices, be it at a rural, subsistence level and /or at an industrial level, there was an associated diversity in current aquaculture education (AE); in course content, standards, delivery mechanisms and in the degree of collaboration between academia, government and industry.

The plenary sessions stressed the need for AE to address changing demands and future directions and the need to address a wide range of issues such as utilization of natural resources, environmental sustainability, cultural needs and so forth.

In view of the increasingly important role that aquaculture plays in rural development and in alleviation of poverty the EC emphasized that social development concerns should be fully integrated with in AE programs with in the region.

Specifically, the key imperative of sustainability for the aquaculture sector dictates the need for development of contemporary teaching methods in relevant aspects of sustainability. For example, the specific principles of Ecologically Sustainable Development, and associated international governmental obligations to the environment, which embrace aspects of biodiversity, inter-generational and societal equity etc., in many cases require a more formal, structured teaching approach than is presently the case. Indeed, inclusion of these matters as an integral part of AE is one way for economies to demonstrate that they are meeting their international obligations toward the environment.

In spite of the above-mentioned diversity in AE, a fair degree of commonality of key issues that need to be addressed in AE was apparent. These common issues included the provision and degree of pure and applied components of curricula, producing generalists versus specialists (for research, for example), vocational versus purely scientific, and provision of short-term tactical (industry-led) versus long-term strategic (public good) training.

The plenary sessions also addressed the difficulties in retaining high quality aquaculture teachers in some economies, particularly in view of the limitations in remuneration and associated incentives. In this context it was agreed for AE to be innovative so as to provide opportunities that ensure career development and there by building of human capital resource, intellectual capacity, corporate memory, continuity/stability in management, planning and development; all elements needed for the long term sustainability of aquaculture.

There was agreement in the need to regularly revise and update syllabus/curricula and such revisions should include critical analysis of short-, medium-, and long-term needs of key stakeholders, i.e. farmers, industry, community, government, as well as the longer term, strategic socio-economic, environmental, resource allocation issues.

The plenary addressed the issue of training the trainers as a priority, which specifically recognizes the Project’s stated objective of ensuring sufficient numbers of appropriately qualified mid-level aquaculture managers and technicians for the future. In this regard, the importance of providing proper training for extension workers, as well as training in extension methods for researchers and academia, were considered. It was also noted however, that a regional approach to AE will need to be comprehensive and will also therefore, necessarily address training needs at all levels of the aquaculture sector.

The plenary was of the view that there is a need for flexibility in aquaculture education, but not at the expense of quality, and the need for regular assessment/ evaluation of the effectiveness of the education provided. It was agreed that AE should adopt a participatory/ experiential approach with emphasis on building problem solving capacity. In adopting such an approach, recognition of the stakeholders and the financial and human resource constraints is needed.

The plenary considered in detail the role of distance education and the use of electronic/ internet/ intranet in the delivery of AE in the region. The issues raised were:

- the relative balance between the different delivery mechanisms; specific needs of certain economies;
- the need for criteria for evaluating the quality of delivery to enable maintenance of consistent standards; and

- the cost-effectiveness of distance education versus conventional delivery

The plenary agreed that a regional institutional framework is needed for aquaculture education if aquaculture is to continue developing in a sustainable manner in the region. It was of the view that such a framework could bring about:

- effective coordination in AE in the region which will reduce duplication;
- consolidation of the existing resource material(s) and determine more objectively and impartially new needs;
- build on existing institutions, in a cost effective manner;
- inter institutional training mechanisms that would ensure efficient use of institutional and human resource capacities available in the region optimally and efficiently; and
- generate synergies that will hold in good stead for sustainable development of aquaculture in the region.

Finally, the plenary also expressed the view that donor agencies should consider paying increasing attention to the need of providing long-term training, particularly for researchers, enabling the Asia Pacific Rim economies to have a critical mass of researchers to meet demands of the growing aquaculture industry in the region.

Findings of the Working Groups

Three Working Groups were convened which took into account the questions and issues raised in the plenary sessions. The groups broadly addressed the following issues:

- regional aquaculture education needs and priorities;
- strategies to meet future needs, with an emphasis on opportunities and mechanisms for regional cooperation; and
- the development of a framework for a pilot regional aquaculture education program.

The findings of the Working Groups were presented and discussed at a plenary session. The following is a synthesis of the above. Working group participants are in **Annex C**.

Aquaculture Education Needs

The EC noted that the needs of the aquaculture industry, and hence the Aquaculture Education (AE) needs of the economies and the regions in which the economies invest are very diverse. However, the EC noted that in order to meet the growing demands of the industry it would be desirable to define optimal level(s) of skills required and the level(s)/ types of education of the main groups of persons associated with the industry, together with the knowledge, skills and attitudes expected of each group. The findings in this regard are summarized in Table 1 below:

Table 1: Indicative target groups for aquaculture education, desired knowledge and skills

Group			Farmer	Manager	Technician	Extensionist	Trainer[1/]	Teacher[1/]	Research Scientist	Policy Maker
Skills (KSA)	Knowledge	Facts	+	++	++	++	++	++	+++	+
		Principles	+	+	+	+	++	++	+++	+
	Skills	Practical Aquaculture	+++	++	+++	++	++	++	+	-
		Problem Solving	++	+++	++	+++	++	++	+++	-
		Teaching Skills	-	+	+	+++	+++	+++	-	-
	Attitudes	Environmental Ethics	++	++	++	++	++	++	++	+++
		Social Ethics	-	-	-	++	++	++	++	+++
Type of Education	Informal	Short Courses	+++	+	+	+	++	+	+	+
	Formal	Vocational	+	++	++	++	+	-	-	-
		BSc	-	+++	+++	+++	+++	+	-	+
		Masters	-	+	+	-	+	++	++	++
		PhD	-	-	-	-	-	+++	+++	+++
Content		Basic Sciences	-	+	++	++	++	+++	+++	+
		Engineering	+	+	++	+	+	++	++	-
		Aquaculture Science & Technology	++	+	+++	+++	+++	+++	+++	+
		Social Science	+	+	+	++	++	++	++	++
		Business Management & Economics	+++	+++	+	++	++	++	+	+
		Ecology & Environmental Science	+	+	++	++	++	++	++	++
		Resource Planning & Management	+++	++	+	+++	+++	++	+	++
		Information Technology	+	++	+	++	++	+++	++	+
		English	-	+	+	+	+	++	++	++
		Teaching Skills	_	-	-	++	+++	+++	+	-

[1/] Trainer and teacher are defined as persons who conducts short-term and specific training needs and imparts knowledge in the conventional sense, respectively. + to +++ represents the level of need (+++ = maximum)

The EC noted that the above provide only general guidelines and there is an urgent need to define the specific needs of selected economies of the Asia-Pacific Rim economies, particularly in respect of economies such as Vietnam, and in economies in which there is Asia-Pacific Rim economies' investments in aquaculture such as in Bangladesh. The EC noted that there should be an emphasis on developing communication skills at all levels. It was also noted that under certain circumstances social science education for practitioners would be very appropriate in dealing with community related problems.

The EC noted that the current aquaculture education, at all levels, is far from adequate, and that there is a need for curriculum development. The existing curricula tend to be biologically oriented. Revisions to curricula should consider incorporating aspects of education on:

- Social and economic aspects;
- Communication skills;
- Management - human resources and business management;
- Environment and integrated resource management, including education on pollution control, biodiversity and comparable issues concerning environmental sustainability;
- Development planning, policy and regulations; and

- Issues of general concern associated with developments in genetically modified organisms, biotechnology, biodiversity, risk management, quarantine, health management, food safety, agro-industry and the like.

The EC also emphasized the need to make greater use of farming systems research and extension approach to identify where aquaculture might contribute to improved livelihoods.

In the above regard, and as globalization of the industry is occurring the EC was of the view that the Asia-Pacific rim economies, and those economies impacting on the industry of the APEC Rim economies should move towards a common framework for curriculum development but with sufficient flexibility to accommodate local needs and resources.

The EC also emphasized the need for curricula to:

- be broad-based, with wide subject matter coverage, practice and theory;
- contain a significant practical component that provides hands on experience; and
- incorporate social and environment ethics.

The EC noted that changes in curricula should go hand in hand with innovative teaching approaches, such as involving students in:

- identifying problems, and solving them;
- information processing, rather than rote learning;
- real world practical experiences, such as working in the industry, extension or development projects.

The teaching should be done in such a manner as to keep the interest of the student and not to over emphasize basic sciences (enabling sciences), but to inculcate the ability to continue life-long learning that would allow people to adapt to changing technologies and circumstances.

The EC emphasized the need to maintain and improve upon the quality of aquaculture education in the region. It was agreed that suitable accreditation mechanisms and periodic evaluation of the education provided are needed, supported by appropriate monitoring tools and performance indicators. Such mechanisms will facilitate and enhance the possibilities of developing inter-institutional aquaculture education in the region. This will ensure efficient and cost-effective resources utilization.

Strategies to Address Needs

Recognizing that the detailed requirements for capacity building and curriculum development are not available to several economies, the EC suggested preparing a master plan for aquaculture education (AE), that would assist in more strategic identification and prioritization of the needs for capacity building and curriculum development in each economy.

This plan should be based on a comprehensive assessment of the present and future requirements of people involved with the aquaculture sector. Individual economy assessments would provide the basis for national planning, and identification of detailed requirements and opportunities for regional collaboration in aquaculture education.

The EC recognized that standard methods be used for developing such plans and suggested that regional guidelines for AE needs assessments be prepared. The aquaculture education needs identified in general terms in the previous section should be used as a basis for developing such guidelines.

The development of curricula, training materials and other tools to support aquaculture education should give attention to the following:

- Developing databases cataloguing existing curricula and training materials for AE in the Asia-Pacific region, with the scope for timely update;
- Preparation of modules based on existing curricula and training materials for dissemination through a regional Aquaculture Education Program;
- Translation of relevant materials as appropriate;
- Improving existing vocational curricula; and
- Developing separate training streams for extension officers particularly to fulfill the need for training in extension skills as dedicated vocational stream. Such an approach would underpin a special recognition of the need to support more effective extension within aquaculture.

In the wake of modern information technologies that are becoming available the EC considered that distance learning was a useful delivery method for AE within the region, particularly for enhancing knowledge base. In certain economies, such as in China, it is becoming an imperative in the near future that AE be provided through in the distance mode to meet the growing demand of the sector. Thailand is intending to develop the delivery of AE in the distant mode. The University of the South Pacific also has some expertise in this area.

A balance between teaching in the distance mode, and more traditional and practical methods, however, should be sought. The distance mode should only be used to augment the conventional modes of teaching and training but not as a substitute. The EC recognized the need to undertake a pilot project to evaluate the potential and the role of distance learning in aquaculture education, and to develop a longer-term development plan for distance learning. The pilot project would also look at the practical aspects of development and implementation of aquaculture distance learning programs.

The EC emphasized the importance of developing sustainable aquaculture education and training programs in the region through giving attention to the following points:

- Collaboration among economies in developing resource materials and sharing of expertise;
- Sharing of institutional resources and facilities, at national and regional levels for all types of education and training;
- Attention to cost recovery mechanisms; a sensible share of costs among the stakeholders and beneficiaries of aquaculture education depending on the governments and political setups;
- Emphasize the use of in-country expertise and resources;
- Use of distance education as an option for continual aquaculture education;
- Donor-funded projects should have a built-in sustainability for aquaculture education;
- Ensure government commitment to aquaculture education; and
- Develop projects based on needs of the economy, in a realistic and pragmatic way.

In developing a regional programme and strategy to support aquaculture education, the EC recommended that the following issues be considered:

- There are a number of existing and potential new providers of aquaculture education operating at regional and national levels. Cooperation should be sought to build on the strengths of existing institutions, prior to supporting the establishment of new institutions to address any subsequent gaps in AE service delivery;
- Regional cooperation should be enhanced where possible through development of a standardized AE accreditation framework that facilitates potential credit transferability;
- Professional qualifications, attitudes and ethics should be addressed in a regional aquaculture education program, directed on an appropriate basis at both secondary and tertiary education levels;
- The need for a pilot development program to assess the role of distance learning in the regional program;
- Enhancing the image of aquaculture education as a profession and its acceptance by the broader community through development of an appropriate public relations policy as part of the proposed regional AE Consortium;
- Encourage recruitment of younger, potential AE leaders through a regional, mentor approach to address longer term potential shortfalls in appropriately trained senior AE personnel in some countries.

Development of the Regional Collaborative Aquaculture Education Programme

In order to implement the above strategy, an **Aquaculture Educational Consortium** (AEC), in the form of a network, should be established comprising existing academic and training institutions in the Asia and Oceania regions. The proposed AEC should engage in institutional capacity building and delivery of aquaculture education through improved collaborative activities and synergies, strengthen the channels of communication, improve human resources and capacity, evaluate aquaculture education needs of the region regularly; maintaining and updating databases of available resources.

The programme should address human resources development needs at different expertise levels as indicated in Table 1. It should also entail the training components at different levels and should include short course training, undergraduate, and postgraduate education.

The EC agreed that the vision in respect of Aquaculture Education in the region should be:

An aquaculture education programme contributing towards an empowered region achieving food security, eliminating poverty, sustaining its economic growth, developing aquatic food resources and ensuring its quality, within the context of environmental sustainability, through a Consortium working together as equal partners in self-actualising and mutually-reinforcing collaborative programmes.

Follow-up Actions

In accordance with the objectives of the EC, and to achieve the above vision, the consultation deliberated in detail on the follow-up actions and the associated mechanisms for executing the recommendations with regard to Aquaculture Education in the region.

In order to develop and sustain such an Aquaculture Education Program, which should incorporate the needs of modern and relevant Aquaculture Education curricula the EC recommended that an **Aquaculture Education Consortium** (AEC) be established. Such an **AEC** will essentially consist of a co-ordinating body which will endeavour to:

- Network existing academic and training institutions in the Asia and Oceania regions;
- Engage in institutional capacity building through improved collaborative activities and synergies;
- Strengthen the channels of communication;
- Improve human resources and capacity;
- Regularly evaluate aquaculture education needs of the region;
- Maintain and update databases of available resources;
- Facilitate the development of new resource materials;

- Coordinate inter-institutional aquaculture education programs, involving exchange of teaching materials, staff and students; and
- Act as a monitoring body for enhancing educational standards and delivery mechanisms.

Recommendations of the Expert Consultation

Having considered the current status of aquaculture education in the region, and the future needs and goals to sustain the aquaculture sector, the Expert Consultation made the following recommendations.

- To establish an interim expert group to undertake the development of the detailed aquaculture education program, and relevant project proposals, based on the needs and strategies identified during the EC.
- The expert group should include representation from at least three economies (China, the Philippines and Vietnam) and regional intergovernmental and organizations which are involved in aquaculture training and education (Asian Institute of Technology, Deakin University and NACA).
- This interim group should continue to communicate closely with the other economies involved in the EC and also with the South Asian economies and the Oceania.
- To initiate pilot projects on aquaculture education in the region for the purpose of:
    - Establishing the institutional mechanisms for the formalization of the Aquaculture Education Consortium.
    - Initiating the collation of the extent of available resource materials in aquaculture education in the region, and assessing the extent to which these materials need to be further developed and prepared in a suitable form for dissemination to fulfil specified training needs.
    - Evaluating the feasibility of delivering aquaculture education in the distance mode in a selected economy.
    - Determining the aquaculture education needs of regional economies that are emerging as major aquaculture producers.
    - Develop an appropriate set of targets and measurable performance indicators for implementation of the Aquaculture Education Program.

The EC also strongly emphasized the need to take immediate steps to implement the above recommendations and accordingly developed the following schedule:

Action	When	Who
Finalize the report of the EC and draft pilot project concepts	July 2000	Project Team & Expert Group
Form an interim group drawing from academic institutions in the region to develop the regional aquaculture program.	July 2000	Project Team
APEC adopt the program concept and considers the funding for pilot project suggested	July 2000	APEC- FWG
NACA Governing council adopt program concept	Dec. 2000	NACA Governing Council
Develop the project proposals as required to support development of the AE program	*	Expert group
Implementation of pilot projects and program development	2001	Project Team
Establish interim consortium secretariat to coordinate activities, in consultation with concerned economies/institutions	*	*

* to be advised later

Annex A: List of Participants

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Annex B: Expert Consultation Program

Expert Consultation on Aquaculture Education in the Asia-Pacific

Hotel Meritus Westlake Hanoi, 11th-15th May 2000

A project of the Asia Pacific Economic Cooperation (APEC) in cooperation with Deakin University, Australia and the Network of Aquaculture Centres in Asia-Pacific (NACA). Consultation hosted by Ministry of Fisheries, Government of Vietnam

Day 1: Thursday, 11th May 2000

0830- 0930	Opening ceremony ***Vice-Minister, Ministry of Fisheries, Vietnam*** ***Professor Robert Wallis, Deakin University*** ***Hassanai Kongkeo, NACA Coordinator***
0930- 1000	**Coffee break**
Session 1:	**Introduction and objectives of the workshop**
Chairs ***Rapporteur***	***Professor Robert Wallis & Dr. Le Thanh Luu*** ***Tim Pickering***
1000-1030	Objectives of the APEC project and workshop *– Sena S De Silva & Michael Phillips*
1030-1040	Aquaculture of the Asia-Pacific rim economies of the APEC - *Sena De Silva, Michael Phillips, Sih Yang Sim*
1040-1130	A summary on aquaculture education in the APEC economies of the Asia-Pacific rim, and key findings of the APEC/NACA project - *Sih Yang Sim, Michael Phillips and Sena De Silva*
Session 2:	**Presentations on country/economy experiences** ***(each presentation will be 15 mins, with 5 minutes for questions/clarifications)***
Chair ***Rapporteur***	***Hassanai Kongkeo & Amararatne Yakupitiyage*** ***Mads Korn***
11:30-12:30	♦ China – *Zhou Hongqi* ♦ Cambodia - *Chuck Borin* ♦ Vietnam - *Le Thanh Luu; Ngo Duc Sinh*
1230- 1400	**Lunch**
1400-1730	**Session 2: continued** ♦ Malaysia – *Suhaili bin Lee* ♦ A Bachelor's Degree Program in Aquaculture, Kasetsart University, Thailand - *Uthairat Na-Nakorn* ♦ Fisheries Education and Training Programs in India – *K. Gopalkumar* ♦ Aquaculture Education in Bangladesh: An Overview – *Md. Fazlul Awal Mollah* ♦ Australia – *Sena S De Silva* ♦ Aquaculture Education in Pacific Island Countries -*Tim Pickering*

- Fiji – *Satya Nandlal*
- Philippines – *Leonor M. Santos*

Day 2: Friday, 12th May 2000

Session 3:	**Assessment of requirements for aquaculture education and potential strategies for meeting future needs**
Chairs	***Prof. Li Sifa and Pedro Bueno***
Rapporteur	***Laurie Laurenson***
0830-0900	Aquaculture education needs - *Peter Edwards*
0900-0930	Training Needs of the Farmers- Experiences from Cambodia and Bangladesh - *M.C. Nandeesha*
0930-1000	Past and future of aquaculture training, based on experiences of NACA – *Zhou Xiaowei*
1000- 1030	**Coffee break**
1030- 1100	Research training: some food for thought - *Sena S de Silva*
1100-1130	Approaches in Regional Education, in the Aquaculture and Aquatic Resources Sector, Southeast Asia - *Mads Korn, Amara Yakupitiyage, Peter Edwards*
1130-1200	AIT- AARM experience on Aqua curriculum development for a regional Masters program - *Amararatne Yakupitiyage*
1200-1230	Aquaculture Curriculum Development in South Vietnam - *H.B. Nielsen*
1230- 1400	**Lunch break**
Session 4:	**Strategies for meeting future aquaculture education needs**
Chairs	***K. Gopakumar, Leonor M. Santos***
Rapporteur	***Robert Gibbons***
1400-1420	Use of the electronic media in aquaculture education: the AIT experience - *Amararatne Yakupitiyage*
1420-1440	An update on the use of electronic media, both CD ROM and Internet, in the delivery of a Second Year university course in Fish Biology *Laurenson, L.J.B.*
1440-1520	How far can we go in distance education? - *Rob Wallis*
1520-1540	**Coffee break**
1540-1800	Summary discussion and finalization of working group arrangements

Day 3: Saturday, 13th May 2000

Session 5: **Working Group sessions**

0830-1000 Three Working Groups will be convened and (tentatively) address the following issues:

- Aquaculture education needs and priorities – skills required and problems to be addressed to build skills – *(the needs)*
- Strategies to meet future needs - with an emphasis on opportunities and mechanisms for regional cooperation, including targets and delivery mechanisms – *(the strategies)*
- Development of a framework for a pilot regional aquaculture education program, with short, medium and long-term objectives and development strategy – *(the follow up actions)*

1000- 1030 **Coffee break**

1030-1230 Working Group sessions continue

1230- 1400 **Lunch break**

1400-1530 Working Group Presentations and Discussion on Action Plan/ Summary Recommendations

1530-1600 Leave for Hai Phong

Day 4: Sunday, 14th May 2000

Field trip to aquaculture areas around Hai Phong, return to Hanoi about 1900h

Day 5: Monday, 15th May 2000

Session 6: **Finalization of Action Plan**

Chair: ***Professors Rob Wallis, Le Thanh Luu, Peter Edwards & Sena S De Silva***

0830-1000 Discussion and finalization of Action Plan/ Recommendations

1000- 1030 **Coffee break**

Finalization of Action Plan/ Recommendations/Closing of workshop

Annex C: Working Group Membership

Working Group 1

Chairperson: K Gopakumar
Rapporteur: Laurie Laurenson

Members: Uthairat Na-Nakorn, Suhaili Bin Lee, Miao Weimin, Sih Yang Sim
Zhou Xiaowei, Satya Nandlal, Peter Edwards, Vu Duy Giang

Working Group 1 summarized the aquaculture needs and priorities for aquaculture education with the Asia-Pacific region with an emphasis on the following issues and questions:

- People and skills required for aquaculture education
- Delivery and methodologies used for aquaculture education.
- Capacity for aquaculture education.

Working Group 2

Chairperson: Le Thanh Luu
Rapporteur: Henrik Benchmann Nielsen

Members: Li Sifa, Chhouk Borin, Geoff Gooley, Md Fazlul Awal Mollah
Leonor M.Santos, M.C.Nandeesha, Chittra Arjinkit, Tim Pickering,
Ngo Duc Sinh,

Working Group 2 assessed the strategies required to meet future needs for aquaculture education, with an emphasis on:

- Building of education capacity to deliver appropriate education, covering institutions and human capacity building.
- Curriculum, training materials and tools required.
- Sustaining aquaculture education and training
- How can regional cooperation in aquaculture education support building of national capacity for aquaculture?

Working Group 3

Chairperson: Robert Wallis
Rapporteur: Amararatne Yakupitiyage

Members: Dionisia Rola, Hassanai Kongkeo, Pedro Bueno, Hongqi Zhou,
Vu Van Xung, Mads Korn, Robert Gibbons

Working Group 3 worked on the framework for a pilot regional aquaculture education program.

- Development of a pilot regional aquaculture education program to support future implementation of regional aquaculture education.
- Follow up actions from the Expert Consultation

Annex D: Presentations Made at the Expert Consultation

The following papers were presented to the Expert Consultation.

Annex D1: Aquaculture of the APEC Asia-Pacific Rim Economies

Sih Yang Sim[1], Sena S DeSilva[2] and Michael J Phillips[1]

[1]Network of Aquaculture Centres in Asia-Pacific, PO Box 1040, Kasetsart Post Office, Bangkok 10903, Thailand

[2]School of Ecology & Environment, Deakin University, PO Box 423, Warrnambool, Victoria 3280, Australia

Status of the Aquaculture Industry

This paper attempts to present the status and the importance of aquaculture to Asia-Pacific rim economies of the APEC. We have chosen to do so primarily using Figures and Tables to enable the readers to evaluate the issues on aquaculture in these economies quickly and easily.

Overall Industrial Trends

Figure 1 shows the world capture fisheries and aquaculture production and aquaculture production of the APEC economies. It is evident from **Figure 1** that:

- World capture fisheries has remained almost static over the last 3 years or so.
- The world aquaculture production has increased and APEC economies contributed nearly **84%** to the world aquaculture production **36,050,168 t** in 1997 (FAO, 1997).

Figure 1: World Aquaculture, Capture Fisheries, and APEC Aquaculture Contribution

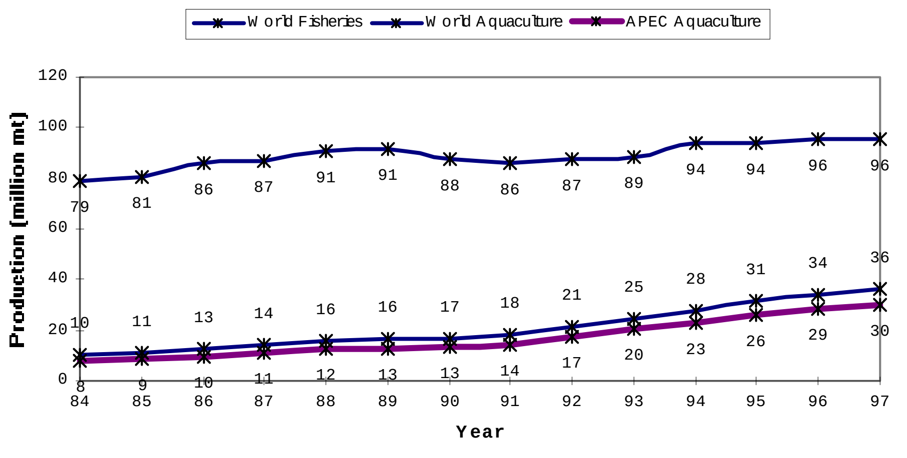


Figure 2 shows the contribution of APEC economies to aquaculture production (Figure 2a) and value (Figure 2b), in comparison to the world total, and the percentage contribution to the world aquaculture industry.

Figure 2a: World Aquaculture Production & Percentage Contribution of APEC Economies in the Asia-Pacific Rim in Total (thousand tonnes)

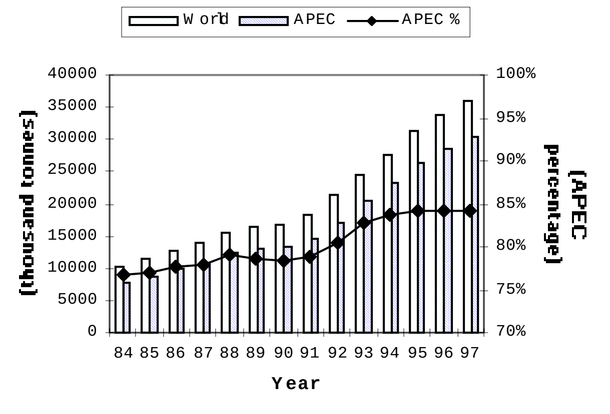
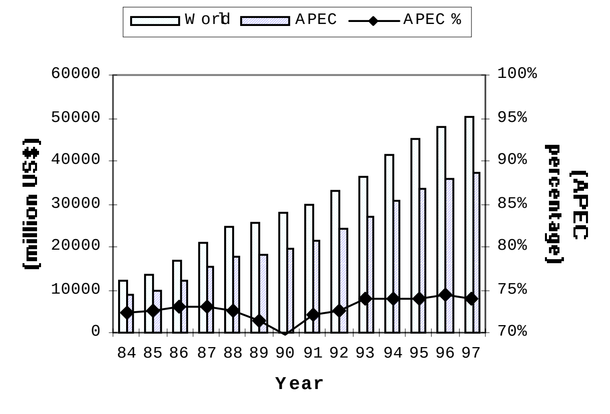


Figure 2b: World Aquaculture Production & Percentage Contribution of APEC Economies in the Asia-Pacific in Total (million US$)



It is evident from the above Figure that:

- The contribution of the APEC economies to the aquaculture industry has been steadily increasing over the years.
- In 1997 the APEC economies contributed 84% and 74% in volume (30,322,337 mt) and value (US$ 37.293 billion), respectively to the world's aquaculture industry.
- The industry recorded an increased of 211% in production for the 14 years period in the economies concerned.
- As such the importance of the aquaculture industry to the economies and to the world are very significant.

Table 1: Shows the top ten ranking economies in aquaculture production in 1984 and 1997.

Economies	1984 Production (mt)	Economies	1997 Production (mt)
China	3,830,077	China	24,030,313
Japan	1,207,962	India	1,776,450
Korea R.	829,000	Japan	1,339,861
Korea D.	545,000	Korea R.	1,074,000
India	510,000	Philippines	957,548
Philippines	478,345	Indonesia	911,610
Indonesia	330,764	Thailand	575,901
US	326,453	Vietnam	492,000
Spain	247,426	Korea D.	456,000
Chinese Taipei	245,199	US	438,331

The Table shows that 8 out of the top 10 nations were APEC economies in 1997.

Figure 3 below depicts the changes in total aquaculture production and value of produce by individual economies of the Asia-Pacific rim economies in 1984 and 1997.

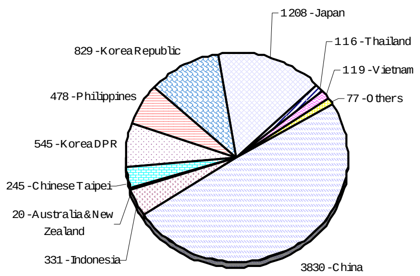


Figure 3a: Contribution to Aquaculture Production By Individual Economy of the Asia-Pacific Rim, in 1984 (thousand tonnes)

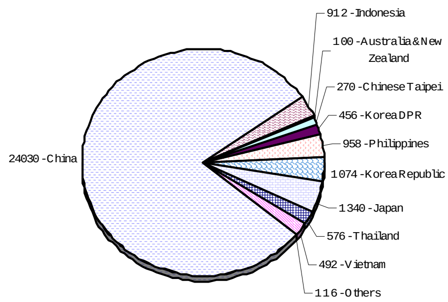


Figure 3b: Contribution to Aquaculture Production By Individual Economy of the Asia-Pacific Rim, in 1997 (thousand tonnes)

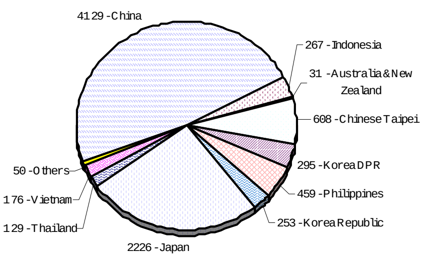


Figure 3c: Value Contribution to Aquaculture Production By Individual Economy of the Asia-Pacific Region 1984 (million US$)

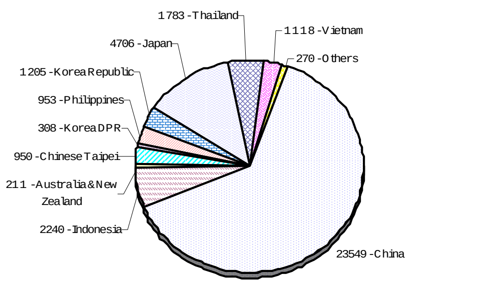


Figure 3d: Value Contribution to Aquaculture Production By Individual Economy of the Asia-Pacific Region 1997 (million US$)

The Figure shows that:

- The mainstay of the economy is the China PR economy, which increased in production from 3.8 x 10^6t to 24.03 x 10^6 t in 14 years, accounted for 74% of the total production of the APEC economies; a growth of approximately 15.8% per year.
- The total value of the produce to the APEC economies in 1997 was US$ 37.293 billion, an increase of 23.8% per year.

Commodities

Figure 4 shows the relative contribution of the major commodities produced in the APEC economies in 1984 and 1997.

Figure 4a: Contribution in Production (thousand tonnes) by Major Cultured Commodities to Total Production in Asia-Pacific Rim Economies of the APEC in 1984

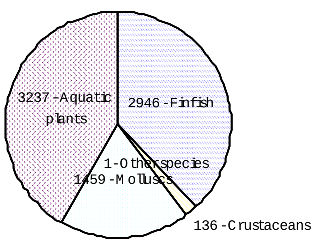
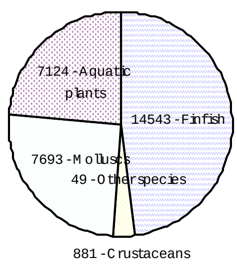


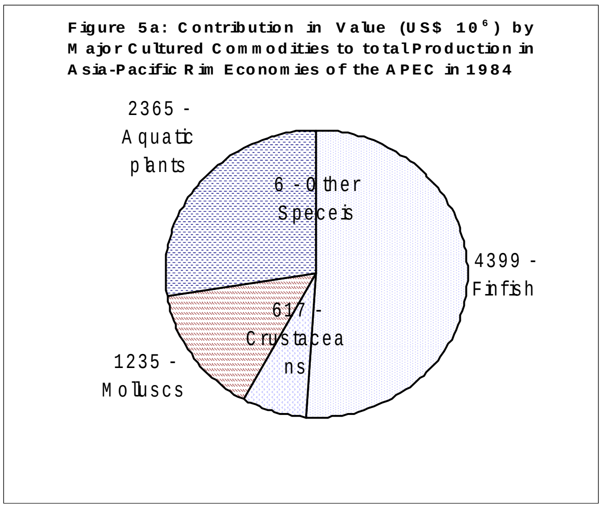
Figure 4b: Contribution in Production (thousand tonnes) by Major Cultured Commodities to Total Production in Asia-Pacific Rim Economies of the APEC in 1997

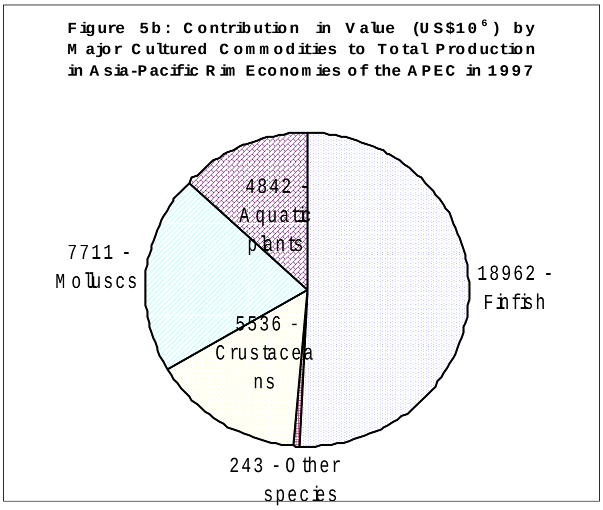


It is evident that:

- In 1984, aquatic plants dominated the aquaculture industry at 41% (3,237 x 10^3
- In 1984, aquatic plants dominated the aquaculture industry at 41% (3,237 x 10^3 mt), but declined to 24% (7,124 x 10^3 mt) in 1997.
- The relative contribution of finfish to aquaculture production in the economies have changed from 38% (2,946 x 10^3 mt) to 48% (14,543 x 10^3 mt) between 1984 to 1997.
- Crustaceans production in the economies increased from its shares of 18.76% (136 x 10^3 mt) to 25.5% (881 x 10^3 mt) in the same period.

Figure 5a and Figure 5b below provide details data on the contribution of each individual commodity group in value for 1984 and 1997 respectively.

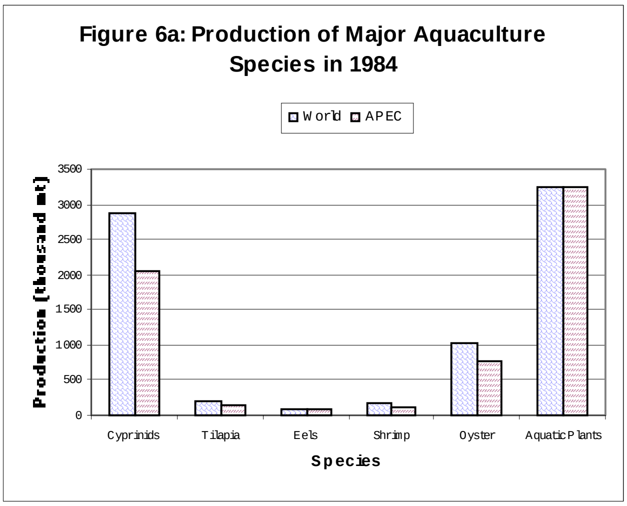


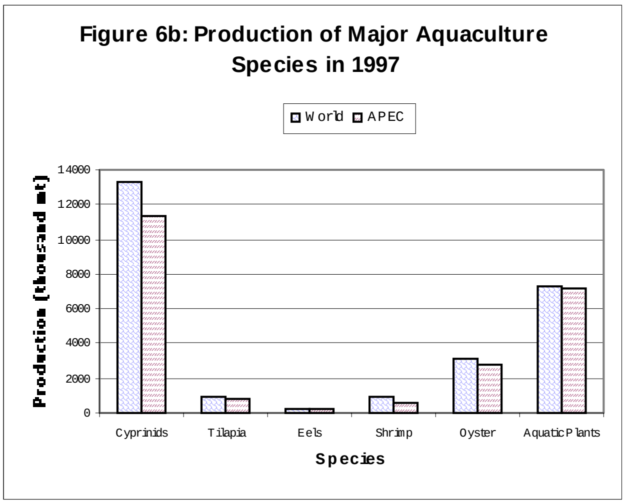


It is seen from Figure 5 that:

- Finfish contributed to US$ 4.4 billion in 1984, and increased by 331% to 18.96 billion in 1997 of total value of aquaculture produce in the economies.
- Crustaceans production in the economies contributed to 7% of the production in the economies in value in 1984, and increased to 15% in 1997.
- Molluscs – 14% in 1984 to 21% in 1997.
- Aquatic plants reduced to 13% from 27% in 1984.

Figure 6a and Figure 6b show major aquaculture species produced in 1984 and 1997, respectively for world and APEC economies in the Asia-Pacific rim.





It is clear that:

- The major contribution to production in the finfish groups viz. cyprinids, tilapias and eels, and shrimp and aquatic plants in the world comes from APEC economies (1984 & 1997).
- In 1997, APEC contribution in oyster production increased in comparison to 1984.
- Cyprinid production in APEC economies continued to increase over the years, and is the species group which contributes most to aquaculture production in the world as well as in the APEC economies.
- The relative contribution of aquatic plants to aquaculture production in the economies decreased from 41% to 24% from 1984 to 1997.
- It is also interesting to note that in economies as well as in the world the bulk of aquaculture production is based on species low in the tropic chain, such as aquatic plants, cyprinids, oyster, etc..

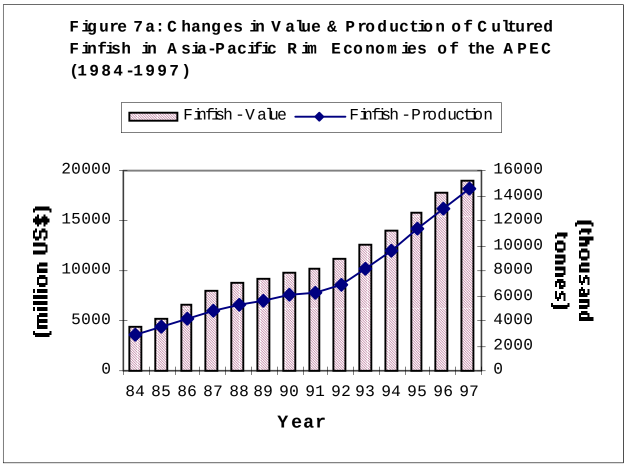
Table 2: Top ten aquaculture species produced in the world. The asterisk* shows those species to which the APEC economies are the main contributor.

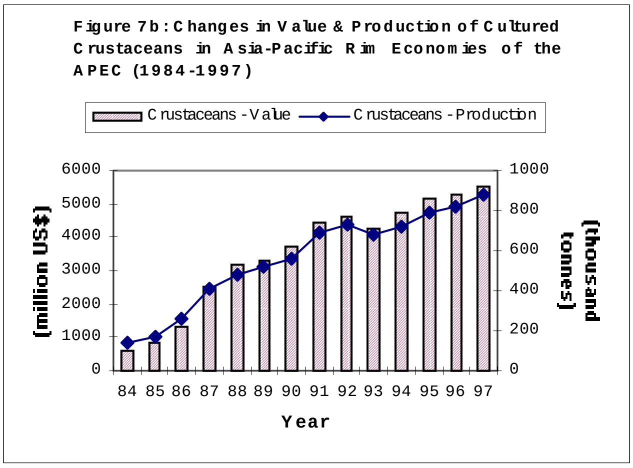
Species	1984 Production (mt)	Species	1997 Production (mt)
Japanese Kelp	1,823,988*	Japanese Kelp	4,401,931*
Pacific Cupped Oyster	881,196	Silver Carp	3,146,410*
Silver Carp	834,593*	Pacific Cupped Oyster	2,968,266
Laver	653,784*	Grass Carp	2,661,611*
Common Carp	616,238*	Common Carp	2,237,422*
Bighead Carp	377,158*	Bighead Carp	1,559,995*
Milkfish	353,764*	Japanese Carpet Shell	1,275,104*
Wakame	494,774*	Yesso Scallop	1,256,162
Grass Carp	297,761*	Laver	861,231*
Rohu	135,433	Nile Tilapia	741,867*

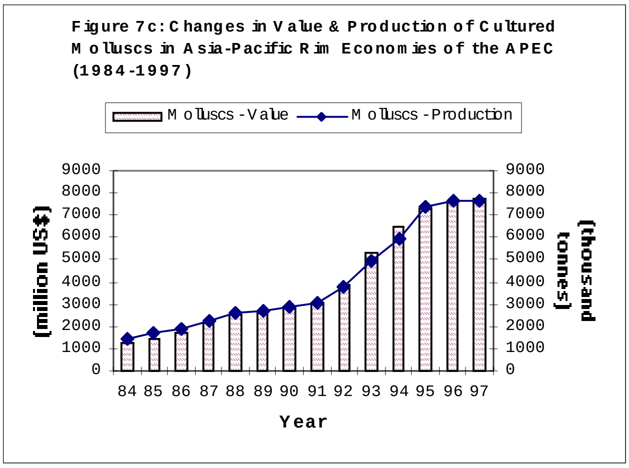
It is evident that:

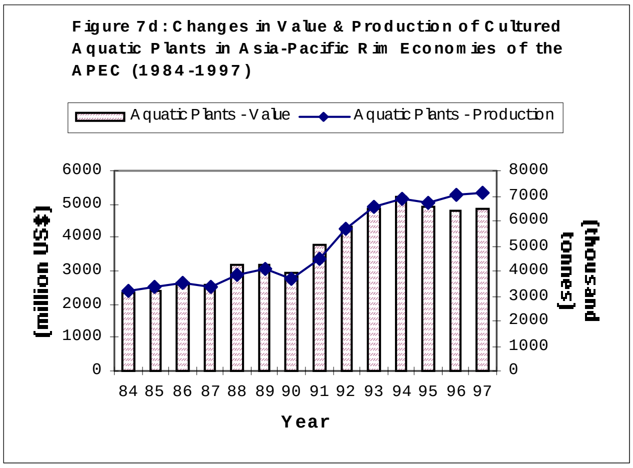
- Cyprinids and aquatic plants dominated production in the world in 1984.
- In 1997, aquatic plants, cyprinids and molluscs contributed most to the industry.
- It is evident that APEC economies dominate production of a great majority of culture species in the world.
- The Table further emphasizes the last point made in regard to the fact that bulk of the production is based on organisms low in the food chain.

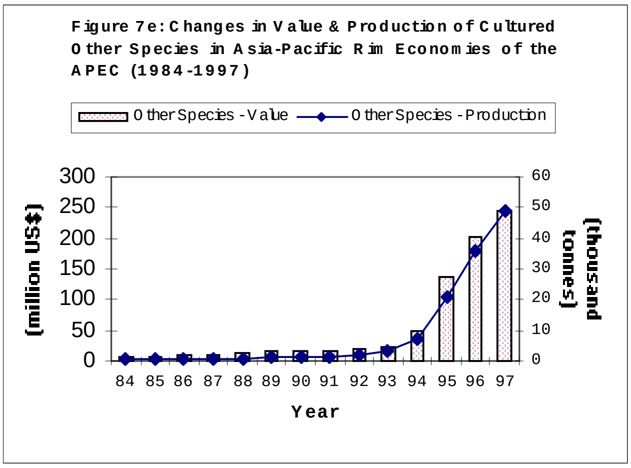
Figure 7 depicts the growth of the major components/commodities of the industry in volume and value in the APEC economies.







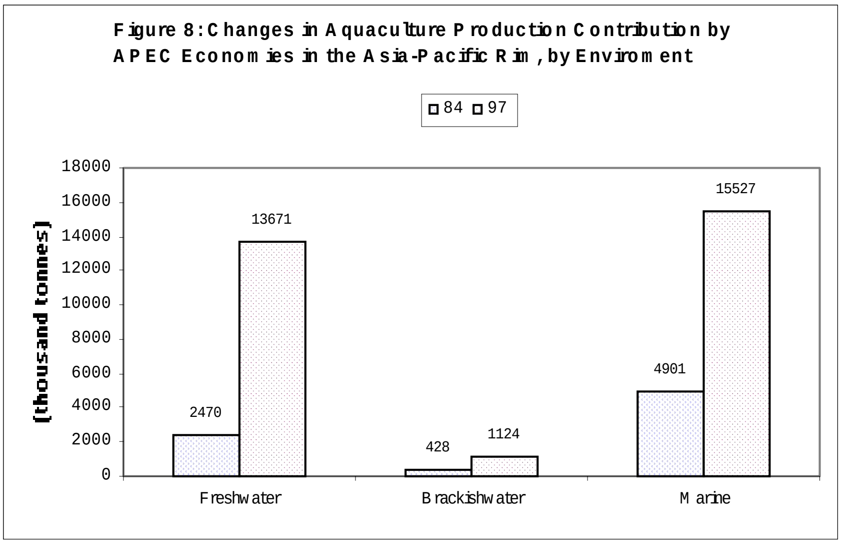




The Figures indicate that:

- The production of all the major commodities i.e., finfish, crustaceans, molluscs and aquatic plants moving on upward trend over the last 14 years period.
- The similar trend is achieved in respect of the value of the major commodities.
- The production of aquatic plants was static for the last few years, and the contribution to the value of the produce appeared to have declined from 1995.
- The production for other aquatic species increased significantly during 1993 to 1997. A very sharp jump in production was evident in 1995, and this may be due to the newly introduced species such as frog, soft-shell turtle, etc.

Aquaculture & the Environment



It is seen from **Figure 8** that aquaculture occurs in all types of waters and that:

- Most production comes from marine and freshwater.
- Freshwater aquaculture production risen by 5.53 times, from 2.47 million mt to 13.67 million mt
- Marine aquaculture increased by 310% in 14 years.
- Brackishwater aquaculture increased by 2.6 times to 1.124 million mt.

Figure 9 indicates the aquaculture production of the few major commodities in relation to environment in the APEC economies in 1984 and 1997.

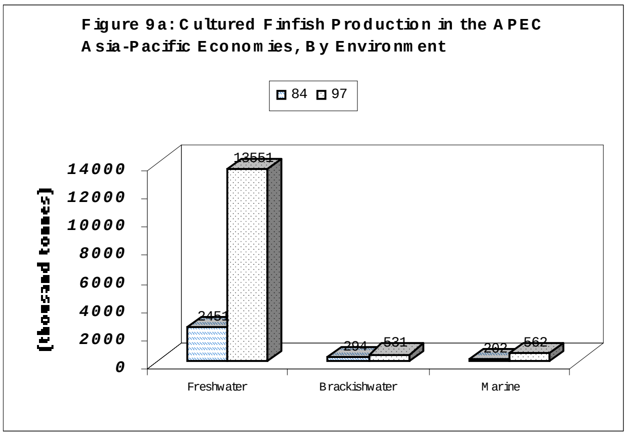


Figure 9a: Cultured Finfish Production in the APEC Asia-Pacific Economies, By Environment

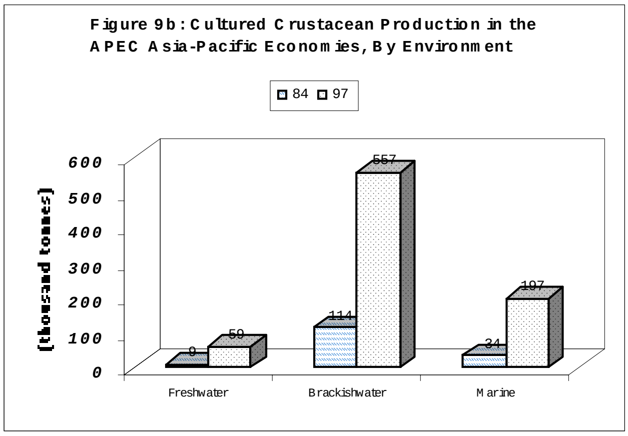


Figure 9b: Cultured Crustacean Production in the APEC Asia-Pacific Economies, By Environment

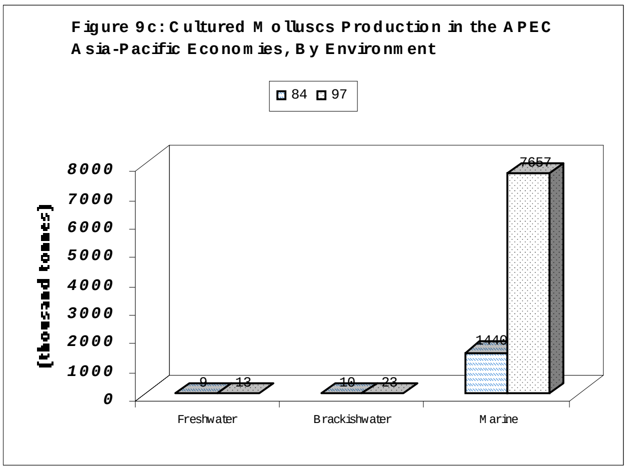


Figure 9c: Cultured Molluscs Production in the APEC Asia-Pacific Economies, By Environment

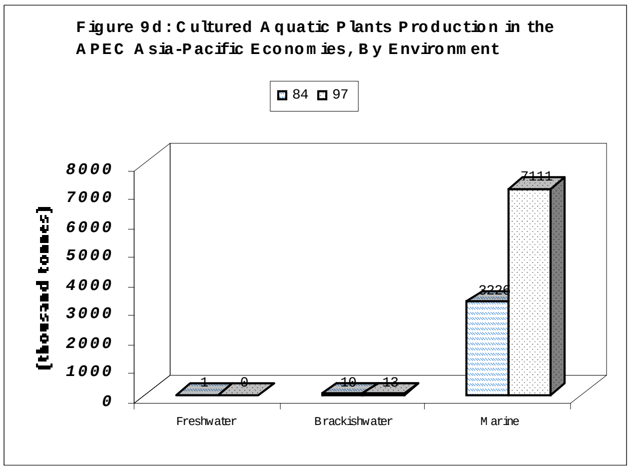


Figure 9d: Cultured Aquatic Plants Production in the APEC Asia-Pacific Economies, By Environment

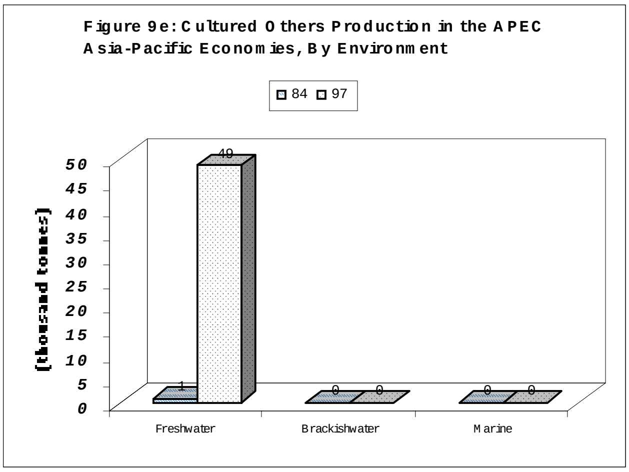


Figure 9e: Cultured Others Production in the APEC Asia-Pacific Economies, By Environment

It is evident from the figures that:

- Finfish production is almost entirely based in freshwater, and very little change has occurred over the last 14 years.
- Finfish production increased by 4.5 times to 13,551 x 10^3 mt from 1984 to 1997.
- The bulk of crustaceans aquaculture occur in brackishwater and the increase evident is a reflection of the change in production over the years where it increased from 114 x 10^3 mt in 1984 to 557 x 10^3 mt in 1997 in the economies.
- Both molluscs and aquatic plants production occur in seawater.
- Other cultured aquatic species had risen by 48 times from 1984, and it accounted for 0.05 million mt in 1997.

Figure 10: Per Caput Fisheries and Aquaculture Production in the Asia-Pacific Rim Economies of the APEC

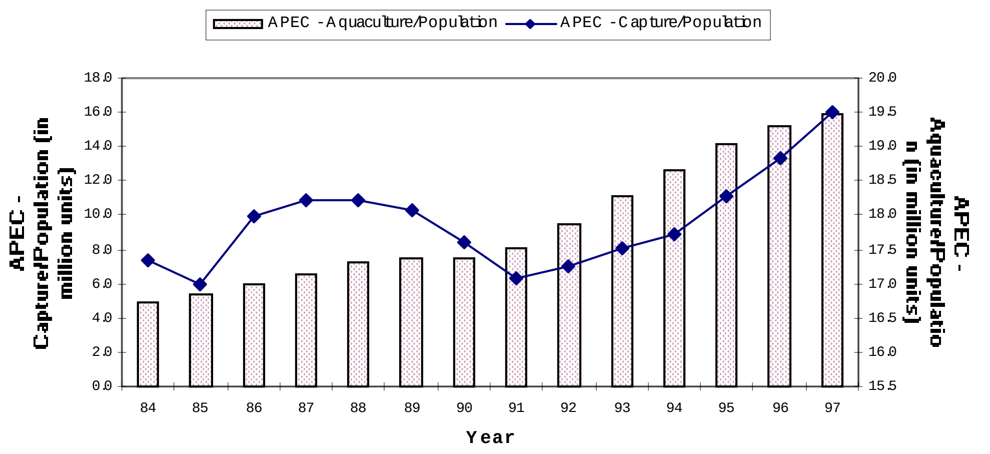


Figure 10 shows that:

- Per caput fisheries production had fluctuated from times while per caput of aquaculture production remained in an increased trend.
- Aquaculture became increasingly important as a source of animal protein over the years.
- It is evident that the contribution of aquaculture to the food supplies is becoming increasingly important in the economies.

Conclusion

- It is evident that aquaculture is an important food source and a means of income generation in the world.
- It is known that the growth of the world aquaculture industry is much higher than agriculture, and that the former is considered to be the fastest growing primary industry in the world.
- The backbone of the aquaculture industry is in the Asia-Pacific rim economies of the APEC.
- The data have considered only the importance of the industry in production volume and value to the economies and to the world.
- The industry also plays a major role in poverty alleviation and employment in most economies under consideration.
- The industry also is important to the economies as an avenue for investment in the other region, such as south Asia.
- The industry also contributes to the economies through other indirect activities that are difficult to quantify. For example, the aquaculture industry has been responsible for the development of a viable aquafeed industry in the economies, and consequently the economies are the leading aquafeed manufacturers in the world. In addition, aquaculture industry also supports other relatively significant manufacturing industries for the supply of pumps, paddle wheels and related items.
- The aquaculture industry also is beginning to impact economically APEC economies in the other regions, most notably some South American economies such as Mexico, Chile, etc.

Annex D2: Aquaculture in China

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China is a country with the longest history of aquaculture in the world. The aquaculture industry has been developed at a surprising speed in the past two decades. During 1979-1998, aquaculture production increased by more than 13 times. Aquaculture production accounted for over 60% of the total national fisheries production in 1998. In 1997, aquaculture production reached 20.28 million tons, which accounted for over 70% of the world aquaculture production of the year. Currently, aquaculture supplies around 17 kg of aquatic products per capita to the people in China.

Many factors contributed to the rapid development of the aquaculture industry in China; traditional importance of fish and other aquatic animals in peoples' diet and an encouraging government policy are important ones. Apart from that, a well-developed aquaculture education system in China has also played very significant role in the development of the industry.

History of Aquaculture Education in China

Although the first monograph on fish culture was written as early as some 2500 years ago in China, formal aquaculture education started less than 90 years ago when first fisheries technical school, Jiangsu Provincial Fisheries School was founded in 1912. The first Fisheries College was Shanghai Fisheries College, which evolved from the Jiangsu Provincial Fisheries School in 1956. The college was lately developed into the only Fisheries University in China, Shanghai Fisheries University.

Currently, there are nearly 55 of institutions of different kinds offering different types of aquaculture courses. These institutions include mainly university/college, research institute and polytechnic school (technical secondary school). Apart from these, there are also fisheries vocational schools that were recently changed from traditional high schools in mostly rural areas in China. The function of vocational schools is still similar to traditional high school, and are not included in the present case study. Degree system in higher education was resumed in China in 1982 when the first batch of college graduates majored in aquaculture were awarded a BSc degree. Some institutions started to offer aquaculture related masters degree courses in mid 80s. Aquaculture related PhD courses have been offered in China only since early 90s.

Institutions Involved in Aquaculture Education and Their Roles

Although China has very long history of Aquaculture, there were not many institutions involved in aquaculture education before the 80s, due to the small contribution of aquaculture to the national economy. Since 1980s, aquaculture education has attracted more and more interests of various educational and research institutions because of the rapid development of the industry and its increasing significant role in the national economy.

Currently, there are around 55 institutions involved in aquaculture education in China (**Annex a**). These institutions belong to three categories, university/college, polytechnic (technical secondary school) and research institute. Up to now, all these institutions are government funded.

University

The University is the most important component of aquaculture education system in China. Universities undertake the major task to train high level professionals for the aquaculture industry.

Currently, there are about 30 universities involved in aquaculture education in China. These universities are of three types; comprehensive university, agricultural/animal husbandry university/college and independent fisheries university/college. Aquaculture courses used to be offered mainly by independent Fisheries University and colleges. Currently, aquaculture courses have been introduced to all agricultural university and some comprehensive universities in China.

Currently, only one Fisheries University and Fisheries College still remain independent. Other Fisheries Colleges were all merged into universities recently. Universities and colleges mainly offer degree courses related to aquaculture, and include bachelor, master and doctoral degrees. Some universities also offer other kinds of aquaculture courses, such as diploma and short term training courses.

Polytechnic/Technical Secondary School

Polytechnic/technical secondary school is also very important component of aquaculture education system in China. Currently, there are around 20 fisheries schools of such kind in China. This kind of fisheries school usually offers 2-3 year diploma course on aquaculture.

Fisheries polytechnic schools accept only persons who have completed elementary education (high school or secondary school). On graduation, most usually work as technicians and extension workers in the aquaculture industry.

Research Institution

There were very few research institutions involved in formal aquaculture education in China before. Recently, some research institutions have started offering aquaculture courses independently or jointly with universities, and some research institutions conduct master and doctoral degree courses jointly with universities. The Institute of Hydrobiology of the Chinese Academy of Sciences (CAS) offers masters and doctoral degree courses independently. The research institution most involved in aquaculture education is the Freshwater Fisheries Research Centre of Chinese Academy of Fishery Sciences. The center has been conducting international training course since its establishment. The center also set up a Fisheries College jointly with Nanjing Agricultural University in 1993. The Fisheries College is currently offering bachelor, master and doctoral degree courses in aquaculture. The center also offers other diploma courses on aquaculture. Besides, most fisheries research institutes conduct different kinds of short-term training courses on aquaculture.

Training Capacity of Aquaculture Education in China

It is rather difficult to have an accurate figure of training capacity of aquaculture education in China as the numbers of students enrolled in different aquaculture educational institutions change every year. According to the number of institutions offering aquaculture courses and normal number of students enrolled, it is estimated that around 1000 bachelors, 100 masters and 10-20 doctoral degrees in aquaculture and closely related fields are conferred annually in China. In addition, around another 1000 students graduate from different kinds of aquaculture educational institutions with diplomas majoring in aquaculture annually in China.

Aquaculture Courses Offered in China

While aquaculture industry develops and expands steadily in China, a well-structured aquaculture education system has been established and perfected gradually. Aquaculture educational institutions are currently offering all kinds of aquaculture courses to national students. Some institutions also offer some aquaculture courses internationally.

Aquaculture Courses Offered in China

Based on the data provided by 16 institutions, aquaculture courses offered in China are classified in **Annex b**.

Currently, aquaculture courses cover all the areas related to aquaculture in China. Aquaculture courses are offered at different levels. Aquaculture courses are mainly conducted through on campus learning.

In China, aquaculture courses target a great variety of students. High school and secondary graduates are the main targets of aquaculture education in China now. However, re-education of people engaged in the aquaculture industry with different educational backgrounds is becoming more and more important. Many new aquaculture courses are designed for this purpose.

Number of Institutions Offering Different Types of Aquaculture Courses

According to the data directly provided by responding institutions and from other sources, number of institutions offering different types of aquaculture courses is shown in Table 1.

Table 1: Number of institutions offering different types of aquaculture courses

Type of course	Number of institutions	Type of institutions
Doctoral degree	5	University & Research institution
Masters degree	9	ditto
Bachelor degree	30	University
Diploma	30	University and polytechnic school
Certificate		Research institute and university

Forms and Methodology of Aquaculture Education in China

Forms of Aquaculture Education in China

Different forms of teaching methods are practiced for different kinds of aquaculture courses in China. The forms are listed in Table 2.

Table 2: Forms used in different kinds of aquaculture courses in China

Type of course	On campus /Distance learning	Full time/part time	Theoretical teaching/practical and research work
Doctor degree	On campus	Full time	20-40%/60-80%
Master degree	On campus	Full time	30-50%/50-70%
Bachelor degree	On campus	Full time	70-80%/20-30%
Diploma	On campus or distance learning	Full time or part time	70-80%/20-30%
Long term certificate	On campus and distance learning	Part time	80%/20%
Short term certificate	On campus	Full time	50-90%/10-50%

Teaching Methodology

Aquaculture education has been carried out in China in large scale for more than 40 years. Almost all kinds of teaching methods are currently used in aquaculture education in China. Although aquaculture education is mainly conducted on campus, distance learning is also practiced for some aquaculture courses. Anyhow, distance learning is currently limited to correspondent courses for diploma and postgraduate courses. Television is also used in aquaculture education in China. But, it is mainly for extension purpose. There is a plan for a self-learning aquaculture diploma course to be offered soon.

Aquaculture education is also benefited from the development of modern technology in China. Modern media are widely used in aquaculture education. Audio and video materials are used as teaching tools in all aquaculture educational institutions.

E-mail and Internet have been introduced to most universities and research institutes (11 out of 13 responded institutions, accounted for 85%). Up to now, e-mail and Internet are mainly used for information collecting and communication related to aquaculture education. Seven institutions have already set up their own website on the Internet. So far, there is no Internet based aquaculture course available, but the work has already been started in China.

Fieldwork is arranged for almost all kinds of aquaculture courses in China. Fieldwork is arranged for the following purposes:

- Fieldwork of important activities and techniques in aquaculture production are arranged for all bachelors and diploma students in order to train their practical capability and enrich their experience.
- Fieldwork may also be arranged for degree students for their thesis study. Many students carry out their thesis study on fish farms.
- Fieldwork may also be arranged for any aquaculture courses just for the purpose to improve the experience and understanding of the students on development, operation and management of different kinds of aquaculture practices.
- Students taking doctoral and master degree courses may work for aquaculture enterprises or development agencies together with their supervisors. In return they may provide technical advisory, help in developing projects and solve technical problems to the aquaculture enterprises.

Teaching Staff Involved in Aquaculture Education in China

Along with development of aquaculture education, a teaching team of large number of well-trained personnel has already been established for aquaculture education in China. Teaching staffs involved in aquaculture education have different qualifications and experience. Table 3 shows the number of teaching staff with different qualifications based on data provided by 17 institutions.

Table 3: Qualification and average time of working experience of aquaculture teaching staff

Qualification	Number	Year of experience (average)	Percentage
Doctor/professor	152	18	37.6%
Master/lecturer	155	9	38.3%
Bachelor	75	8	18.5%
Diploma	18	9	4.4%
Other	5	18	1.2%
Total	405		100%

Collaboration of Aquaculture Educational Institutions in China

Collaborative activities are commonly carried out by aquaculture educational institutions in China. The collaborative activities mainly include four different types.

Collaboration With Aquaculture Enterprises

Currently, the government encourages research and educational institutions to join the production sector and more directly promote economic development in China. All aquaculture educational institutions make an attempt to comply with this requirement and consequently carry out different kinds of collaborative activities with aquaculture enterprises.

Such collaboration includes mainly technical assistance and consulting services, and joint research and training of personnel. Some aquaculture educational institutions even have joint economic activities with enterprises.

Collaborative activities between education institutions and production sector provide direct support to aquaculture enterprises in solving technical problems and human resource development. On the other hand, aquaculture institutions also generate income to support other activities and have a better understanding of the real needs of the production sector. It also improves the practical capability of the teaching staff and their students.

Collaboration With Extension Institutions

There is also close collaboration between aquaculture educational institutions and extension institutions in China. This mainly includes re-education of extension staff and technical support to aquaculture extension projects. This kind of collaboration is mainly limited to university and research institutions involved in aquaculture education. Such kind of collaboration promotes the quick application of research achievements in large scale.

Collaboration With Research and Other Educational Institutions

Collaboration between aquaculture educational and research institutions is also expanding currently in China. Such kind of collaboration includes mainly training of high level professional, joint research activities and academic exchanges.

Currently, many universities start to offer master and doctoral degree courses jointly with research institutions. Students finish their course subjects in the university and do their degree thesis research in the research institutions.

International Collaboration

International collaboration is a very important indicator of academic level of aquaculture educational institutions. Almost all the universities and research institutions involved in aquaculture education have some international collaborative activities in China currently. Such collaboration is mainly limited to joint research activities, academic exchanges, short-term international training and training of staff abroad.

Considering rapid aquaculture development in China and the world, most aquaculture educational institutions expressed strong interest in strengthening and expanding international collaborative activities. Special interests are on exchange of teaching staff, jointly offering aquaculture courses with foreign educational institutions and training of teaching staff etc.

Impact of Aquaculture Education on the Industry in China

Aquaculture education has created great impacts on the development of aquaculture industry in China. Aquaculture education has contributed to the rapid development of aquaculture industry tremendously in China.

Aquaculture education has been providing very strong support for the human resource development in aquaculture sector in China. People trained through aquaculture education comprises the major proportion of academic, technical and managerial personal in aquaculture research, extension, education policy making and management institutions and enterprises.

According to incomplete statistical data, there were 28,378 technical personnel engaged in national-wide aquaculture extension service in China 1998. The total number of staff of all independent fisheries educational institutions was 3,763 in 1998 in China. This did not include teaching staff involved in aquaculture education in other educational institutions. The total number of staff of all fisheries research institutions was more than 5,000 in China 1998. In addition, almost all the technicians and engineers work in aquaculture enterprises have had some degree of aquaculture education.

Many aquaculture policy makers and administrators are also trained in aquaculture. Therefore, well-developed aquaculture education has been one of the key factors contributed to the rapid development of aquaculture industry in China during the last three decades.

Development Trend of Aquaculture Education in China

A well-structured aquaculture education system has already been established in China. Anyhow, development of the aquaculture industry and change from planned economy to market oriented economy raise new requirement to aquaculture education in China. On the other hand, reform of education system is undergoing in China. All these are bringing significant changes in the development of aquaculture education in China in the future. The following changes can be most significant development trends of aquaculture education in China.

Changes in the General Pattern of Education

The traditional pattern of education emphasizes strongly teaching of knowledge in China. Students play a rather passive role in the teaching activities. This results in a curtailment of the ability of students in solving practical problem and suppresses their creativity. People trained in such way are no longer competent to face the strong challenges in today's changing world.

Currently, importance of competence and capability training in education are fully recognized at different level of education in China. Substantial changes will also take place in aquaculture education from now on. In general, aquaculture will be more oriented to train people with high competence, creativity and practical capability rather than just knowledge *per se*. Training in managerial and marketing skills, computer utilization and foreign language skills will be further strengthened to meet the challenges of a globalize economy.

Changes in the Form of Education

In the past, aquaculture education is conducted mainly in the form of on campus and full time study. Thus, only a very small percentage of people were re-educated after employment. Nowadays, knowledge refreshment and re-education are attracting more and more attention of people. There are increasing number of aquaculture courses that are conducted in a more flexible form such as correspondent teaching, self-learning and other off campus and part-time courses. Aquaculture courses will be offered through the Internet in the near future in China. Such changes will greatly facilitate the knowledge refreshment and re-education of people in aquaculture sector.

Strengthening Training of Professionals at High Levels

Currently, training of high level professional (master and doctoral degrees) is underdeveloped in China. Very small percentage of college graduates can continue their studies for a higher degree. Development of knowledge based economy and new technological revolution need more and more highly qualified personnel. Therefore, all aquaculture educational institutions are strengthening their capability to train high level professionals. It is very sure that there will be a quick increase in the proportion of people holding master and doctor degree in aquaculture education in China.

Annex a: Aquaculture educational institutions in China

Institutions	Classification	Location
Aquaculture Department, Dalian Fisheries College	Traditional university	Dalian, Liaoning province
Fisheries College, Zhanjiang Ocean University	Traditional university	Zhanjiang, Guangdong province
Fisheries College, Huazhong Agricultural University	Traditional university	Wuhan, Hubei province
College of Animal Science, Shandong Agricultural University	Traditional university	Tai-an, Shandong province
College of Animal Husbandry and Fisheries, Anhui Agricultural University	Traditional university	Hefei, An-hui province
Shanghai Fisheries University	Traditional university	Shanghai
Fisheries College, Qingdao Ocean University	Traditional university	Qingdao, Shandong province
Wuxi Fisheries College, Nanjing Agricultural University	Traditional university	Wuxi, Jiangsu province
Fisheries College, Jimei University	Traditional university	Xiamen, Fujian province
Fisheries Department, South-Western Agricultural University	Traditional university	Chongqing
Fisheries College, Suzhou University	Traditional university	Suzhou, Jiangsu
Zhongshan University	Traditional university	Guangzhou, Guangdong province
Hunan Agricultural University	Traditional university	Changsha, Hunan province
Fisheries Department, Tianjin Agricultural College	Traditional university	Tianjin
Fisheries College, Ningbo University	Traditional university	Ningbo, Zhejiang province
Fisheries Department, Jielin Agricultural University	Traditional university	Changchun, Jielin province
Department of Animal Husbandry and Fisheries, University of Military Supplies	Traditional university	Changchun, Jielin province
Fisheries Department, Hubei Agricultural College	Traditional university	Jinzhou, Hubei province
Fisheries Department, Sichuan Agricultural University	Traditional university	Ya-an, Sichuan province
Institute of Hydrobiology, Chinese Academy of Science	Research institute	Wuhan, Hubei province
Freshwater Fisheries Research Centre, CAFS	Research institute	Wuxi, Jiangsu province
Yangtze River Fisheries Research Institute, CAFS	Research institute	Jinzhou, Hubei province
Yellow China Sea Fisheries Research Institute, CAFS	Research institute	Qingdao, Shandong province
South China Sea Fisheries Research Institute, CAFS	Research institute	Guangzhou, Guangdong province
Institute of Hydrobiology, Jinan University	Research institute	Guangzhou, Guangdong province
Lianyungang Fisheries Technical Secondary School	Technical secondary school	Lianyungang, Jiangsu province
Anhui Provincial Fisheries Technical Secondary School	Technical high school	Hefei, An-hui province
Jimei Fisheries Technical Secondary School	Technical secondary school	Xiamen, Fujian province

Zhejiang Provincial Fisheries Technical High School	Technical high school	Xiangshan, Zhejiang province
Dalian Fisheries Technical Secondary School	Technical secondary school	Dalian, Liaoning province
Jiangxi Provincial Technical Secondary School of Fisheries and Animal Husbandry	Technical secondary school	Nanchang, Jiangxi province
Heilongjiang Provincial Fisheries Technical Secondary School	Technical secondary school	Haerbin, Heilongjiang province
Sichuan Provincial Fisheries Technical Secondary School	Technical secondary school	Chongqin, Sichuan province
Shandong Provincial Fisheries Technical Secondary School	Technical secondary school	Yantai, Shandong province
Beijing Fisheries Technical Secondary School	Technical secondary school	Beijing
Shanghai Fisheries Technical Secondary School	Technical secondary school	Shanghai
Hebei Provincial Fisheries Technical Secondary School	Technical high school	Qinhuangdao, Hebei province
Guangdong Provincial Fisheries Technical Secondary School	Technical secondary school	Guangzhou, Guangdong province
Hubei Provincial Fisheries Technical Secondary School	Technical secondary school	Wuhang, Hubei province
Fisheries Department, Erzhou University	Traditional university	Hainan province
Fisheries Department, Ganshu Agricultural University	Traditional university	Lanzhou, Ganshu province
Fisheries Department, Hebei Agricultural University	Traditional university	Baoding, Hebei province
Fisheries Department, Guangxi University	Traditional university	Nanning, Guangxi Region
Fisheries Department, Sichuan College of Animal Husbandry and Veterinary Science	Traditional university	Chongqing
Fisheries Department, Nanchang University	Traditional university	Nanchang, Jiangxi province
Fisheries Department, Henan University	Traditional university	Zhenzhou, Henan province
Fisheries Department, Zhilimu College of Agriculture and Animal Husbandry	Traditional university	Tongliao, Inner Mongolia
Fisheries Department, Laiyang Agricultural College	Traditional university	Laiyang, Shandong province
Fisheries Department, Hainan University	Traditional university	Hainan province
Fisheries Department, Pingdong University of Science and Technology, Taiwan	Traditional university	Taiwan
Changdao Fisheries Technical Secondary School	Technical secondary school	Changdao, Shandong province
Tianjin Fisheries Technical Secondary School	Technical secondary school	Tianjin
Guanxi Fisheries Technical Secondary School	Technical secondary school	Nanjing, Guangxi region
Huanggang Fisheries Technical Secondary School (Hubei Province)	Technical secondary school	Huanggang, Hubei province
Jingzhou Fisheries Technical Secondary School (Hubei Province)	Technical secondary school	Jinzhou, Hubei province
Zhoushan Fisheries Technical Secondary School	Technical secondary school	Zhoushan, Zhejiang province

Annex b: Aquaculture courses offered in China

Title	Type	Duration (month)	Target group
Fish nutrition and physiology	Ph. D	36	National M.Sc holder
Fish genetics and breeding	ditto	ditto	Ditto
Aquaculture ecology	ditto	ditto	Ditto
Aquaculture biology	ditto	ditto	Ditto
Culture and enhancement of marine invertebrates	ditto	ditto	Ditto
Medicine of aquatic animals	ditto	ditto	Ditto
Fish development biology and genetics	ditto	ditto	Ditto
Fish cyto-genetics and breeding	ditto	ditto	Ditto
Fish molecular genetics	ditto	ditto	Ditto
Fish parasitology and immunology	ditto	ditto	Ditto
Germplasm resource and seed technology of aquatic animals	ditto	ditto	Ditto
Intensive Aquaculture	ditto	ditto	Ditto
Nutrition and feed science of aquatic animals	ditto	ditto	Ditto
Aquaculture and enhancement of aquatic animals	M.Sc	36	National B. Sc holder
Aquatic germplasm resource and genetic breeding	ditto	ditto	Ditto
Medicine of aquatic animals	ditto	ditto	Ditto
Fish ecology	ditto	ditto	Ditto
Nutritional physiology of fish	ditto	ditto	Ditto
Nutrition and feed science of aquatic animals	ditto	ditto	Ditto
Fish genetics and breeding	ditto	ditto	Ditto
Fish nutrition and physiology	ditto	ditto	Ditto
Culture of high valued aquatic animals	B. Sc	48	National high school graduates
Aquaculture	ditto	ditto	Ditto
Freshwater Fisheries	ditto	ditto	Ditto
Culture of high valued aquatic animals	Diploma	36	National high school graduates
Aquaculture	ditto	ditto	Ditto
Marine aquaculture	ditto	ditto	Ditto
Freshwater aquaculture	ditto	ditto	Ditto
Culture of high valued aquatic animals	Diploma	24	National high or secondary school graduates
Aquaculture	ditto	ditto	Ditto
Freshwater aquaculture	ditto	ditto	Ditto
Integrated fish farming	Certificate	3	International
Freshwater aquaculture technology	ditto	3-6	National, industry

Annex D3: Aquaculture Education for Industry Personnel in Malaysia

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Introduction

During the last two decades, the aquaculture sector in Malaysia has experienced tremendous development. Among others, aquaculture education has played an important role in achieving the growth of the sector. The Department of Fisheries in Malaysia has carried out formal and informal aquaculture education training at the aquaculture training centers as well as by the state/provincial Fisheries Offices respectively.

Current Status of Aquaculture Education

There are three Aquaculture Training Centres in Malaysia, two located in West Malaysia and one located in East Malaysia.

1. Aquaculture Extension Centre, Enggor, Perak, Malaysia
   (Fresh Water Aquaculture Training)
2. National Prawn Fry Production Centre, Pulau Sayak, Kedah, Malaysia
   (Marine Aquaculture Training)
3 Inland Fisheries Training Centre, Kuching, Sarawak, Malaysia
(Freshwater Aquaculture Training)

The statistics on aquaculture training at the three centers are as follows: -

No. of Participants Attending Aquaculture Courses from 1996 till 1999			
YEAR	Fresh Water Aquaculture Courses	Marine/Brackishwater Aquaculture Courses	Total no. of trainees annually
1996	343 + 50 = 393	307	700
1997	427 + 55 = 482	162	644
1998	595 + 60 = 655	246	841
1999	506 + 65 = 571	232	803

Besides formal training at the training centers, there are also informal training which are conducted by all the State Fisheries Officers by means of Educational Field Visits and tour to the various successful aquaculture projects within the country. Other forms of training that has been conducted were seminars, workshops and group discussions among the aquaculturists. These form of 'training' can be very useful if the seminars/workshops are conducted nearest to the project sites and within one or two days to discuss specific issues (e.g. diseases). This type of courses also would be able to accommodate fish farmers who cannot leave the farm for too long.

Type of Aquaculture Course/Training Provided and Duration

(A) Fresh Water Aquaculture Courses

	Type of Course/Training	No. of Course Held Per Year	Duration of Course/Training (Days)
1	Basic Aquaculture	4	6
2	Basic Aquaculture (For Armed Force Personnel)	4	6
3	Management of Aquaculture Estate (for Corporate Bodies)	2	5
4	Fresh water fish culture in ponds	4	6
5	Basic aquarium fishes	2	6
6	Fresh water prawn culture in ponds	3	5
7	Fresh water fish culture in cages	2	5
8	Fish culture in pens	2	5
9	Breeding of Clarias species and Tilapia	3	6
10	Breeding of Clarias Species and Tilapia (For Armed Forces Personnel)	1	6
11	Breeding of Carps (Javanese/Puntius bulu)	2	6
12	Breeding of River Catfish and Snakefish gouramy	2	6

(B) Marine/Brackishwater Aquaculture Courses

	Type of Course/Training	No. of Course Held Per Year	Duration of Course/Training (Days)
1	Breeding of Giant Sea Perch! Seabass (Siakap)	2	24
2	Breeding of Sea Prawns/Shrimp	2	20
3	Breeding of Giant Fresh water Prawn	2	30
4	Brackish Water Fish Culture using Cages and Rafts	2	6
5	Prawn Culture in Brackish Water Ponds	3	13
6	Preparation of Feed for Fish Farms	2	5
7	Culture and Fattening of Mud Crabs	1	5
8	Fish/Prawn Health Management	1	6
9	Basic Aquaculture for Fisheries Assistants	1	11
10	International Course (MTCP)	2	44

No. of fish farmers/trainees
participating in the informal training
(1995 - 1999)

1.	Aquaculture Field Visits & Tours	-	1,555 participants
2.	Seminar and Workshop on Aquaculture	-	1,770 participants

The fish farmers who are selected by the Department to attend the various programs are provided with food and accommodation at the training centers by the Department. On the top of that each fish farmers is paid RM1O.00 per person per day as income substitution allowance.

As the entry requirement is very low, (as long as they are literate) the syllabi of the courses are designed giving emphasis on practical training

Employment Prospects

The labor force in the aquaculture sector has been facing quite an acute problem in recent years. It is estimated that more than *50%* of the workers in the aquaculture sector are foreigner. The local therefore need to be encouraged and trained in the field of aquaculture since aquaculture has a vast potential to be developed in the near future.

Credit Transfers Between Institutions

As the training described so far, confined to local fish farmers and practitioner the level of training is comparatively low. As such institution of higher learning do not recognize the basic training that are conducted at the present training centers. Nevertheless the Department is reviewing the syllabi for the training courses that are conducted at the centers to enable linkages with the institution of higher learning.

There are no clear indications that the private sector is involved actively in aquaculture education. This could be due to poor demand from the industry.

Future Needs and Strategies to Meeting the Needs

The target for the production of aquaculture products in the Third Agriculture Policy (i.e. 1998 - 2010) is to increase the production by four times, slightly more that (i.e. from 135,000 metric tons (1998) to 600,000 metric tons in 2010).

In order to achieve that target two important parameters should be looked into. firstly an increase in area for the aquaculture projects and secondly to increase the productivity.

Of course there are other important aspects that should be given due considerations, such as technology, problems on disease, species, feeds and others. In relation to the above, aquaculture education would be vital in creating skilled labor for the sector to achieve the target production. It is considering this factor that the Government is reviewing the capability of the present training center to produce the required labor force and including possibilities of linking ourselves with Institution of higher learning.

Annex D4: Fisheries Education in the Philippines: Aquaculture

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Miagao, Iloilo 5023, Philippines

Fisheries are a vital component of Philippine development. Its importance in the economy is recognized, contributing 2.8% of total Gross Domestic Product equivalent to PhP 67.7B (1997) and 15% of gross value added for the agriculture sector. It is estimated that one million people are directly employed by the industry, four to five times this number will be dependent on it, based on an average Filipino family size of five. With the present thrust of the government on food security, the contribution of fisheries is even more highlighted.

Of the three sectors of Philippine fisheries namely aquaculture, commercial and municipal, it is projected that aquaculture shall be the primary source of fish supply in the future. The trend for the last decade or so has shown a declining catch from the commercial and municipal sectors while that from aquaculture has increased. Such trend is expected to continue, with aquaculture increasing its share in providing the fish needed by the growing population.

Any industry development plan must include human resource development. With the enactment of RA 8550 otherwise known as the Fisheries Code of 1998 and the implementation of RA 8435 known as the Agriculture and Fisheries Modernization Act (AFMA) of 1997, it has become imperative that fisheries education in general, and in particular, aquaculture, be properly addressed; indeed the MAKAMASA program, a flagship program of the government which aims to modernize fisheries, identifies human resource development as one of the key issues and concerns. Education will provide the expertise needed to implement the plans whether on technical, managerial or policy-making level. The best plans will fail if the implementers are not adequately prepared.

Overview of Aquaculture Education

The present discussion will concentrate on formal education and will only touch briefly the non-formal sector.

Curricular Programs

The following is a list of curricular programs in the country.

Post-Secondary	Diploma in Fisheries Technology, major in Aquaculture or Inland Fisheries
Baccalaureate	Bachelor of Science in Fisheries, major in Aquaculture

	Bachelor of Science in Fisheries, major in Inland Fisheries
	Bachelor of Science in Education, major in Inland Fisheries
Graduate	Master of Aquaculture
	Master in Fisheries Technology, major in Aquaculture
	Master of Management in Fisheries
	Master of Science in Aquaculture
	Master of Science in Fisheries, major in Aquaculture
	Ph D in Aquaculture
	Ph D in Fisheries (Aquaculture)

There are 66 state universities and colleges (SUCs) and institutions supervised by the Commission on Higher Education (CHED) which offer programs in aquaculture (CHED Directory, 1997). Some of these are private institutions but they are very few compared to the SUCs and CHED-supervised schools. The preceding list of curricular programs is limited to those offered in the following institutions:

1. University of the Philippines in the Visayas – College of Fisheries
   (U.P. Visayas), Miagao, Iloilo
2. Cagayan State University – College of Fisheries
   (CSU), Aparri, Cagayan
3. Cebu State College of Science and Technology – College of Fisheries Technology
   (CSCST), Carmen, Cebu
4. Central Luzon State University – College of Fisheries
   (CLSU), Muñoz, Nueva Ecija
5. Davao del Norte State College (DNSC)
   Panabo, Davao
6. Iloilo State College of Fisheries (ISCOF)
   Barotac Nuevo, Iloilo
7. Samar Regional School of Fisheries (SRSF)
   Catbalogan, Samar
8. Sorsogon State College (SSC)
   Magallanes, Sorsogon
9. State Polytechnic College of Palawan – Aquatic Science and Technology Institute
   (SPCP), Puerto Princesa City
10. Sultan Kudarat Polytechnic State College (SKPSC),
    Tacurong, Sultan Kudarat
11. Zamboanga State College of Marine Science and Technology (ZSCMST),
    Zamboanga City

Diploma in Fisheries Technology. A 2 or 3-year program intended to provide skills in aquaculture operations; for technician level. The program includes General Education (GE) courses such as language and communication, humanities and social sciences while major courses are geared towards skills development in pond construction and operations. The student undergoes a one-year apprenticeship in industry; some schools specify the aspects of aquaculture the students must get into during the apprenticeship while others do not. The Diploma program is supposed to be a terminal program, however, a number of schools are implementing this under the "ladderized" concept leading to a Bachelor of Science degree.

Bachelor of Science in Fisheries, major in Aquaculture or Inland Fisheries. A 4-year program leading to a baccalaureate degree. In addition to the major aquaculture courses, some schools require subjects on cooperatives, extension education and in a few others, computer applications. The program includes one-summer (240 hours) on-the-job training (OJT) and a special problem or undergraduate thesis. The OJT is done either in private establishments or in the school's fishponds and aquaculture facilities. One school (ZSCMST) provides the student options: either for research and development, or entrepreneurship. For the former, the student is required a thesis while for the entrepreneurship mode, s/he is required to execute a small business plan.

Some schools, e.g. ZSCMST, implement a ladderized program that enables the student to stop at specific points in the program with corresponding title and competencies:

Year 1:	Certificate in Aquaculture; fishfarm / hatchery aide
Year 2:	Associate in Aquaculture; fishfarm/ hatchery assistant
Year 3:	Diploma in Aquaculture; fishfarm / hatchery technician
Year 4:	B.S. in Aquaculture

Throughout the four years, students have an option to join the R&D stream or the entrepreneurship stream, for each of which a separate set of courses is provided.

A ladderized program enables the student to get off at specific points and still get a title that will qualify him for a job. This is especially advantageous for those who, mainly for economic reasons, are not able to proceed and complete a 4-year degree. A major drawback however is that the BS program by its nature, should not be a mere continuation of a technician course; courses for the BS program are necessarily treated with more depth, and the science rather than skill development is emphasized. This is perhaps a major reason why under the 6^{th} World Bank Education Loan Project covenant, the Diploma in Fisheries Technology must be offered as a terminal program. A practical question though arises when a technician has demonstrated such competency that s/he can be moved to a supervisory job but could not be promoted since an undergraduate degree is lacking. Under the terminal program concept, this technician must start from the bottom of a BS program.

Master of Aquaculture. This was originally a post graduate training program for senior aquaculturists implemented by NACA at SEAFDEC; the trainees were allowed to enroll in the university and awarded the degree on successful completion of the program. The program was suspended late in the 1980's and was resumed as a U.P. Visayas program in 1996. This is a non-thesis program and the curriculum is heavy on practical or fieldwork. The present enrollees are mainly those who are engaged in extension work as fisheries officers or equivalent, in local government units and field offices of the Department of Agriculture. The program runs for one year and one summer. Formal courses are capped by field visits or tours to different aquaculture establishments in the country. Thirty units of course work are required; except for 1 or 2 courses, subjects in the M Aquaculture program are different from those for the MS Fisheries (Aquaculture).

Master in Fisheries Technology, major in Aquaculture. Offered by ISCOF, the program is geared towards strengthening managerial and technical capabilities of the students who will serve as fishery technologists, extension workers or managers. A thesis is required. Based on the objective, one deduces that the program is not research-oriented although a number of course titles bear much similarity to those of the MS in Fisheries (Aquaculture) program. This is the only program among those included in this paper that includes social science subjects among the foundation courses.

Master of Professional Studies in Aquaculture. This is offered at CLSU and aims to produce graduates who will serve as managers, extension workers and subject matter specialists. The thesis is replaced by apprenticeship wherein the student works in an agency, usually one that deals on project management. Course requirements are very similar to those for MS in Aquaculture. The program to date, has not attracted a good enrolment.

Master of Management in Fisheries. The 2-year program at ZSCMST is concentrated on management of aquaculture systems although the title is very general. The program includes biological subjects such as cultivable species, feeds and feeding, but majority is on management including marketing and finance, and management of human organizations.

Master of Science in Fisheries, major in Aquaculture; Master of Science in Aquaculture. U.P. Visayas and CLSU offer these respectively. The programs are essentially similar in content and requirements although emphasis vary to some extent, possibly reflecting the strength of the institutions i.e., U.P. Visayas is the national center for brackishwater aquaculture while CLSU hosts the freshwater aquaculture station.

Ph D Fisheries (Aquaculture); Ph D in Aquaculture. The program is offered by two leading institutions in fisheries education: U.P. Visayas and CLSU. U.P. Visayas implemented the program in 1996; at CLSU, implementation was started in June 1999. U.P. Visayas has yet to produce its first graduate; annual admission has averaged three, composed mostly of faculty members from other fisheries schools. The program at CLSU requires 60 units and provides for two areas of concentration, namely genetics and fisheries management. The U.P. Visayas program on the other hand, requires 42 units and although no specific major field is indicated, the student can acquire specialization through a system of electives and cognates. At U.P. Visayas, the candidate must present a manuscript accepted for publication in a scientific journal before the degree is conferred.

The Ph D Aquaculture is the only doctoral program in fisheries in the country; none is available for capture fisheries or postharvest fisheries. Likewise at the Masters level, the first program to be implemented is that in aquaculture. This could be reflective of the importance of aquaculture in the Philippines; the beginnings of a graduate education can be traced partly to a USAID-supported project on Inland Fisheries which started what is now the Brackishwater Aquaculture Center at U.P. Visayas and the Freshwater Aquaculture Station at CLSU. The same project made possible acquisition of advanced degrees in aquaculture by the staff, providing the human resource requirement for graduate programs.

A related program, the Ph D in Marine Science, offered at the Marine Science Institute of U.P. Diliman is the first doctoral program in the country in marine science and fisheries. It has also catered to fisheries graduate students especially those desiring to work on aquaculture-related systems e.g., marine algae, mycology and similar areas. Instituted in 1989, the program has produced graduates who are now with fisheries schools and research institutions.

A number of these curricular programs have been reviewed in a previous paper (Santos and Lacanilao, 1993).

All programs are offered in the residential mode. Distance education has been pursued in many universities in the Philippines. At the University of the Philippines System, the Open University is a separate constituent university and takes care of all distance education courses. However, fisheries programs have yet to be offered in the distance mode. U.P. Visayas has a standing proposal to offer the Master of Aquaculture program in this mode. It is proposed that the subjects will be “stand alone” courses such that a student may opt not to complete the program but enroll only in specific subjects for which s/he will get a certificate of completion. Individual courses do not progress into the next but are more or less independent of each other.

Entry and graduation are governed by policies of the schools that have their own structure for the purpose e.g. Board of Trustees. An examination is usually required. Likewise transfers of credits depend on school policies, some of which require validating examination.

The CHED, through the Technical Panel for Agriculture Education (TPAE) formulates minimum standards for academic programs in fisheries and the criteria cover curriculum, faculty, and physical facilities required for an institution to implement an academic program in fisheries. The Diploma and similar programs below the baccalaureate level are within the authority of the Technical Education and Skills Development Authority (TESDA). The minimum requirements are periodically revised, the latest of which was done in 1998 (CHED Memo. Order No. 34, s.1998).

Training Programs

Many of the SUC's conduct training programs in different aspects of aquaculture. This is especially true with U.P. Visayas, CLSU and ZSCMST. Areas cover research methods and data analysis to specific techniques in aquaculture. SEAFDEC Aquaculture Department based at Iloilo, Philippines conducts training programs regularly for international and local clientele. U.P. in the Visayas through its Brackishwater Aquaculture Center at Leganes, Iloilo hosts group and individual training programs. There are a number of experimental ponds for the purpose plus access to cooperators' ponds that make possible actual fieldwork for trainees. Clientele include faculty members of other fisheries schools, personnel of government institutions and local government units. The enactment of the Local Government Code (RA 7160; 1991) two features of which are the devolution of fisheries officers to the local government and the decentralization of the administration of fishery resources put pressure on these personnel to upgrade themselves. This is also a precipitating factor for the institution at U.P. Visayas of the master of Marine Affairs Program.

Training programs are non-credit and at the end of the course, the participant is awarded a certificate.

Key Issues and Concerns

The following discussion covers fisheries education in general but they too apply very well to aquaculture education.

Rationalizing Fisheries Education

The proliferation of substandard institutions has been pointed out many times in previous discussions on fisheries education; the issue still stands. Substandard institutions turn out mediocre graduates that start off a cycle of mediocrity. The historical background to this event is traced in the paper of Juliano and Flores (1988), and briefly in the paper of Garcia (2000). Efforts were not lacking however, to correct the situation. In 1977, the Department of Education formulated the national agriculture education system (NAES) which proposed a flagship model under which schools concentrating on specific roles will be identified and government support will be given only to schools so designated. The NAES though did not materialize. In 1997 the Congressional Commission on Agricultural Modernization pointed out that human resource must be properly developed if increased agricultural productivity will be attained. The recently enacted Fisheries Code of 1998 (RA 8550) and the Agriculture and Fisheries Modernization Act of 1997 (RA 8435) had each provided for human resource development. Specifically, Title 2, section 66 of RA 8435 mandates the creation of the National Agriculture and Fisheries Education System (NAFES) which aims to establish an integrated system of fisheries education and modernize the same to promote global competitiveness. As provided for in the law, there shall be a network consisting of national universities or colleges of agriculture and fisheries (NUCAFs) and provincial institutes in agriculture and fisheries (PIAFs). The NUCAF will produce graduates for scientific research, for higher education and management, while the PIAF will produce technologists and extension workers, and fisheries entrepreneurs.

CHED has started implementing the NAFES and to date has identified five national universities in fisheries. These universities shall be supported by a PhP 3M grant annually for three years, after which re-evaluation will be conducted. With government support being focused on few institutions, it is expected that these institutions will be suitably upgraded while substandard institutions will be gradually phased out.

Upgrading Human Resource

In 1993, close to 70% of the faculty in fisheries institutions do not have graduate degrees in fisheries or allied science (Santos, 1993). The situation has probably improved to varying degrees especially at state universities, but it is doubtful if the over-all picture has substantially changed. In some institutions such as U.P. Visayas, more than 50% of the faculty of the College of Fisheries are doctoral degree holders and only two of the 41 faculty members do not have graduate degrees. In other schools, in contrast, an MS Fisheries degree holder may be lacking in the entire faculty roster. Data for 1993 shows that for aquaculture, available manpower for R&D is estimated as follows: 25 Ph D holders, 130 MSc and 215 BS, for R and D. Except for those who are with SEAFDEC Aquaculture Department, the rest practically represents faculty resource of state colleges and universities; particularly those in the BS level.

Government scholarships, as well as from private foundations, though limited in number, are available for graduate studies. Availability of financial support, though, does not appear to be the only factor in the lack of competent teachers. For example, the Philippine Council for Aquatic and Marine Research and Development (PCAMRD) often finds that available slots are not fully subscribed to. Some institutions would not release faculty members for full-time graduate studies because substitutes could not be hired to absorb the fellow's teaching load. Still, others would not wish to study where enrollment will make them leave their families behind. In the latter instance, the faculty member usually opts to enroll in a master's degree in education or public administration that is most probably available in a school close to their place.

At this point, however, there is no national human resource development plan for fisheries which would have included the quantity needed for specific fields of fisheries and the level of competence desired. Such a plan, would have provided direction in rationalizing education as well as in upgrading of educational institutions.

Increasing Accessibility of Graduate Programs

As briefly discussed in the preceding section, upgrading of faculty competence rests not only on availability of financial support but program accessibility as well. A system that will enable the faculty members to pursue graduate studies on a part-time basis, without taking leave from their work and not being away from home is most desired though may not necessarily be the best.

Offering the programs in distance mode is a very attractive proposition and in fact, our College has received informal requests to offer the graduate programs in distance mode. As mentioned earlier, we have proposed the implementation of the Master of Aquaculture program in this manner. For aquaculture programs, distance mode requires more logistics because of the laboratory component of the different subjects. This places more demand on the satellite learning centers that must be as equipped as the laboratories in the home university. Likewise, the demand on tutor's time is greater compared with programs that do not have laboratory work components.

As a strategy to "bring the program to the clientele", the ZSCMST hosted the Master of Science in Fisheries major in Aquaculture program of U.P. Visayas, under the CHED-Mindanao Advanced Education Project (MAEP). The MAEP seeks to upgrade faculty competency in CHED-supervised schools in Mindanao. Under the agreement, U.P. Visayas "loaned" its MSc Fisheries (Aquaculture) Program to ZSCMST for a period of two years; faculty member from schools in Mindanao enrolled in the program that was jointly handled by UPV and ZSCMST faculty. The degree was granted by ZSCMST. Classes were offered on weekends and after office hours such that students did not have to take leave from their work nor be away from home for extended periods. The program was limited to faculty members of CHED-supervised schools in Mindanao.

A slightly different set up has been proposed for the MSF major in Fisheries Biology also of U.P. Visayas but the basic purpose is the same. It is mentioned here because we intend to replicate this for the aquaculture program. Under this arrangement, students will be enrolled at U.P. Visayas while the recipient agency, in this case the Bureau of Fisheries and Aquatic Resources (BFAR), will host the program. The faculty will be on a fly-in mode and classes will be conducted on a continuous basis. Again, a basic assumption is that the host agency is fully equipped for the necessary laboratory work, and library materials are fully accessible. As planned, the program will be open only to BFAR personnel.

Professionalization of Fisheries

At the U.P. Visayas College of Fisheries, enrolment has declined relative to figures a decade ago. For the last few years, enrolment tended to be more or less constant. Across the country, the general trend is the same. This appears to be a contradiction: aquaculture will play an increasingly important role in economic development and yet, seemingly few students want to study aquaculture. This can imply any one of the following: that aquaculture education programs are substitutable with other programs e.g., zoology or aquatic biology; the present programs do not equip the graduates adequately so students do not find any need for it; or fisheries/aquaculture is not an attractive program. In order to improve the image and status of fisheries graduates in the country, both the Fisheries Code of 1998 and AFMA of 1997 provided for the professionalization of fisheries. In accordance with these acts, there shall be a Fisheries Board of Examiners that will grant eligibility to graduates through the Professional Regulation Commission thereby putting the fisheries profession in the same level as, for example engineering and veterinary medicine. Such professionalization will help dispel the impression that fisheries is a vocational course rather than a career in science.

Increasing Relevance of the Program

The only officially reported trace study of graduates in fisheries is that conducted by BFAR on its scholars (BFAR, 1989). The study that is rather limited in scope, showed that a good majority of graduates believed that the curriculum is highly theoretical. As Juliano (1996) pointed out, it appears that curricular programs do not immediately prepare the students for industry. This is a general comment from industry that seems to expect a graduate of the BS program to be able to immerse himself in a specific task on first meeting. On the other hand, industry needs are often specialized skills whereas fisheries graduates have broad training. Undergraduate education is less intended to develop skills but are designed to equip students with an understanding of the system and the ability to respond to particular situation involving the system (Santos and Lacanilao, 1993). Furthermore, industry, government and society each has needs that do not necessary converge. Perhaps a better gauge of a good academic program is the trainability of the graduate for a specific task.

Greater participation of the private sector in curriculum development and implementation will be a big help in making the curriculum more relevant. At present, it is doubtful if the private sector has formal involvement in curriculum development although it is certain that to varying degrees their concerns are incorporated in the programs. It is likewise not common that industry people participate as lecturers or part-time faculty members in fisheries institutions unlike in colleges of business or public administration, governance and management, where practitioners in private and government agencies are involved as lecturers. Such arrangement would have given students first-hand information on, and bring them closer to, the industry. Information from the industry and government sectors filter to the students through seminars, lectures and forums.

The most direct participation of the private sector is by hosting the on-the-job training or practicum of students. Here, the students are immersed in usually several aspects of the industry. For the greater part, however, industry is a passive host to the student where the latter generally learns by observation, although there are not too few instances when the industry manager discusses with, and treats the students as active learners rather than as additional labor. The OJT also provides the student an opportunity for employment upon graduation.

Curricular programs are revised, generally once in five years, where developments in the discipline are incorporated to make the program relevant and responsive to current issues. Colleges and universities have administrative structures within their respective systems that take care of curricular revisions. It should perhaps be the case that curricular revisions are taken up in some kind of forum with the private sector.

Relevance may also be improved if constant dialogue by the faculty with industry and other sectors are held. This will enable the faculty to incorporate present issues and concerns in specific courses, without necessarily revising the program. U.P. Visayas for example, conducts roundtable discussions periodically mainly to collectively address specific issues; the advantage to the faculty-participant should not be over-looked. This point also emphasizes the need for faculty members to keep themselves updated and in-tune with developments in their discipline; continuing education of teachers through non-formal programs is imperative.

Networking

Networking is a strategy that has been pursued since the early 1980's. A very good example is NACA that started as a UNDP/FAO project and progressed into an autonomous body for regional cooperation. The situation has considerably improved relative to when the Asian Fisheries Society (1988) stated that at all levels of fisheries, there is a lack of cooperation between institutes nationally, whilst such cooperation is almost non-existent amongst institutions of different countries, except perhaps between researchers at a personal level. Juliano (1996) points out that in the Philippines, educational institutions in fisheries are not linked through an organization except for the Philippine Fisheries Institutions Network (PhilFIN) which is made up of the U.P. Visayas and seven other recipients of the World Bank Loan. The PhilFI, after a lull of 3-4 years, is again very active and there is every indication that it can provide the nucleus for a countrywide fisheries institutions network.

There is no lack of initiative to network; in fact, everyone agrees that networking should be pursued but the missing term is sustainability. What usually happens is that a network will be precipitated by a specific project at the end of which, the network dissolves. A usual constraint is funding which is easily solved if there is a common project that ultimately becomes the source of operational funds for the network. As in any organization, leadership is very critical.

Although a network covering the major if not, all fisheries institutions does not exist, the different institutions have cooperated with each other in varied ways:

a. A consortium has been organized by some schools (ISCOF, DNSC and SRSF) mainly in the offering of graduate program in aquaculture;
b. U.P. Visayas has temporarily loaned its MS Fisheries (Aquaculture) program to ZSCMST to enable the latter to implement the upgrading of teachers in Mindanao; Both schools jointly handle the program;
c. SPCP – ASTI has entered into agreement with Silliman University to implement a program in coastal resource management;
d. U.P. Visayas has a Memorandum of Understanding with SEAFDEC Aquaculture Department that enables the University to tap expertise from SEAFDEC as thesis advisers and panelists, and to send its thesis/practicum students to work with SEAFDEC scientists;
e. Since 1998, U.P. Visayas has implemented with Kagoshima University in Japan the Core University Program (CUP) under the auspices of the Japan Society for the Promotion of Science. The CUP involves exchange of research scientists between the institutions; in the Philippines, 14 other fisheries schools are involved with U.P.

Visayas College of Fisheries at the helm. The exchange of research scientists also involve participation as members of graduate thesis committee.

f. In 1999, a Memorandum of Understanding was signed between U.P. Visayas and the Tokyo University of Fisheries for academic cooperation covering exchange not only of research scientists but students and faculty as well.

These agreements, however, are for a fixed period of time coinciding with the project life.

There are a number of advantages and possibilities in networking. An effective and functioning network would enable institutions to (Juliano, 1996):

a. facilitate interaction and discussion of problems in fisheries education;
b. assist each other in curriculum development, faculty upgrading, sharing of facilities, accreditation and generally, improving fisheries education;
c. organize an information system on fisheries education and research; and
d. help each other in field trials of developed technology.

The network could also address the issue of transfer of academic credits, mobility of students from one institution to another to avail of institutional specialization (e.g. one school may be specialized in freshwater aquaculture while another on brackishwater, or one may be strong in genetics, another on fish health), and continuing education of fisheries educators and administrators.

Concluding Remarks

Aquaculture education in the Philippines has moved forward if only the availability of graduate degree programs at both the masters and Ph D levels is used as gauge, and there are other aspects where positive developments can be identified. While the key issues and concerns elucidated in this paper have been there for some time, there appears to be sincere effort on the part of university administrators to improve their faculty complement and their programs. The institutions have been rather aggressive introducing innovations and instituting new programs that veer away from the traditional areas. Despite a budgetary cut on the allocation of state universities and colleges, the government, through the CHED, seems serious in upgrading fisheries institutions. The enactment of two laws on fisheries, AFMA and the Fisheries Code, presents an opportune time to institute needed reforms. The timeliness of the efforts could not be understated: developments in science and information technologies are so fast that our educational system must respond now, otherwise the gap will grow wider and aquaculture education will not be able to produce human resource that is globally competitive, to the detriment of the industry. The initial step on rationalization of education through the designation of centers of excellence must be sustained and the phasing out of substandard institutions must be implemented. Networking is not only desirable, under the present circumstance, it is almost imperative: complementation is even more critical when resources are low, and globalization is a force that is, no longer an option but a necessity. Aquaculture is expected to narrow the gap between fish food supply and demand, aquaculture education must be such that the human resources needed to carry the task is available. The human resource base is the most important element in any development plan, not physical properties or resources. It is no longer resources that limit decisions – it is the decision that makes the resources (Toeffler, 1970).

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Annex D5: A Bachelor's Degree Program in Aquaculture, Kasetsart University, Thailand

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Introduction

Aquaculture has been practiced in Thailand for more than 50 years. It was commercialised when intensive catfish culture was established about 30 years ago. Its importance has become vital for the Thai economy since tiger prawn culture was established some 14 years ago. At present it occupies approximately 74,000 ha of the coastal area with an average annual production of about 24,000 t and valued at US$ 1,150,000[1]. Tiger prawn export has generated the highest income among the country's agriculture commodities for at least 5 years. Freshwater aquaculture, although has limited exported market, supplies the country with approximately 200,000 t annually, valued at about 132 million US$ dollars[2]. It occupies an area of more than 80,000 ha across the country. Substantial expansion of the business is observed yearly along with the expansion of related businesses such as feed production, drugs and chemicals. This indicates substantial needs for well-trained personnel in this field.

In Thailand there are at least 7 institutions that offer bachelor degree programs in fisheries (and related field i.e. Marine Science, Aquatic Science, etc.) (Table 1). Of these the Faculty of Fisheries, Kasetsart University, is the only one that offers a curriculum in aquaculture, although a few courses related to aquaculture are included in curricular offered by another institutes. Additionally, there are a few institutes that offer certificate in aquaculture.

Curriculum

The Faculty of Fisheries, founded in 1943, was one of the three founding faculties including Faculty of Agriculture and Faculty of Forestry. It offers five undergraduate programs in 5 major fields, Aquaculture, Fishery Biology, Fishery Products, Marine Science and Fishery Management. However, every program awards the same degree, Bachelor of Science (Fisheries) after four years of study (the academic year is divided into 2 semesters with a six week summer session during hot season). Language of instruction is Thai.

Each program requires a total of 145 credit hours (1 credit hour = 15 hours/semester) which comprise of 41 credits of general education and 101 credits of specific requirements. The general education comprises of 21 credits of basic Science and Mathematics, 9 credits of Language, 3 credits of Sciences, 6 credits of Humanities and 2 credits of Physical Education. Among 101 credits of specific requirements, 24 credits are required for core courses (essential knowledge for fisheries personnel) and 77 credits of major field (13 credits Chemistry, 8 credits Calculus, 6 credits Statistics, 3 credits of Genetics, 35 credits of other courses in Aquaculture and 12 credits of Technical Electives) (see table 2).

In addition to the course work the students are required to have 200 hours of field training (on the job training) in fish farms or fisheries stations. Practically they will spend the first 100 hours practicing freshwater aquaculture. The second 100 hours will be dedicated to brackish-water aquaculture (mostly shrimp culture).

Staff

There are 62 lecturers in the Faculty of Fisheries and 11 of them work for Department of Aquaculture. Qualification of the lecturers in Department of Aquaculture is higher than that of overall Faculty of Fisheries, Faculty of Agriculture and Faculty of Forestry as indicated by higher ratio of Ph. D. holders. However, regarding academic position most of them (6) have not achieved professorship which may be due to their short teaching experience (less than 10 years) (Fig.1).

Teaching experience of the lecturers is between 2-32 years (1 lecturer = 32 years; 3 lecturers = 20-22 years; 4 lecturers = 5-7 years; 2 lecturers = less than 5 years). They have been teaching courses of the same specialized fields, fish culture, fish breeding and Genetics, water quality, fish nutrition and fish health, since they started the career. Additionally there are 2 scientists and 26 workers supporting laboratory and practical classes as well as maintenance of ponds and other facilities.

Research activities of the staff are strengthened partly by the 2 postgraduate programs, a regular MS (Aquaculture) Program which is instructed in Thai language and the International MS (Aquaculture) Program instructed in English. At present approximately 100 students are studying in the first program. The Ph. D. Program in Aquaculture (instructed in Thai) is being offered in the first semester of the year 2000.

Special Lecturers

Every semester, about 5-6 special lecturers are invited for the courses related to their expertise (mostly for the 3rd and the 4th year students). The lecture mostly covers less than 10 % of the whole course. Most of them are from government institutions. A few of them are from feed company and private farms.

Involvement of Industry Personnel in Teaching

Only few personnel from industry sector participate in teaching courses in aquaculture (about 2 persons/semester). They are from feed companies and private shrimp hatcheries/farms. However, private sector plays important role in accepting the 3rd year students for field training.

Occasionally industry personnel is invited to share their experiences with the students outside classes. However, their opinion was seriously considered for the recent curriculum improvement.

Admission to the Department of Aquaculture

Having obtained the secondary school or grade 12 certificate, admission to the Department of Aquaculture is dependent on a candidate successfully passing the national university entrance examination which is organized by a committee consisting of representatives from public universities and the Office of Permanent Secretary for University Affairs. In addition, Department of Aquaculture provides high school students in certain provinces in rural area with special quota (of about 6-10 students/year) to enroll in the department by taking a special entrance examination conducted by Kasetsart University

Quality of Incoming Students

Quality of incoming students based on entrance score is below average. The average scores between 1993-1998 ranged from 198.7 ($\pm$ 12.4) to 222.1 ($\pm$ 12.4) which were less than 50 % of the total score (600). However, when a comparison is made among students of related fields, the quality of the incoming students to the faculties of Agriculture and Forestry is of similar level to that of Department of Aquaculture (only minimum entrance score was available for the other two faculties, therefore it is used for the comparison. However, considering the score of Aquaculture students, either minimum or average score seems to give the same trend.)

The minimum entrance score of Aquaculture students was slightly higher than that of students entering the Faculty of Agriculture ($\overline{X}_{min}$ = 196.7; range =172-203) but lower than minimum score for Faculty of Forestry ($\overline{X}_{min}$ = 212.1; range =189-216) (Fig. 2, 3). There was a hint of a trend of the score to be dependent to total fish production profile (correlation coefficient – r = -

.23), and even better correlated to annual shrimp production (r = .39). However, a few more years of data are needed to confirm the existence of such trends.

Attempts to Recruit Good Students

The Faculty of Fisheries realizes that quality of the enrolling students is one of the limiting factors for successful achievement of the programs. However, not much can be done to attract good students due to the centralized entrance examination system set by Ministry of University Affair. Amongst a few attempts which have been made are:

- Providing quota for high school students in rural area to enter Department of Aquaculture through a special examination.
- Providing high school students with more information regarding Faculty of Fisheries.

Substantial amount of scholarships is given every year mostly to needed students. However, they do not have impacts on attracting good high school students.

Approximately 100 new students are enrolled in Department of Aquaculture each year. Among which 75.8 % was graduated with grade point average of 2.38-2.65 (total = 4).

Employment Prospects

Percentage of employment over the past 6 years for the graduates in aquaculture was slightly higher and more persistent than that of agriculture and forestry graduates[3,4,5,6,7,8] (Fig.4). The BS (Fisheries) holders graduated from any of the five departments has similar employment prospect. In the past, most of them (>80 %) worked as researchers in Department of Fisheries, Ministry of Agriculture and Cooperative. The trend has changed since tiger prawn business was established, about 80 % of the scholars graduated from Department of Aquaculture joined private enterprises such as shrimp farms, feed production companies and etc. However, the trend has changed downward since 1993 which might be due to partial saturation of the business. It is obvious that none of the graduates are employed by freshwater fish farms. This might be owing to small size of such businesses. The percentage of the graduates that worked for private companies dropped sharply in 1996 due to the economic crisis of Thailand. As of 1998, 42 % of them joined private companies. Government service was an occupation for 26 % of the graduates in 1998. The trend for this occupation has been gradually increased since 1993. It is quite obvious that percentage of the graduates who pursued their own aquaculture businesses was increasing over the past 6 years. The percentage of the graduates from Department of Aquaculture, Faculty of Agriculture and Faculty of Forestry pursued different careers are shown in Fig. 5.

The average income (as of 1998) of the graduates from Department of Aquaculture is equal to that of Faculty of Agriculture (about US$ 230/month) which is higher than that of Faculty of Forestry(about US$195/month)[8].

Potential of Networking

The Ministry of University Affairs has a policy to encourage higher education institutions to establish academic collaboration, both among local and international institutes. Many university consortia have been established in order to strengthen higher education in various fields except aquaculture. Under the consortia, the institutes involved are able to set up their own agreement regarding credit transfer, exemption of expenses, etc. Additionally the ministry has set up many projects in order to support institutional collaboration such as:

Student/Faculty Exchange Program

MUA has encouraged students and staff exchange with countries in different regions of the world; for example, Australia, Belgium, Canada and the United States of America. The program will lead to the strengthening of academic standard and improvement of human resources with widened vision and international competence.

ASEAN University Network (AUN)

The Network under the supervision of ASEAN, targets to strengthen ASEAN awareness and cooperation through the promotion of the exchange of students, faculty members and resources among the participating universities. Kasetsart University itself has a strong policy projects towards internationalization which encourage local and international academic collaboration in the faculty level. Thus, Department of Aquaculture has high potential in establishing a networking of aquaculture institutions.

Future Prospect

Importance of aquaculture is tremendously increasing towards the new millennium. Higher aquaculture production is required to ensure world food security whereas natural resources become more limited. Therefore, more advanced technology should be employed to maximize production while saving the environment. This readily forecasts the increasing demand for well-trained aquaculture personnel.

The trend is also true for Thailand. In the near future not only shrimp culture businesses but also freshwater aquaculture businesses should be equipped with advanced technology to cope with various problems on environment, product quality, value adding of the product, etc. Hence, it is necessary to improve quality of the graduates to enhance capability in problem solving and having adequate creativity for sustaining of aquaculture. They should address the problems with global perspective, capable of integrating knowledge for problem solving, having aquaculture vision for at least at the regional level. Therefore, close collaboration among regional academic institutions would be of great benefit. It enables sharing of expertise and resources, thus allows strengthening of the counter-parts. This will eventually be great contribution to aquaculture business of the region.

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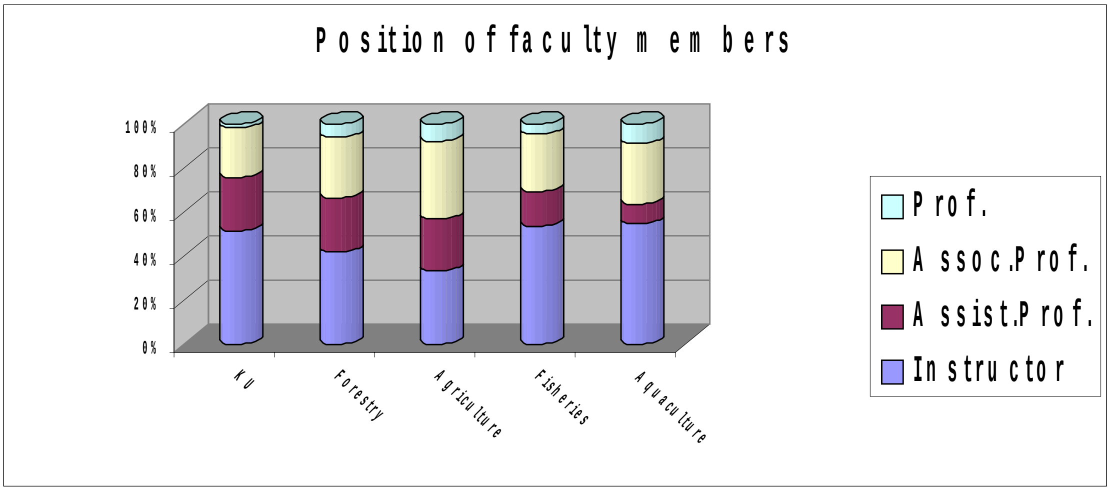
Table 1: List of Thai Universities/Institutes offering Bachelor's Degree Programs in aquaculture and related fields.

Universities	Faculty	Department	Degree awarded	No. of incoming students/year
1.Kasetsart University	Fisheries	Aquaculture Fishery Biology Marine Sciences Fishery Product Fishery Management	B.S. (Fisheries) B.S. (Fisheries) B.S. (Fisheries) B.S. (Fisheries) B.S. (Fisheries)	70 40 40 40 60
2.Chulalongkorn University	Sciences	Marine Science	B. S. (Marine Sciences)	30
3.Khonkhaen University	Agriculture	Fisheries	B. Sc. (Fisheries)	20
4.Burapha University	Sciences	Aquatic Sciences	B..S (Aquatic Science)	20
5.Prince of Songkhla University	1.Natural Resources 2.Sciences and Technology	Aquatic Science Fisheries	B.S. (Aquatic Science) B..S.	20 10
6.Maejo University	Agricultural Products	Fishery Technology	B. S.	23
7.King Mongkut's Institute of Technology	Agricultural Technology	Fishery Sciences -	B.S.(Agriculture)	25
8. Walailak University	Office of Agricultural Technology	Fisheries Fisheries	B.S. (Agriculture)	30
9.Rajamangala Institute of Technology*	1.Sciences and Technology 2.Agriculture		B.Sc.(Fisheries) B.Sc.(Fisheries)	360 15

Table 2: Lists of major field courses for undergraduate students major in aquaculture.

Course Title	Credits
General Chemistry I	4
General Chemistry II	4
Organic Chemistry	5
Fish Pond Construction	3
Calculus I	4
Calculus II	4
Principles of Statistics I	3
Principles of Statistics II	3
Breeding and Nursing of Freshwater Fishes	3
Fish Feed and Feeding	3
Breeding and Nursing of Marine Animals	3
Diseases and Parasites of Fishes	3
Quality and Productivity of Fish Ponds	3
Genetics of Aquatic Animals	3
Freshwater Fish Culture	3
Mariculture	3
Water Analysis	3
Fishery Engineering	3
Principles of Genetics	2
Laboratory in Genetics	1
Seminar	1

Figure 1: Position and qualification of faculty members in Kasetsart University, Faculty of Forestry, Faculty of Agriculture, Faculty of Fisheries and Department of Aquaculture



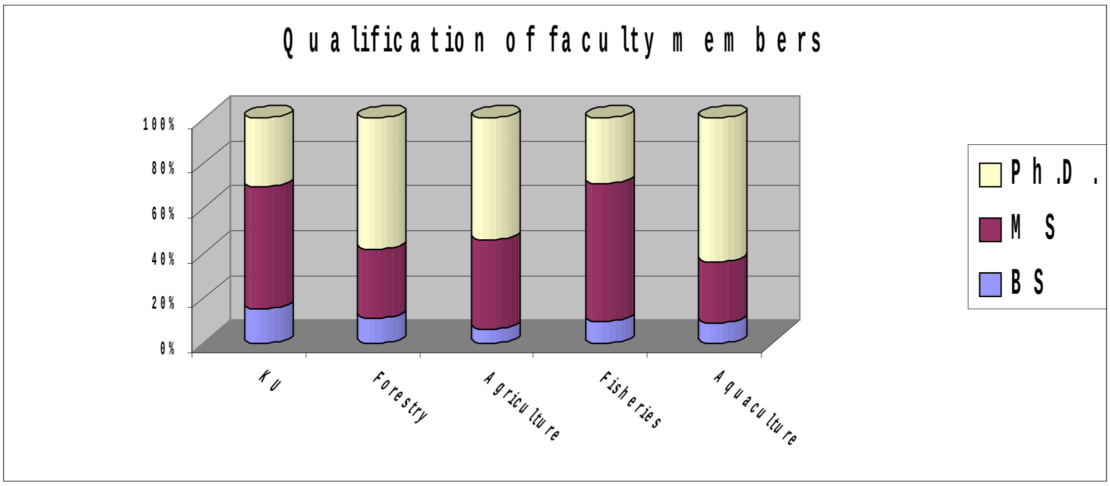
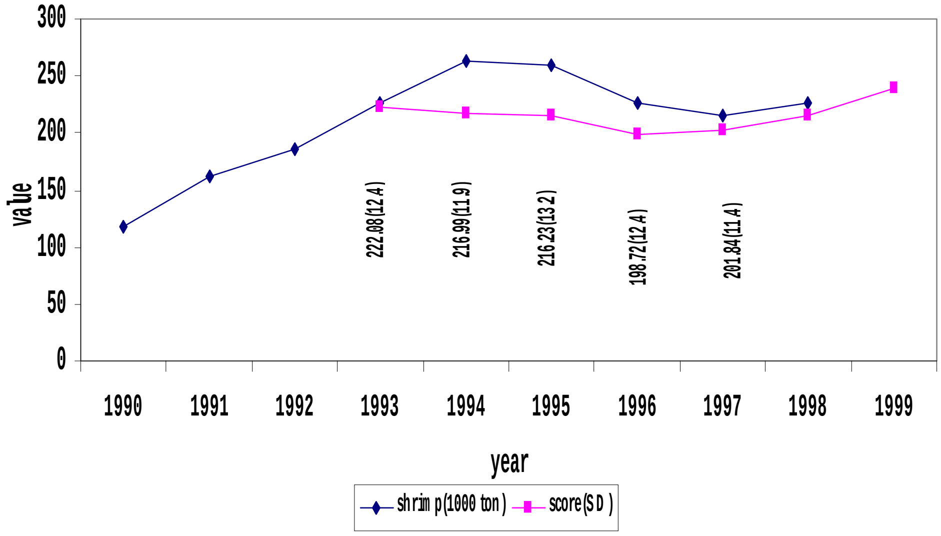


Fig. 2 Relationship of quality of high school students (indicated by entrance score) entering Department of Aquaculture and trend for aquaculture industries (shrimp production).



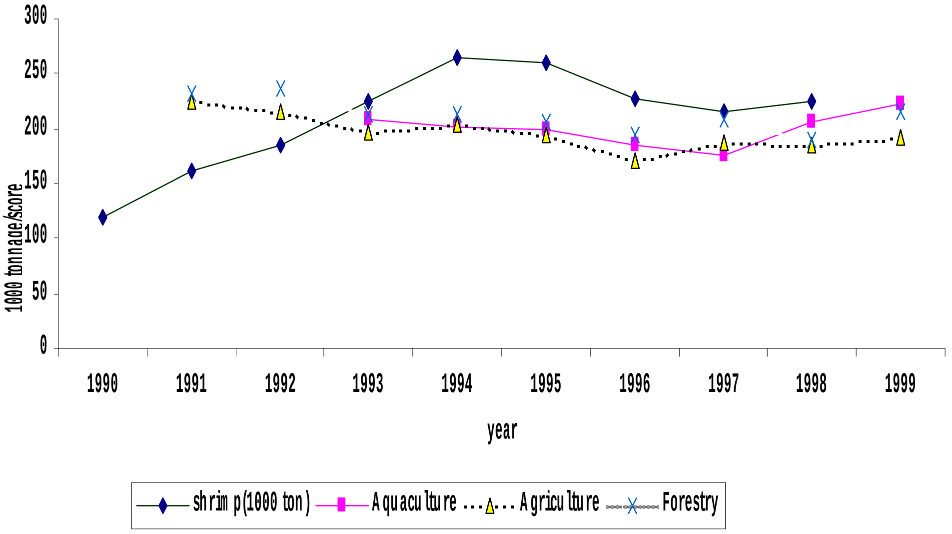


Fig.3 Quality of high school students (indicated by minimum entrance score) entering Department of Aquaculture; Faculty of Forestry and Faculty of Agriculture plotted against shrimp production.

Fig. 4 Percentage of employment of the bachelors graduated from Faculty of Forestry, Faculty of Agriculture and Department of Aquaculture.

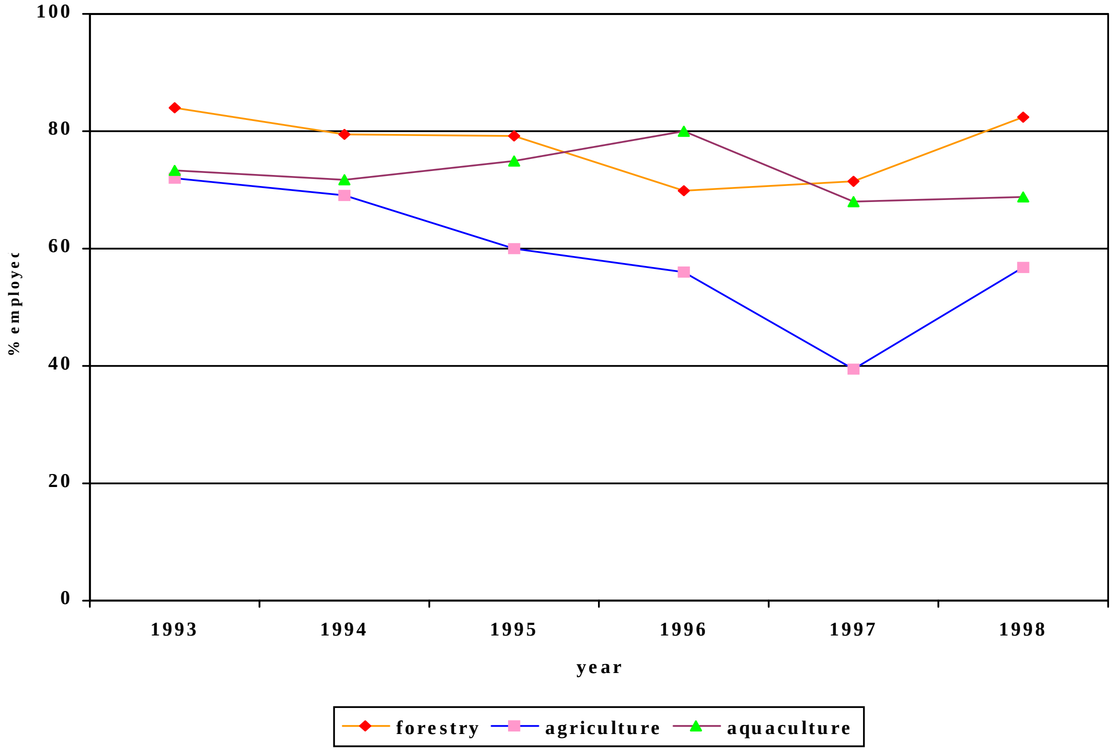


Fig. 5 Trend for the graduates (BS (Fisheries) major in Aquaculture) persuing 3 types of jobs, private company employee, government service, and private agricultural business, during 1993-1998 (total less than 100% , other careers not shown).

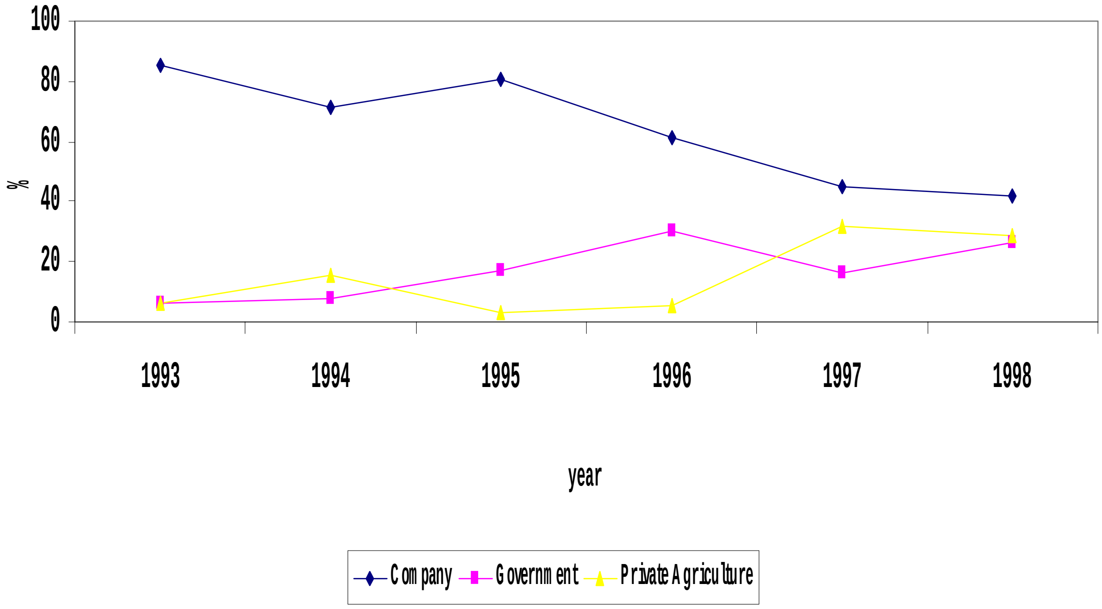
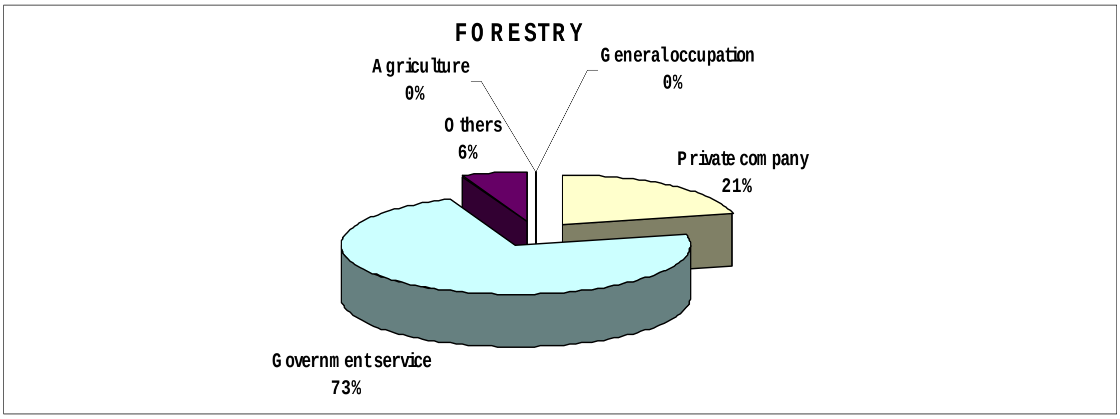
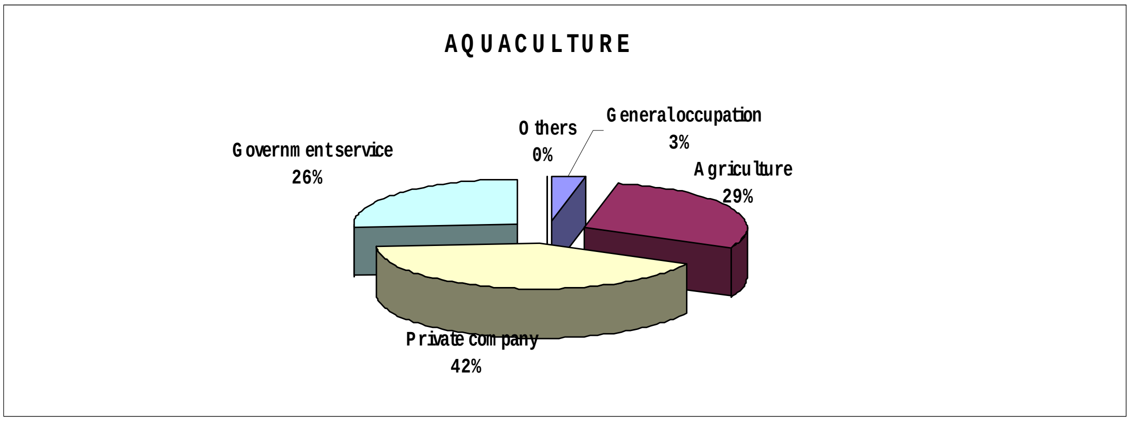
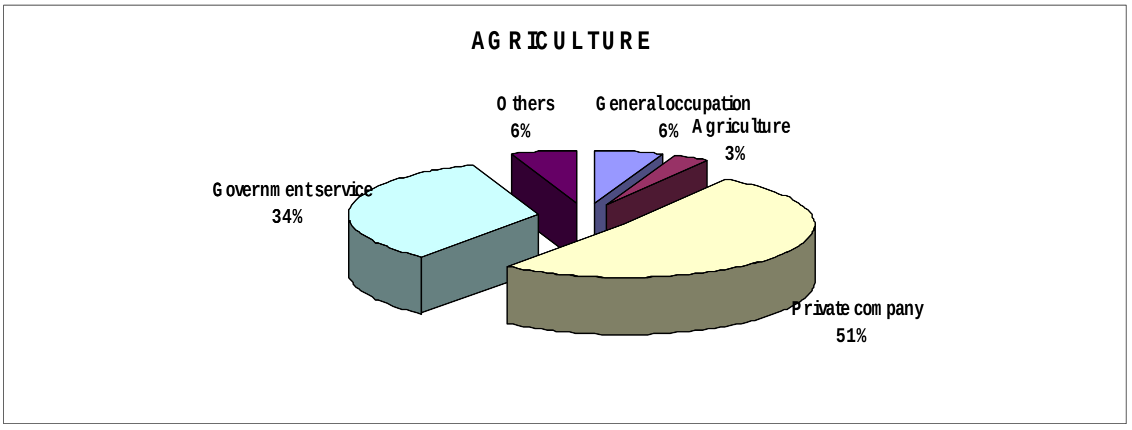


Figure 6: Occupations of the bachelors graduated from Faculty of Forestry, Department of Aquaculture (Faculty of Fisheries), and Faculty of Agriculture, Kasetsart University, Thailand in 1998







Annex D6: Aquaculture Education and Training in Vietnam

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Aquaculture Education and Training Systems

Education and Training Institutions

Education and Training System of the Ministry of Fisheries (MoF).

Since the middle eighties, under the new policies of restructure of the education and training system, the Fisheries education at the tertiary level has been transferred from the Ministry of Fisheries to Ministry of High Education and later all renamed by the Ministry of Education and Training with merger of the two ministries, Ministry of Education and Ministry of High Education. Nowadays, under the ministry of Fisheries, there is a training system consisting three vocation schools No 1,2,4. Among these vocation schools, only school No 4 is involved with aquaculture training, while No 2 has infrequently trained aquaculture technicians. School No 4 is also conducting sandwich training for a BSc. program on aquaculture and job-skill training. Apart from aquaculture, these schools provide training up to technical level in administration, accounting, navigation, mechanic fields, etc.

Education and Training System of the Ministry of Education and Training (MoET)

Ministry of Education and Training is in fact, responsible for all education and training in Vietnam including fisheries. Although, administratively, the vocational schools come under the purview of the MoF, technically, these are also under the MoET, as is the university system. Presently, aquaculture education at the BSc. level is conducted in Nha trang University of Fisheries, Can tho University, College of Agriculture and Forestry of the State University in HCM, Hue University, Vinh University. BSc. program in RIA-1 is collaboration program between RIA-1, Hanoi University, Hanoi and the Agricultural University under license of Nha trang UoF. Hanoi Agricultural University is permitted to conduct BSc. in Aquaculture, but to date it has not been undertaken since the collaborative program is still operational.

Other Formal and Informal Education and Training System

This relates to the type of provincial vocation school. Such schools are found only in Thanh hoa province for training of local students as aquaculture technicians. Last few year, one in-service BSc. program in sandwich form for only the local students was also conducted.

Changes in Education and Training for the Last Decade (1989 - 1999)

No significant change in structure has occurred in the last decade. However, status of education and training in Vietnam has been greatly changed since the open economic policy started. Before, 1988 all students were offered complete scholarships that included board and lodging. Since 1988, only part scholarship is offered and is only for 15-25 % of the best students. As a result, many children of poor households are unable to enter high schools and universities.

Before 1988, there were three institutes conducting BSc. on aquaculture namely University of Fisheries (UoF), Nha trang; Can tho University and College of Agriculture and Forestry (CAF), Ho Chi Minh city. All these institutes are located in South Vietnam. Presently, three other universities and Research Institutes in the North are also conducting BSc. These are Hue University, Vinh University and Research Institute for Aquaculture in collaboration with Hanoi Agriculture University.

The curriculum of BSc. is very diverse depending each institute condition, target priorities. For example, while the UoF very much focuses on biology, aquaculture technology of marine species, CAF is focusing on processing technology, culture technology of freshwater species of south Vietnam waters.

Institutional Function

Description of Institutional Function Relating to Aquaculture Education (Tables 1,2,3)

- Research Institute For Aquaculture No.I (RIA-1). Since 1994, in cooperation with Asian Institute of Technology and University of Fisheries, RIA-1 has responsibility in BSc. and MSc. Training. Total students graduated from RIA-1 were 72 in the last 3 years (1997 - 1999) and 12 MSc. in 1999.
- Research Institute of Marine Products (RIMP), in cooperation with the National University and others functional Universities, RIMP only train students at PhD level. Starting in 1994, RIMP has trained 5 PhD in different sectors in Fisheries/aquaculture.
- University of Vinh (UV), started training in aquaculture in 1994, the first three years were open forms and from 1997 up to now are regular (full time). The first three year with the open form, UV had trained 135 BSc. in aquaculture and more than 250 students are still studying there. In UV aquaculture is one part of Faculty of Biology.

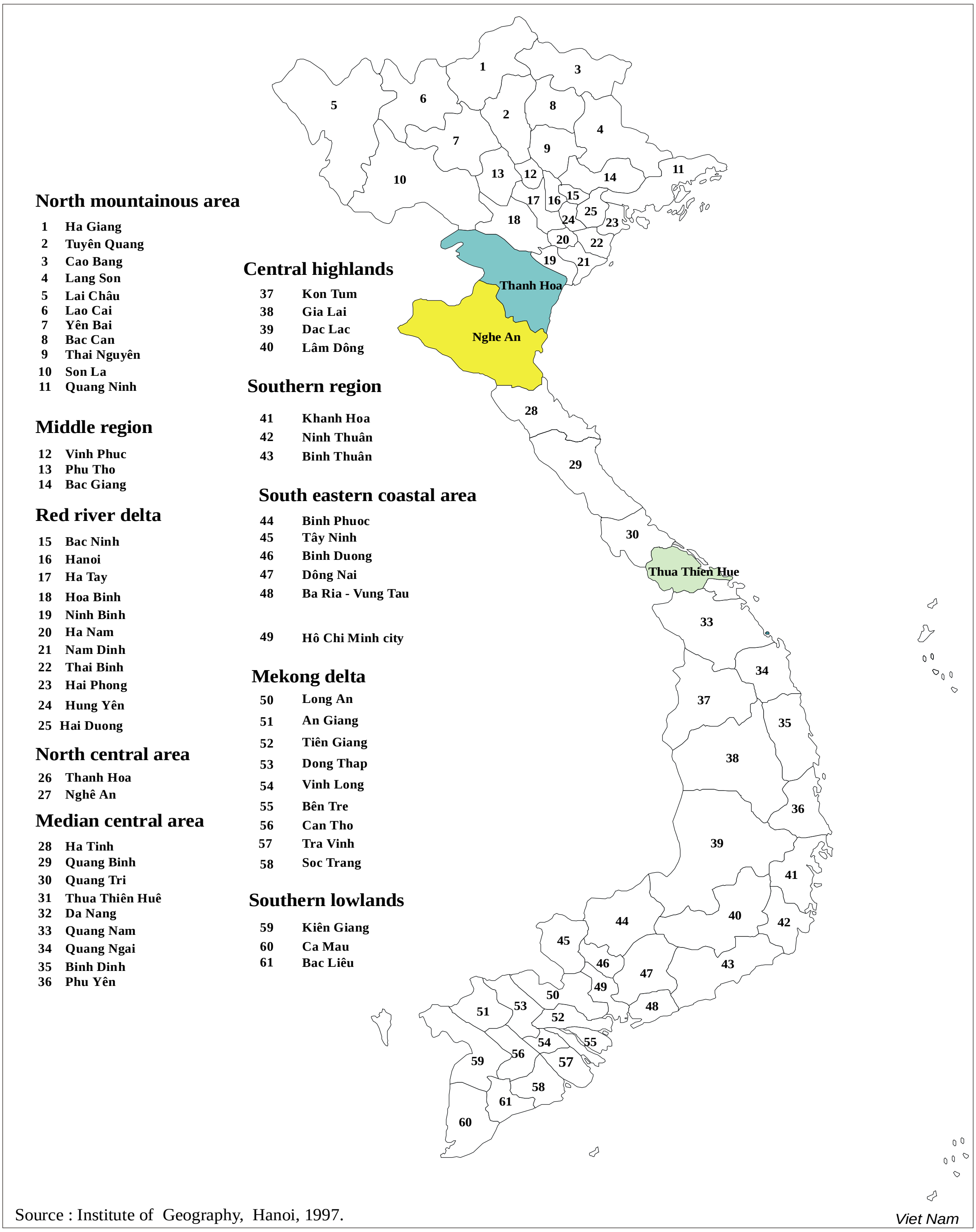
- Hue Agro-Forestry (HAF) also started training in aquaculture since 1994 under Faculty of Animal Husbandry. Up to now, 62 regular BSc. were graduated from HAF and 117 students are studying there.
- University of Fisheries (UoF), Nhatrang is the most important training institutions for human resource development for aquaculture in Vietnam. It is also have a longest history in aquaculture training and it is the one that trains at BSc., MSc., and PhD levels. Since 1959, through 40 years of training, 1531 regular BSc. in which 950 BSc. graduated before 1989 and 581 BSc. graduated after 1989. Beside of the number of regular BSc., 390 in-service and 209 open BSc. were also trained there. For the last 10 years, 5 PhD. were graduated from UoF (in which 3 persons are UoF persons). Five post-graduate courses were finished with 64 MSc. and two more MSc. courses are still going on.
- Faculty of Fisheries, (CAF)Ho Chi Minh city. Since 1974 FoF HCMC was established and through 25 years 1483 BSc. were graduated (in which 587 were before 1989). In this academic year, 125 regular students and 8 in-service students are studying at CAF. Beside of BSc. education, from 1999 CAF is permitted in MSc.
- Faculty of Fisheries, Cantho University (CTU). For the last 20 years, up to 1997, FoF CTU has trained 994 BSc. of Aquaculture providing human resources for Mekong delta (MRD) areas. According to CTU in 1997, about 450 - 500 graduated students from CTU alumni are working in MRD areas.
- Vocational Fisheries College No.IV (VFC-4) involving in aquaculture education and training from 1965 at vocational level. Since 1994 VFC-4 started to training Part-time BSc. of Aquaculture. After 35 years of training nearly 2000 aquaculture vocational students and 106 in-service BSc. student and 417 long-term aquaculture training workers graduated from VFC-4.
- Vocational Fisheries College No.II (VFC2) started training in 1997 at vocational level, infrequently small number of Vocation aquaculture students were graduated there.

Table 1: Year of establishment of the institution and started training in aquaculture.

Training institutions	Year of foundation	Year of started training Aqua
RIA-1	1963	1994
RIMP	1975	1994
HAF	1967	1994
UV	1959	1994
VFC4	1962	1965
VFC-TH	1966	1990
CAF	1944	1974
VFC2	1986	1987
UoF	1959	1959

Present PhD Education

Ph.D. education in aquaculture can be conducted only by Nha trang University of Fisheries and Hai Phong Research Institute of Marine Products. Hanoi University is permitted to provide PhD training in Ichthyology or Fish biology while Institute of Oceanography is permitted to do so in Marine Biology. RIA-1 is collaborating with UoF and Hanoi Agriculture University in PhD. education so in 2000 RIA-1 will start recruiting annually 1-2 Ph.D. students in aquaculture or related fields.



Map of Vietnam

Present MSc.Education

MSc. education has been available since early nineties. Presently, UoF and College of Agriculture and Forestry (CAF) are officially permitted to conduct MSc. program on aquaculture. The same situation with Ph.D., RIA-1 this year is conducting the second MSc. batch under the NORAD financial support. The first MSc. batch was also conducted in Can tho university in middle of nineties. The two batches (10 students) under the NUFU financial support have been conducted in UoF. Up to date, about 45 MSc. students have been graduated at UoF, Can tho University and RIA-1. Although, regular base of MSc. is given to UoF and CAF, nevertheless, not every year these universities are able to fill the places available, and has resulted in the cancellation of some MSc. program.

Present BSc. Education

Annually, about 220-250 new students are entering to aquaculture faculty at different universities. This formal education lasts 4.0-4.5 years in the universities and research institute. Meantime, some fifty-sixty students are entering to BSc. program in sandwich form in vocation school such as VFC 4.

Present Technician Training

Technicians are trained by two vocational schools No 2 and 4 that are located in Ho Chi Minh city and Bac ninh province. However, registry number for such training is very limited. The local school in Thanh hoa is also conducting such technical training for mainly local people.

Present Other Training (duration one month onward)

On the job and skill training programs are conducted by the vocational schools for young students under funding support of the government. Every year 5-8 batches are conducted in the provinces for the young of the rural areas. The vocation schools often make plan based on request of the provinces and apply for funding.

Table 2: Training level in aquaculture (biology in case of PhD)

Training institutions	Skill/job	Technician	BSc.	MSc.	PhD.
RIA-1	-	-	✔	✔	-
RIMP	-	-	-	-	✔
HAF	-	-	✔	-	-
UV	-	-	✔	-	-
VFC4	✔	✔	✔ (Sand.)	-	-
VFC-TH		✔	-	-	-
CAF	-	✔	✔	✔	-
VFC2	✔	-	-	-	-
UoF	-	✔	✔	✔	✔

Table 3. Priority ranking of activities related to aquaculture

Training institutions	Training	Research	Extension
RIA-1	3	1	2
RIMP	2	1	3
HAF	1	2	3
UV	1	2	3
VFC4	1	3	2
VFC-TH	1	-	-
FoF-HCMC	1	2	3
VFC2	1	3	2
UoF	1	-	-

Note: Value 1, 2, 3 denote level of priority

Assessment/Notes

- The general note is that except UoF, CAF and vocation school which have had a longer life, other education and training institutions are quite new.
- Looking at education and training degrees, it impresses that while BSc. education is widely spread out through country and in a numbers of institutions, the lower training levels as technical, and skill/on the job training are very limited. This indicates that the system is not in harmony with the industry in terms of structure and lower training level needed.
- While, the country needs also a large number of MSc. and PhD staff to work in universities, research institutes and in the provinces with high potential for aquaculture. The MSc. and PhD. education at this stage is much in ad-hoc nature rather than in regular base. This is explained that the costs of MSc. and PhD. education are to high for the most of applicants.

Capacity/Infrastructure of Education and Training System

Present Teaching Capacity

The human resource of all universities and research institutes involved with aquaculture education has been improved for the last decade in both number of staff and qualified professional staff (MSc, PhD). Before 1989, the number of the qualified staff (MSc., PhD) was accounted very few in each faculty of fisheries (Can tho University and College of Agriculture and Forestry HCM) and even in university of Fisheries, Nha trang. Presently, the qualified staff are dominant among the professional and support staff of the faculty (table 4, 5).

Table 4: Human resource (capacity)

Training institutions	Total No. of people	Management staff	Lecturers	Support staff	Research-teaching staff
RIA-1	22	3	-	2	17
RIMP*	136	-	97	35	4
HAF	12	2	8	2	-
UV	36	3	25	8	15
VFC4	62	9	28	25	0
VFC-TH	34	2	23	9	5
CAF	27	4	21	2	0
VFC2	4	0	4	0	0
UoF	27	3	23	1	0

(*) Here the number is nearly all of the RIMP staff who could involve in education and training. Otherwise, RIMP only train PhD. level. In fact, only 22 people are involving in PhD. education.

Table 5: Number of lecturers by educational level

Institutions	PhD	MSc.	BSc.	Invited teachers
UoF	8	11	5	24 PhD
CAF	2	11	8	12
HAF	-	1	8	17
UV	12	11	5	8
RIA-1	8	3	8	15
VFC4	-	5	23	
VFCTH	-	-	23	
VFC2	-	-	4	
CTU	1	15	7	

However, a number of high qualified staff who have PhD. in the most of the universities is still very low compared with the needs. It is explained while a number of invited teachers are high and in many cases are dominant.

Present Infrastructure

The data in the Table 7 demonstrate the practical base, which can be use for student practices. In fact, all education institutions including research institute have quite good stations for field practices. On contrary, the vocation schools, where the students should have good conditions for skill training, are often lack of necessary conditions for practices.

Table 7: Practical sites of the training institution

Training institution	Name of farm	Square (ha)	Main equipment
RIMP	1. Brackish water aquaculture 2. Marine aquaculture	38.845 0.125	
RIA1	1. Brackish water aquaculture 1& hatchery 2. Brackish water area and hatchery for marine fishes 3. Melinh fresh water aqua. 4. H.Q. farm	3 ha 12 ha 8.0	
UoF	Haison Fresh water aqua. Living aquatic animal	4.4 6.0	
VFC4	1. Practical farm	0.48	
CAF HCMC	Old practical farm New Practical farm	0.5 2.8	
Can tho University	Campus station Omon Freshwater Research & Extension Station Bac lieu brackishwater Research & Extension station Long phu brackishwater experimental station Vinh chau brackishwater experimental station	1.5 1.5 6.5 30.0 15.0	

Relating to library, besides the research institutes, which have quite wide range of research monographs and proceedings in foreign languages, the education institutions are in shortage of the reference books or at least not enough literature for students. The number of magazines/journals as well as books in Vietnamese are also very limited.

There are a lot of books, monographs in the research institutes in Russian and Chinese languages, which were bought some years ago. Presently, these books are less in use due to limitation of the researchers obtaining these languages.

Table 8: Library and number of book available

Training institutions	Foreign language book	Vietnamese book	Foreign magazine	Vietnamese magazine	Vietnamese
RIA-1	130 (2300 *)	80	80	17	10
RIMP	2591		2573		-
HAF	30	470	-	3	12
UV	-	85	-	-	-
VFC4	79	8913	-	-	-
VFC-TH	-	20	-	-	-
CAF	342	1298	5	5	12
VFC2	-	-	-	-	-

* the books in Russian and Chinese

Present Training Facilities/Base

Table 9: Labs and facilities

Training institutions	Name of Lab	Area(m^2)	The main equipment
RIA-1	1. Environmental Lab. 2. Aquatic disease Lab. 3. Biological Lab. and Fish Museum	43,5 43,5 68	
RIMP	1. Marine Resources Lab. 2. Environment Lab. 3. Fisheries Lab. 4. Fishery Processing Lab. 5. Aquaculture Lab. 6. Seaweed Lab.	- - - - - -	
HAF	1. Disease Lab. 2. General Lab.	16 20	
UV	1. Aquatic botany 2. Aquatic physical - chemical Lab. 3. Animal - Physiological Lab. 4. Genetics & Micro organisms	24 24 24 24	
VFC4	1. Chemical Lab. 2. Aquatic animal Lab. 3. Fish classifiable Lab	60 70 70	
VFC-TH	1. General Lab.	30	
FoF - HCMC	1. Aquatic chemical and biological Lab. Aquatic Ichthyological Lab. Micro Organism and Processing Feed and Feeding	54 54 54 54	
VFC2	1. Biological and chemical Lab.	48	
UoF	Environment and Disease Biological Lab.		
Can tho University	Disease of aquatic animal lab Fish nutrition and feeding lab Water quality analysis and management lab		

Generally, the universities as well as vocation schools are still facing with problems of lab facilities for practice and exercise of the students. The research institutes seem to be better because there are research labs that partly students can use for their studies especially for MSc. and PhD.

education. Although it is not indicated the available facilities and equipment in the faculty labs, but it is impressed that the new facilities and equipment serving for student practice are inadequate in most of the education institutions (Table 9). In UoF there are some model equipment for basic research but the constraint is that there is not enough funding for running and maintenance. Lack of funding resources for carrying out the research serving for training and education is occurred in all education institutions.

Table 10: Teaching support facilities

Training institutions	Over head	Slide project	Television	Video	Computer
RIA-1	2	1	1	1	16
RIMP	1	1	1	1	1
HAF	1	1	1	1	1
UV	1	1	1	1	1
VFC4	10	2	3	3	45
VFC-TH	-	-	-	-	-
CAF	3	2	1	1	15
VFC2	-	-	-	-	-
UoF	1	1	1	-	1

Relating to teaching facilities, it seems that most of the institutions have poorly (inadequate) teaching facilities except VFC4 (Table 10). This may reflect on what is calling traditional teaching methodology in which the teacher prefers to read lecture. Unbalance of investment of teaching facilities is seen between vocation school and universities. The Vocation School has more computers than the universities do. There is no information on how to use these teaching facilities for lecture. However, it impresses that visual materials are not in use or at least very seldom. Auditorium hour seems to be use for the teacher to talk and student to listen.

Assessment/Notes

Although, there is great progress in human resource development in all education and training institutions, inadequacy of qualified teacher with higher degrees is still a big issue that constraints education quality. The lack of practical base of the vocation schools and poor equipment and facilities of the labs and poor teaching facilities in the most of universities obviously, negatively impact on quality of education and in some extend frustrate on knowledge and practical skill of the students. Low service capacity of the library of the universities and lack of information exchanges and poor scientific literature and journals for reference will cause the student on narrow outlook of development as well as limit their initiation.

Education and Training Operation

Curriculum Structure of BSc.

In the first period of one and half years, the fundamental science subjects are taught in all faculties having the same biology nature. For example, the subjects taught at the Biology faculty of all universities, at faculty of Animal Husbandry, at faculty of Crops and Plan Protection of all Agriculture Universities are similar.

After the third semester, the curriculum for qualification of each institute differs from the others depending on the need and focus. In the previous period (before 1990), the curriculum was not so much changed time by time and very technologically and basically oriented. Recently, there are some changes found in the UoF, CAF aiming at wider perspectives of the development. The balance between environment/resource and socio-economic and technological subjects has been seen as tendency of curriculum development in the most institutions. Four months of skill-practice in freshwater and brackish-water aquaculture as well as 6 months thesis practice for the last 2.5 years are considered as standard practice ratio in most institutes.

Present BSc. Course Structure

The course structure of BSc. subjects is similar in the most institutions. 25-35 % of the teaching time is used for lab. and field practices (Table 11). It is more meaningful because each lab and field practice hour is accounted a half of the lecture time. In vocation schools the time for practice little bit higher but still a lot for lecture. This is the main constraint since the vocation school is aiming at on-job and skill training.

The training course structure is differs from institution to institution and it is given in Table 11.

Table 11: Course structure balance

Institutions	Level	Theory (%)	In Lab. Practice (%)	Field practice (%)
RIA-1	Regular BSc.	75	12	13
	MSc.	70	15	15
VFCTH	Vocation	75	8	17
	Part time BSc.	75	7.5	17.5
VFC4	Vocation	60	5	35
	Part time BSc.	70	5	25
CAF	Higher	72	12	16
	Regular BSc.	73.5	14.8	11.7
	Part time BSc.	75	14	11
	MSc.	84.4	4.5	11.1
VFC2	Vocation	60	13	27
HAF	Regular BSc.	60	20	20
UV	Regular BSc.	70	5	25

Assessment/Notes

The changes in curriculum for qualification has been seen with wider perspective and less technological orientation. The subjects on environment, resources and socio-economic are balanced in the most BSc. program. Course structure is seen as the government standard in which the ratio between lecture and lab with field practices is 3:1 in percentage, but calculated in hour time it is about 3:2. Nevertheless, the practice time in the school is still not sufficient, since this should be focus on more skill training.

Quantity and Quality of Student

Entry Examination Registry of Students for BSc.

In fact, the registry number to aquaculture faculty or aquaculture qualification is much higher than the number of admitted students because each student is permitted to register and take examination at two - three universities. In order to secure the possibility to enter to university, each student maximizes their opportunity by taking an entry examination at two/three universities. That's why the registry number is often high.

Entry Criteria for Aquaculture

Although the entry marks of the universities changed from year to year, depending on selected number, but generally it is noted that the quality of the entered students is not very high compared with the other faculties. Usually, entry marks of the aquaculture faculty or aquaculture qualification is one of the lowest compared with the equal subjects such as biology in the universities, crop sciences and animal husbandry in the agriculture university. In some years, the standard marks have to be reduced in order to increase the number of selected students. This is explained that either aquaculture is not attractive enough or poorly introduced to the school students. Usually, if the student is admitted into two/three universities after entry examination, the first choice is not aquaculture.

Number of BSc. Students: i/Formal; and ii/Informal (Open Form) in Aquaculture

During the last 10 years, number of BSc.students and graduates from all universities has been increasing. The number of the universities conducting BSc. program has been added from three to six. It indicates that the need in aquaculture is increasing. Nevertheless, the number of students in two main universities (UoF and CAF) does not seem to be increased. In some extend, this number is decreased.

On the other hand, while asked the provinces Department of Agriculture and Rural development, it was told that there was a need of qualified aquaculturists. In fact there is shortage but not easy to be recruited to DARD/DOF for working due to government policies (reduction of the permanent staff), low salary etc.

Data from table 12 clearly shows unbalanced number of education levels. More attractive level is BSc., while lower level (vocation/technician and between BSc. and vocation level) practically is not interested among the applicants. This is caused by several reasons of which employment and salary are the main of selection.

Table 12: Number of students registered to study in aquaculture by training level and training institutions in last ten years.

	90	91	92	93	94	95	96	97	98	99
PhD level										
RIMP	-	-	-	-	5	-	-	5	-	-
UoF	-	-	-	-	-	4	1	-	-	-
MSc										
* RIA-1	-	-	-	-	-	-	-	12	-	11
* UoF	-	-	-	-	6	20				
Regular BSc.										
*UV	-	-	-	-	-	-	-	43	63	52
*HAF	-	-	-	-	25	18	20	39	38	40
*RIA-1	-	-	-	-	25	25	22	22	-	25
* CAF	85	86	90	52	63	59	39	27	-	-
* UoF	160	193	219	347	364	476	391	303	450	309
Sandwich BSc.										
* VFC4	-	-	-	70	58	-	-	68	45	-
* CAF HCMC	-	-	-	-	-	-	-	8	-	-
* UoF	-	-	-	31	26	26	24	-	-	-
* VFCTH	-	-	-	-	45	-	-	-	-	-
Open BSc.										
UV	-	-	59	25	19	35	81	-	-	-
UoF	60	30	30	-	-	-	-	-	-	-
Higher (between BSc. and vocation)										
* FoF HCMC	16	-	-	-	-	-	-	-	-	-
* UoF	-	-	-	-	-	26	26	20	-	-
Vocational level										
VFC4	21	17	34	34	37	22	31	34	39	30
VFCTH	45	-	-	-	-	-	-	-	-	-
VFC2	44	-	-	-	-	20	9	17		

UoF. Total of the students in the faculty.

Primary Assessment of Teachers in Faculty on Quality of the Entry Students

There is not enough information about quality of the entry students assessed by the teachers. However, it is impressed that students of the last years have better preparation and background compared with previous generations. Especially, present students have better prepared in foreign languages, computer science. They adapt quicker to new conditions and have broader knowledge. This own richer information sources, better education conditions including teaching materials, textbooks, and other access to education. However, endeavor to work and studies does not seem to be compared with the previous student generations. The students often do not like to practice in the fields where they seem these are not prosperous. For example, students do not like to work with small scale aquaculture or devote for research. They like to work in the fields where in the future they can earn better for example dealing with shrimp hatchery, shrimp culture etc.

Table 13: Number of students graduated in aquaculture by training level and training institutions in last ten years.

	90	91	92	93	94	95	96	97	98	99
PhD level										
RIMP	-	-	-	-	-	-	5	-	-	-
UoF	-	-	-	-	-	-	-	4	1	-
MSc										
* RIA-1	-	-	-	-	-	-	-	-	-	12
* UoF	-	-	-	-	-	-	5	-	20	-
Regular BSc.										
*UV	-	-	-	-	-	-	-	-	-	-
*HAF	-	-	-	-	-	-	-	25	17	20
*RIA-1	-	-	-	-	-	-	-	25	25	22
* CAF	31	40	35	46	67	79	80	90	53	59
* UoF	29	23	23	30	44	43	84	65	108	-
Part time BSc.										
* VFC4	-	-	-	-	-	-	-	58	48	-
* CAF	-	-	-	10	-	-	-	-	-	-
* UoF	-	-	-	-	-	-	24	-	-	-
* VFCTH	-	-	-	-	-	-	-	-	-	37
Open BSc.										
UV	-	-	-	-	-	59	25	19	35	81
UoF	1	-	23	-	-	-	-	-	-	-
Higher (between BSc. and vocation)										
* CAF	-	-	-	16	-	-	-	-	-	-
* UoF	-	-	-	-	-	-	-	24	-	-
Vocational level										
VFC4	28	26	20	15	33	26	26	18	25	-
VFCTH	-	-	42	-	-	-	-	-	-	-
VFC2	-	-	44	-	-	-	-	17	9	

*** Case of CAF, the data indicated an annual graduated students, but not all qualified on aquaculture. Some are qualified on processing.*

The graduated number of the students of different level again indicates unbalanced situation in whole education and training system in Vietnam. The educated number of vocational and higher level is much less than BSc. level has impacted on lack of the skill technical working in a field. In many provinces there is no technical workers and skill technicians while some BSc. are recruited to work in the government agencies. On the other hand, government policy is focusing on recruitment of the BSc. but technicians also poorly impacting on the educational and training system. The other note is that all education and training system in aquaculture is located in lowland and coastal. No vocation schools and universities are located in the mountain. This is resulted in poor human resources in these provinces.

Attractive Factors for Students to Enter to Aquaculture

Although knowing that work in aquaculture is not generating high income, but some still expect that in specific area such as shrimp culture may be an opportunity for getting higher income compared with other qualifications.

Table 14: How to attract high quality students enter to aquaculture (this is the response from the user)

	North highland	Red river	Coastal	South East
(1)	21 (29.6)	33 (82.5)	113 (66.9)	47 (45.2)
(2)	14 (19.7)	30 (75.0)	66 (39.1)	28 (26.9)
(3)	-	3 (7.5)	11 (6.5)	20 (19.2)
(4)	14 (19.7)	16 (40.0)	64 (37.9)	21 (20.2)
(5)	26 (36.6)	19 (47.5)	66 (39.1)	15 (14.4)
(6)	13 (18.3)	7 (17.5)	50 (29.6)	14 (13.5)
(7)	-	-	4 (2.4)	1 (1.0)

1. Higher income
2. Better working conditions
3. Better opportunities
4. More opportunities for higher education
5. Have more concern from local Authorities
6. Prior policies for women
7. Others

Depending on the geographical location, the high income and better working conditions are still the main factors to attract to students to enter to BSc. on aquaculture. Two other factors are opportunity for higher education and the authorities also encouraging students to enter to aquaculture. A very low percentage of graduates gave an emphasis on work promotion (Table 14), a common psychology of the most of students. That’s why more students try to enter to the college or universities where they expect to get more income, such as business administration, computer sciences, foreign trade etc. Within aquaculture, more students like to be qualified in brackishwater and shrimp culture rather than in freshwater aquaculture. This is because that working in shrimp and brackish water aquaculture, the graduants may get much better income compared with other jobs. A considerable number (19.7-40.0%) of the students decide to enter to aquaculture due to the easier opportunity to get bachelor degree. These students after graduation often try to find other jobs rather than work in aquaculture.

Assessment/Notes

Quality of entry student on aquaculture is not high as relevant qualification in the other universities. However, the number of BSc. student in aquaculture is increasing.

Present student has better preparation and wider knowledge in all aspects. High income and good working conditions are the main factors to attract the applicants to aquaculture.

Quality of Graduated BSc.

Primary Assessment of Teacher/Users on Quality of the Educated Students

According to assessment criteria of the universities and vocational schools, the rate of good and excellent students is ranged from university to university. It is noted that the newly established BSc. Program often has higher percentage of good and excellent rate and it is over 50 %. For example, rate of good and excellent of graduated students in RIA-1 ranges from 80-96 %, while in Hue Aquaculture Faculty, University of Vinh this figure are higher than 50 % (table 15). This rate of the vocational schools is much lower, except students from Vocation Fishery School 2 where this rate is ranged from 47-67 %.

Table 15. Quality of graduated student for last 5 years

Training Institutions	**Rate of good and excellent student**				
	1994	*1995*	*1996*	*1997*	*1998*
HAF	-	-	48	51	54
VFC4*	6.4	8.3	11.5	6.6	13.6
UV	75	65	50	68	65
VFCTH*	-	-	-	25	31
RIA-1	-	-	-	96	80
CAF	64.2	48.1	28.8	32.2	25.0
VFC2*	-	-	-	47.0	67.0

(*) For Vocational student

The users (farms, research institutes) are having quite same opinion that present students are more active and more involved with the development programs as well with private sector. On the other hand, students/graduants have wider knowledge on social-economic and environment compared with the previous. The previous students were technically oriented and mainly focused on technologies, while present students have better knowledge on market and easy changing their direction in case necessary or better choice event it is not related to aquaculture.

Student Assessment on Appropriateness of Curriculum

While most of the students are concerning that the present curriculum is reasonable (Table 16). Only 52.6 % students from RIA-1 and 61.9 % students from FVS No 4 considered the present curriculum as good. More than 23 % of CAF students and 31% of Hue University students negatively responded on appropriateness of the taught curriculum.

Table 16: Feeling of the student about training program

Training institutions	Feelings			
	Good	**Reasonable**	**Not good**	**No Idea**
RIA No.I (19)	52.6	47.4	-	-
HAF (29)	6.9	62.1	10.3	20.7
UV (21)	23.8	66.7	-	6.5
FVS No. 4 (21)	61.9	33.3	4.8	-
FVSTH (20)	25.0	75.0	-	-
CAF (65)	7.7	69.2	12.3	10.8
VFC2 (10)	10.0	90.0	-	-

Percentage of Educated Students Having Jobs Within 5 Years

Table 17: Getting job opportunity of the student after graduation

Training Institutions	Rate of student have job after graduation (% of the total graduate)									
	1994		*1995*		*1996*		*1997*		*1998*	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
CAF	70	30	70	30	70	30	70	30	70	30
VFC2	-	-	-	-	-	-	58	20	67	-
RIA1							96	4	100	-
VFC4	80	20	50	50	80	20	60	40	45	55
HAF							70	30	65	35

1. In aquaculture /fisheries sector
2. Out of aquaculture sector

The rate of graduated students having a job is quite high although a part from them are working in other sectors rather than aquaculture (Table 17). This indicates that there is still great need on aquaculture qualification, although there is limitation of the government regulation on recruitment of the new staff. There is a note that the graduants from the university have better opportunity to get a job compared with the graduants from the Vocational School.

Assessment/Notes

The quality of presently graduated is better compared with previous generations. The rate of student having a job is high, however, the rate of student working for other job is considerable.

Needs in Capacity Building and Curriculum Development

Main Constraints

The education system for aquaculture does not seem to be harmony. Although, the number of B.Sc. student is reasonable for the country where potential for aquaculture development is huge and fishery sector is considered one of the priority area in the country economics.

Nevertheless, the training on technician level and on-job training seem to be limited. There are totally two vocation schools, which are unable to conduct enough number of the trainers for the country. On the other hand, geographical location of the universities and Vocational School in the education and training system does not seem to be appropriate. Of course, the BSc. is more less suitable, while the number of training schools are totally inadequate. Habilitation of the schools is also inappropriate. There is not any school in a huge potential area such as Mekong river delta or the similarity situation is seen in the mountain region in the north Vietnam.

The second point is that most of the universities and vocation schools have very poor labs and conditions for student practice. Therefore, quality educated and trained is poor and lack of experience.

The third is that although present curriculum of the most universities has been improved and changed, the curriculum needs in continued development process that can meet rapid development.

Human capacity of the universities and vocation school is also the issue to be addressed. The faculty of Fisheries of CAF, Cantho University, Hue agriculture university are faced with the mentioned problem. The vocation school No 4 while there are more less 600-700 students, only 28 teachers are responsible for teaching.

Needs in Capacity Improvement

Obviously, there is an urgent need on improvement of capacity of education institutions. The above analysis clearly illustrates that in all aspects, the education institutions are far to meet the demand. In one, this issue may be human capacity, in others may be teaching facilities or experiment base, infrastructure etc. Rehabilitation of education and training system is required. Especially, education and training of low level are required to improve. The number of Vocational Schools need to be increased with the focus in Mekong delta, in mountainous.

Human Resource Development

The universities such as Cantho, College of Agriculture and Forestry, Hue are requested to have more number of teachers having higher education level (PhD.) while the vocation schools need to have more MSc. level. Other universities such as Nha trang, and others have fairly number of the teachers with degrees, however, there is a need of exchange with other international universities on experiences in teaching and scientific knowledge.

Need in Development of Facilities for Education and Practice

Lab facilities for student practice of most education institutions are poor or old of date. In some institutes such as Can tho University, the practice facilities seem better own the international support project funded by Netherlands. There is a need for improving not only practical facilities (especially water quality analysis, biology) but also number of labs, aquatic diseases, genetic selection, biochemistry, etc. in most of the universities and institutions for BSc. and MSc. students. While the vocation schools should have more field facilities and field practical base for student daily job practice.

Need in Development of Practical/Experimental Base

The institutions with BSc. education level have their practical /experimental base. Besides, the institutions always collaborate with the provincial hatcheries and farms for the student practices especially course and thesis placement. Meantime, the vocation schools do not have enough practical base for daily field practices and improvement of skill. This becomes crucial since vocational training level should be focused more in skill or on-job training.

Needs in Curriculum Development

Need in Appropriate Curriculum

Presently, main institutions such as UoF, RIA-1, Cantho University, Faculty of Fisheries, CAF regularly revise their curriculum to improve it and fit it in development context. The revised curriculum in some extend has reflected the need of development in a region. In these regards, the revised curriculum should cover wide subjects of different fields in socio-economics, environment, and technologies.

Need of exchange of information on curriculum with other institutes/countries

All kind of information including teaching methods, experiences, technical and scientific literature are subjects for exchange between national and international level.

Need of Exchange of Experience

Experiences in teaching and learning are also will be useful for many universities and vocation schools. Experiences of building institution capacity and development of curriculum can be subjects for exchange.

Networking of National Institutions

Needs in Collaboration With Other National Institutions

The collaboration with the other national institutions in aquaculture training and education is required in order to improve exchange of information flows of teaching and learning experiences, curriculum development, research and library.

Needs in Regional Collaboration

The regional and international collaboration is needed to improve teaching/ learning experiences and methodology as well as increase information flows. The collaboration also required for helping the country to build human resources in aquaculture. Out of this, the regional/international collaboration will also provide opportunity to gain from the other country technical and scientific knowledge in aquaculture and related fields.

Annex D7: Aquaculture Curriculum Development in South Vietnam: A Case Study from the Collaboration between Faculty of Fisheries University of Agriculture and Forestry and the AARM Field of Study, Asian Institute of Technology

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Abstract

The development of an aquaculture curriculum has to be viewed from a holistic point of view encompassing the national and regional sector needs. It is crucial to look at the institutional set-up and capacity in the development process. Educational objectives and purposes constitute the main framework from which course development can take off. These have to take root in an educational need analysis. The AIT-UAF collaborative Project on aquaculture curriculum development works on participatory principles, which encourage ownership feeling and responsibility. The effect of the educational improvement and the HRD is clearly recognizable at the institutional level but the wider impact may yet take years to assess.

Introduction

The University of Agriculture and Forestry (UAF) is located in Thu Duc district in the suburbs of Ho Chi Minh City. It is member of the Ho Chi Minh City National University (NU-HCMC). UAF is the institute of tertiary education with specific responsibilities for serving agricultural development in the areas of the eastern part of Southern Vietnam, the southern part of Central Vietnam and the western Highland region.

The University has presently about 4000 students enrolled in eight Bachelor degree programs, including Agronomy, Animal Science, Veterinary Medicine, Forestry, **Fishery,** Agriculture Engineering, Agriculture and Forestry Economics, Processing and Preservation of Agricultural Products. Presently the University has about 350 staff.

The Faculty of Fisheries (FoF) officially became one of the faculties of UAF in 1974. The FoF was set up to train B.Sc. students with three major disciplines in the field of fisheries, respectively Aquaculture, Fish Processing and Fishing Technology. In 1975 the Faculty narrowed its profile of specialization to aquaculture. However, the main subjects of aquaculture and fish processing were brought together for the integrated approach in fisheries education.

Apart from training of personnel in the field of fisheries, the Faculty has also carried out research and extension services for public and private sectors in the southeast provinces of Southern

Vietnam. The three primary functions and activities are however, teaching, research and extension to meet the regional need of the fisheries sector.

The Faculty of Fisheries has a staff of 21 academic lectures and one lab supervisor. Of the academic lectures two are holding a Ph.D. degree, ten of them have a Master Science degree and nine are holding a Bachelor Science degree.

The present paper is a case study from the collaboration between Faculty of Fisheries of UAF and the Aquaculture and Aquatic Resources Management (AARM) Field of Study of the Asian Institute of Technology, Thailand.

Formal collaboration between UAF and AIT began with the signing of a three-year memorandum of understanding (MoU) in March 1994 followed by a second MoU signed in May 1999. Both MoUs were largely based on the Danida and Sida support to the AIT Aqua Outreach Program[2]. The outputs listed in the MoUs constitute the framework for the day-to-day work with the Faculty of Fisheries of UAF.

The aim of the collaboration and memorandum seeks to address two main components: **a)** issues related to the development and management of aquatic resources in south-eastern Vietnam and sector policy; **b)** issues relating to the supportive educational services and strengthening of local institutions.

This paper mainly cover the work and progress outlined under b – focusing on educational strengthening of the aquaculture services at the Faculty of Fisheries, UAF.

Capacity Building and Curriculum Development

The method of the curriculum development at the Faculty of Fisheries takes on a holistic approach, which implies that, several areas are subject to improvement or revision at the same time in order to achieve the development objectives[3].

The Danida component of the collaboration with UAF focuses on curriculum development in the broader context with ample considerations to both *curricula* and *capacity building.* Figure 1 below depicts the elements of the wider curriculum development effort including capacity building, supportive environment and human resources market. The supportive environment - in the context

[2] The Aqua Outreach Program is an integrated part of the AARM Field of Study of AIT. It is now termed AARM FoS

of the figure below - comprises government policies and strategies, institutional linkages etc. The human resources market implies needs of graduate users in terms of quantity and quality. The present case study, however, focuses only on the capacity building and curriculum development in terms of course structure and syllabus.

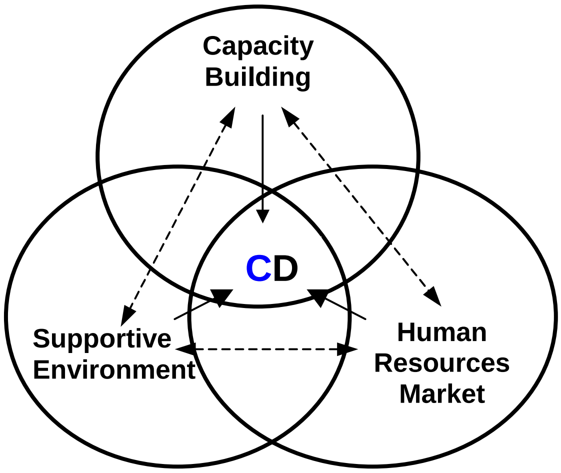

Figure 1: The holistic approach to curriculum development at Faculty of Fisheries, University of Agriculture and Forestry, HCMC.

The B.Sc. degree training was and is seen as the core object for CD assistance. In early 1995 an initial workshop on the B.Sc. program of the Faculty of Fisheries was arranged to set out directions for revisions in accordance with objectives and purposes and to include content of more local and regional relevance.

In 1995, the specialized phase of the B.Sc. program consisted of 38 courses of total 145 credits distributed over the following six groups: General Education, Fishery Biology, Freshwater Aquaculture, Coastal Aquaculture, Aquatic Products Processing and Other Subjects. The structure has been modified and the courses for the second phase of the B.Sc. program are now made up of 33 courses with a total of 120 credits. *See Annex 1 to this paper for details*.

The work on curriculum improvement has involved writing up of lecture notes. It has had two purposes – a) to address the content in order to evaluate and compare the syllabus of the different courses and b) to provide inexpensive teaching materials to the students. The curriculum development effort has also looked at the production of relevant case studies to be fed into the curriculum and course teaching. Faculty of the AARM Program has supported this. The working

[3] The objective of the current MoU with FoF, UAF is "to upgrade the capacity of the Faculty of Fisheries to serve changing national demands for the sustainable development of the fisheries sector, with special emphasis on the management of aquatic resources systems in the southeast region of Vietnam on a long term basis."

methods for curriculum development inputs are usually conducted through workshops, seminars training sessions and meetings with the staff and faculty.

In 1999 the Faculty responded to a request to open a Master of Science program in Aquaculture as part of the Vietnamese governments efforts to upgrade the level of education generally. The M.Sc program in aquaculture at UAF comprises 26 courses including six selective courses. See Annex 2 to this paper for details on M.Sc courses.

The involvement of AIT-AARM in this process has included a faculty workshop to scrutinize the educational objective against the course composition and content. This work is ongoing with continuous revision of courses and content. Modest support to course teaching is also provided by AARM Faculty. The assistance aims to improve the course content and teaching methodology of the local staff.

On the road to improving aquaculture curriculum at FoF, a participatory approach has been applied in order to encourage ownership feeling and responsibility.

Laboratory Facilities

The Faculty has four 150 m^2 laboratories for hydrobiology, ichthyology, fish processing and aquaculture. As is the case from other institutions in Vietnam, government funds have and are very limited and laboratory equipment is often few and outdated. Parallel to the upgrading of the curriculum it was therefore deemed highly relevant to make an upgrading of the laboratory facilities to meet the demand for more practical oriented teaching. Based on funding from Danida and Sida the Faculty has received a number of equipment and facilities to carry out laboratory exercises and teaching, that meets modern requirements. These include inter-alia microscopes, pH meter, spectrophotometer, analytical balance and other laboratory equipment for water quality analysis.

Experimental Farm

Until 1999 the Faculty operated a small and somewhat defunct hatchery facility near the main building of the University. However, in 1996 the Faculty formulated plans to construct a new experimental farm accommodating a hatchery, a wet lab and pond facilities for use by student and staff for on-campus trials and experiments. With co-financial support from AIT/Danida and NU-HCMC the farm is now complete with twelve medium size (320 m^2) and two large ponds (1200 m^2) for nursing and grow out and 18 cement tanks for hatchery purposes.

The new farm complex adds a valuable and qualitative dimension to the teaching of aquaculture courses at the Faculty. It is now possible to conduct Faculty research and provide the students with facilities for special projects or experiments leading to thesis preparation. Also the day-to-day teaching is expected to change as the facility has fishponds and wet laboratory placed at convenient proximity to one another.

Apart from being a facility for the Faculty for educational purposes, plans are underway to establish income-generating activities like fish fry production and sale of quality broodstock.

Teaching Materials

In particular for the first phase of the UAF-AIT collaboration, attention was also directed towards the need for upgrading the Faculty's common and basic teaching materials and facilities like overhead projector, slide projector, camera and AV equipment for video screening and computers for writing up lecture notes, information material and general communication purposes, internet etc.

In connection with supply of teaching materials training sessions and seminars were arranged to ensure qualitative outputs from the acquired equipment. Training sessions for slide production and transparency production were arranged. Teaching methodology seminars were held. At this point it may be worth mentioning, that teaching equipment, which is normally considered a natural classroom inventory in a western educational institution, is not necessarily the case in the countries of the Indochina region. Moreover, the techniques of using AV based educational equipment may come easy to some, but most have to be trained in the proper use. After all correct use is crucial to the quality of the learning process.

Library and Information Upgrading

The library of an educational institution takes on a very important part of the educational process. This is particular so when considering the availability of information outside the classroom lecture. The AARM Program of AIT is witness to an often-absolute lack of tangible information for the students, beyond what they can grasp and note during classroom sessions.

As a response to this, funds through the UAF/AARM collaboration has been provided for a modest number of English textbooks and copies of Vietnamese books from libraries of other educational- and research institutions in Vietnam. Adding to this a room has been negotiated with the University administration and set up with tables, chairs, bookcases and a computer for cataloguing of the library resources. The library has also become an important meeting room for the staff of the Faculty and plans are to turn the library into a multimedia information center comprising much more diverse information than just ordinary textbooks.

Perhaps the most important contribution provided through the AARM-AIT Danida/Sida support to the Faculty of Fisheries is the human resources development of the staff. There are different means whereby this is achieved.

First to mention is the **formal training program** by which selected staff from the Faculty is awarded a scholarship for a M.Sc study at the AARM Field of Study of AIT. So far four staff have obtained a M.Sc degree at AIT since 1995; three are presently enrolled and one staff is following a Doctoral degree program as non-resident student.

The formal training provides the student with an internationally accredited Master or Doctoral degree conducted in English. They receive technical training, experience in research and development problems and they get contact to faculty and lifelong professional networks with students and alumni. It is often an eye opener to the outside world and the vast amount of information available from among others library resources, fellow colleague students and Faculty of the AARM program.

Secondly **short courses** are offered either through the Training and Consultancy Unit of the AARM Program or by other relevant institution in the region. Since 1995 twelve staffs have been trained in respectively Nile Tilapia production, Silver Barb production, Water Quality Management, Laboratory Management, Fish Disease, Coastal Aquaculture Management and Hatchery Management at AIT, Marine Fish Seed Production at SEAFDEC and Small-Scale Aquaculture Development at IIRR.

The short courses provides for technically focused training of duration less than one month.

Thirdly, **in-country training** of trainers has been conducted for 12 staff of the Faculty in 1996 in order to raise their training capacity. The objective being to support FoF staff to serve more directly the needs for training and information of provincial and district level staff working closely with farmers.

In country **training workshop** have also been held in aquaculture extension methodology, use of desktop publishing software and library management. Further, more than twenty **workshops and seminars** have been held over the last five years with the aim to revise course structure and content, improve teaching methodologies, identify research areas, appraise student requirements, add technical information or improve planning and management of the Faculty of Fisheries. Of interest might be worth mentioning the annual student and teacher research workshop, which facilitated by the AIT collaboration, gather students and teachers from several universities and research institutions in Vietnam to present student research papers and boost the aquaculture networking among institutions.

Finally, three **study tours** have been arranged for staff of FoF to Thailand in 1995 and '96 respectively and in-country (Southern Vietnam) in 1997.

Achievements

What are the measurable achievements gained so far from the AARM of AIT collaboration with the Faculty of Fisheries of UAF?

The collaboration between the FoF of UAF and the AARM FoS of AIT is still on going and therefore achievements at this stage will have to be seen in the context of a process. So far the overall curriculum development structure has been revised, the B.Sc. curriculum is constantly being improved and since December 1999 effort is being made to modify the structure and course content of the M.Sc program in aquaculture. In addition 12 short course modular training curricula have been developed for use with provincial staff. *See Annex 3 for details*.

Eight staff of the Faculty has received AIT scholarship including three presently enrolled at AIT and at least 33 staff persons have received training during Phase I and II. In addition innumerable staff persons have participated in workshops arranged in collaboration with the Project.

The confidence and skills of a large number of young teaching staff has been developed through a variety of training/research activities. The appreciation of revising course content in line with the need of national and local requirement with ample considerations to the students need has been enhanced.

Considerable improvement has been accomplished in the development of physical facilities for teaching and field practices. Computer facilities and software training has led to the tangible output of a newsletter regularly produced by the FoF with contributions from collaborating provinces. Lecture notes are now being written up on computer and revisions and distribution has taken a healthy step forward.

Conclusion

The AARM – AIT Project with FoF, University of Agriculture and Forestry follows a participatory approach in aquaculture curriculum development. The Danida funded component of the project is basically an educational project focusing on upgrading the human resources and institutional capacity to provide service to the aquatic sector in southeast Vietnam. The outputs set forth by the project documents and MoU are largely achieved. Although the process of capacity building is a long-term process the last five years effort has clearly strengthened the capacity of the FoF.

The wider impact on the aquatic sector is, however, complicated to verify at this stage. The training of human resources to support increased fish production, food supplies and incomes is a long-term goal, particularly in the context of degree training. More immediate impact may derive from non-formal training at provincial and district levels.

Then again the quality of non-formal training, the identification of the real need of the farmers, the teaching approaches applied, and the way information is communicated may best be achieved by support from a trained cadre of staff from local and regional institutions.

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Annex 1

UAF Courses
For the B.Sc. Program in Aquaculture

1	**English for Fisheries**
2	**Biochemistry**
3	**General Microbiology**
4	**General Genetics**
5	**Fisheries Extension Methods**
6	**Estuarine and Coastal Ecosystems**
7	**Food Microbiology**
8	**Biochemical Changes in Raw Aquatic Animal Material**
9	**Introduction to Fisheries**
10	**Aquatic Ecology**
11	**Water Quality in Aquaculture**
12	**Aquatic Botany**
13	**Aquatic Zoology**
14	**Ichthyology**
15	**Physiology of Fish and Crustaceans**
16	**Fish Nutrition and Feeding Technology**
17	**Fish Genetics and Selection**
18	**Aquaculture Engineering**
19	**Experimental Design**
20	**Fishing Technology**
21	**Freshwater Fish Culture**
22	**Brackishwater Fish Culture**
23	**Fish Artificial Propagation**
24	**Crustacean Culture**
25	**Mollusc Culture**
26	**Diseases of Fish and Shrimp**
27	**Aquatic Resources Conservation and Management**
28	**Aquaculture Economics**
29	**Aquaculture Farm Management**
30	**Aquatic Products Processing I & II**
31	**Ornamental Fish Culture**
32	**Specific Aquatic Organisms Culture**
33	**Water Quality Assessment**

Annex 2

UAF Courses
For the M.Sc Program in Aquaculture

	Fundamental Courses
1	**Philosophy**
2	**Informatics**
3	**English Language (Adv. Level)**
4	**Research Methodology**
5	**Teaching Methodology**
	Aquaculture Specific Courses
6	**Molecular Biology**
7	**Data Analysis Methods and Experimental Design in Aquaculture**
8	**Water Quality Management in Aquaculture**
9	**Fish Biology Study Methods**
10	**Advances in Fish and Shrimp Nutrition**
11	**Fish Breeding and Hatchery Management**
12	**Applied Genetics in Aquaculture**
13	**Fish Health Management**
14	**Inland Aquaculture Production Systems**
15	**Marine and Coastal Aquaculture Production Systems**
16	**Aquatic Resources Management and Conservation**
17	**Thesis Proposal**
	Economic and Rural Development Courses
18	**Planning and Evaluation of Fisheries Development Projects**
19	**Fisheries and Aquaculture Economics**
20	**Rural Development**
	Selective Courses
21	**Mangrove Ecology**
22	**Fish Processing Technology**
23	**Environmental Impact Assessment in Aquaculture**
24	**Seaweed Resources and Culture Techniques**
25	**Applied Bio-Technology in Aquaculture**
26	**Management of Investment Projects in Aquaculture**

Annex 3

UAF Courses

Curriculum of the Modular Training Program on ARM and D for Provincial Staff

1	**Introduction to Aquaculture**
2	**Farming System Research for Aquaculture Development**
3	**Aquatic Ecology and Water Quality for Aquaculture**
4	**Fish Biology**
5	**Natural Feed Development for Aquaculture**
6	**Freshwater Fish Culture**
7	**Fish Seed Production**
8	**Crustacean and Special Aquatic Organisms Culture**
9	**Fish and Shrimp Disease**
10	**Fisheries Extension Methods**
11	**Aquatic Resources Management**
12	**Aquaculture Economics and Marketing**

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Annex D8: Approaches in Regional Education and Aquatic Resources Sector, Southeast Asia

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Introduction and Abstract

AIT offers tertiary education to regional learners through enrolment of students at the regular academic programs at AIT in Thailand and through joint research and capacity building with national institutions. A component of the Aquaculture and Aquatic Resources Management (AARM) Field of Studies offers particular support to the strengthening of local universities and agricultural colleges in Southeast Asia working within the fisheries domain. An open and dynamic network of partner institutions has emerged on the basis of a shared development framework, where national constraints and local development needs in the aquaculture sector are addressed in a mutual learning approach.

AIT's role in regional education is highlighted as component of the advancement of tertiary national institutions and elements to success in addressing educational reform and development needs are provided.

Why HRD?

Social and economic factors are often perceived as major constraints in the development of a country. The realm of addressing these constraints is linked to the capacity of the national institutions and the qualifications of their personnel. Human resources development (HRD) is a key area as countries in Southeast Asia play a growing role in world economy and measures are implemented to improve living standards. In the name of progress and economic growth there is a need to educate still larger groups of people, ranging from the elite to large rural populations.

In economies dominated by the agricultural and fisheries sector, in which aquaculture belongs, there is a need to educate local officials, producers and farmers in the use of appropriate and environmentally friendly technologies to improve overall living conditions and secure the sustainable exploitation of existing natural resources. Human resources development through community partnerships, action research and informal and formal tertiary education is required to explore and develop feasible ways of managing the diverse inland aquatic resources and coastal areas of target countries.

Although, regional governments may have ambitious national plans for the fisheries sector, a number of apparent constraints exist. Among these, are the lack of adequate modern and applicable technologies, the general low qualifications of technical manpower and the limited capacity of the responsible institutions to meet changing requirements. It is becoming increasingly apparent that the availability of qualified lecturers at the educational institutions and officers with the provincial line agencies is a bottleneck to the implementation of development plans and the servicing of local needs.

In Vietnam, aquaculture plays a vital role, with annual production yields of almost 420,000 metric tons, equivalent to 24% of the country's total fish supply and almost half of export value of aquatic products (due to high proportion of farmed shrimp). Around half a million people are currently engaged in aquaculture enterprise and renewed attention has been given to fish cultivation as instrumental in the development of poor hinterlands and poverty eradication. New development goals set by the government strives at boosting production within the sector to 2.0 million tons by 2010. To cater for this sector expansion, a demand for 2,000 BSc and 6,000 vocational workers is estimated during the period. Since around half of graduates take up jobs within the sector, this will impose a major challenge to the eleven tertiary institutions and a larger number of lower level training centers, ultimately, responsible for future education and development of the sector (1).

Nationwide, a couple of hundred lecturers are responsible for aquaculture education, amongst whom 48% possess a post-graduate degree (mainly masters), 45% hold a bachelors (or equivalent) and the remaining hold a diploma degree. In the provincial line agencies, heads would typically hold a bachelor degree, while staff would hold a diploma. The lack of post-graduate lecturers, deficient infrastructure within the existing educational system and the general limitation of public budgets, are seen as major constraints in addressing provincial needs and implementing national policy. This has resulted in the immediate opening of post-graduate programs at several universities and an enforcement of in-service training programs for provincial staff of the Departments of Fisheries and Agriculture and Rural Development.

In Cambodia, a national task force on high education was established in 1996, which scrutinized agriculture education and the three tertiary institutions responsible for education in this sector. General recommendations were to align sector needs with curricula reform and introduce a national credit system that allows for wider flexibility. The current status of the academic staff involved in fisheries education is that around five teachers hold master degrees, of whom most are only part-time teachers since primary jobs outside the university are necessary to retain an acceptable living standard. Out of the remaining teachers at two of the lead institutions, 69% have a bachelor's degree and other 17% a diploma. Since the early nineties, a large donor community has provided substantial financial support to the development of the educational sector, though, mostly in the form of projects targeting specific areas at individual institutions (2, 3).

In the Lao PDR, three vocational colleges and the newly established national university are responsible for education in the agriculture and fisheries areas. Though these institutions all belong to the Ministry of Education, informal training in the fisheries domain is also provided by some line agencies under the Ministry of Agriculture and Forestry to better complement specific manpower requirements in areas related to rural development and local obligation.

In Thailand, vocational education is under reform. After the introduction of "education for life" with the agricultural colleges the recent trend is devolution of organizational structures, under which colleges either expand their interaction with the local community and are transferred to the provincial authorities or open bachelor degrees to obtain a position with the Ministry of University Affairs, which will be combined with the Ministry of Education anyway. While the first trend may serve to better address local development needs, the second trend may rather serve as step towards higher education. In both cases the development of human resources is at core and reforms to improve general educational standards should be seen in the context of the financial crisis that was offset in 1997.

AIT and it's Role in Regional Education

At present, AIT does not have a formal mandate to offer tertiary education at universities in the region, but has long been involved in partnerships with national educational institutions in Asia assisting them in their development of undergraduate degrees and curricula. In this regard, AIT has gained experience in Bangladesh, Pakistan and, recently, Vietnam, Cambodia and the Lao PDR. In this work, AIT´s expertise in regional development is a major asset, through which AIT faculty and associated professionals have established a working relation with a wide range of partner institutions, comprising research institutions, universities, government agencies and even the private sector, with funding support from development assistance agencies and/or the partner institutions themselves.

Among several initiatives, the Aquaculture and Aquatic Resources Management Field of Study (AARM) is to be highlighted here, with its clear development objective and regional institutional reach. AARM has the following mission: *" to improve the quality of life in Asia, with a focus on poverty and the environment. We are committed to Improving regional institutional capacity in aquaculture and aquatic resources management and related fields, through innovative approaches that integrate education, research and development " (4).*

Besides operating as an academic field of study providing regular diploma, MSc and doctorate courses, AARM has an extensive outreach service, in which country units were established in 1989, first in Northeastern Thailand and, from the early nineties, in the three countries of Indochina.

The formal objective in rural development and poverty alleviation is based on collaboration and capacity building with national institutions in planning and management of aquatic resources in general and aquaculture and rice-field fisheries, in particular. Thus, the direct beneficiaries are counterpart institutions, which improve their capacity to undertake teaching, training and research and effectively disseminate information relevant to improving rural livelihoods. In the development framework, resources, institutional mission and educational objectives are reassessed together with the local partner institution in a mutual learning approach, to serve as a basis for HRD and curriculum improvements, which are seen as corner stones in academic advancement. In this process, AIT specialists and external resource persons act as facilitators to promote and stimulate the genesis of local resources (5). Figure 1 (The Regional Curriculum Development Framework).

In regional education, AIT and AARM targets two distinct groups of learners, namely, the students enrolled in regular programs at AIT and regional learners who may benefit from AIT programs in a more in formal way or indirectly. The latter group consists of government officers, institute and provincial officers or personnel of other professions, who need short specific training, are unable to leave their job for extended periods or who do not meet AIT requirements in other regards.

AIT enrolment requirements are, besides a sponsor, an English language level equivalent to TOEFL and an academic degree equivalent to a BSc for post-graduate studies or a qualifying vocational degree for enrolment at diploma level. Modular training and distance learning approaches are being developed by AARM and regional partner institutions as part of the development framework, to address remote user groups and build research skills and teaching/learning methodologies.

To meet diverse regional demands, AARM has provided a massive number of in-country training workshops addressing particular development needs at a variety of institutions and regional partners. During the last decade, almost 800 trainees have received formal technical short-courses and hands-on training in aquaculture and specific aspects of aquatic resources management. Much of this has been arranged through a special AARM short-course unit and through roving regional specialists funded through donor projects based with AIT. National institutions are picking up as several Vietnamese, Thai, Lao and Cambodian institutions now offer short courses within the field.

AIT is undergoing curriculum reform where inter-disciplinarity is a key issue in addressing regional development needs and a Centre for Distributed Education has recently been established to extend the geographic reach. The AARM Field of Study has come up with a proposal in which post-graduate courses may be provided in modular packages, through which students may acquire credits and extend the formal post-graduate education for up to five years, from two years in the conventional program. Feasibility will depend on recruitment procedures and the numbers of qualified candidates.

English language proficiency turns out to be a major bottleneck, particularly in the recruitment of students from the Lao PDR, Cambodia and Thailand and English training courses have been set up at many partner institutions, even in Vietnam, as an answer to local requests. In parallel, AARM has started to investigate options of accrediting working records, to enhance enrolment of technically experienced staff who do not posses a qualifying degree. This initiative is still at its initial stage.

To target the ultimate beneficiaries, a line of research has moved from adaptive to action research, in which appropriate technologies are developed in participation with the end users through series of farm trials, most clearly demonstrated through the extension work carried out by the network of regional partner institutions. Other joint research agendas have emerged from socio-economic surveys or applied research implementing new technologies.

It is through this approach, that curriculum development at the vocational level has taken an added importance as AIT has begun to work more closely in the research and development projects at the provincial levels. In the beginning AARM worked through local institutions immediately, rather than establishing a direct field passage. Only as the collaboration has grown, have the real development needs and constraints in formal education modes become clear and movement towards more informal training modes begun. From this work, recommendations for local governance, community based-management and regional strategies may emerge. For reference, this is reflected through the extension of donor funding for a second and third phase of Danida and Sida funding, respectively (6, 7). Table 1 (Main Thrust of Human Capacity Building by Country, from reference no. 6).

The Outreach Network

The establishment and operation of a regional network, essentially, requires an agreed development framework, which adheres to national policy goals and is wide enough to cater for the advancement of its stakeholders and the diverse systems. It must incorporate the assets and competency of it's comprehensive resources (institutional and personnel) and enable dynamic and flexible inter-institutional relations around shared development goals and local interests. A holistic and long-term strategy is essential for the consolidation, expansion and sustainable collaboration within the network.

As such, a holistic framework has been established through AIT and AARM's many years of experience in the region, in which strategic alliances are reinforced between Southeast Asian institutions and alumni within the fisheries domain. In the context, a shared regional development goal and consistent project purposes have been formulated and uniquely agreed between all partner institutions and the committed donor agencies; essentially, Danida, Sida and DFID. An open network of more than a dozen partner institutions, primarily constituted by sector departments at provincial level, research institutes, universities and agricultural colleges, has been established and it's viability is secured through multiple funding resources; long aligning different projects into the development objective (5, 8). Table 2 (Partner Institutions in Regional Development).

The framework approach encompasses building of local governance and capacity to manage projects within the agreed development objective. Hereunder, 1) resource surveys 2) problems oriented research, 3) academic advancement 4) capability to reach poor population groups. Several independent new donor projects have started up with the regional partner institutions, some of which have aligned approach and development scope with the framework objectives, which serves to reconfirm the general applicability of sector approach. Inter-institutional collaboration has resulted in collaboration between fisheries educational institutions in Hanoi and Nha Trang, where facilities have been made available for thesis research in an innovative bachelor education at Research Institute for Aquaculture No.1. Collaboration has resulted in the invitation of new schools to join established partners and resources in curriculum development are shared between vocational colleges in Northeastern Thailand. In the Lao PDR, a Regional Development Committee has been constituted by the Department for Livestock and Fisheries, Ministry of Agriculture and Forestry and similar initiatives, though less official, have been implemented in North and South Vietnam.

Since, information and high quality educational media are essential in academic advancement and extension campaigns and, furthermore, become instrumental in keeping a network together, investment has been put into the consolidation of local media units and AARM is operating an extended service from Bangkok. Selected aquaculture course modules have been redesigned in educational packages suitable for dissemination and local adaptation. Funds and training input have been provided via AIT for the basic upgrading of local libraries, information technology and media production capacity. Inter-institutional training in this area has resulted in recommendations for national co-ordination and standardization of library systems within the sector, though still pending formal approval. The AARM web site, quarterly Newsletter and paralleled initiatives by partner institutions serve to strengthen communication within the network but also draws a broader audience.

Regionally, momentum is sustained through the exchange of experiences and the inter-institutional formulation of new pilot projects and field surveys, which are carried out by the partner institution and often, reported in more than one language for regional dissemination. This, in turn, offers economies of scale in strategic research and testing of methodologies, and the opportunity to establish generic development models. Synergy is also established between research and field activities and HRD within the sector. Geographic spread of impact is further extended via the institutional network (9).

It is seen that the local capacity to facilitate and direct government and donor resources towards national and local development goals has significantly strengthened during the course of partnership. At the institutional level, management capacity has generally improved and both government and project funding supplement existing resources, as new resources are applied for within the development mandate, alongside regular activities. New specialists are recognized within the regional institutions and their involvement as resource persons and trainers within the network will hopefully be expanded in the course of the coming years.

Development Needs and Market Requirements

Most education in the region is not market driven, in the sense that only limited reference is made to national conditions and sector needs when syllabi and curricula are designed. In countries with a past based in a planned economy, the numbers of produced graduates is determined by public sector employment, but little has often been done to extend interactions between the tertiary educational institutions, the line agencies and the public and private sector, when it comes to education quality and course contents. The higher educational institutions are mainly placed in urban environments and their academic staff and lectures are often isolated from the rest of the sector, which on the other hand is undergoing rapid transformation to a more market-oriented economy in countries like Vietnam.

In some countries of Southeast Asia, the higher educational institutions in the fisheries sector still reside within their line ministry, while others are in transition or have been transferred to the educational ministries. In both contexts, fundamental components of curricula take up considerable time with such subjects as political science, national economy, foreign language and physical training. The more specialized courses in fisheries and aquatic resources field of study have often derived from imported curricula or components hereof. In Cambodia the Russians left the Universities with short notice in 1990, when the former Soviet Union collapsed and Vietnamese teachers were responsible for the curricula at the lead agricultural college. With the "doi moi" open policy in Vietnam, many scholars are returning from education abroad and contribute to a rapid growth of national expertise, but Vietnamese references and textbooks are still sparse. One reason to this is that very few regional institutions have notable research attachment, as compared to universities in the western world. Resources are simply not at hand to extend national research agendas, though some international funding agencies are providing joint research and twinning opportunities.

Therefore, approaches to monitor local needs and address development constraints, should at the same time incorporate the building of local researcher capacity and improve linkages to the surrounding community. Ideally, this would then feed into the upgrading of educational programs and, ultimately, adjustment in national policy and fortified sector progression.

However, this may not generally be how development needs and market requirements are assessed, with some few exceptions of which examples from Cambodia and Vietnam will serve to illustrate.

In most countries of the region an apparent imbalance exists between the basic requirements of the agrarian communities and poor farmers on one side and national investment and educational policy on the other side. To deal with this, a national masterplan for educational reform within the agricultural sector was developed in Cambodia by the Ministry of Agriculture, Forestry and Fisheries, the Royal University of Agriculture and consultants from FAO; of which FAO was pushing the project forward. Based on a primary market survey carried out by researchers from the Royal University of Agriculture and the French development agency (Caisse Francaise de Development), a preliminary need for the retraining of 6,000 government officers and the introduction of agriculture in elementary and secondary curricula was envisaged and technical recommendations drawn up for syllabus revisions. Since, this market survey was the most recent available to the National Task Force on Higher Agriculture Education, this constituted a central reference in the elaboration of the National Action Plan on Agriculture Education, eventually published in 1999 (10,11).

As a result of a changing political climate and these efforts, the tertiary agricultural institutions have gained increased autonomy and are consolidated as public establishments, allowing them to supplement government budgets with the generation of own income. A basis for a more dynamic and flexible educational system has been established, through which new institutional incentive may lad to a better match between user needs and syllabi.

The government of Vietnam is also in the process of implementing a master plan for the fisheries and aquaculture sector. As a supplementary initiative to improve education, an informal Consultative Group on Aquaculture Education (CGAE) was established within the educational sector in 1997, with participation of representatives from eight leading tertiary institutions and two ministries. Under the affirmation of this group, it was decided to conduct a National Assessment of Aquaculture Educational Progress (NAAEP) covering the whole country. The main purpose being to survey quality and quantity requirements in the sector and to relate these to governmental projections and educational reform. Furthermore, it was decided to conduct the survey in an inter-institutional collaboration, through which local researchers would be involved and their capacity would be strengthened at the same time. Funding was provided through AIT involvement and refresher training was carried out in field surveying and data handling techniques, through a Vietnamese consultant. All in all, twenty-eight researchers and staff attended in the survey and almost 1,500 interviews were carried out covering all 61 provinces and higher educational institutions from the north to the southern tip of Vietnam. This survey was completed by the turn of the millennium and is currently pending final compilation and endorsement by mid 2000.

Preliminary results point at reconfirming provincial needs and market development in matters of addressing technical and socio-economic constraints. Independent of agro-ecological zones, fish disease and treatment, seed supply, water quality and production management and economy come out as nation wide priority areas. The need for a large number of vocational level technicians and the re-training of senior officers of line agencies is accentuated. A wider assessment of the conventional fisheries sector has been proposed and is expected to follow as supplement to the current aquaculture focused survey (12).

AIT had earlier been involved in a similar effort in the monitoring of aquaculture manpower needs in the southern Mekong River Delta Region. Main conclusions of this survey pointed at a need for around 300 new aquaculture graduates in the Delta region over the next ten years, which would require annual batches of 50-60 students, since the current retention of alumni within the fisheries/aquaculture sector is around 50%. The need for dialogue between the educational institutions and the end-users was emphasized and research in technical and socio-economic aspects of aquaculture was recommended, particularly, related to high value fish and shrimp species. The survey revealed generally unsatisfactory working conditions, which is seen as problematic for future student recruitment, with job opportunities in the tourist and business sector in Ho Chi Minh City already attracting large number of university graduates. The survey was carried out in 1996, with a Vietnamese alumnus as principal investigator, assisted by a couple of field staff for interviews and provincial data collection. AARM resource persons mostly backstopped and helped in data interpretation and compilation of the English language report (13).

A parallel survey was also conducted in the context of assessing the status of information at regional partner institutions, with the financial scope of supporting local information centers. This initiative has resulted in a stronger emphasis on capacity building in information technology and the earlier mentioned upgrading of local libraries and media processing capacity, which is still under progress (14).

Building Institutional Capacity

As illustrated in the examples provided above, regional institutional capacity building may take a starting point in local -or even national- resource assessments. In the framework approach, joint research and building of human resources in conjunction with resource surveys serve as part of the mutual learning process where the existing competency of local researchers is strengthened horizontally. Different elements of the approach have been introduced in the above and the current chapter provides a series of examples illuminating modes of working and processes of approach. Four inter-linked key elements are highlighted: participatory approach and competency building; human resource development strategy; development of locally relevant curricula and institutional management and inter-provincial co-ordination.

Regional advancement and capacity building is consolidated by the described development approach through the joint efforts of AARM, regional line agencies and educational institutions, with a starting point in the identification of system constraints and the design and appraisal of pilot projects in small scale aquaculture and rice-fish systems. Weaknesses and strengths are addressed together with researchers in local communities and, when relevant, these are allowed to feed back into national curricula and improved media at the institutional level.

Participatory Approach and Local Competency Building

With the large span between the cultural and developmental settings of Indochina countries, AIT has found it necessary to apply a roving mode of operation, in which specialists and external resource persons essentially act as facilitators to promote and stimulate the genesis of local resources.

In the development framework, participatory approach and grass-root methods have become essential in capacity building, which aims at empowering partner institutions to become national and regional project implementing agencies. In the participatory approach, research techniques, educational strategies and extension methodologies are developed in a mutual learning set-up; essentially, bringing into public domain and sharing the knowledge of network resource persons (be it local, regional or international capacities).

Through in-country training and learner centered workshops, technical/science upgrading may be achieved building on national experience and the existing competency of involved trainees. Task oriented workshops center around specific activities that not only brings people together, but also results in outputs that are part of the institutional accomplishments. Principally, self-improvement in knowledge, skills and personal attitudes, are influenced and stimulated within the particular teacher target group as central themes in modern educational philosophy and institutional management are introduced. Connections to the surrounding community are accentuated and field excursions are applied where possible.

HRD Strategy, Staff Development Schemes and Scholarship Programs

An input from AARM specialists has been the provision of, more or less, conventional training need assessments (TNA) of confined staff groups at the national educational institutions. From these, recommendations are elaborated to empower local management in the allocation of scholarship resources and the assertion of institutional policy. Interviews are carried out with teacher groups and key administrators and strategic staff development criteria are compiled from participatory workshops and are put forward as basis for detailed personnel development schemes. In the process of securing academic and staff assets, ideas from AIT have been subject to extensive local debate all most institutions have revised and formally endorsed the developed proposals. A couple of universities have commented back to AIT, that these internal staff development plans are the first they have had and they have now become instrumental in faculty and career development policy.

To AIT and AARM, which hold the ultimate role as project implementing agency, this has resulted in the transfer of responsibility to the local context, where it belongs, and incorporated the necessary flexibility in staff management and academic direction. For instance, requests for the conversion of post-graduate to bachelor scholarships and more informal training has been put forward by a couple of institutions. In the Cambodian case, this would serve to upgrade a larger number of vocational school teachers with a limited foreign language proficiency within the national educational; i.e. providing for the transfer of credits to resume graduate training at the Royal University of Agriculture. Other scholarships may be directed at studies network institutions in Vietnam, which reflects some of the credentials of the regional development framework.

To support accessibility of international education, extensive parallel efforts are directed at English language programs and the building of academic capacity, in which a variety of foreign funded agencies are involved. Regional and international resource persons link into the institutional capacity building efforts, through formal short-courses, in-country training and joint research surveys as illustrated in the text and the case below.

Curriculum Development, Regional Relevance, Local Training Units, Distance Learning

Overall, aquaculture curricula seem to gradually improve to better reflect local development needs. In partner institutions the majority of teachers have been upgraded in the context that they have received continuous training in how to relate theory to practical applications in a relevant context. Local teaching materials are produced, based on the combination of better awareness of the status of the sector in their country and regionally, based on renewed field experience and access to a wide range of information sources in their subject areas and a continuous curriculum development process has been initiated. Teacher competency has been expanded and this will, ultimately, be reflected in the acquired qualifications and proficiency of the next generations of graduates to play an active role in the future development of the sector. Through improvements in curricula, facilities, training activities and information services, it is believed that the universities and colleges are put in a position to provide students with a variety of skills to better meet the different walks of life and ever changing demands of society.

The approach to technical/science improvements has been as described. Central stakeholder workshops have tried to assess local needs, when more comprehensive market surveys have been impossible and competency profiles for available jobs within the sector now set the standards and performance criteria with the vocational colleges in Thailand, etc. The latter is, primarily, the result of a Danida project with a similar curriculum development approach, which supported the management of DOVE vocational colleges in Thailand during 1995-1997.

Progress in teaching-learning methodologies are gradually being improved as teacher training courses are arranged by AIT and a broad spectrum of international organizations, NGO's and local resource persons, who recently have become involved in the laborious retraining of teachers without a pedagogic background. Skills-oriented teaching has been improved through inventory and experimental facilities; innovative laboratory sessions have been designed for students and experiments are carried out in the university farms supervised by the faculty.

Course content is revised through the linkage to resaves persons at AIT or international specialists. But, the process is complicated as it may involve the “parachuting in” of external expertise with limited local insight. The elaboration of improved course outlines and student support materials is done through individual teacher consultations and the establishment of local quality committees that work to the Scientific Committees at the national institutes. The standardized formatting of lecture notes can be instrumental in accessing content by English Language speakers, since Language represents the single most limiting factor in collaboration across the boarders.

Action research and farm trials are designed and carried out through line agencies and research institutions to improve aquaculture techniques together with fish farmers in remote areas. Extension approaches and materials are developed and tested together with the ultimate target groups and project support is available for the production of preliminary textbooks at the more advanced educational institutions.

Due to inadequate capacity of the existing educational institutions in the Lao PDR the provincial line agency of the Department of Livestock and Fisheries, has sought a set-up in which provincial resource officers are used for in-service training of colleagues in other provinces. Through the establishment of an inter-provincial training unit these initiatives have been formalized and selected course materials developed. Some components of these standardized modules are in the process of being redesigned and disseminated to the provincial offices in Southern Laos as part of an emerging distance learning system. This system, aims at upgrading the capacity of also district staff and, eventually, the local farmers, i.e. as part of the extension of new appropriate technologies (14).

Local short course units have been established under AARM project support at many regional educational institutes. Some of these have had impact on the national relevance of graduate curricula and institute revenue, since the feasibility of technical short-course offered on the free-market or arranged for national institutions or NGO's, is dependent on the market relevance.

Ongoing attempts to offer formal post-graduate education at AIT through modularization and the optional accreditation of qualifications obtained during work have been mentioned earlier. Paralleled to the support for local short-course units and the diversification of scholarship means, this reflects elements of the mutual learning approach within the outreach network, in which staff development resources are redesigned to diverse local requirements.

Institutional Management and Regional Collaboration

A formal contract (Memorandum of Understanding, MoU) constitutes the foundation for project co-operation between AIT and the regional partner institution. These MoU's have always been elaborated through a series of consultations with the partner institution, during which time development objectives are communicated and adjusted to local needs. Each institutional MoU is therefore different in that all major ideas of the counterpart have, essentially, been incorporated, as long as they are compliant with the shared development framework and the mandate of the donor agency.

Management of project activities at the typical university is constituted by bi-annual project steering committee meetings, which monitor project progress and endorse annual implementation plans. To support this, responsibility areas of sub-section and a variety of different incentives (staff development schemes, scholarships, training events, language classes and modest salary supplements or honoraria for the production of upgraded local educational support materials, lab manuals, etc.) is provided, when project means allows for this. Besides, a resident AARM field staff and, eventually, an AIT Country Unit Manager support project implementation, as required.

Through these means project input is managed and enforced by the local institutions and AIT in the shared interest of a feasible project implementation, which may be illustrated through several different donor projects being coordinated and incorporated in the same set of activity plans; here also inviting these different agencies to sit in on each others projects.

In the Lao PDR, the Department of Livestock and Fisheries has set up a coordinating mechanism in a Regional Development Committee (RDC) covering six provinces in the south and extending development reach. This model has been followed in North and South Vietnam where inter-provincial meetings have taken place during the last couple of years and been fruitful in drawing on shared experiences.

Conclusion

The countries of Indochina remain among the poorest in Asia, as they emerge from several decades of political turmoil and the capacity of professionals and laymen to serve development in the agricultural and fisheries sector is limited. Long regional experience with AIT and the Aquaculture and Aquatic Resources Management Field of Study has resulted in recommendations for sustainable development models and approaches in tertiary education, which incorporates national institutions in a development framework

In this framework, the development of aquaculture and aquatic resources management is seen as an effective entry point into rural livelihoods, towards which AIT works through a network that, builds on existing institutional structures rather than replacing them.

The work with tertiary educational institutions follows the same learning process approach as work with farmers. The approach is to work together with teachers of partner institutions to identify the institutional objectives and constraints in their realization. Through an interactive mode the ownership of changes made to curricula, teaching and research agendas is secured. Through international linkages and regional networking, multiple funding sources are sought that may sustain activities also at the regional level.

With the improvement of academic standards of selected partner institutions joint degree programs or even post-graduate programs may be a possible option in a near future. In the design of distance learning systems the success of these programs will probably depend on local applicability and the difference in learning cultures.

It is concluded that regional educational co-operation and institutional capacity building across boarders may be quite central in choice of strategy and sector development. It is believed that the presented model, may serve to highlight the variety of opportunities in the region and the importance of consensus among stakeholders on development objectives and required mechanisms in realizing these within the complex systems.

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In brief, Danida resources are directed at improving institutional structures, with the bulk of efforts centered round local curriculum and human resources development and improvement of basic educational and research facilities. This is addressed in the above described integrated approach with AARM as implementing agency and through participatory approaches, workshops, informal training and scholarships/fellowships for local teachers, selected inventory and integrated regional research activities, as mentioned. As something new in the Phase II of the project support, a limited number of local scholarships have been made available for less privileged students.

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Annex D9: Distance Education – How Far Can We Go?

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Abstract

Distance education involves students learning through mediated information and instruction using a variety of media and technologies and at a distance. Distance education is expected to grow rapidly in the next decade in response to several drivers: the world-wide trend to mass education, the globalization of the economy and the community, the explosion of knowledge, the rapidly changing employment market and the resultant need for adult learners to engage in life-long learning. Asia has the highest concentration of participants in distance education, but it is still expected to expand in the Asia-Pacific dramatically in he next decade.

Proponents of distance education stress its flexibility for students to learn at the own pace, in their own place and in their own time, the ease of changing curriculum content and the advantages offered by new technologies to enhance learning. Disadvantages have included students' sense of isolation, high establishment costs, inability to adapt content to meet local needs and the expensive requirements for staff professional development in distance teaching. The contribution to distance education of the *world wide web* and *computer mediated communication* are also examined. Finally, I explore the potential for Deakin University's postgraduate courses in Aquaculture to be adapted to take advantages of the recent developments in distance education but which also address the needs of local students and their industry in the Asia-Pacific Region.

What Is Distance Education?

Distance education involves students acquiring "knowledge and skills through mediated information and instruction, encompassing all technologies and other forms of learning at a distance" (US Distance Learning Association, 2000). It originated with sets of written materials forwarded to students who completed assignment by 'correspondence' but now embraces all kinds of learning activities using a variety of media and technologies. Today's students can learn at their own convenience – location, time and pace using the world wide web, CD-ROMs, computer mediated communication packages as well as more traditional print, video and audio media.

Why Will Distance Education Grow in the Future?

There are a number of reasons why distance education can be expected to expand rapidly in the next decade:

- The world-wide trend towards mass education from one in which post-secondary education was a privilege of the elite
- The explosion of knowledge. It has been suggested that the half-life of most professional knowledge is about five years. After this time professionals need to retrain and relearn.
- The changing job scene. Most graduates entering the employment market can expect to have at least five job changes and even career changes. These factors have led to the realization that institutions need to facilitate *lifelong* learning (Candy *et al.*, 1994).
- The globalization of the economy and the community – societies are going to have to be at the cutting edge of training in order for them to successfully compete in world markets.
- Governments can no longer afford the necessary infrastructure to not only provide training and education for school-leavers but also satisfy the needs of life-long learners. The price of telecommunications should continue to fall so that most universities should be able to have mass communication within their community electronically.

Distance Education in the Asia-Pacific Region

Murphy and Yuen (1997) have noted that Asia already has the largest number of tertiary level students enrolled in distance mode than any other region in the world but that the growth in enrolments is likely to expand even further in the next decade. The Open University of Hong Kong serves as an illustration of the need for a distance education provider and even in its short history has graduated 6,000 students and has over 24,000 students enrolled as continuing education students. Tam (undated) has predicted this University will become an Asian mega-university with in excess of 100,000 enrolments! The case of Hong Kong is an interesting one in that every part of the Special Administrative Centre is accessible within 30km, but there is still clearly a need for distance education! Tam clearly believes the growth is because of the urgent need for universities to 'raise the quality and quantity of human resources through higher education' to help supply the needs of an expanding economy.

Advantages and Disadvantages of Distance Education

The most important reason people need to enroll as distance education students is the freedom to select their timing, location and pace of study. For many students attendance on campus is simply not practicable. Many are already employed and undertake their study out of work time. Distance education has provided many innovations that in turn prove advantageous to conventional teaching and learning. On-line curriculum materials are readily upgraded or modified in response to new discoveries, resources or student feedback.

Distance education has had its critics, however. Some have argued that the emphasis has been on the innovative technology rather than the needs of the learner. Some senior university managers could be seduced by the persuasive sales pitch of educational technologists without carefully considering the pedagogy behind decisions made about technological ‘improvements’ to education.

Tam (undated) also raises the so called Type 1 error whereby cultural relevance of the curriculum designed in a developing country is assumed to be equivalent in the societies of developing countries. Another problem that has been identified is the sense of isolation of distance students from teachers and also from their peers. “It appears that many people erroneously mistake distance communication for distance teaching. In any teaching situation, every learner must be made to react or interact within a humanistic and cognitive constructive environment in which ‘learning’ and ‘learner-centered’ is more important than mere communication” (Tam,). The development of Computer Mediated Communication (see below) certainly addresses these concerns.

The costs of converting print-based teaching materials to on-line is also a disadvantage. Inglis (1999) has argued that in his analysis of Australian tertiary programs, the decision to shift to on-line delivery cannot be justified in terms of cost savings alone. Rather, he claims such decisions should be made for other reasons such as increased access and improved quality. Other costs involve the need to train staff in the capabilities and appropriate use of the technology for teaching and learning (Graham *et al*,.1999).

Two Technologies Used in Distance Education

Computer Mediated Communication

One disadvantage that has been associated with distance is the one way nature of teacher to learner communication. Learning is enhanced by high levels of interaction between learners and their teachers and between learners themselves – this increases motivation as well as allowing knowledge to be better structured (Chalmers and Fuller, 1995). At Deakin University an asynchronous learning network has been set up for Commerce students studying at a distance. The network involves learners accessing a communication software system to interact with staff and other students at a time and pace that are convenient to them. All members do not have to be online simultaneously. The development of this asynchronous learning network has enriched the learning environment for the students and improved the quality of the program being delivered (Graham *et al.*, 1999).

In one unit discussed by Graham *et al.* (1999) (Macroeconomics), interactions include discussions of key concepts as well as administrative matters relating to resources and assessment. The unit 'conference' contains 'subconferences' with particular purposes, such as the Resources folder (with references and Web hyperlinks), the Assessment folder, the Noticeboard and a Current Issues folder used to stimulate discussion of the application of the theory being discussed.

Students also work in small teams. Each team member has interactive access to others in their team as well as to the tutor. Students surveyed after they had used computer mediated communication noted how they found access to tutors and to other students had enhanced their learning experience. The network also increased the availability of resources. Staff believed they made positive and valuable contributions in the network although their role changed to be facilitators, moderators and group participants rather than directors of learning (Graham *et al.*, 1999).

World Wide Web

The World Wide Web (WWW) offers educators an exciting set of new resources to enhance student learning. However, as with any new technology, it comes with costs and disadvantages. The pros and cons of using the WWW for teaching are given below.

Advantages

- Material can be much more current than that which is available from traditional sources. For example, students can access up to date climatic data for any part of the world, instantaneous transmission of views from cameras set up in hundreds of locations, up to date sporting information etc.
- The WWW can be used to teach critical analysis. There are often so many sites with a range in quality and reliability that students can learn to be critical and discerning users of information.
- Search engines reduce time spent seeking out information. Some providers offer link services which guide content and quality of the sites hyperlinked.
- The WWW is excellent for remote learners. Chat rooms can improve communication, especially for shy students.
- The web allows access to a large range of media (video clips, data sets, sound etc.) which can improve a student's motivation and make learning more exciting.
- Costs can be reduced. Much software that can be downloaded is free.

Disadvantages

- Most web material is not peer reviewed. True there are a growing number of per-reviewed electronic journals, some of which are of very high quality. There is also a lot of rubbish posted on the web which students may uncritically accept.
- Even though the web can save a lot of time, it can also be a great time waster. Francek (1999) notes the WWW lacks a 'well-defined information infrastructure for conducting research''. Sites whose titles may sound appealing turn out to be irrelevant. Few sites clearly identify their purpose, scope or intended audience.
- The WWW is not available to everyone. Not everyone has access to a computer with a modem.
- The WWW can be expensive to use, especially for remote users having to pay hefty communication charges to carriers. Some web facilities e.g. the need to access movies, videoconferencing – can be very costly.
- The web can encourage 'cyber-plagiarism' in which students simply cut and paste material for assignments.

Francek's (1999) take home message is that educators need to be aware of the benefits and the limitations of the WWW in their teaching and for 'on-campus students' use it preferably as a supplement to traditional methods.

Aquaculture Education in APEC

At present Deakin University offers the only postgraduate suite of courses in aquaculture which are available to distance education students. The materials rely on print-based medium with sets of readings, activities and assessment tasks. Students interact with teaching staff most often by telephone and email. Domestic students have the opportunity to attend on-campus sessions for hands on activities.

Whilst the School of Ecology and Environment (which administers the programs) has investigated the use of on-line teaching materials, the costs and effort necessary to transform the printed materials have been a disincentive for change. We are investigating instead, producing CD-ROMs to accompany the notes where appropriate to add video and color photographs.

However, the greatest opportunity we see for the expansion of the availability of these programs in the Asia and Pacific region is for another University to enter into an agreement with Deakin to offer these programs as a twinning partner. Students would enroll with this partner and could graduate either with that University's award, a Deakin award or a joint award. The partner would use Deakin materials to teach students in their own country, adapting the materials where necessary to use local examples and fit with local cultural needs. Deakin staff would visit annually to brief teaching staff, review assessment and quality of teaching and even provide some keynote lectures to students. The advantages to the twinning partner are that it can offer high quality (internationally accredited and having won many awards) graduate programs in aquaculture up to Masters level without the expense of having to develop the materials from the start. Fewer faculty appointments are necessary as the teachers effectively guide the students through already prepared work.

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Annex D10: A Re-evaluation of the Use of Electronic Media, Both CD-ROM and Internet, in the Delivery of a Second Year University Course in Fish Biology

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Abstract

The world has recently seen substantial increases in electronic communications technologies including the Internet and computer CD-ROMs. Electronic delivery methods have some clear advantages over conventional methods. For example, they have the ability to reach a far greater catchment of potential students and can be considerably cheaper to deliver than conventional methods. Deakin University in Victoria, Australia has developed course resources for a fish biology unit, which can be delivered entirely using electronic media. However, the importance of face to face contact with the students and the need for some practical experience has necessitated the inclusion of a practical component to the unit. Students are expected to attend a single day long practical held at a central location during the course of the semester. The resources for the unit either can be accessed through the Internet, CD-ROM or are available in printed form. Fish Biology has been trialed as an off-campus unit in three consecutive semesters. Access to the resources on the Internet is restricted entirely to students registered for the unit and is controlled through user identification and password security systems. Students gain access to the academic staff using E-mail or telephone, select assignments over the Internet, complete electronic practical exercises and weekly learning exercises covering each of the programmed topics of the unit for the duration of the semester. Students can complete the unit at their own pace but within the framework of a single semester. The unit has been evaluated favorably by the students on each occasion that it has been offered. The aim of this workshop is to demonstrate the form, function and teaching methods that have been followed in the development of the unit materials and to present some data on student evaluations and outcomes.

Introduction

In the 1990s, the School of Ecology and Environment of Deakin University introduced a combined Fisheries Management and Aquaculture Degree at the Warrnambool Campus. During the earlier stages of the program, both fisheries biology and aquaculture were taught as a combined second year unit. In 1996, the fisheries biology and aquaculture components were split into two discrete second year units.

The resources for the fish biology unit were re-written incorporating the objectives of the University's Strategic Directions in Online Teaching and the Schools Teaching and Learning

Management Plan. Both of which emphasize quality teaching and increasing use of technology in teaching. Material was developed with a view to online delivery to off-campus students and delivery across all campuses of the university to on-campus students. On-campus students are those who can normally attend classes while off-campus students usually cannot.

Fish biology was first delivered at the Warrnambool Campus to on-campus students in first semester 1997. Lectures were given but all unit resources (text, revision questions, practical exercises and assignments) were made available via the Internet. The results obtained by students were critically examined at the end of the semester and appropriate modifications incorporated to the course material and delivery. In second semester of 1997 and first semester of 1998, the unit was delivered across all campuses of Deakin to both on and off-campus students. Students were encouraged to use E-mail as the primary method of contacting the unit chair and to regularly access an announcements page that was established on the Internet.

World Wide Web Resources Structure

The World Wide Web (WWW) resources for fish biology have been developed with the intention of making them self explanatory, easy to use, and instructive. The site contains approximately 2300 separate files that are all inter-linked by topic. The list below details the primary index pages contained in the web site;

- Start page
- Announcements
- Introduction
- Course structure and objectives
- Assessment items
- Assessment schedule
- Unit evaluation requirements
- Lecture notes, lecture overheads and exam questions
- Practical guide
- Essay selection
- Unit references
- Sites to visit
- Fish identification practical introductory page

Student Evaluation of the Unit

At the end of each semester, students are asked to anonymously assess the unit that they have completed. A standard evaluation form is provided. Table 1 lists a subset of the statements that students are asked to respond to, concentrating on those, which are of particular relevance here.

Table 1: Statements that student's are asked to respond to after they have completed an Ecology and Environment unit at Deakin University.

Number	Statement
1	The information relating to the aims, contents and assessment of the unit was clearly set out.
2	The workload was appropriate to the level of the unit.
3	The unit was interesting and informative.
4	I would have liked more resources to help my understanding of the material.
5	I had no difficulty getting hold of staff when I needed to.

Table 2: Responses of students to evaluation statements (listed in Table 1) for the Fish Biology unit summarized from data collected over three consecutive semesters during 1997 and 1998 (%).

Number	Negative Response	Neutral Response	Positive Response
1	10	16	74
2	0	19	81
3	3	7	90
4	24	22	54
5	11	25	64

Statement 1. Seventy-four percent of students indicated that they were happy with the outline of the resources that had been provided with the unit (Statement 1, Table 1, 2). The bulk of this material was provided through the units web site and the evaluations indicated that the method of disseminating information was acceptable and useful to these students.

Statement 2. Eighty-one percent of the students indicated that the workload was appropriate to the level and degree of difficulty of the unit (Statement 2, Table 1, 2). Despite the positive response from the students, the scope of the materials are always under review and content is changed where and when deemed appropriate.

Statement 3. Ninety percent of students indicated that they were happy with the material, presentation and outcomes (Statement 3, Table 1, 2). Considerable effort has been put into ensuring that the visual impact of the resources is high and that it maintains the interest of students. Use of multimedia tools such as in the fish identification and audio practical exercises reinforce this.

Statement 4. Fifty-four percent of students felt that more resources could be made available to assist them in their understanding of the material (Statement 4, 1, 2). As part of the ongoing review of unit resources, material is continually being upgraded and supplemented. The most frequently occurring problem during the course of this study was the difficulty in obtaining access to computer facilities and the reliability of computer networks. This was evident in the attitude of the students and has been resolved by the provision of resources in CD-ROM and printed form in addition to the web site. Students can thus access materials at their own leisure and without Internet access.

Statement 5. Sixty-four percent of students indicated that they were happy with the level of access to supporting staff members (Statement 7, Table 1, 2). The online delivery method has increased the access of off campus students to staff members. E-mail is particularly useful as students questions can be answered and delivered in bulk to all students taking the unit.

Comparison of Unit Evaluations Between First and Second Semester 1997

The evaluations of units that are completed by the students are submitted anonymously. Information that is missing from the evaluations includes campus attended and enrolment (off or on-campus). Thus, demographics of the student responses cannot usually be analyzed. However, during1997, all students completing the unit in first semester were on-campus and all students completing the unit in second semester were off-campus. This allowed a unique opportunity to examine how the perceptions of the students varied between those who had traditional lectures and those who did not. Points that should be considered when examining these data include;

1. Lectures were given to students in first semester and all students were on-campus at Warrnambool. WWW resources were provided to these students.
2. Some 10 of the students taking the unit in first semester at Warrnambool were high achieving mature age students and were atypical of the normal student cross-section. This makes comparisons between the groups somewhat difficult.
3. Students in second semester did not receive lectures; however, two tutorials were organized at other campuses, these were both poorly attended.

The evaluations given by students from semesters 1 and 2 were similar varying a maximum of only 6% (Table 1, 3). This suggests that the on-line delivery did not negatively effect the student's acceptance of the unit. Students have accepted the reduced direct contact and indicated that they did not feel disadvantaged by the delivery method.

Table 3: Comparisons between student evaluations from semesters 1 and 2 in 1997 for fish biology. The questions listed in the table correspond to those given in Table 1.

	SEMESTER 1			**SEMESTER 2**		
Statement	Negative Response	Neutral Response	Positive Response	Negative Response	Neutral Response	Positive Response
1	7%	19%	74%	8%	19%	73%
2	0%	22%	78%	0%	23%	77%
3	4%	4%	93%	4%	4%	92%
4	26%	22%	52%	20%	24%	56%
5	11%	19%	70%	12%	20%	68%

Student Results Across Campuses

Table 4 compares the grades obtained by students completing the fish biology unit off-campus with those completing the unit on-campus in semesters 1 and 2, 1997 and semester 1, 1998.

Table 4: Student grades comparing results from students studying fish biology on-campus and off-campus.

Grade	On Campus	Off Campus	Totals
Higher Distinction	13%	3%	9%
Distinction	27%	24%	26%
Credit	26%	41%	33%
Pass	17%	23%	19%
Fail	18%	9%	14%

While the data given in Table 3 demonstrate that students were happy with the flexible mode of delivery for the fish biology unit, the grades achieved indicate that this mode of delivery may have some negative effects (Table 4). Note that these data need to be considered in the light of the fact that the grades were biased by a strong cohort of students (Semester 1, 1997). Nevertheless, an interesting generalization can be made; the distribution of grades by on-campus students includes substantial percentages of both high achievers and low achievers. This contrasts markedly with off-campus students where grades tended to bracket the mid-ranges. That is, off-campus students do not necessarily achieve high grades but are more likely to pass the unit than on- campus students.

Conclusions

This study has demonstrated that use of the Internet in combination with traditional teaching methodology, in the short term has not had a negative effect on the final grades of students. Furthermore, student attitudes towards teaching using electronic media are currently positive. While there are potentially some biases in these data, and longer-term studies would undoubtedly prove useful in further evaluating the use of electronic media in teaching, the preliminary results presented here are promising. Particularly as the use of Internet technology has provided the mechanism for students to study at Deakin University in cases where normal teaching methods did not provided this service.

SQB261 has been delivered electronically for just over three years. During this time students have been given the option of either obtaining electronic learning resources or having the materials in a printed form. Experience has shown that there is resistance from students to electronic delivery methods. The majority of students prefer printed materials, preferring to working from hard copies of materials. Resistance from students to these methods is not unique to the School of Ecology & Environment, experience from the School of Architecture at Deakin University mirrors the views expressed here.

Annex D11: Intranet as a Delivery Tool in Aquaculture Education and Training: AIT Aquaculture Experience

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Introduction

During the last decade, Aquaculture and Aquatic Resources Management (AARM) program of the Asian Institute of Technology is interested in finding answers to the following questions in regarding pedagogical methods: Is Internet a suitable (or usable) teaching tool for our target audience? What extent the computer aided education is suitable for teaching and training students/ lessons can be delivered effectively? What should the content be included in computer based/ assisted courses? How should one develop computer-aided instruction for the entire aquaculture curriculum? It should be noted that we did not attempt to use Internet as a media of instruction for distance education, however, one of the objectives was to understand student response for the computer aided lecture materials. This paper describes some experience gained from this exercise.

Potential Pedagogical Help from the WWW

1. Use of html format to provide student with class notes. Variations include:
    - Electronic handouts (plain text)
    - Textbooks (or handouts) with sketches and pictures
    - Textbooks (or handouts) with demonstration video clips

2. Provide students with mathematical simulation methods (using widely available software) for independent practises of analytical techniques. Examples:
    - Linear programming for least cost feed formulations
    - Farm budgetary analysis
    - Growth models

3. Simulating the classroom environment by providing students with lecture notes accompanied by audio or video instruction. Variations include:
    - Handouts/ overhead transparencies/ slides with voice of the instructor (a cursor pointing the text referred by the voice/ image of the instructor). Students can send written questions to the instructor(s) and receive a written reply
    - Handouts in the left side of the screen with video image of lecture delivery by the instructor(s) + written questions & answer.

4. Internet conferencing: real time delivery.

Perceived Advantages

Academic administration:

- To use as an electronic library (text/ graphics/ photos/ videos) – another important issue here is to maintain institutional memory.
- Instructors are encouraged to prepare written lecture materials (and to provide students in advance) and also facilitate instructors to share resources (e.g. picture slides)
- Help to audit the curriculum: public auditing or by a selected audience)
- Can add a bulleting (containing announcements/ instructors whereabouts/ relevant reading materials within copyright limits)

Students:

- Lecture notes + slides + video clips readily available to use at any time.
- Language help for ESL students (can use attached glossary or electronic dictionaries/ thesaurus to find the meaning of the difficult words; also pronunciation help and getting adjusted to instructors accent if his/her voice is attached).
- Outside classroom interaction with instructors.

Instructors:

- Easy to interact with students outside contact hours (this is especially advantageous for weak students).
- Easy to updating teaching materials.
- Peer review.

Disadvantages

- Extremely time consuming (initially) for preparing materials
- Relatively high cost
- Copyright issues – for using published materials (if wider circulation is desired)
- Psychological barriers (previous teaching/ learning/ reading habits affect whether student prefer to use some computer aided materials)

Methods for Measuring the Students' Responses

A questionnaire was delivered to students at the end of Aquaculture Nutrition and Feed Technology course in 1998. Students were requested to evaluate various parts of the computer aided teaching aids a scale of 1 - 5, in ascending order of their preferences where 1 stands for "do not like it at all" and 5 for "like very much", respectively. In addition, students were requested to provide both written and verbal comments on both the content and the presentation techniques. Computer log file was set quantify student access to the web based teaching materials.

Using summative evaluation techniques, Aquaculture Nutrition courseware was assessed for the overall effectiveness of the learning materials and to check how well the various functions work in a real educational setting. Verbal and written comments are used to evaluate teaching methods in subsequent years for the above course and rest of the web based courses.

Student Preferences

A summary of student responses for several components of Aquaculture Nutrition course is shown in the Table 1. The results indicated that the majority of the students like to use web based teaching materials but there were number of constraints and difficulties to adjust into this new learning environment.

Excel workbook based materials i.e. least cost feed formulations and budgetary analyses were popular instantly among students as they provide extra practice to expertise particular techniques. Excel workbook was the only interactive component of the aquaculture Nutrition course during 1998.

All students printed lecture notes or photocopied from their classmates. This is partly because the open book examinations for this course make students feel necessary for them to have lecture notes at their disposal during the exams. However, all except one student said that they prefer to read printed lecture notes claiming that they were not used to read on the computer screen. Unavailability of computers (when the students are free) and the need for carrying a dictionary to the computer lab, and difficulties in making notes while reading in the computer lab were other reasons claimed to be affected accessing teaching internet based teaching materials

Table 1: Students' response on the web components of Aquaculture Nutrition Course in January 1998 term.

Number of responses					
Component	*Like very much*	*Like*	*Neutral*	*Dislike*	*Do not like it at all*
Html Format Notes	4	7	1	1	0
Word Format	5	7	0	1	0
Excel format	9	2	1	0	1
Assignments	4	8	0	1	0
Bulletin	2	9	2	0	0
Notebook	3	8	2	0	0
Discussion forum	1	7	4	0	0

A number of students expressed difficulties to adjust to new learning environment. For example, some students complained that it was difficult to do assignment on the computer screen as they cannot see the whole assignment (or difficult to overview). Although the students continuously interacted with the instructor, the computer log file indicated that no student took part in the discussion forum claiming that either they had no time, there were no specific topic to discuss or they would like to maintain their contribution to be anonymous. Students, however, expressed their strong desire to have all aquaculture courses available on the Internet.

Students' requests for the modification of the computer aided presentations were: (1) add more graphics, (2) show what's going to cover in the next session, (3) make whole curriculum (all courses) available in the web, (4) provide more exercises for independent studies, (5) make on-line available materials be broader than class lecture notes, and (6) to encourage classmates and instructors participate in the net based discussions.

The Profile of New Recruits

Being a regional educational institute, the Asian Institute of Technology (AIT) recruits students from all over Asia. While the multicultural and multinational teaching and learning environment has its advantages, it also makes sure that newly recruits have varied education backgrounds and language skills. Majority of the new students expose to English medium instruction for the first time when they enter to AIT. These factors might have affected the choice of pedagogical methods. Generalized profile of students in this study is shown in Table 2.

Table 2: The generalised profile of AIT Aquaculture students at recruitment.

Criteria	Profile
Age	25 – 40
Education qualification	B.Sc. or equivalent degree
English language skills	Vary (over 50% has poor English language skills)
Computer literacy	Poor
Employment	Mainly from Department of Fisheries and the educational institutes and some from the private sector.

Conclusions

Local area network can be used to enhance the learning environment in Aquaculture education. Perhaps the age of students, the ways they have been taught and learned, the ways they have been used to read and learn affect the students' preference for this new teaching and learning tool.

There is a new generation, age between 10 – 20, growing up with the Internet and they are integrating this new medium throughout their lives. Pedagogical methods utilising Internet appears to be promising teaching and learning tools for aquaculture education for years to come.

Annex D12: Aquaculture Education in Fiji

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Abstract

This paper provides a summary of aquaculture status of Fiji. In addition, future needs in aquaculture education with some strategies for meeting the future needs are outlined.

While there had been some formal training in aquaculture, at present there is hardly any training offered in aquaculture to meet the needs of Fiji's aquaculture industry. This low level of formal training in aquaculture is affecting the development of aquaculture sector in Fiji. Some strategies for meeting the future needs and opportunities for regiona1 cooperation in aquaculture are provided.

Introduction

Aquaculture in Fiji is dominated by small to medium scale tilapia *(Oreochromis niloticus)* production by the extensive and semi-intensive culture methods. In 1999, a total of 296 tonnes of tilapia valued at F$ 1,000,000[4] was produced (Fisheries Division, 1999 Annual Report) and sold domestically. Apart form *O.niloticus* culture there a number of mariculture and brackishwater activities mostly at the research and establishment phase. These include shrimp and prawns *(Penaeus monodon* and *Macrobrachium rosembergii),* milkfish *(Chanos chanos),* seaweed *(Euchema cottonii),* pearls *(Pinctada margarfera),* giant clam, *Trochus* and sea cucumber. *Trochus* and sea cucumber are researched for stock enhancement, while giant clam is used for stocking as well as for culture for the thriving aquarium and sushi market in the US and Japan. Milkfish culture is mainly for the tuna 1ong line industry as baitfish while prawn farming is targeting the local market, which is estimated to the 600 tonnes annually.

Historically, aquaculture in Fiji dates back to 1940 when the possibility of freshwater fish culture was first suggested, although it was not until 1962 that the Government of Fiji introduced the Inland Fisheries Program that included fish culture. In 1970, the United Nations Development Program (UNDP) sponsored project "South Pacific Islands Fisheries Development Agency" (SPIFDA) had the objective - among the others - to assess the potential of aquaculture in Fiji. Although fish culture was a promising enterprise at that time, development was limited by the lack of expertise, experience, and suitable technology. Since the mid 1970's, aquaculture development activities have increased. Several projects were implemented in the framework of various programs, with a focus on different fields of freshwater aquaculture; *e.g.*, introduction of new species, improvement of infrastructure and development of rural aquaculture.

In the framework of the Eighth Development Plan (1981-1985) a program was launched to develop subsistence and commercial fish farming. Further Development Plans from this time include various components aiming at the development of different fisheries sub-sectors.

Since the late eighties aquaculture education has received increasing attention and hence fisheries officials have been given the opportunity to participate in various training programs. They now form the core staff tasked to implement research and extension programs although training is still required to keep officials acquainted with latest developments.

Successful aquaculture involves skilful management of the stock and the environment in which it is raised. This calls for sound knowledge of the requirements and habits of the cultivated organisms and expertise in the methods of maintaining conditions favorable to their rapid growth and high survival. Infinite patience and attention to detail are considered essential for successful farming. Whether this is really so or not it certainly is true that the failure of many aquaculture programs in Fiji can be traced to lack of necessary expertise and trained personnel. While successful farms cannot be developed through mere training, most of the theoretical as well as practical knowledge that an aquaculturist needs are capable of being imparted through appropriate education and training programs.

A brief summary of Fiji's physical features, fisheries and aquaculture is given below

Fisheries and Aquaculture Development

Fiji is located between the latitude 15 degrees and 22 degrees South of the equator and between 177 degrees West and 175 degrees East longitude. Fiji is often referred to as the hub of the South Pacific as it lies on the major sea and air transport routes in the region.

Fiji is very small by global standards, its land area being 18,272 km^2. Over 300 islands comprise the Fiji archipelago. Of these, however, only about ninety-seven are inhabited. Viti Levu (10,388 kin) is by far the largest island, comprising 57 percent of the total land area. Vanua Levu *(*5,532 km^2) is the second largest island, comprising 30 percent of the land area. The other three principal islands are Taveum (440 kin^2), Kadavu (411km^2) and Ovalau (108 kin^2). The two main islands and the three smaller islands thus comprise 93 percent of Fiji's total landmass.

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[4] 1US$ = 2.17F$

The main islands are of volcanic origin and their interiors are mountainous. Fiji has a moderate, tropical climate. There are no really marked climatic contrasts, although two mild contrasts are usually noted. First, the main islands are divided into windward (Southeast) and leeward (Northern and Western) sides. Second, there is a recognized hurricane season from November to March. Rainfall averages 1,778-2,032 millimeters on the leeward side and 2,921-3,175 millimetres on the windward side, with weak seasonality. The average yearly temperature is about 25 degrees Centigrade, with a slightly lower average on the windward side, and higher average on the leeward side. The relative humidity is high, ranging from 75 to 80 percent.

Capture Fisheries

Fisheries contributes about 2.6% of the country's total GDP (Marine sector report 2000). The sector consists of industrial, commercial, artisanal and recreational fisheries, aquaculture and subsistence fisheries. Industrial fisheries is capital-intensive and export oriented. It includes distant water fishing nations (DWFNs), the recently established sashimi tuna fisheries and the Pacific Fishing Company (PAFCO) which cans tuna. Commercial and artisanal fisheries emphasize income earning but are smaller in scale, conducted in nearshore areas using minimal investment and cater for the local demand. Recreational fishing includes sale of ornamental fish and game fishing. Aquaculture, which is dominated by small-scale operations and some experimental farms, now provides a notable source of food and income to some rural settlements. Subsistence fishing is conducted by people in rural areas where fish are pursued to meet the daily nutrition and social requirements for the families.

Fisheries are an important part of the country's economy. This is particularly true of industrial fisheries and lately of aquaculture. In 1999, Fiji had 60 hectares of aquaculture water surface, of which 45 ha was freshwater ponds and the remaining 15 ha were brackishwater ponds.

The Fiji Fisheries Division in Suva is the governmental agency in charge of fisheries and aquaculture. Two of its fifteen subsidiary stations (Naduruloulou Aquaculture Station and Makogai Mariculture Station) are set up primarily for aquaculture research and extension work.

Aquaculture

Concerted effort to develop aquaculture in Fiji began in the mid 1970s through government programs on freshwater prawns, tilapia, carps, shrimp and rabbit fish. Naduruloulou Aquaculture Station was established near Nausori, north of Suva, in 1975. It mainly involved breeding of carps for biological weed control in rivers and later in early 1980 included breeding and distribution of tilapia fingerlings to subsistence farmers, and also prawns. A marine aquaculture station was built on Makogai island in the mid 1980's. It involves research and extension on giant clams, *Trochus*, beche-de-mer and turtles.

In the mid 1980s farming of seaweed *Kappaphycus alverezi* was introduced by a New Zealand company, Coastal Biological Limited. This company ceased its operations in 1990 due to marketing problems. During this time, a joint venture shrimp farm between the Fiji government and overseas partners was established at Raviravi near Ba and is still in operation but now privately owned. A pearl farm was established in Ra and later moved to Vanua Levu.

Aquaculture development especially tilapia farming in Fiji received a boost in 1988 with the introduction of the 'Chitralada' tilapia strain from Thailand and some capital funding from government. A major boost in aquaculture development took place in 1997 with the introduction of the "Commodity Development Framework". This resulted in reorganization into three main sections: freshwater, brackishwater and mariculture and involves the following projects: tilapia, polyculture of carps, freshwater ornamental fish, integrated farming system, shrimp, milkfish, giant clams, *Trochus,* pearl and seaweeds. Of these projects, tilapia, polyculture of carps, shrimps, pearl and seaweed are now at the semi-commercial stage of development.

Aquaculture of tilapia is gradually moving out of the experimental stage with over 270 farms (6 commercial, 10 semi-commercial and over 250 subsistence farms) established throughout the country. Characteristically, fish farms are small, with from less than 200m to a hectare of water surface, and are run mainly by family members. With small fish farms, a proper community master plan for aquaculture development is often lacking and each farm is developed and operated on its own.

Contribution of Aquaculture to the National Economy

At present, almost all of the edible aquaculture products (tilapia, carps, prawns and shrimps) are sold locally, while seaweed, aquarium-sized giant clams and pearls are exported.

In 1999, the Fisheries Division recorded production of 300 tonnes of tilapia valued at F$1 million; some carps; 2.2 tonnes of *Macrobrachium* prawns, shrimps and 300 tonnes of seaweed valued at F$150,000. No information is available on production of pearls.

Aquaculture production in Fiji is therefore still very small but is expected to increase greatly within the next 2-3 years.

Government Objectives for Aquaculture

The Government of Fiji places a high priority on economic growth, and sees both stimulation of the domestic private sector and the attraction of foreign investment as vital to achieve this. One of the main components of policy and strategy for the fisheries sector is: developing aquaculture through continued research into appropriate production technologies and extension programs (Ministry of National Planning 1999). In providing support for aquaculture development, government will be giving effect to four main objectives:

- Food security- improvement of human nutrition, and increase in availability of dietary protein at the subsistence level of the economy.
- Rural development-poverty alleviation through additional income and employment for rural dwellers, and to ease some of the pressure on inshore fisheries;
- Import substitution- provide for local demand using locally produced seafood, and avoid loss of foreign exchange on imported goods;
- Export earnings-brings in overseas dollars and contributes to export-led economic growth.

Current Status of Aquaculture Education

In general aquaculture education in Fiji has been very poor. The formal training in aquaculture consists of a three-week lecture and a field visit in one of the graduate courses (units) of the School of Pure and Applied Science of the University of the South Pacific. In addition, a course (unit) of the Diploma in Tropical Fisheries program of the Institute of Marine Studies used to represent the primary force in formal training in aquaculture. This Diploma program has been stopped since 1987. A vocational school (Monfort Boystown) was offering a 6-month training in aquaculture, basically tilapia culture, to junior high school students in the early 1990 and this too has stopped due to a lack of staff to teach the course. Postgraduate training is usually obtained from overseas institutions.

Government funding for aquaculture training has been very small and is channeled mostly through the Fisheries Division. Most of the training in aquaculture is obtained through donor agencies, especially UNDP/FAO.

Most of the staff involved in aquaculture have received some level of training. Many are holders of a diploma from the University of the South Pacific and have also attended short courses in aquaculture at overseas institutions.

Current Projects and Staff Capacity

1. Freshwater Aquaculture includes four projects: tilapia, polyculture, ornamental fishes and integrated farming systems. Currently 5 technical staff and 20 support staff are involved in research, development, extension and training in aquaculture with over 270 fish farms in operation. Of these *5* technical staff, two have acquired Diploma in Tropical Fisheries, BSc and MSc qualification. One of the two has over 18 years of experience in freshwater culture and is presently pursuing Ph.D. studies on a part-time basis with University of the South Pacific and Queensland University of Technology. One staff has a Diploma and the other two have attended short courses in aquaculture. All the staff have attended short course on various aspects of aquaculture at overseas institutions through funding assistance of UNDP/FAO, Japan International Cooperation Agency (JICA) and funding by Fiji government. Most of the support staff have received practical training on hatchery and grow-out methods for specific commodities. The Naduruloulou Aquaculture Station offers a series of extension courses to fish farmers annually. The farmers maintain a close contact with scientists from the research station.

2. Brackishwater culture involves two projects: shrimp and milkfish. Presently technical staff are involved with over 20 support staff. There are two commercial shrimp farms in operation and a government demonstration milkfish farm. Of the 9 staff, 4 have a Diploma in Tropical Fisheries and all of them have attended short course at overseas institutions.

3. Mariculture includes seaweed, pearl, *Trochus* and giant clam projects. Currently 13 technical staff are involved with over 40 support staff. There are over 500 seaweed (individual farms), 2 experimental pearl farms and a government operated giant clam hatchery and grow-out farm. Of the 13 staff, one has a BSc, two have Diploma in Tropical Fisheries, and a majority of the staff have attended short courses and on-the-job training at overseas institutions.

Future Needs in Aquaculture Education

Aquaculture has been identified in Fiji’s Fisheries Plan; however, the track record of aquaculture development has so far fallen short of expectations. One factor contributing to this is the lack of any course or regular training programs on tropical aquaculture in Fiji. The training needs range from those at the community level to tertiary and postgraduate levels. An aquaculture industry requires the support of training and research programs if it is to succeed.

There is a critical need for managers and technical staff. In Fiji, the need for technical staff is often recognized and the key role of managerial staff is generally disregarded. Most of the aquaculture installations are managed by technical staff who hardly have any background in specialized farm or business management training.

It should be noted that researchers need a high level of scientific training in the principals of biology and in research methodology applicable to their cultured species and culture methods. Extension workers and technical support staff require more practical training on hatchery and grow-out methods for specific commodities as Fiji is now attempting large-scale aquaculture development projects.

Strategies for Meeting the Future Needs

Almost all the short-term training's or courses have been carried outside Fiji and as such this has to some extent limited the value of some of the training given. First, most of it has been given outside Fiji (tropics), remote from local farm situations. Second, while training in overseas institutions has been and remains vital in providing higher qualifications for Fijian trainees, it is clear that more training should be done in contact with real farm situations in Fiji.

The University of the South Pacific has proposed to develop an undergraduate course in the Marine Studies Program 5-year plan. Furthermore, the closing-down of the FAO/UNDP South Pacific Aquaculture Development Project Phase II in 1999 has prompted discussion among South Pacific Commission (SPC) member countries about the need for a Regional Aquaculture Strategy, of which training would be a major part. At the SPC Fisheries Technical Meeting of November 1998 in Noumea, member countries endorsed a paper outlining a draft strategy, in which the main regional institutions taking part would be SPC, ICLARM and USP. It is hoped that development of an undergraduate course on aquaculture and with short course training will contribute greatly towards the implementation of the Regional Aquaculture Strategy.

Opportunities and Interest for Regional Cooperation in Aquaculture Education

The key to closing most of the gaps between training needs and opportunities is for the University of the South Pacific and institutions involved with aquaculture to continue to upgrade their research and teaching programs and ultimately train their own technicians in graduate programs and technical courses. Countries with advanced aquaculture training facilities must continue to assess the impact of their training programs and be fully aware of their influence on trainees.

Another possibility is the future development of new international aquaculture centers devoted to specific commodities as has been successful for rice, wheat and maize etc. under the Consultative Group for International Agricultural Research (CGIAR) system. Such centers have been shown to be very effective in concentrating research and training. As aquaculture follows the pattern of agriculture and focuses on the few important commodities we may see similar developments.

In the end it all comes down to money, manpower and facilities. Increased expenditure on aquaculture research and development, including training programs, can only be justified by increased production. For this reason, the cooperation of smaller island nations, institutions and the private sector in training programs should be encouraged.

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Annex D13: The Fisheries University in Indonesia: Program of Study – Aquaculture Technology

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The Present

Introduction

The Fisheries University (FU) is a higher education institute in the fisheries field under the administration of the Ministry of Agriculture. The FU originated from the Academy of Fisheries established in Jakarta on 7th September 1962. The Main campus is located in Pasar Minggu, South Jakarta. In Indonesia, there are no other universities that run the Diploma IV Program, so far.

The FU formerly only offered one study program, Fishing Technology but has gradually expanded the number of programs of study to keep up with the fisheries development program of the Government. At the present time, the FU offers five programs of study, viz. Fishing Technology, Processing of Fisheries Product Technology, Fisheries Engineering, ***Aquaculture Technology***, and Aquatic Resources Management Technology. The Aquaculture Technology Program was started in 1981.

Since 1984, the Ministry of Education and Culture stimulated FU to offer the Diploma III Program, and by the end of 1987 the FU was also committed to run the Diploma IV Program (four-year Diploma). Simultaneously, the FU has developed its facilities with an out-station at a coastal area situated in Banten Bay, Serang, West Java, namely Serang Coastal Training Station. Serang station is a field training facility designated to meet the objective of producing and preparing the youth or graduates to enter the labor market as professional employment with high skill on aquaculture aspect.

Study Scope

The course program of Aquaculture Technology offers knowledge and skills on hatchery and rearing systems. Graduates of this program have the capability and competency to produce fry/seed and to rear finfish and shellfish in marine, brackish water and fresh water environments. The students must take a certain number of compulsory subjects. The subjects consist of 40% theory and 60% practical subjects. The number of credit semester that has to be completed by the student within eight semesters (4 years) is a minimum 144-credit semester unit and a maximum

159-credit semester unit. The study subjects are broken down into three groups: common subjects group, base subjects group, and specialized (advanced) subjects group. The numbers of credit semester units of those groups are revealed in **Table 1**.

Table 1: The distribution of credit semester unit of each subject group.

No.	Subjects Group	Credit Semester Unit			Percentage
		Theory	Practice	Total	
1	Common Subjects	15	1	16	10.39
2	Base Subjects	21	27	48	31.17
3	Specialized Subjects	27	63	90	58.44
T o t a l		63 (40.91%)	91 (59.09%)	154	100.00

Enrollment

The enrollment is announced annually through public advertisement and through dissemination of brochures. About 50 new students are recruited annually. The requirements of enrollment are as follows:

- Graduates of A1 (Physic) and A2 (Biology) of Senior High School and Fisheries Senior High School or equivalent.
- The maximum age of the candidates is 22 years old at the time of admittance.
- The minimum body height is 160 cm for male and 150 cm for female.
- The minimum body weight is 55 kg for male and 45 kg for female.
- Good condition of health and wearing no glasses.
- Pass the entrance examination. There are two kinds of selection. First selection is an academic examination consisting of several subjects i.e. English, mathematics, biology, physic, and chemistry. Candidates who pass the first examination will be allowed to attend the second stage of selection. The second selection consists of a physical and health examination and an interview test.

The candidates come from throughout Indonesia, and enrollment is performed through a zoning system. The first zone is Jakarta, which covers Java Island and Sumatra Island (the western zone) and selection is performed in Jakarta. The second is eastern zone that covers the rest of the islands of Indonesia. For the second zone, the selection is conducted in 11 capital cities of each province in the eastern part of Indonesia, viz. Jayapura (Irian Jaya Province), Ambon (Mollacas Province), Ujung Pandang (South Sulawesi Province), Palu (Center Sulawesi), Kendari (Southeast Sulawesi), Banjarbaru (South Kalimantan), Samarinda (East Kalimantan), Kupang (West Timor), Manado (North Sulawesi), Pontianak (West Kalimantan), and Palangkaraya (Center Kalimantan).

Educational System

- Four-year completion to achieve Diploma IV Graduate

- The subject courses are delivered in credit semester system. The number of the credit semester unit that has to be achieved by the student is mentioned above. The curricula are well defined. The routine revision is done at least once a year based on the needs of the labor market and the international, national, or local developments in the aquaculture field. Moreover, total revision is performed every 5 years.
- Physical and mental discipline practices are given in a "semi-military system". Therefore, the students must live in a dormitory during study period without any charging. Furthermore, the students do not have to pay tuition fee at all. The "semi-military system" is the characteristic of the FU. This system has resulted in high quality graduates characterized by being hard working, highly disciplined and highly confident people. From 1981 until now, the number of graduates from the Aquaculture Study Program include 564 persons from the Diploma III Program and 197 persons from the Diploma IV Program.
- Practical course activities are conducted using three methods: laboratory practices conducted on campus and field practices conducted off-campus, in the coastal village area, or in an aquaculture company/industry. There are three kinds of field practices, as follows:
  - First field practice is carried out for 2 weeks at the beginning of third semester. The aims of this practice are to know the general figures of fisheries and aquaculture activities in the coastal village and to know the life style of the coastal village community as well.
  - Second field practice is conducted in the Serang Training Center for 1 month at the beginning of the fourth semester. The aims of this practice are to improve the knowledge and the skill of the student in aquaculture.
  - The third field practice (integrated practice) is conducted in the partner industry for 1 month at the beginning of the sixth semester. The aims of this practice are to give students real field experiences on aquaculture operations, to improve the managerial aspect and to develop self-confidence level of the students.
- Writing a final report (thesis) is compulsory. The final report is based on the field practice that has to be performed for 4 months by the student. This report should be defended by the student at the end of the study period (semester 8^{th}).
- Evaluation system: mid semester examination, semester examination, and final/comprehensive examination.

The Number of Students and Lecturers

The number of students and lecturers are shown in **Table 2.**

Table 2: The numbers of the students and lectures.

No.	Group	Number	Percentage
1	Student		
	• 1st year	51	25.12
	• 2nd Year	46	22.66
	• 3rd year	52	25.62
	• 4th year	54	26.60
T o t a l		203	100.00
2	Lecturer		
	• Graduate	44	65.67
	• Master	20	29.85
	• Doctorate	3	4.48
T o t a l		67	100.00

In performing lectures, the FU has also collaborated with other institutions whether state/private university, government institution or private institution. The number of them are 82 lecturers which consist of 36 persons of graduate level, 30 persons of Master Degree and 15 persons of doctorate.

Facilities

- Office Building
- Lecture rooms
- Auditorium
- Meeting/Seminar rooms
- Student dormitories
- Dinning rooms
- Recreation center
- Swimming pool
- Sporting space
- Mosque and chapel

Training Facilities

- Laboratories: chemistry, biology, microbiology, toxicology, hydrology, and live food laboratory
- Workshop: mechanical workshop, electrical workshop, and feed mill workshop
- Hatchery units and rearing culture units
- Library
- Serang Coastal Training Station.

The Coastal Training Station is a technical operation unit that belongs to the FU. It was established in 1986 in order to provide the most appropriate environment for students to obtain good experience in a realistic aquaculture situation. The station is located in the coastal area of Banten Bay, Serang District, West Java Province and has area of about 20 ha. More than half of the area is covered by aquaculture culture ponds.

The facilities available in the station include:

- Office building
- Research and teaching facilities especially on the aquaculture field
- Library
- Laboratory and workshop i.e. biology, microbiology, chemistry, hatchery, mechanical workshop, and life food laboratory
- Student dormitories with the capacity of about 300 persons.
- Meeting room
- Ten hectares of nursery and rearing ponds for training and for research purposes.
- Demonstration ponds
- Tennis court

Partnership

Partner Village

To make the graduates familiar with their field, they need to know the daily life and activities of fishermen and fish farmer and their families in the coastal village. To meet those needs, FU chose Lontar Village, Serang District, West Java Province as a partner village and as a field laboratory. In the partner village, the students are able to get to know the real life of fish farmers and their families, existing aquaculture technologies, and the agribusiness system that works in the village. The lecturers have also opportunities to do research or field study in the village. For the village community (fish farmer), FU supports technical and managerial development, facilities, and provides advice for solving problems faced by the fish farmers.

Partner Industry

Instead of the partner village that is dominated by traditional way of aquaculture, the other aquaculture methods are semi-intensive and intensive way performed on an industrial scale. As in the partner village, the FU uses the partner industry as a location for students to study and practice on aquaculture technology. Amongst the partner industries are the following:

- National Shrimp Project located in Labuan District, West Java, that is under the administration of the Directorate General of Fisheries and produce shrimp fry.
- Brackish Water Development Project located in Labuan District, West Java, that is under the administration of Directorate General of Fisheries and undertakes shrimp culture.
- Tri Sumber Windu Co. Ltd. located in Serang West Java, is an aquaculture company and operates an intensive shrimp culture system.
- Mutiara Biru Co. Ltd. located in Tangerang, West Java, is an aquaculture industry which has several aquaculture activities, including eel culture, shrimp culture, milkfish culture, and a shrimp hatchery.

The Future

Employment Prospect

Indonesia is the largest archipelago country in the world consisting of more than 17,500 islands with a coastal length of about 81,000 km. Those figures show that Indonesia has high potency in aquaculture activity. Recently, the Ministry of Agriculture has declared a program "*to increase the export of the fisheries product 2003*", called *PROTEKAN 2003*. Shrimp aquaculture is seen as an important contributor to the objectives of the program, meaning that labor with high skills in shrimp culture techniques will be required. The FU is the only higher education institutes in Indonesia that runs an Aquaculture Study Program focussing on such skills. Therefore, the FU will play important role in supporting the development of aquaculture in Indonesia by providing professional employment.

Training Facilities

Training facilities are important to produce professional graduates. The FU has planned to establish a Fresh water Station Center. Recently, the FU has identified some locations in Sukabumi District, West Java Province as a possible site. Besides that, the Serang Local Government has allowed the Serang Training Station Center to manage two small islands situated in Banten Bay for mariculture activities for production, training or research purposes.

Annex D14: Aquaculture Education in Pacific Island Countries

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Abstract

Despite past disappointments, interest in aquaculture in the Pacific island countries remains high. Realization that there is a need to learn from the past has placed new emphasis on aquaculture education.

The region's main tertiary educational institution, the University of the South Pacific, has responded by creating a new Lecturer in Aquaculture post, and now possesses a modest aquaculture facility. A regular university course in aquaculture will commence from July 2000. Additional external funding from Government of Canada has been obtained for curriculum development work for a range of aquaculture short-course modules aimed at community, private-sector and public-sector stakeholders in aquaculture. Other funding from the same source is available for post-graduate scholarships in marine science, some of which have been on aquaculture-related topics.

A Regional Aquaculture Strategy is being developed by Pacific island regional organizations to coordinate their various existing or proposed activities in support of aquaculture in their member countries. USP will help to implement this strategy through its new aquaculture training activities, and through post-graduate research.

The Pacific island region is ready to make a big stride forward in aquaculture education. The NACA Expert Consultation on Aquaculture Education (Hanoi, 11 – 15 May) is therefore very timely for our region, and has the potential to assist us greatly.

Introduction

Aquaculture is identified as a priority in most Pacific island countries' national fisheries plans; however there are currently no regular courses or training program available. The training needs range from those at the community level to tertiary and post-graduate levels. A successful aquaculture industry requires the support of training and research programs if it is to succeed. There is also need for support of aquaculture industries by Government in the form of legislation, environmental monitoring, allocation of aquaculture sites, quarantine, and research & development. However skills in these areas are scarce.

Aquaculture in Pacific Island Countries

Intensive aquaculture is a new industry to most Pacific Islands Forum countries (the "Forum Island Countries" or FIC's), although low-input aquaculture has been traditionally practised in some places for many centuries (for example, Hawaii, Cook Islands). Many of the so-called Pacific "micro-states", wanting to stimulate economic development but with meagre natural resources, have identified aquaculture along with capture fisheries and tourism as ways to promote economic growth based upon their natural advantages, which are clean waters and high marine biodiversity. Advantages relevant to aquaculture (Bell 1999) are:

1. High diversity of marine species, many of which have high value in overseas markets for seafood, pharmaceuticals, or aquarium fish;
2. The bigger island groups have a large number of potential aquaculture sites, owing to the huge area of sheltered lagoon waters within island archipelagoes;
3. Many FIC's have a relatively cheap labor force, along with few competing economic opportunities in rural areas.
4. Some countries like Fiji have a central location in the Pacific that is at the hub of Pacific air and sea transport routes to metropolitan countries of the Pacific rim;

However progress to develop aquaculture in most Pacific island nations has been disappointingly slow. Constraints on aquaculture can be technical, socio-economic, and environmental, and many of these constraints are particularly marked in Pacific island developing countries though certainly are not unique to these countries. Experience has shown that, owing to cultural and economic differences, aquaculture developments cannot always be directly transplanted from SE Asia to the FIC's.

Some of the leading constraints are as follows:

Lack of trained personnel. Fish farming requires biological knowledge and understanding of culture requirements, plus technical skills in operation of equipment and skills in small-business management. Governments need personnel able to support aquaculture industries in the fields of legislation, environmental monitoring, allocation of aquaculture sites, quarantine, and research & development. Some of these skills are lacking even in more-developed countries, and are particularly scarce in the Pacific island developing countries.

Lack of supporting infrastructure. Many forms of aquaculture require engineering services, biological expertise, refrigeration, or processing facilities, in addition to such fundamentals as electricity, freshwater supply and telephone. Some places like Fiji are considered to be quite "developed," however this description applies only to the coastal rim of the two main islands, Viti Levu and Vanua Levu. Fiji's outer islands and interior share the same infrastructure constraints as any other "micro-state" in the Pacific.

Distance from export markets. Pacific Islands are isolated by ocean, and transport costs to export markets are very high. The time taken to reach destinations can be a problem for export of live organisms. Any fisheries products from Pacific island countries will be competing with similar operations in SE Asia that are much closer to the important Japan, Chinese Taipei and Hong Kong markets for high-value seafood.

Small domestic market. The local markets for seafood are relatively small and for the most part unwilling to pay top gourmet prices, however the exception is the tourism industry of some countries, which represents a good local marketing opportunity for selected aquaculture products.

No aquaculture tradition. In some FIC's such as Fiji, Vanuatu or the Solomon Islands, aquaculture is not a traditional activity. It can be hard to convince local communities that they should integrate aquaculture into traditional subsistence lifestyles, where it must compete as a part-time activity with their other subsistence needs and community obligations.

Poor management and planning. There has been a tendency in the past to concentrate on the technical aspects of aquaculture production, and find out too late that market volumes or prices are insufficient to sustain the operation. Ventures must be market-driven, and large-scale production should not begin until market studies are complete. There has been a poor past record of success with aquaculture in the Pacific island countries, though this trend is not unique to the Pacific. Various writings by Uwate and Kunatuba (for example, Uwate 1984) provide case studies of regional failures, and analysis of the reasons behind them. According to Davy and MacKay (1999), there has been a global trend of problems in aquaculture development among less-developed countries, and this poor image is now affecting support for the aquaculture sector by development agencies.

Despite these constraints, and despite the unglowing track record of aquaculture development in the Pacific region so far, support for aquaculture development remains high. Not all of the above constraints apply to all types of aquaculture, and many can be avoided or mitigated by appropriate training, management and planning.

Pacific island governments are generally supportive of aquaculture development because they see a need to:

1. Increase the productivity of fishery resources;
2. Ease the pressure being placed upon natural fish stocks. Many high-value inshore species are severely depleted in some areas (for example giant clam, spiny lobsters, groupers, beche-de-mer) because of high demand and relatively easy access;
3. Reduce imports and place greater reliance on local resources, to save foreign exchange and avoid "leakages"of revenue from industries like tourism. For example, much of the seafood served by resort hotels in Fiji is imported;
4. Increase export earnings, to gain foreign exchange. Aquaculture is a significant export earner for places like Philippines and Okinawa, and Pacific island countries could follow suit.

5. Increase employment, especially in rural areas to reduce urban drift. Aquaculture requires farm labor, and needs to be sited in clean water away from urban or industrial developments, so it goes hand-in-hand with rural development;
6. Improve food security and human nutrition in many rural areas. For Pacific island countries fish is the main source of protein in human diets, however in the interior parts of high islands like central Viti Levu, fish are scarce. Subsistence-level tilapia aquaculture is one way to overcome nutritional protein deficiencies in these communities;
7. Support private-sector business growth and economic development generally. In theory (though not always) the private sector has the best information to bring about economic growth, to generate jobs and income for a nation. A focus of FIC government activities, and of assistance from aid donors to the Pacific, is now to provide support for private sector development. Aquaculture can be a useful part of this trend.

The size of the economies of Pacific island developing countries is small, and a large proportion of the population are part of the subsistence economy rather than the cash economy. The pool of domestic savings available for investment is therefore small, so Pacific island developing countries rely heavily on either foreign investment or external economic assistance to achieve economic growth. Most FIC governments place a high priority upon economic growth, and see attraction of foreign investment as vital to achieve this

Current Economic Contribution From Aquaculture

FAO statistics for worldwide aquaculture production by region show that Oceania always comes last in terms of both tonnage and value (FAO 1999). Even then, the Oceania figures are dominated by Australia and New Zealand production of pearl oyster, edible oyster, salmon, and mussels, with Pacific island aquaculture production being globally insignificant. Nevertheless, aquaculture has the potential to be regionally very significant in these smaller economies, as export earners, for import substitution (particularly to support tourism industries), and for food security. Income from pearl aquaculture is now a mainstay of the economy in the Cook Islands and French Polynesia.

Aquaculture Training in the FIC's

While aquaculture is identified as a priority in most FIC national fisheries plans, there is currently no course or regular training program available in the FICs. There has been training offered on an irregular and piecemeal basis, for example an FAO/UNDP SPADP Tilapia Farming Workshop in Fiji in October 1995, a USP/SPADP Regional Seaweed Farming Training Workshop in Fiji in May 1999, and JICA/USP Training Course on Sustainable Use of Coral Reef Fisheries Resources with Special Emphasis on Shellfish Production and Release in Fiji and Tonga in February 2000. However the aquaculture training needs of the region range from those at the community level and short-course in-service training through to tertiary and post-graduate levels.

A feature of the Pacific island countries is their strong support for “regionalism”, in other words for political and economic cooperation through regional institutions, such as the Pacific Islands Forum Secretariat, Secretariat for the Pacific Community (SPC), Forum Fisheries Agency (FFA), South Pacific Regional Environmental Program (SPREP), Tourism Council of the South Pacific (TCSP), and the University of the South Pacific (USP). So far, aquaculture has been a peripheral part of the activities of these organizations.

Assistance in aquaculture development has, however, been provided over the last decade or so by two international organizations, the International Centre for Aquatic Resources Management (ICLARM) in Solomon Islands, and the UNDP/FAO South Pacific Aquaculture Development Project (SPADP) based in Fiji Islands. ICLARM carries out long-term pre-commercial research and development (with a focus upon giant clam and beche-de-mer), while SPADP offered small-scale technical assistance and training. SPADP came to an end in 1999, and ICLARM’s operations are in the process of being reduced and restructured owing to the recent ethnic unrest on Guadalcanal Island in the Solomon Islands.

Marine Studies Program at the University of the South Pacific

The University of the South Pacific is a regional tertiary-education institution that is jointly owned by twelve FIC’s, Cook Islands, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, and Samoa. The main campus is at Suva in Fiji Islands, with a School of Agriculture in Samoa, a School of Law in Vanuatu, and a University Centre in each of the member countries. Distance education is extremely well developed and is the envy of other regions in the world, however distance mode has not yet been utilized for aquaculture education at USP. Most USP graduates become employed by the member-country governments or education systems, however NGO’s and the private sector are also significant employers.

The Marine Studies Program (MSP) is an inter-disciplinary, University-wide program, whose mission is to (1) provide the necessary opportunities for Pacific Islanders to understand, conserve, develop, manage and utilize their living and non-living resources in a rapidly-changing world; (2) provide Pacific Islanders with the widest possible range of opportunities for research, education, training and employment in the marine sector; and (3) provide for improved collaboration between the University of the South Pacific, island nations, regional and international bodies in their common goals in the marine sector.

The need to develop an undergraduate aquaculture course was identified in the MSP 5-year plan, and a new Lecturer in Aquaculture position has now been created, with the post to be filled starting in July 2000. In 1998 a new Marine Studies Centre, which contains a modest aquaculture facility, was completed in Suva through support from the Government of Japan. The Japan International Cooperation Agency (JICA) in 1999 provided a short-term Japanese Expert to USP to assist with aquaculture program development, and will in future provide another expert on aquaculture engineering. An Aquaculture Training Project proposal, to cover development of regionally-appropriate aquaculture course materials and to enable the running of community workshops, private-sector and public sector in-service training, and undergraduate teaching, was submitted by MSP to the Canada & South Pacific Ocean Development Program (C-SPOD). Funding for this Aquaculture Training Project USP04 has now been approved.

Coordination of Regional Organizations' Aquaculture Activities

In a parallel initiative, the winding-down of FAO/UNDP SPADP in 1999 prompted discussion among SPC member countries about the need for a Regional Aquaculture Strategy, of which training would be a major part. At the SPC Fisheries Technical Meeting of November 1998 in Noumea, member countries endorsed a paper outlining a draft Regional Aquaculture Strategy, in which the main regional institutions taking part will be SPC, ICLARM and USP. At the 1st Heads of Fisheries Meeting in August 1999 the draft strategy was strongly re-endorsed and SPC was urged to continue looking for donor support to implement it. The draft strategy proposed that existing regional organizations with a role in aquaculture should coordinate their activities in an agreed fashion to make best use of scarce resources and funding. USP was identified as the main provider of training needs and of short-term research for aquaculture in the region, ICLARM as the provider of long-term commercial-scale research, and SPC through their Coastal Fisheries Program is to have a coordination role plus a training role.

USP intends to direct C-SPODP support under the Aquaculture Training Project USP04 toward fulfilling USP's role in this Regional Aquaculture Strategy.

C-SPODP/USP Aquaculture Training Project USP04

The **goal** of the project is to contribute to the development of a diversified, economically viable and sustainable aquaculture industry (both commercial and non-commercial/subsistence) in Pacific Island countries. The **purpose** is to improve public-sector institutions (Government departments, NGO's, RPO's) and private sector capacities to implement successful aquaculture development projects.

The project will be done in conjunction with related initiatives of the MSP, which among other things include

- the completion of the new MSP facilities on the USP Suva campus, which includes some basic installations for aquaculture teaching and research;
- the presence of four core-funded USP staff with expertise/interest in technical or socio-economic aspects of aquaculture, and the creation of a new post at MSP entitled Lecturer in Aquaculture;
- development by MSP of a detailed strategy for aquaculture training and development in association with the private sector both regionally and in Canada, as part of the Council of Regional Organizations of the

Pacific (CROP) Marine Sector Training Needs Assessment Project (Project USP-01 funded by C-SPODP);

- development of MSP's Institute of Marine Resources (IMR) facilities to, among other things, enable aquaculture research and training in Solomon Islands
- MSP's Atoll Research Activities unit in Kiribati has the capability to include aquaculture as part of its marine development mandate for the atoll countries
- the current development within MSP of an aquaculture R&D program with funds being sought from the Japan International Cooperation Agency;
- past collaboration by MSP with FAO/UNDP SPADP and Fiji Fisheries Division (focussing mainly on seaweed aquaculture);
- establishment of "MSP-Train" within MSP to provide capacity for training at all levels and to coordinate the training aspects of this project, while International Oceans Institute-South Pacific (IOI-SP, an international NGO based at MSP) has capacity to develop marine awareness aspects.

The **activities** specific to the aquaculture training project, which will be conducted over three years, fall into three main areas.

1. *Adaptation and, where necessary, development of regionally- and gender-appropriate aquaculture training materials.* Curriculum development work on aquaculture courses and modules for offer in the region. Priorities are to be guided by the outputs of USP01 Marine Sector Training Needs Assessment, and will take into account views about training needs from government, community, business, and tertiary education sectors in the region. Once priorities have been identified, course materials will be developed either in-house or sub-contracted, as necessary. "Course materials" will include both written material (manuals, handbooks, literature, etc) and any small items of equipment needed to offer the course.

2. *Offer of regionally- and gender-appropriate in-country aquaculture training courses utilizing regional and Canadian trainers*. During the lifetime of the project, the courses that have been developed under (1) above will be offered to regional participants from Government, community and business sectors involved in aquaculture. (Note that it is planned to continue to offer these courses beyond the life of the project, subject to additional funding support).

3. *Training of regional personnel through training attachments within and outside the region.* Where training needs are identified that either require work-experience components or which cannot be met from within the region, then these will be met by funding personnel on short- to medium-term training attachments within or (if necessary) outside the region. The priority areas for such attachments will be identified under C-SPODP-II Project USP01.

Expected **results** and **impacts** include the following*:*

- Increase in economically-viable and sustainable aquaculture projects in the FIC's;
- Improved public-sector support for private-sector aquaculture development (both commercial and non-commercial);
- Improved links between regional organizations and in-country stakeholders in aquaculture;
- Increased capacity to meet regional aquaculture training and project implementation needs;
- Development of regionally-appropriate training courses and materials;
- Increased access of all stakeholders, including women, to training and education programs required for successful implementation of aquaculture projects;
- Acquisition by USP of capacity to operate plant and equipment supplied under other donor initiatives;
- Enhanced links with private sector to provide technical "critical mass" in support of commercial and subsistence aquaculture.

The projects **beneficiaries** will be:

- USP and its 12 member countries,
- SPC countries,
- public and private sector aquaculture personnel.

Post-graduate Research in Aquaculture at USP

Another important component of aquaculture training is in scientific research techniques. The Marine Studies Program is being developed as a center of excellence in post-graduate marine scientific research, of which aquaculture research is already a part. Recent research topics for Masters of Marine Science or PhD at USP include studies on giant clam mantle color, blacklip pearl biology and reproduction, and *Gracilaria* seaweed environmental tolerances and agar quality.

Student numbers have recently been boosted by the availability of post-graduate marine science scholarships funded under C-SPODP. However this arrangement has a finite lifespan, and there is room for other collaborations in post-graduate research to be developed.

Future Needs in Aquaculture Education

The Pacific island region is poised to make a leap forward in aquaculture education. Despite past disappointments, interest in aquaculture remains high. Realization that there is a need to learn from the past has placed new emphasis on aquaculture education.

The region's main educational institution, the University of the South Pacific, has responded by creating a Lecturer in Aquaculture post within its Marine Studies Program, and a modest aquaculture facility has been completed. A regular university course in aquaculture, taught in collaboration with Fiji Fisheries Division and the aquaculture private sector in Fiji, can now become a reality. Additional external funding under C-SPOD has been obtained by MSP for curriculum development work on a range of aquaculture short-course modules, aimed at community, private-sector and public-sector stakeholders in aquaculture.

A Regional Aquaculture Strategy is being developed to coordinate the activities of regional organizations in support of aquaculture in their member countries. USP will help to implement this strategy through its aquaculture training activities, and through post-graduate research.

To build upon the progress that has been made so far, we in this region are looking to establish appropriate collaborative links that will assist us to:

- Review the aquaculture education resource materials that are currently available;
- Introduce regionally-appropriate aquaculture training materials into our curricula, without “re-inventing the wheel”;
- Make necessary contacts for mutually-beneficial exchange of information, and for obtaining any assistance or expertise needed for course development work;
- Make contacts with potential aquaculture trainers or education providers to help offer particular courses in our region;
- Establish collaborations in post-graduate research.

The NACA Expert Consultation on Aquaculture Education is therefore very timely for us at USP. It affords us an opportunity to find out at first hand the very latest developments in aquaculture education, to make valuable personal contacts, and enable us to begin the task of selecting specific aquaculture topics and educational materials that will be appropriate for introduction or modification in the Pacific island region.

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Annex D15: Needs and Development of Aquaculture Talent in China

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Aquaculture Education

Aquaculture education in China started at the beginning of 20th century. In 1946, the aquaculture department was founded in Shandong University. Shanghai Fisheries College was founded in 1952 and Zhoushan Fisheries College in 1958. Since 1978 Dalian Fisheries College, Zhanjiang Fisheries College and Xiamen Fisheries College were set up in turn. Aquaculture departments have also been established in agriculture colleges. In 1985, Shanghai Fisheries College was upgraded into the Shanghai Fisheries University. The blossoming of aquaculture education in the recent years is to support the educational requirements for development of aquaculture production and aquaculture as a science.

Development of Aquaculture

Aquaculture in China is transforming from a traditional practice into an economically important industry producing high quality products.

Aquaculture in China has a long history. The traditional cultured fish are grass carp, bighead carp, silver carp, common carp and so on. Since the implementation of reform and the open door policy, the requirement for aquatic products has increased with the development of the economy and living standards. Precious aquatic products, such as marine fish, prawn, crab, soft-shell tortoise, eel and shellfish have become common dishes. The breeding and culture of precious aquatic species has gradually replaced traditional aquaculture, which tend to give lower economic benefits to producers.

Due to the relationship between aquaculture and market economy, cultured species are now developed based on market demand. The success in changing aquaculture production in response to market demand and the new economic situation is greatly dependent on scientific research and technical development.

Development of Aquaculture as a Science

The development of aquaculture is dependent on the evolution of aquaculture science and techniques. In general terms, future aquaculture science will probably focus on the following three aspects:

(1) Research on genetic resources and breeding. The culture species is the basic requirement of aquaculture. Selecting and breeding good species is an effective way to increase production. So, there is a need to study

the genetics and diversity of aquatic animals. On the other hand, biotechnology may be utilized to reconstruct their genetic structure so that new species can have good characters, such as fast growing, disease resistance, cold and heat tolerance and so on.

(2) The second aspect is research on the nutrition and feed of aquatic animals. To prevent disease (rather than curing disease), people need to study the nutritional balance and nutritional requirement for cultured species. The aquaculture animal's utilization of nutrients can be enhanced by studying their nutrition, immunity can be understood in part by studying nutrition and immunity, pollution can be reduced by studying the nutrition and environment, and food quality can be improved by studying nutrition and quality of aquaculture products.

(3) The third aspect is research in the fishery environment. The quality of fishery water has been an obstacle to the continued development of aquaculture. So we need to reinforce the monitoring and appraisal of the fishery environment. Studies should be carried out on the impact of environmental pollution on fishery water, aquaculture impact of wastewater on the quality of environment and the regulation and treatment of fishery water.

Need for Trained People in Aquaculture

With the development of aquaculture production and aquaculture as a science, there is increasing need for the skilled people in aquaculture at various levels, such as teachers, researchers and technical levels. Technicians are required because of the emphasis on aquaculture as a science. They have to be not only familiar with breeding and culture, but also need to have a solid knowledge foundation and proficient skills, so that they can change culture species to suit the market demands.

The directors of fish farms should not only be familiar with technique in aquaculture, but also have sufficient knowledge of management and marketing.

To develop industrial culture, the talents with knowledge in biotechnology, environmental engineering and automatic control are required.

To develop "leisure fishing", the talents engage in ecological culture. The construction of aquarium in big cities requires talents in industrial design, water treatment, culture technique and so on.

Due to the various demands for the talents, there are diversified levels of aquaculture education in China. Vocational schools have responsibility to train technicians with strong practical skills, as well as basic theoretical knowledge.

The program at bachelor level aims to train the talents who have a wide range of basic knowledge including mathematics, physics, chemistry, biology and environmental science, and strong practical skills. They need to grasp the basic knowledge and skills in the enhancement and culture of aquatic animals and plants, nutrition and feed of aquatic animals, prevention of aquatic diseases and breeding. They also need to know the current status and future trends in the enhancement and culture of aquatic animal and plants.

The education program at Masters and Doctoral level is required to develop students ability to explore and create, provide good knowledge, promote a team working spirit, develop their sense and ability to practice and develop their sense of the environment.

Future Developments

Education Combined with Production and Research

The teaching program of aquaculture includes theory and practice teaching. Before the reform of Chinese aquaculture education the teaching program was focused on the theory and technique of enhancement and culture of traditional cultured fish. Because this knowledge was generally behind the current state of aquaculture production, student's practice teaching was not welcome to fish farms. Though some farms agree the University had to pay lot for practice teaching. It fell into dire straits.

At that time, aquaculture was developing rapidly. New projects in aquaculture science came out and research was required to keep pace with development. This change forced us to reform the undergraduate aquaculture education. The teaching program had to mirror scientific and technical development of aquaculture. Students had to have practical experience in fish farms. Farms need new technique and new cultured species in order to profit. The University had superiority in aquaculture science.

In such circumstances, education could be combined with production and research. The teachers who had new scientific techniques could guide the students to the farms and help farms overcome difficulties. Farms provide expenses of transport, accommodation and part food to the teachers and the students. The teachers and the technician of the farms have exploited breeding of precious aquatic animal and written proposals for joint project to overcome new difficulties in aquaculture production.

This education model benefited students, farmers and teachers/researchers. The students get to know the current status and new skills of aquaculture production. The student's ability to analyze and solve concrete problems is improved. The research ability of young teachers has developed. The research that focuses on production difficulties also help promotes the development of aquaculture as a science. New scientific techniques have helped the development of aquaculture production and the farms have made good profit.

Cooperative Education Among Universities

Well-trained aquaculturists are required by all parts of the country. The development of aquaculture education is uneven in China. So there is undergraduate cooperative education among universities. For example, the Shanghai University and ChangDe Normal College, JiangXi Agriculture University, YanTai Normal College cooperatively foster students respectively. The students learn basic courses in JiangXi or ChangDe or YanTai at first two years, and specialized courses in our university at last two years.

Our university is going to cooperate in postgraduate education with ZheJiang Ocean College.

Cooperative Education Between Universities and Research Institutes

Universities engage famous experts as part-time professors or consultative professor from research institutes. Joint cooperation in postgraduate student studies has also been set up. Both advantages enhance teaching and research.

Adult Education

Because of development of the science and need to renew the knowledge, adult education is becoming more important. Training classes have been non-periodically carried out. Experts give fresh knowledge, idea and strategies in aquaculture production and management.

Annex D16: Education to Farmers: Process Adopted, Observed Impact and Lessons Learned in the GOLDA Project of CARE Bangladesh

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Introduction

The Agriculture and Natural Resource Sector of CARE Bangladesh has been working intensively in the area of agriculture for almost a decade and currently there are nine major projects under operation in the sector. These projects are broadly categorized into three groups: projects with focus on rice-fish are brought under a rice-fish program (four projects), while those projects which are looking at homestead activities covering vegetable cultivation and agro-forestry are included under a homestead program (three projects) and the projects which are largely experimental in nature are grouped under pilot initiatives (two projects). All the projects work directly with farmers at the grass root level with over 1000 staff spread in different parts of the country and serving over 100,000 families annually. The basic approach used in all projects is to enhance knowledge and skills of farmers to solve problems encountered by themselves. This approach has been found to be effective in creating some sustainability for the activities initiated through various projects and in many instances, the approach has led to lateral spread of technologies.

The Greater Options for Local Development through Aquaculture (GOLDA) has been designed to address the problems of *gher* farmers. The project is under operation in the southwestern part of Bangladesh and it aims to improve the economy of people involved with the *gher* activity by enhancing their knowledge and problem solving skills. The project is supported by the Department for International Development of the UK (DFID).

Genesis of the Project

The cultivation of freshwater prawn, *Macrobrachium rosenbergii*, in the modified rice fields with peripheral canals and wider dikes is locally known as the *gher*. This is a system evolved locally by the farmers about two decades ago, probably to cope up with the problems associated with rice cultivation. These problems are - low profit from rice cultivation, frequent crop loss due to floods, unsuitability of many areas for cultivation of paddy due to water logging, etc. The easy availability of freshwater prawn seed in the local rivers and the high price of prawns in the international market appear to have prompted several farmers to venture in to this activity. Currently, it is estimated that there are over 50,000 farmers spread in different parts of Southwestern Bangladesh, and on an annual basis, about a 10% increase in the number of *ghers* can be seen.

With the rapid expansion of *ghers*, there has been an emergence of a number of unsustainable cultivation practices. This resulted in farmers facing much more challenges to meet their livelihoods. Some of the major problems noticed in the systems are:

1. Intensive exploitation of snails for feeding to prawns.
2. Heavy mortality of other species seed during the collection of prawn larvae and almost total dependence of farmers on wild caught seed.
3. Almost complete emphasis of farmers only on the prawn component
4. Heavy usage of chemical fertilizers and pesticides for cultivation of paddy in the central portion of the *gher* during *boro* (rice planting) season.
5. High cost of credit: farmers borrow money to meet major input costs like seed and feed with very high interest rate of 10-12% / month

With a view to address these problems, the GOLDA project was developed by CARE and it has been in operation since 1996. The project looks at the farm holistically through the concept of a farming system and based on a number of analysis made with farmers, key intervention areas covering agriculture, horticulture, aquaculture, environment and social sectors have been identified.

Agriculture

Currently, rice is grown mainly during the *boro* season. It is an important part of the system, but with the major focus on prawns, the benefit that could be derived from the cultivation of this crop all throughout the year has not been exploited. Secondly, pesticide usage and unbalanced fertilizer application has been causing heavy damage to the environment even through the only one crop is cultivated during *boro* season. An opportunity to educate farmers to change their cultivation strategy and undertake two-three rice crops, instead of only one crop was seen as a good area for intervention.

Horticulture Crops

Large size dikes available with most *ghers* are either unused or underused in most cases. As a result the economic benefit that could be derived from this component has not been fully exploited by the farmers. Here again, for vegetable cultivation, pesticide usage is common.

Aquaculture

Many of the cultural practices currently followed by the farmers are environmentally unfriendly. Heavy exploitation of the snails by the farmers to feed prawns is expected to have a severe impact on the ecology, since an important component of the system would be removed through this exploitation. Farmers have perception that hatchery produced seed do not grow well like the seed collected from the nature. In addition, focus on prawns has also led farmers to be more vulnerable, if there is risk.

Environmental and Social Issues

The negative consequences of unplanned *gher* construction appear to have resulted in water drainage problems. In addition, problems are added to the environment from this system because of heavy exploitation of snails, pesticide usage, etc. There are also some of the social problems that have emerged because of this system – like increased dowry, conflicts in the community, loss of employment for certain groups of people, etc.

Process

The project has a goal to improve the economic situation of 15,000 farm households through the five-year project. Since the project has an household approach, in essence it has to impart education and have measurable impact on 30,000 individuals. To reach this large target audience and still have a sustainable impact, project staff structure and intervention strategies are designed to meet the field needs.

Currently, there are nearly 160 staff at different levels and more than 45% of them are female. The field trainer is the extension agent and through him/her, changes are enacted at the farmers level. The project officers, whose major responsibility is managing the implementation of the activities, directly assist these staff spread in the target area. These field-based staff are supported by Technical personnel from different disciplines of the intervention areas that have been identified above. The coordination unit coordinates the entire project with the Project coordinator being responsible to coordinate this process. The project derives regular support from the other projects/ support units of ANR and from the Institutional Learning Unit of CARE particularly in area of monitoring and evaluation, partnership, gender and livelihoods.

Foundation Training for the Staff

Excepting for the Technical positions, all other positions are filled with the people from varied backgrounds. While this provides an opportunity to work with farmers with people from different background, it also provides great challenge to bring the level of understanding of all these staff to a common level so that they help farmers in such a way to help themselves. None of the CARE projects have no input support or credit support to the participants and have to solely work on the knowledge. The Technical team only acts as a supporting team to these staff in implementation of various activities and they do not interact directly with farmers. The field trainer has to deal with farmers on aspects related to agriculture, aquaculture, farm finance, environment, social issues, etc. In order to ensure that staff gain the confidence to address these varied and complex issues, they are given training over a period of one rice crop cycle with heavy emphasis on facilitation process and the learning strategy that has to be adopted in addressing varied problems.

Approach

Experiential learning cycle is the approach that has been used by the project to build knowledge of the staff as well as farmers. The duration of such a training is actually one full crop cycle to ensure that staff gain good understanding on the concept. However, for training of staff paddy crop has been taken as the basis since the aquaculture crop cycle is generally longer.

Experiential Learning Cycle (ELC)

The training approaches used are participatory in nature and the participants learn most of the activities by doing. The field trainer will act largely as a facilitator rather than trainer. It is the responsibility of the facilitator to create a conducive, threat free and friendly atmosphere to ensure maximum participation and output from each participant. It is argued that every human being has the potential, but that potential can be unearthed only when there is happiness for the mind, lack of fear and self-confidence. Usually farmers tend to underestimate their capacity (or the facilitator) and do not take part in the discussions freely. Creating an environment for the active participation of all is a challenge for the facilitator. The experiential learning approach is an important step forward in the adult learning process, wherein the learner not only learns it by doing, but makes the participants experience a thinking process (Fig. 1). Kurit developed this concept in 1980 and it believes that adult learners are not an empty pot but they are full of experiences and knowledge. Hence, when others recognize adult learners, then they will be enthusiastic in learning.

Key elements of experiential learning:

- Respect for the experience and knowledge of the farmers
- Built upon learners experience and based on self-learned discovery
- Information that is given is not as valuable as self-learned concepts
- ELC is not complete until the learner has made observations, processed, generalize and applied them
- It is a cycle; it leads to new experiences, new problems and new questions

Learn In Village Environment (LIVE)

As part of the training course, every staff was made to stay in the village with the *gher* farming family with an objective of helping the staff to gain good complete understanding of the life of farmers beyond the technical issues.

Attitudinal Changes

When the idea of LIVE was proposed, staff did not have positive attitude to stay with farmers. Staff had their own doubt and expressed that they would not learn anything more than what they have observed externally. The reluctance of staff to stay with farmers was proportional to the level of education staff had. However, as this was part of the course staff had no option except to agree with the proposition. Some of the common norms to be observed, while with the families were developed and agreed upon prior to movement to the villages.

Completion of staff stay in the farmers' residence and the evaluation of their impact revealed very interesting and positive scenario from almost every participant. Staff expressed that they could learn many new aspects of the households, which they did not experience earlier. The attitude of most of the staff changed and they recommended that this should be part of every new staff training. The major learnings of the staff were

- Practical experience in the process of building relationship with farmers was understood
- Communication skills with farmers has been improved
- Could feel the sufferings, pains, wants, hopes and aspirations of the farm families
- Obtained good idea on the farming system of the farm families, particularly in respect of the work schedule of the farmers
- Learned about the financial flow of the families and the role of borrowed credit in meeting various needs. This was possible for the staff as they became slowly part of the family and were able to get good understanding on what is happening in the family.
- Gained good understanding on the social issues, particularly in regard to the female participation in the family decision process.

Overall Impact of Foundation Training on the Staff

Experience indicate that the benefits that has been derived from the provision of such a common training to all the project staff has brought many benefits to the staff and the project. The major changes that were observed in such a training were

1. Confidence in the process. Traditionally staff have been used to obtain a ready-made solution for every problem by the experts. The new approach helped them to learn the strategy of making the farmers analyze the situation and help to think critically to find solution to the problem.
2. Necessity of looking at various issues on the farm from the systems perspective instead of a narrowly focussed approach of any one particular component.
3. Change in the attitude of people to place farmers priority first and develop plans based on the farmers need.

Following completion of the training, staff were deployed to their work site in various locations. A pair of male and female field trainers (FT) were placed in each area and each of them should handle five groups of farmers. While male FT is responsible for male, female FT is generally responsible for female group. However, these gender-based roles are changed depending on the conservative status of each area.

Formation of Farmer Groups

Support to farmers is provided through group approach by following the farmer field school philosophy, wherein farmers learn in a group environment and have the opportunity to discuss with other farmers. This approach has been found to be effective both from the viewpoint of serving large number of farmers and also reducing cost. In each group, there will be a maximum of 20-25 farmers and these farmers meet once in 20-25 days depending the agreed plan, date, time and place. Formation of homogenous groups with almost similar interest is important to keep up the integrity of the group and also identify issues that have common interest and relevance to many people.

Family Approach

In the GOLDA project, a family approach has been initiated from the very beginning and one of the pre-condition for farmers to be members of the group is that both male and female members of the family should agree to attend the sessions regularly. This approach has been adopted to bring not only gender equity in the approach, but also to ensure sustainability for the activity. In this approach, both male and female members of the family are trained. Because of the cultural barriers, women and men groups are formed separately and trained by the female and male Field trainers, respectively. This approach has been found to be effective in creating good discussion within families on various issues and test the strategies jointly to solve the farming problem. However, it should be noted here that interest of women in rice cultivation is minimal and hence their participation in the actual rice cultivation practice would be minimal. However, they play a crucial role in post-harvest technology. Special area of interest for women are vegetable cultivation, feeding fish, fertilization and financial management of the family.

Problem Identification and Training Need Assessment

In the first session, prior to the commencement of any other activity, farmers are encouraged to elect their own leader through discussion process. For each group, normally, there is a secretary and a President. After completion of the election of the leader, the session is facilitated in such a way that farmers are engaged in identifying the problems encountered by them in different areas of the farming system. In each of the components of the farming system, the problems encountered by the farmers are listed, preferably pictorially. Common problems that are encountered by majority of the group members are prioritized. The type of problems that are encountered by the farmers are listed in Table 1. In the first year of operation, there were batches, while during the second and third batch, there were 540 groups each. The problems that were identified by each of this group is taken in to consideration in such a way that all the problems identified by the farmers are taken in to consideration while developing session plans.

In the first year, after making the assessment of the farmer needs, facilitators carried all the problems to one place to make decision on what should farmers learn about. Since the sessions were decided by the facilitator without consulting the farmer, different problems were encountered. However, during the third year of operation, sessions to be learnt were decided by the farmers. This appears to be having a positive effect on the farmers and has created ownership among them. These plans are preserved by the farmers and the group leaders take responsibility to ensure that the plans are preserved.

Development of Session Guides

For the identified problems, session guides are developed to facilitate the sessions. Using these session guides, facilitators facilitate the sessions. In this process, main emphasis will be on understanding the farmers' knowledge on the issue and the scope that exists for the facilitator to provide additional new information. Farmers are encouraged to test the new ideas / information through careful observation, when it is totally new. In the first year, session guides were entirely developed by the project staff. Technical staff felt that farmers would not be able to contribute in the development of the session guide. However, some of the sessions, particularly those related to farm finance, social issues and environment were not found interesting. Investigations revealed that these sessions do not address the needs and particularly sessions on environment were not interesting to the farmers. In the second year, session guides were developed through the active participation of farmers – some of the session guides on social issues were almost completely developed by the joint participation of male and female farmer participants.

Reciprocal Learning Sessions

The sessions are generally conducted in one predetermined place, which is easily accessible to all. Facilitator should ensure that a place, which is easily reachable to all participants are chosen. All the materials needed for conducting the session should be assembled in advance and the facilitator should guide the discussion rather than directing. The attributes of a good facilitator are presented in Table 3.

The learning sessions are called reciprocal since there is continuous two way process of exchanging the information. The facilitator derives new knowledge from the farmers and the farmers derive new information from the facilitator. All the learning sessions should be action oriented. Sessions without action will not have desired effect on farmers.

While the male participants have no problem to go in to the field and do most of the activities in pond, women participants are hesitant. The women are more happy with the homestead activity, and others like feeding and fertilization. Hence, gender needs should be understood while designing the learning sessions. For example, women are not interested in sessions related to paddy cultivation.

The majority of the farmers will not be able to concentrate in sessions when it exceeds two hours. Even this two-hour session should be action oriented. A number of observations indicate that sessions exceeding 2-3 hours are generally ineffective. Group dynamics should be part of the sessions, but care must be taken in designing the activity taking into account social and cultural conditions.

Group Tutoring

With a view to improve the facilitation skills of the staff, dummy sessions are conducted with the session modules. These dummy sessions have been a big help for the new staff and the new topics that are included in the sessions. Also, these dummy sessions help the staff to gain confidence and the areas in which they need to make additional preparation.

Evaluation

Evaluation forms part of the process of all activities that are conducted. At the end of each session, farmers review the sessions and identify areas, which were interesting and those areas that require additional sessions. At the end of each year learning cycle, farmers document the changes that have been brought not only in their knowledge, but also changes that occur visibly in the farming system.

Self evaluation of staff at the end of each year gives an opportunity for every staff to review and make plans for the coming season. In these sessions, staff discuss the progress, difficulties encountered and the strategies that are used to overcome the problems. The annual forum provides an opportunity for actual sharing of experience across all staff and gives an opportunity for the staff to make workable plans. These self-evaluation workshops have provided great opportunity for the staff to improve their knowledge, confidence and facilitation skills.

Cross Visit

Cross visits have been found to be very effective in enhancing knowledge, building confidence among the farmers. In the first year of work, farmers were taken to see some of the other farmers who have been following/initiated some of the good cultivation practices. A well planned cross visit is one of the best tools to influence the farmers in making a proper decision. From almost all the groups in the first year, farmer leaders were taken to see the cultivation of other farmers. These farmer leaders exchanged the information with other farmers on the new practices they have seen and what could be adopted in their project site after testing their suitability.

In the second year of operation, organization of cross visits became easier since these new farmers could be taken to see the activities of the first year project farmers and learn about the process they adopted and the benefits they derived.

Action Research

The ability of farmers in doing research to solve the problems using the resources that are available to them has so far been underestimated. However, with the demonstration of different forms of extension strategy that have been used so far being not completely effective, farmer participatory research is now gaining acceptance as another form of extension approach. Extension through research concept encourages farmers to make observation of their own farm conditions and find solutions to their problems. While this may not be totally acceptable to the scientific community because of lack of scientific vigor with adequate replicates and treatments, farmers are happy with the results as it helps them to make decisions based on their best judgements. A number of action research trials are set up by the farmer groups either in the community observation plots or in their own *ghers*. Testing the efficacy of the fertilizers, rice varieties, feed trial, hapa-nursing, stocking density, *etc*, can form the basis of action research for farmers. The important point that needs to be considered in these farmer designed and implemented trials is that they should not expose farmers to risk.

Drama and Folk Songs

These are the common art forms that are being used to educate farmers. In the first year, farmers were not totally interested in attending sessions related to environmental aspects. Hence, the project began to explore the possibility of using different mass media to educate farmers. Drama, folk song and posters have been found to be effective tools in spreading the message. A drama script of 120 minutes incorporating environmental, social and gender messages are played regularly in the area. A survey conducted in the first year has shown that observers of the drama have adopted one or more of the practices that were shown in the drama. Currently, the project employs drama show as a common activity being conducted in every village before commencing the activity.

Farmers Field Day

Though this has not become a common activity in aquaculture projects, unlike in the farmer field schools (FFS) approach many of the farmers have already voluntarily taken up the activity to present the results through organizing special days. During these days farmers gather and share the results with others in the community. With the third batch of farmers, it is planned to undertake this activity vigorously.

Participatory Monitoring, Evaluation and Planning (PMEP)

Though in the early stages quantitative monitoring alone was used to measure the progress of the project, from the second year, a participatory monitoring and evaluation tool was used with a dual purpose of increasing the participation of farmers in the activity and enhance sharing of information. In addition, when the activity is carried out carefully by the staff, it can also generate adequate amount of quantitative information, which could be used to compare or contrast the quantitative data, which would just based on sampling. This approach, which uses tactile tools helps even illiterate farmers to take an active part in the discussion. A common approach is used to increase ownership and participation of the people. In addition, this participatory planning approach gives an opportunity for the farmers to create discussion on the subject. In the GOLDA cultivation, the PMEP system has been evolved wherein each group will make an assessment of the present status, particularly in regard to present cultivation practices and also fix a target for the coming season. For example, with regard to snail meat usage reduction, pesticide reduction, number of post larvae stocked, etc. farmers will make an assessment of the results they obtained at the end of the season. This approach will help them to make an understanding of the progress they have made and problems encountered in reaching the best production.

Observed Impact

The GOLDA project has completed working with two groups of farmers since its inception in 1996. The project worked longer with the first batch of farmers, but with the second group of farmers, the contact period was just one year. However, the project was able to bring many visible changes even with this short contact period. The monitoring results indicate that project has been able to make a very good impact on the community. The most important change brought is the organization of farmers in to groups to discuss their problems collectively and explore collective actions to address these common problems. Inclusion of women in the learning session or family approach appears to have contributed significantly to quicker adoption/adaptation of several of the practices to suit their conditions. Overall, the project has resulted in doubling of income from the *gher* system through better management of the resources.

Agriculture

In the agriculture sector, almost all the farmers began using dikes for cultivation of vegetables and nearly 21% of the households began dike crop production through the project intervention. Others intensified production activities. The increase in production has not only been 100%, but the types of vegetables cultivated increased from an average of two varieties to six varieties. The pesticide usage reduction has been very significant as nearly 75% of growers did not use pesticide. This helped families to save cost and influenced others in the community to reduce/eliminate pesticide usage. Also, interestingly, nearly 5% of the farmers with bigger dikes began cultivation of fruit and tree species and 7% of the farmers have adopted improved methods of compost preparation. In rice cultivation, the yield has increased by about 20% and the ongoing boro cultivation indicate that farmers would be able to further gear up production because of the adoption of judicious management practices. However, pesticide reduction in rice is yet not impressive, though there has been reduction in usage. Efforts are needed in this area to strengthen farmer understanding on the rice field ecosystem. Most importantly, about 8% of the participants are now cultivating paddy with prawn during the dry season and cultivation of additional crops of rice will substantially increase income.

Aquaculture

In the area of aquaculture, reduction in snail meat usage by nearly 56% of the participating household has been observed and nearly 23% of the households gave up the snail meat usage completely. Several of the farmers have begun using homemade feeds and the cost was reduced by nearly 40% through adoption of these management practices. There are more than eighteen different types of feed making machines invented locally by farmers and women in the family have taken up feed preparation and selling as an income generating activity. About 28% of the farmers began polyculture of fishes with prawns for the first time, thereby focussing shift from solely to prawns to other potential areas like fish inclusion. With those farmers this polyculture activity has been going on, production has almost doubled. The production of prawn also has increased with the adoption of nursing of post larvae in a nursing area of the *gher* or hapa in about 30% of the farmers. All these strategies have contributed to nearly 146% increase in cost benefit ratio (2.7) as compared to base line information (1.1).

Farm Finance

Partnership has been established with eight credit NGO’s to lend money with at least 2-3 months grace period. This initiative would be a big help to farmers in reducing cost of production. Book keeping is now commonly practiced by about 40% households. About 20% of the women have initiated special IGA and this activity is expected to improve the position of women in the family. In addition, results indicate that nearly 49% of women actually take part in family economic decision making process as compared to 18% in the baseline.

Environmental Issues

Since the learning sessions on environment have not been effective, the alternative strategy of putting on drama shows has been developed and demonstrated in project areas. Several of the farmers (more than 40%) indicated that they used the learnings from the drama in one way or another either to improve their production practices or change in their attitude in regard to social issues. Survey results indicate that drama has been powerful in demonstrating the negative impact of pesticide usage, implications of excess feeding of snail meat to prawns and thirdly, in women empowerment. The new approach piloted to involve school children in the environment awareness building exercise has been successful. Nearly 2000 school children were educated on the environmental implications of unhealthy agricultural and *gher* farming practices. The study conducted by the team also demonstrated the impact of current wild prawn seed collection techniques on the survival of other aquatic species in the environment. Nearly 1000 fish/shrimp seed die for every post larvae collected from the river.

Social Impact

On the social side *gher* farming has contributed substantially to improve the economy of the people and improve their livelihoods. Through "social fencing" in the community, poaching has been reduced in many areas, although it continues to be a major problem in some areas. Another important social issue in the area is dowry and *gher* farming appear to have contributed for the increase in dowry in the area. Project participants have developed a poster to illustrate the bad effect of dowry.

Lessons Learned

1. Foundation training for the staff should be part of all projects and this component should be taken into consideration while designing the project. Emphasis in such a training should be to develop the facilitation skills, enhancing knowledge on social issues and farming systems. Investment in a broad range of staff development and training will have a significant impact on the project output quality and sustainability.
2. Projects can have significant impact on family income through the provision of appropriate education. To accomplish this it is most essential to make first a needs assessment of farmers and develop plans to address those identified needs. Farmer participation in session/activity plan development is most essential. Experienced farmers should be used for session guide development and in some cases, it may be more appropriate for the farmers to conduct some sessions
3. Family approach should be used in all interventions and there should always be gender balance in staff recruitment and deployment for fieldwork. Shortage of adequately qualified women for technical positions has resulted in male dominance in technical positions and this is likely to have an impact on the knowledge level of female staff because of communication barriers.
4. In training of farmers, prepare all materials keeping in view illiterate farmers. Ensure all components of the training are action oriented. Do not exceed two hours for each training session.. Have adequate group dynamics in the session. Avoid incentives for farmers to attend training sessions / conduct activities. Adjust training schedule to meet the convenience of farmers. Provide as much individual

support to the farmers through follow up visits. Learning sessions alone are not adequate to bring the changes.

5. Give support to farmers to increase their confidence and their analytical ability. Experiential learning cycle is a powerful tool to assist farmers in increasing their self-reliance in solving the problems. Staff should view themselves as knowledge and learning catalysts and not as information givers. Facilitation is very important since farmers have generally been used to obtain ready-made answers.
6. Use participatory approaches at all times and maintain transparency in all negotiations. Apply participatory planning, monitoring and evaluation process to measure the progress of the project. This PPME process not only enhances the ownership, but also helps as an effective medium for the dissemination of information
7. To ensure sustainability, projects should focus on science and not on technology.

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Table 1: Farming related problems identified by the farmers. Total Group 540 (270 male and 270 female)

Prawn related issues	
Name of the Problem	**# of groups**
Diseases of Prawn	534
Water quality	489
Feed preparation	464
Gher preparation	328
Identification of male & female prawn	301
Nursery management	291
Method post larvae (PL) stocking/nursing	124
Low growth of Prawn	110
Aquatic weeds	95
Unavailability of PL	91
Application of Lime & Fertilizer	66
Old prawn rearing methodology	57
Narrow dike of ghers	31
Wild fish entry	23
High price of PL	17
Small snail	16
Gases in soil	12
Hatchery PL	11
White fish related issues	
Diseases of white fish	415
Poly-culture technology	236
Species identification	139
Low growth of white fish	71
Identification of fish fry	44
Fish competition for prawn feed	42
Feed of white fish	32
Fish predation on prawn larvae	12
Least harvesting than stocking	8
Water problem	8
Crabs	6
Low growth of prawn due to fish cultivation	3
Salinity	3
Rice related issues	
Diseases of paddy	439
Pests attack on paddy	313
Fertilizer Application	311
Rat problem	277
Lack of good seed	251
Inter culture operation problem	183
Proper cultivation methods	182
Seed preservation	123
Seasonal crop cultivation	109
Land preparation	103
Salinity	78
Use of pesticides (dose)	62
Seed bed preparation	55
Irrigation	53
Paddy containing no rice (*Chita)*	38
Aush paddy cultivation method	36
Identification of seed	26
Low yield	21
Identification of variety	12
Using of pesticides in rice field damages prawn prod.	9
Vegetable related issues	
Disease/pest problem	429
Lack of good seed & sources	387
Application of fertilizer and pesticides	265
Method of cultivation	161
Rat problem	153
Fruit dropping	95
Season wise crop cultivation	93
Narrow Dike	51
Irrigation problem	42
Inter culture operation	39
Agro Forestry	36
Identification of good seed	31
Hard soil	15
Crop selection	10
Salinity	8.5
Bed quality soil	8
Germination of seed	5
Low price	5
Low production in the summer season	4
Damage of Seedlings	3

Farm Finance related issues	
High Interest rate	372
Lack of capital	363
Not getting loan at the right time	243
Lack of accounts maintenance	122
NO savings	108
Lack of budget planning	90
Procedure of Loan taking not known	82
Sources of Loan not known	71
Planning	69
Misbehaviour of Bank management	58
Bribe for bank loan	56
Threat of Loan	51
High production cost	40
Weekly installment	35
Marketing	32
Assets mortgage for loan	25
Bad effect of Interest	19
Lack of easy condition for loan	10
Lack of enough loan	6
Not getting loan	4
Dependency on credit money	3
No benefit from taken loan	3
Environment related issues	
Water logging	219
Lack of Snail	211
Lack of Grazing Land	145
Declining of native fish	106
Flies & mosquito	102
Disease for snail	98
Air pollution by bad smell of snail	94
Lack of fodder	88
Open latrine	65
Arsenic	48
Least production for snail shell	44
Lack of plants	42
Lack of fuel/firewood	35
Disturbance of livestock	34
Lack of poultry	30
Drainage system	26
Methods of pesticides	25
Lack of drinking water	24
Decline of land fertility	17
Salinity	17
Communication	12
Disease of poultry	10
Use of chemical fertilizer	10
Water pollution	10
Decline of livestock	9
Population problem	7
Unplanned Gher	6
Decline of water body	4
No exchange of gher water	4
Aquatic weed	3
Social issues	
Poison & poaching	280
Family conflict	225
Dowry	215
Dike conflict	108
Social conflict	88
Disturbs of cattle	76
Least importance of women	57
Multi marriage	55
Early marriage	50
Women oppression	48
Unemployment of women	30
Lack of education	19
Conflict due to cattle grazing	17
Social superstition	17
Crop theft	12
Conservativeness	10
High pollution	9
Terrorism	6
Unsociable activity	4
Lease conflict	3

Table 2

Sl	Name of the REL
1	Gher preparation
2	Nursery Management
3	Gher Budget
4	Loan Procedure
5	Crop planning and good quality seed
6	Poly-culture
7	Supplementary feed
8	Land preparation
9	ICM/IPM
10	Intercultural operation and diseases management of crops
11	Water quality management
12	Diseases control of prawn and fish
13	Rice cultivation
14	Income Generating Activities
15	Own Finance
16	Botanical pesticides preparation
17	Compost preparation
18	Seed preservation
19	Land preparation for saline area
20	Rotenone, lime and fertilizer mixing
21	Old prawn rearing
22	Fish meal preparation
23	Aquatic weed control
24	Threat of loan
25	Women’s empowerment in family decision making process

Table 3

WHAT IT TAKES TO BE A GOOD FACILITATOR

- A clear idea of ones' role as a facilitator
- The respect of the group
- No value judgement on people
- No value judgement on opinions
- Group respect for the facilitator's role
- Flexibility willingness and ability to adapt.
- Creativity
- Curiosity
- Humor
- Energy and presence

Most of these points are related to:

Your confidence as a facilitator

Source: Creating good learning environment: simple tips for facilitators, CARE NOPEST PROJECT

Figure 1: Experiential Learning Cycle (ELC)

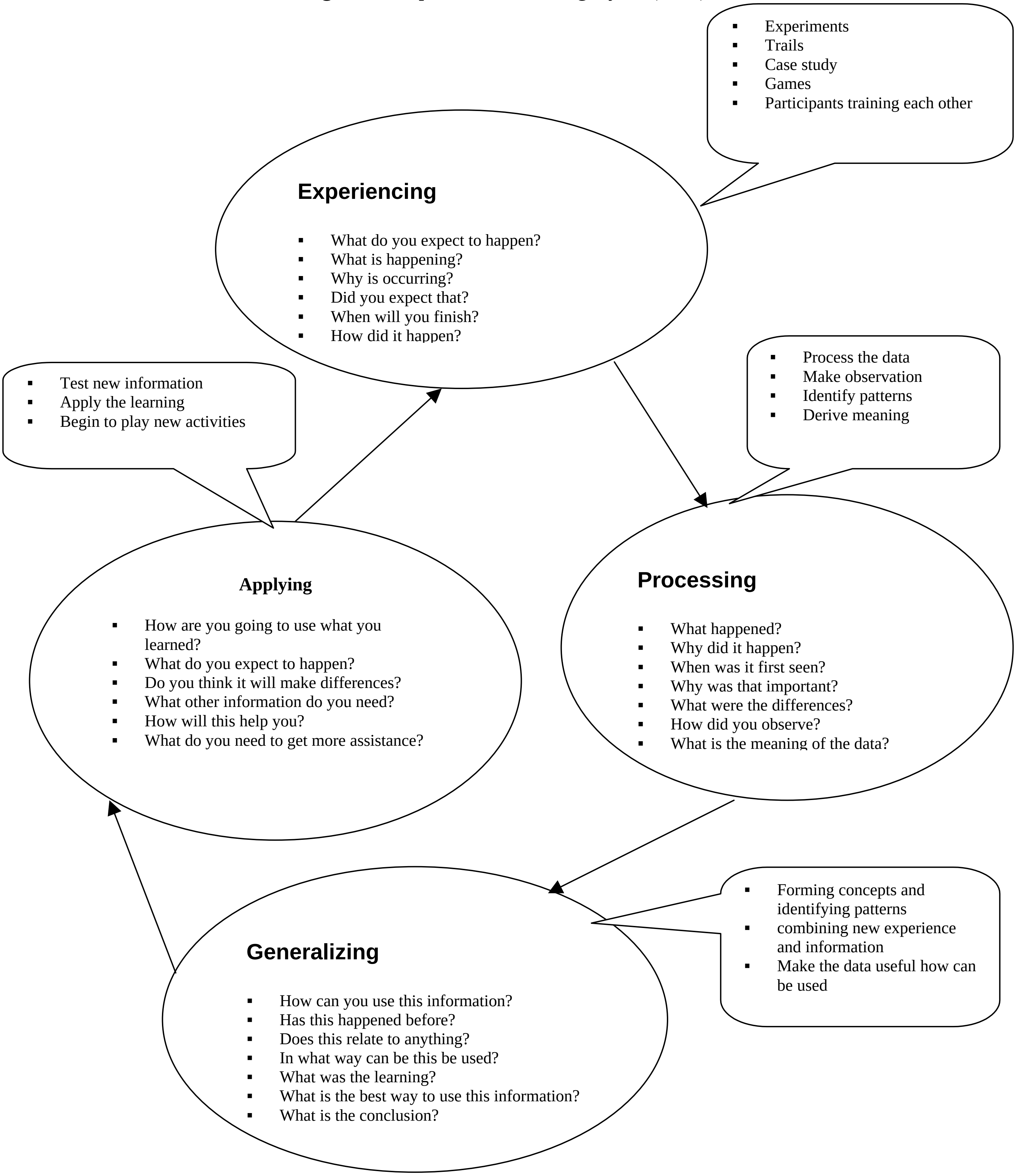
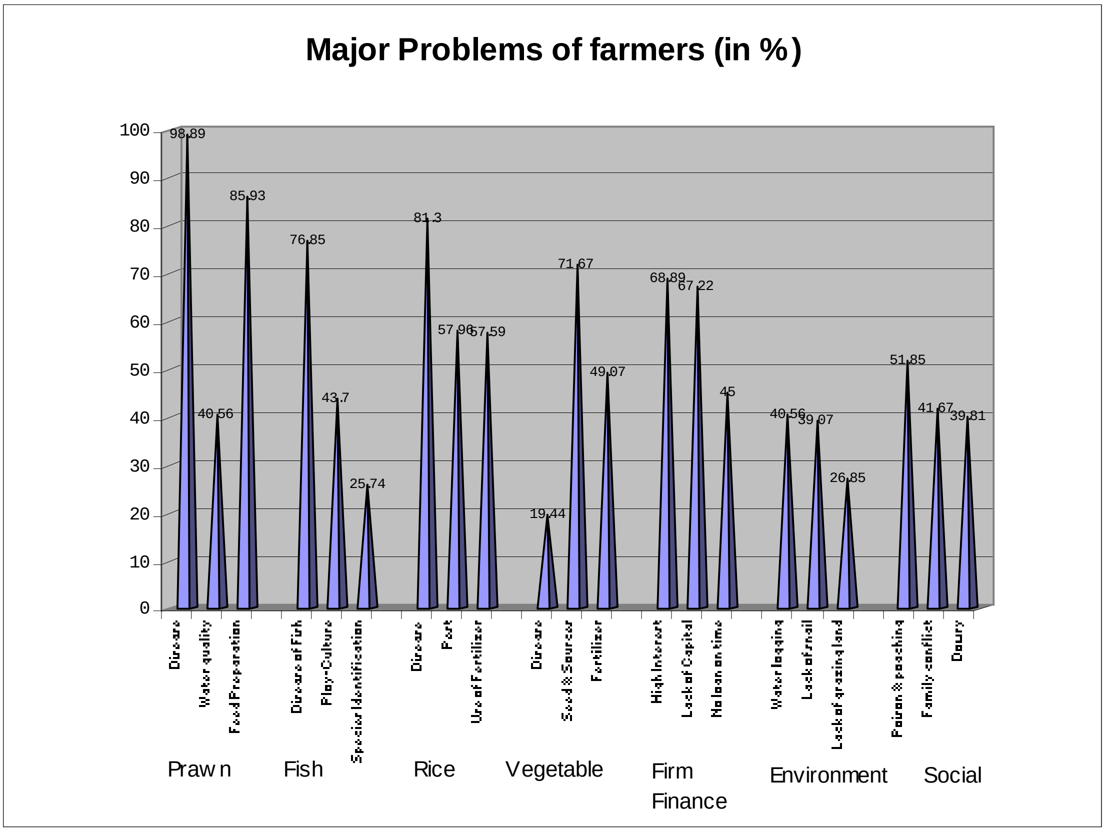


Figure 2


Major Problems of farmers (in %)
100
90
80
70
60
50
40
30
20
10
0
98.89
40.56
85.93
76.85
43.7
25.74
81.3
57.96
57.59
19.44
71.67
49.07
68.89
67.22
45
40.56
39.07
26.85
51.85
41.67
39.81
Disease
Water quality
Feed Preparation
Disease of Fish
Play-Culture
Species Identification
Disease
Pest
Use of Fertilizer
Disease
Seed & Sources
Fertilizer
High Interest
Lack of Capital
No loan on time
Water logging
Lack of snail
Lack of grazing land
Poison & poaching
Family conflict
Dowry
Praw n
Fish
Rice
Vegetable
Firm
Finance
Environment
Social

Annex D17: Overview of Fisheries/Aquaculture Education in Cambodia

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Abstract

Considerable progress has occurred in developing fisheries and aquaculture curricula at two educational institutions in Cambodia; however, there are a number of issues and constraints that remain to be addressed. Key issues currently being examined are development of credit systems, incorporating research and training outcomes in curricula, and improving student thesis research activities. Additionally, there remain a number of constraints to curricula development and teacher capacity building that need to be overcome. These include English language capacities of teachers, access to electronic media, high staff turnover, inadequate data on fisheries/aquaculture sector manpower needs, and weak links between the private sector and educational institutions.

Introduction

B.Sc. and Diploma II in Fisheries are currently offered at two educational institutions in Cambodia, the Royal University of Agriculture (RUA) and the Agricultural School of Prek Leap (SAPL). Aquaculture is offered as part of the fisheries curriculum at both RUA and SAPL. No specialized degree program is currently offered in aquaculture, although there are plans to do so, in future.

A Bachelor of Science in Fisheries has been offered at RUA since 1986. The RUA Fisheries curriculum was developed with Soviet assistance, and Russian was the language of instruction from 1986 until the beginning of 1990, when Russian aid was terminated. This curriculum was used until RUA began recruiting Cambodian faculty. Khmer is currently the language of instruction at both RUA and SAPL.

The fisheries curriculum at RUA was revised, again, beginning in 1993 with donor assistance. At present, on-going curriculum development activities are being assisted by AIT (DANIDA), Saint Mary's University (CIDA funded) and PAFAARC (French).

Fisheries graduates have typically been recruited for positions within the government sector (Ministry of Agriculture Forestry and Fisheries (MAFF), and Department of Fisheries (DoF)), although this is changing, as the public sector can no longer absorb all new graduates. Recently, an exam was introduced to select graduates for Government employment.

Issues

Both RUA and SAPL are currently examining a number of key issues related to fisheries curricula development activities:

- Development of a credit system to allow transfer of credits between institutions;
  comparison of course offerings at SAPL (Diploma II) and RUA (B.Sc.) in order to identify gaps and possible areas of overlap;
- Attempts to incorporate research and training information and outcomes in curriculum revisions;
- RUA student thesis research activities.

Credit Systems

The identified need for credit systems are to enable comparable and interchangeable systems for fisheries education in Cambodia. The specific objectives identified are:

- To enable flexible transfer of educational units between SAPL and RUA, and/or work experience obtained in the private and public sectors;
- To enable the flexible transfer of educational units and/or work experience between educational institutions in the region.

To this end, a draft credit system for fisheries curriculum, dated December 1999, has been outlined for RUA. The draft credit system that is proposed for RUA curriculum allocates twenty-four (24) credit hours for aquaculture courses.

A workshop is scheduled for June or July 2000 to further discuss and clarify the issues identified.

At present, there are no mechanisms for transferring credits between SAPL and RUA Fisheries programs. This means that students who complete a Diploma Level II in Fisheries from SAPL, need to sit an entrance exam for entry to the B.Sc. at RUA, and complete a full four and a half year program, in order to obtain the B.Sc.

There is a further need to evaluate course subject and content of the SAPL and RUA curricula for gaps and/or overlaps, and devise a method for credit transfers. Additionally, there is a need to address how courses completed at RUA and SAPL can be compared with regional standards and credit systems.

Strategic Need to Incorporate Research and Training in Curricula

An important issue in revising and improving the curricula at SAPL and RUA is the need to incorporate local/regional research activities and donor training into curricula and student training materials. This is not occurring, at present, in a systematic manner.

RUA Faculty of Fisheries (FoF) could benefit from a model for incorporating research activities, and donor sponsored training as part of the curriculum. There is also a need to focus more on practical training as part of the required coursework and curriculum development process.

The Asian Institute of Technology Aquaculture and Aquatic Resource Management Unit (AIT/AARM) has been conducting research and farmer trials in cooperation with the Department of Fisheries (DoF) in several Provinces since 1996, including Svay Rieng, Takeo and Kompong Speu. It is recognized that these activities can provide a valuable resource tool for strengthening course materials, practical experience of the Fisheries students, and capacity of the teachers.

AIT/AARM and other donor organizations have provided resources and research opportunities to both RUA and SAPL students. A number of fourth year RUA Fisheries students have completed thesis research with the AIT/DoF project.

RUA Student Research Thesis Activities

RUA student thesis research topics are typically conducted in collaboration with AIT/DoF and other donor organizations working on fisheries/aquaculture activities. The percentage of RUA fourth year students working on aquaculture related topics averaged around 37% over the past five years.

An issue related to topic selection is that student thesis research is often redundant or duplicated. Another problem is that student thesis final reports are not fully utilized by teachers and students, as inputs to curriculum development and revisions.

Fourth year Fisheries students are usually dependent on donor funding for thesis research. Students that cannot obtain donor funding or support for thesis research are considerably disadvantaged, and their employment opportunities are limited after graduation.

Teacher capacity to supervise and assess thesis final reports is also a limiting factor. This has had a negative impact on the quality of thesis research and the final report.

Stronger private sector links could improve topic selection concerns, and increase student abilities to address “real world” problems.

Discussion

A number of key constraints limit the teacher capacity building and curriculum development activities at RUA and SAPL. These include:

- English language capacity of the teaching staff;
- Access to electronic media, especially internet facilities;
- High rate of teacher and staff turnover;
- Inadequate data on manpower or skill needs in the fisheries/aquaculture sectors;
- Limited aquaculture private sector, and weak links to training institutions.

English Language Capacities of Teachers

Many RUA and SAPL teachers were trained in Russian or Vietnamese, and have only recently received training in English language skills. This has created problems in fully utilizing reference materials provided with donor assistance.

A number of donor organizations are currently supporting in country, English language-training opportunities for RUA and SAPL teachers. The Australian Center for Education (ACE), located in Phnom Penh, is an important resource for English language training, and teachers at RUA and SAPL are taking advantage of this resource with donor assistance. There is still a noticeable capacity gap in this area, but real improvements are in evidence.

Teaching is in Khmer; however, most reference materials are primarily in English. This has constrained the development and revision of curricula.

Students entering the fisheries programs at RUA and SAPL, in many cases, have better English language skills than some teaching staff. Another issue is donor assisted training opportunities are limited by the lack of English language capacities of some teachers, as English language capacity is seen as a minimum criteria for overseas training opportunities.

Access to Electronic Media

A number of constraints to use of electronic media applications, especially Internet access exist at both RUA and SAPL. Several of these have been addressed with donor assistance recently. For example, both faculties have received financial support enabling purchase of computer equipment.

This has had a positive impact on teacher capacity and productivity, and opens the possibilities for Internet access. A number of constraints still limit Internet use. There are several infrastructure and funding constraints that limit Internet access and use, including regular and reliable power and phone line installations. Hopefully these can be addressed in the near term, with donor assistance.

The University of Tropical Agriculture (UTA) located on the RUA campus has recently begun offering a Masters degree program in integrated tropical agriculture that emphasizes the use of electronic media and computer access to teaching materials. It is hoped that UTA will further develop and extend its' Intranet server to other faculties at RUA, in collaboration with donor organizations. This may provide opportunities for overcoming the identified constraints to Internet access and use at RUA.

When constraints to Internet access are overcome, it should be possible for both RUA and SAPL Fisheries faculties to establish links with regional partners and research centers. This would greatly improve the access to relevant, regional reference materials, and assist both teacher capacity and curricula development.

High Rates of Teaching Staff Turnover

This concern relates to the above discussion on salary disincentives. Teachers receiving donor assistance to complete post-graduate qualifications, typically overseas, are often hired away by better paying jobs with NGO organizations. If viable distance education options were available, post-graduate candidates could study while continuing to work in their teaching positions, rather than going overseas for up to two years.

Limited Aquaculture Private Sector and Weak Links to Training Institutions

The aquaculture private sector in Cambodia is limited to date, with few employment opportunities for fisheries graduates specializing in aquaculture. The private sector operators that do exist are not well linked with to RUA or SAPL, with few exceptions. This will need to be addressed as the private sector grows, and opportunities for collaboration increase. Hopefully, in future, linkages should be fostered to encourage collaborative research and training.

Conclusion and Recommendations

Considerable progress has been made in curriculum development and teacher capacity with donor assistance over the past tens years, but many key issues and constraints remain to be resolved.

Recommendations include:

- Develop a credit system model for transferable units between institutions in Cambodia and regional fisheries/aquaculture education providers;
- Develop a model for incorporating research and training activities into curricula materials;
- Improve student thesis topic selection, supervision and thesis research utilization;
- Continue access to English language training opportunities for Fisheries teachers;
- Establish Intranet/Internet access at Fisheries faculties;
- Improve opportunities for post-graduate distance education;
- Foster links with the small but growing aquaculture private sector in Cambodia;
- Continue to improve and strengthen collaboration and cooperation with aquaculture education providers within the APEC framework.

Annex D 18: Fisheries Education and Training Programs in India

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Introduction

Fisheries Education in India as a subject saw its beginning very late compared to other organized disciplines in science and humanities. The fisheries subject was relegated to an appendage of the subject zoology in most Indian traditional colleges. Fisheries training started in 1952 when a tripartite agreement, better known as the Technical Cooperation Mission, was signed between the Government of India, USA and the UN. Under the agreement, India received a number of fishing vessels and processing equipment that led to the establishment of a chain of training institutes in maritime states. These establishments were mainly catering to the marine fisheries sector and assisted mostly in training personnel in fishing operations and processing.

Based on the "Report of the First Sub Committee of Policy No. 5 on Agriculture, Forestry and Fisheries dated 18th January 1945, the fisheries as a subject gained independent status. This led to the establishment of Central Marine Fisheries Research Station on 3rd February, 1947 in the Department of Zoology of Madras University. The administrative control of the institute was under the Ministry of Food and Agriculture, Govt. of India. Later its headquarters was shifted to Mandapam in 1949 and the Institute was given the name Central Marine Fisheries Research Institute (CMFRI). In 1967, administrative control of the Institute was transferred to the Indian Council of Agricultural Research (ICAR) and the headquarters shifted to a new campus in Cochin. This Institute played a lead role in developing marine fisheries research in India.

In order to cater to the development in inland fisheries, the Royal Government of India created another institute called the Central Inland Fisheries Research Station, at Barrackpore (West Bengal) on 17th March 1947. This station was elevated to an Institute in 1959 and named as Central Inland Fisheries Research Institute. In 1957, the Govt. of India set up the Central Institute of Fisheries Technology at Cochin to cater to the research needs of harvest and post-harvest technology in fisheries. This was followed by the creation of the Central Institute of Fisheries Education in 1961. On 29th March, 1989, the ICAR elevated this institute to the first National Fisheries University in India.

In 1987, the ICAR reorganized the whole fisheries research and training in India and created 4 more Institutes. As of today, ICAR has 8 institutes under its umbrella. The details and mandates are given below:

FISHERIES RESEARCH INSTITUTES

Under Indian Council of Agricultural Research &Their Mandates

Name of the Institution	Mandate
Central Marine Fisheries Research Institute (CMFRI) Kochi, Kerala **Phone No. 00 91 (0)484 394 798** **Fax No. 00 91 (0)484 394 909** **E.Mail cmfri@x400.nicgw.nic.in** **mdcmfri@mdz.vsnl.net.in** **** 12 Research Centres*** **** 28 Field Centres*** **** 11 Fish Farms*** **** 11 Research Vessels*** **** 01 KVK*** **01 TTC*	* Capture fisheries database, assessment of marine fishery resources, fishery forecasting, monitoring fishery environmental characteristics, mariculture technology for finfish and shellfish, transfer of technology and consultancy services.
Central Inland Capture Fy. Research Institute (CICFRI) Barrackpore, West Bengal **Phone No.: 00 91(0)33 - 560 0177** **Fax No. 00 91(0)33 - 560 0388** **E.Mail: cicfri@x400.nicgw.nic.in** **** 11 Research Centres*** **** 06 Survey Centres*** **** 01 KVK/TTC*** **** 01 Fish Farm*** **** 02 Research Boats***	* Conservation and sustainable development of open water ecosystem and study on population dynamics of exploited inland water bodies for developing fishery management system for their optimum utilization, transfer of technology and consultancy services.
Central Institute of Fisheries Technology (CIFT) Kochi, Kerala *(Established in 1957)* **Phone No. : 00 91 – (0)484 667 039** **Fax No. : 00 91 – (0)484 668 212** **E.Mail : cift@x400.nicgw.nic.in** **root@cift.ker.nic.in** **** 05 Research Centres*** **** 04 Research Vessels***	* Development and standardization of harvest and postharvest technologies, package of practices for extraction of biomedical, pharmaceuticals and industrial products from aquatic organisms, transfer of technology and consultancy services, fish inspection and quality control, electronic instrumentation, fishing boat and gear design
Central Institute of Fisheries Education (CIFE) Mumbai, Maharashtra **Phone No. : 00 91 (0)22 636 3404** **Fax No. : 00 91 (0) 22 636 1573**	* Conduct education and research programs leading to postgraduate (M.F.Sc.) and doctoral (Ph.D) degree in specialized disciplines of fisheries science and technology. Serve as a repository of information on HRD in fisheries including database on available manpower resources.

E.Mail : cife@x400.nicgw.nic.in

**** 03 Research/Edn. Centres***
**** 04 Fish Farms***
**** 03 Research Vessels***

National Bureau of Fish Genetic Resources (NBFGR) Lucknow, U.P.
(Established in 1983)

* Management and conservation of diversity of the vast and diverse fish genetic resources and quarantine.

Phone No. : 00 91(0)522 442 403
Fax No. : 00 91 (0)522 442 403
E.Mail : nbfgr@x400.nicgw.nic.in
nbfgr@1wl.vsnl.net.in

Central Institute of Freshwater Aquaculture (CIFA) Bhubaneswar, Orissa
(Established in 1987)

* Basic and applied research on seed production and culture of commercially important finfish and shellfish in freshwater, transfer of technology and consultancy services.

Phone No. : 00 91 (0)674 465 421
Fax No. : 00 91 (0)674 465 407
E.Mail : cifa@x400.nicgw.nic.in

**** 06 Research Centres***
**** 10 Field Centres***
**** 04 Fish Farm***

Central Institute of Brackish-water Aquaculture (CIBA) Chennai, Tamilnadu

(Established in 1987)

* Seed production and culture of finfish and shellfish in brackishwater system, transfer of technology and consultancy services.

Phone No. : 00 91 (0)44 855 4851
Fax No. : 00 91 (0)44 855 4851
E.Mail : ciba@x400.nicgw.nic.in

**** 03 Research Centres***
**** 01 Field Centre***
**** 02 Fish Farm***

National Research Centre on Coldwater Fisheries (NRCCWF) Bhimtal, U.P.
(Established in 1988)

* Assessment of coldwater fishery resources in the upland areas and formulation of strategies for their sustainable exploitation.

Phone No. : 00 91 (0)5942 47279
Fax No. : 00 91 (0)5942 47279

**** 02 Field Centres***
**** 02 Fish Farms***
**** 02 Research boats***

DISCUSSION

Fisheries Education

Organizational Set Up

Fisheries education in India today is well organized. The country has a 4-year Bachelors Degree in Fisheries Science (B.F.Sc.) and a Two-year postgraduate course called the Masters in Fisheries Science (M.F.Sc.). These courses are run by the Agricultural Universities in India numbering 29 and one Central University and one Deemed University. The state Agricultural Universities (SAUs) are set up by the State Governments and run with the financial support from the ICAR. The Council plays a lead role in the management of Agricultural Universities in making policies, organizing curriculum and selection of Vice Chancellors and teaching staff.

The ICAR also gives substantial financial support by way of research grants and for building infrastructure like setting up modern laboratories, hostels, etc. 15% of the seats at B.F.Sc. level out 25% at M.F.Sc. level in all these colleges are reserved for ICAR. The ICAR conducts national tests for selection of suitable candidates for B.F.Sc. and M.F.Sc. courses. All students who opt to study outside their states are given a scholarship by ICAR. The list of Fisheries Colleges offering graduate and postgraduate courses in India are given in Table 1.

Table 1: Fisheries Colleges Offering Graduate and Postgraduate Courses in India

Name and address of Fisheries Institute/College	Course offered*
College of Fisheries (University of Agricultural Sciences) Mangalore, Karnataka	1, 2 and 3
Fisheries College (Tamilnadu University of Veterinary and Animal Sciences) Tuticorin, Tamil nadu	1,2 and 3
College of Fisheries (Orissa University of Agriculture and Technology) Berhampur, Orissa	1,2 and 3
College of Fisheries (Kerala Agricultural University) Panangad, Kochi, Kerala	1 and 2
College of Fisheries (Gujarat Agricultural University) Rajendra Bhavan Road Veraval, Gujarat	1 and 2
College of Fisheries (G.B. Pant University of Agriculture and Technology) Pantnagar, U.P.	1 and 2
Fisheries College (Konkan Krishi Vidyapeeth) Ratnagiri, Maharashtra	1 and 2
College of Fisheries (Rajendra Agriculture University Muzaffarpur, Bihar.	1
College of Fisheries Science (Acharya N.G. Ranga Agricultural University) Nellore, Andhra Pradesh	1
College of Fisheries (Assam Agriculture University Raha, Assam	1
College of Fisheries (West Bengal Veterinary and Animal Sciences University) Calcutta, West Bengal	1
College of Fisheries (Central University of Agricultural Sciences) Lembuchera, Tripura	1

**1=B.F.Sc., 2=M.F.Sc., 3=Ph.D.*

Table 2(a): M.F.Sc. and Ph.D. Programs Offered by the State Agricultural Universities (SAUs) and the Deemed Universities

College of Fisheries Mangalore
(University of Agricultural Sciences, Bangalore)

- ☞ Fish Production & Management
- ☞ Industrial Fishery Technology
- ☞ Aquaculture
- ☞ Fishery Resource management
- ☞ Fishery Oceanography
- ☞ Aquatic Biology
- ☞ Fish processing Technology
- ☞ Fishery Microbiology

Fisheries College, Tuticorin.
(Tamil Nadu University of Veterinary and Animal Sciences, Coimbatore)

- ☞ Fishery Biology
- ☞ Fisheries Environment
- ☞ Processing Technology
- ☞ Fisheries Engineering
- ☞ Aquaculture

Table 2(b):

Fisheries College, Berhampur
(Orissa University of Science & Technology, Bhubaneswar

- ☞ Inland Fisheries
- ☞ Aquaculture
- ☞ Fish Nutrition
- ☞ Fish Pathology
- ☞ Soil & Water Environment (Aquatic Microbiology)

Fisheries College, Panangad
(Kerala Agricultural University, Trichur)

- ☞ Aquaculture
- ☞ Fishery Biology
- ☞ Processing Technology
- ☞ Fishing Technology
- ☞ Fisheries Engineering
- ☞ Fisheries Management

Table 2(c):

Central Institute of Fisheries Education. Mumbai

- ☞ Fisheries Resources Management
- ☞ Inland Aquaculture
- ☞ Mariculture*
- ☞ Freshwater Aquaculture
- ☞ Post-Harvest Technology
- ☞ Fisheries Resources Management
- ☞ Inland Aquaculture
- ☞ Mariculture*
- ☞ Fish Processing
- ☞ Fisheries Extension
- ☞ Fisheries Statistics
- ☞ Fisheries Economics

Table 2(d):

Indian Institute of Technology, Kharagpur

- ☞ Aquaculture Engineering

Central Marine Fisheries Research Institute, Cochin

- ☞ Mariculture

Central Institute of Fisheries Technology, Cochin

- ☞ Postharvest Technology

Central Institute of Freshwater Aquaculture, Bhubaneswar

- ☞ Aquaculture

Other Research Establishments

The Ministry of Agriculture has two major important training Institutes on marine fisheries. They are the Central Institute of Fisheries Nautical and Engineering Training (CIFNET) at Cochin and the Indo-Norwegian Project set up in 1952. This became later the Integrated Fisheries Project (IFP) and today devotes attention to fishing technology, postharvest technology and marketing. Details of these two establishments and their mandates are given in Table 3. Fisheries Management in India comes under the Ministry of Agriculture and the organizational set-up is given below:

Table 3:

Integrated Fisheries Project **Foreshore Road** **P.B. No. 1801** **Kochi – 682 016, Kerala** *(Established in 1952)* **Phone No. 00 91 (0)484 361317** **Fax No. 00 91(0)484 373516** **E.Mail : ifp@ker.nic.in** * 01 Research Centre * 05 Fishing Vessels	* Development of marine fisheries harvest and postharvest technologies & product development with value addition. * Marketing infrastructure support to fishing industry.
Central Institute of Fisheries **Nautical & Engineering** **Training (CIFNET), Dewan's Road** Kochi-682016, Kerala *(Established in 1963)* **Phone No. 00 91 (0)484 351107** **Fax No. 00 91 (0)484 370879** **E.Mail L cifnet@ker.nic.in** * 03 Research Centre * 04 Training Vessels	* Create technical manpower for operation of ocean-going fishing vessels. * Support shore-based infrastructure establishment for the effective operation of fishing vessels.

ORGANISATIONAL & OPERATIONAL INFRASTRUCTURE FOR FISHERIES RESEARCH, DEVELOPMENT & EDUCATION IN INDIA

GOVERNMENT OF INDIA

↓

MINISTRY OF AGRICULTURE

↓

Department of Agriculture Research & Education

- **Director General, I.C.A.R.**
- **Deputy Director General (Fisheries)**
  - ***Assistant Director General (Marine)***
  - ***Assistant Director General (Inland)***
    - **Fisheries Research Institute**
      - * CMFRI
      - * CICFRI
      - * CIFT
      - * CIFE
      - * NBFGR
      - * CIFA
      - * CIBA
      - * NRCCWF
    - **Fisheries Colleges & Faculties under State Agricultural Universities**

Department of Animal Husbandry & Dairying

- **Fisheries Division**
- **Joint Secretary (Fisheries)**
  - ***Fisheries Development Commissioner***
    - *** IFP**
    - *** CIFNET**
    - *** CICEF**
  - *** FSI**
  - *** State Fisheries Department**

Intake Capacities

There are 12 fisheries colleges under the State Agricultural Universities in India. The number of seats available in these college varies from 20 to 30 at graduate level and Postgraduate Programs are offered only in some colleges.

Table 4: Number of seats offered in different courses in the fisheries colleges.

Faculty	No. of Colleges	B.F.Sc.	M.F.Sc.	Ph.D
Fisheries	12	290	175	54

Central Institute of Fisheries Education (CIFE), Deemed University under ICAR

CIFE, Mumbai was established on 6th June 1961 by the Government of India with the assistance from FAO/UNDP. During the initial years, it had three divisions, Fishery, Biology, Fishery Technology and Fishery Economics and conducted a two-year Postgraduate Diploma in Fisheries Science (D.F.Sc.). CIFE came under the administrative control of the ICAR on 1st April, 1979.

The ICAR has accorded the status of a Deemed University with the approval of the University Grants Commission, the appellate authority to grant permission to academic courses and recognition to Universities under the Union India. CIFE conducts only M.F.Sc. and Ph.D. programs.

CIFE has approved three institutes under the ICAR, the Central Marine Fisheries Research Institute, Cochin, the Central Institute of Fisheries Technology, Cochin and the Central Institute for Freshwater Aquaculture, Bhubaneswar as its affiliated agencies to conduct three postgraduate programs; M.F.Sc Mariculture, CMFRI, Fish Processing, CIFT, Cochin, and M.F.Sc., Freshwater aquaculture at CIFA and also Ph.D. programs in the above disciplines.

The following Postgraduate programs are now offered by the CIFE.

Table 5: PG academic programs* conducted at CIFE, Mumbai.

Program	Intake capacity	Place where conducted
Master		
M.F.Sc. (Fisheries Resources Management)	15	HQ, Mumbai
M.F.Sc. (Inland Aquaculture)	15	HQ, Mumbai
M.F.Sc. (Mariculture)	10	CMFRI, Kochi
M.F.Sc. (Freshwater Aquaculture)**	05	CIFA, Bhubaneswar
M.F.Sc. (Post-harvest Technology)**	05	CIFT, Cochin
Doctoral		
Ph.D. (Fisheries Resources Management)	05	HQ, Mumbai
Ph.D. (Inland Aquaculture)	15	HQ, Mumbai
Ph.D. (Mariculture)	10	CMFRI, Kochi

* In addition to the above listed programs a one year PG Certificate course in Inland Fisheries Development and Administration is conducted at Calcutta Centre of the Institute with intake capacity of 50.

** Proposed to start from 1998-99 academic year

Table 6: Human Resources Developed by CIFE (from 1961 to 1996-97).

Academic Programs	Number of Graduates		
	Up to 1995	***1996-97***	***Total***
Ph.D.	16	02	18
M.Sc. (by research)	30	-	30
M.Sc. (Fisheries Management)	140	-	140
M.Sc. (Inland Fisheries Administration & Management)	38	-	38
M.F.Sc. (Fisheries Resources Management)	-	20	20
M.F.Sc. (Inland Aquaculture)	-	19	19
M./F.Sc. (Mariculture)	-	11	11
Diploma in Fisheries Science	994	26	1020
Certificate course in Inland Fisheries Development and Administration	1242	10	1252
Certificate course in Fisheries	344	-	344
Certificate course in Inland Operational Management	900	-	900
TOTAL	**3704**	**88**	**3792**

Education Programs

Vocational Education

Various states, notably Karanataka, Maharashtra, Orissa, Tamilnadu and West Bengal have introduced vocational courses in fisheries at 10+2 level. Books in local languages have also been prepared through the National Council for Educational Research and Training (NCERT), and its counterparts in the concerned States. Recently, the UGC has also suggested the vocationalisation of first degree program at +3 science level for students with Zoology and Chemistry as their optional subjects. The vocational subjects for the three years are (i) Fishery Biology and Capture Fisheries, (ii) Aquaculture and Aquarium Fish Keeping, and (iii) Fish Processing Technology. The choice of these courses, however needs reconsideration in the light of the existing potential and requirements (Tripathi, 1997).

Traditional Universities

Specialization in one or the other aspects of fisheries at the M.F.Sc. or Ph.D. level in Zoology is offered by various traditional universities. In addition, about a dozen universities also offer M.Sc. and Ph.D. programs in Marine Sciences, Marine Biology and Oceanography, Limnology, Freshwater Biology and Limnology, Aquatic Biology and Fisheries, Aquaculture, Coastal Aquaculture and Industrial Fisheries.

State Agricultural Universities

Of the various fisheries colleges under the SAUs, only four are offering postgraduate or doctoral programs while the rest are catering to the requirements of the undergraduates. Table 2 lists the M.F.Sc. and Ph.D. programs offered by these Fisheries Colleges.

Deemed University

The Central Institute of Fisheries Education, Mumbai, which obtained the Deemed-to-be-University status in 1989, was till recently offering M.Sc. courses in Fisheries Management (FM) and Inland Fisheries Administration and Management (IFAM). These programs are now suitably revised into M.F.Sc. programs in Fisheries Resources Management (FRM), Inland Aquaculture (IAC), and Mariculture (MC), the latter being offered at the CMFRI, Kochi. Corresponding Ph.D. Programs are also offered. Two new M.F.Sc. programs are being offered from 1998 onwards, viz. Freshwater Aquaculture (FA) programs at the CIFA, Bhubaneswar, and Postharvest Technology (PHT) program at the CIFT, Kochi. Specialized courses in Fish Pathology, Fish Nutrition and Fishery Biotechnology are being prepared.

Other Institutes

The Indian Institute of Technology Kharagpur (West Bengal) offers M.Tech and Ph.D. courses in Aquaculture Engineering. However, much remains to be achieved in these disciplines despite its association with a leading Institute (Tripathi, 1997).

Training Programs

Till 1973, when the first batch graduated from the College of Fisheries, Mangalore, fisheries activities in the country were supported by manpower trained at various institutes and centers of the ICAR, Government of India and the State Governments, some of which continue to be offered till date. Of late, training centers have been established in the private sector too.

Certificate Course for Inland Fisheries Development and Administration

The course was offered by the first fisheries training center established in India in 1945, later attached to the Central Inland Fisheries Research Institute, Barrackpore, in 1947. Its administrative control was transferred to the CIFE, Mumbai in 1979, and the center designated as Inland Fisheries Training Centre (IFTC). Recently, the Centre was shifted to its own 1.6 ha. Facility at Salt Lake City, Calcutta.

The Centre offers a one year certificate course in Inland Fisheries Development and Administration to private as well as in-service personnel with B.Sc. (Zoology) as the minimum qualification. About 1.500 candidates have been trained from 1947 till date.

Fisheries Training Program at the CIFE

The Central Institute of Fisheries Education (now a Deemed University) was till recently conducting four All-India Training Programs of which only one is in operation currently.

Post-Graduate Diploma in Fisheries Science (D.F.Sc.)

A two years Postgraduate Diploma in Fisheries Science (D.F.Sc.) was offered by the Central Institute of Fisheries Education, Bombay, from its inception. The course, open to trainees deputed by various State Fisheries Departments and Industries in India as well as countries of Asia and Africa, and a few private candidates, has been recognized as equivalent to the M.Sc. degree of traditional universities by the Union Public Service Commission (UPSC), Agricultural Scientists' Recruitment Board (ASRB) and the Government of India for job requirements. So far, nearly 1000 candidates have been trained of which 32 are from foreign countries. The course was discontinued with effect from June, 1998.

Two earlier programs, viz. one in Inland Fisheries Operatives offered by the Chinhat, Lucknow Centre and another in Fisheries Extension, offered by the Kakinada Centre of the CIFE were updated in 1990 into One-Year PG Certificate Course. A total of 1,010 candidates in the former case and 486 candidates in the latter case were trained from inception till 1995 when both the courses were wound up.

Employment Prospects *vs* Annual Output

Graduates and Postgraduates in Fish Processing Technology find easy entry into industrial establishments. The country has more than 600 fish processing establishments and they are always in need of technologists in processing and quality control. For candidates with B.F.Sc. and

M.F.Sc. (Aquaculture) there is opportunity both in private and public sector establishments as aquaculture has become an established farming sector.

In recent years most states under the Indian Union have been preferring Fishery Science graduates/postgraduates in the fisheries establishments and provide employment in various sectors under the Ministries of Fisheries. Besides, they also find employment as teaching staff in Agricultural Universities and traditional universities. The 8 national Institutes under ICAR have nearly 600 posts of Scientists and about 60 percent are faculty representing fisheries.

At the present level of entry, the candidates may find it easy to find employment either in the public or private sector.

Private Sector Participation

The seafood industry offers excellent support. All postgraduate students, after completion of academic program, are accommodated for a specific period free of charge to undergo extensive training. This is mandatory for completion of the course. In the fish farming sector, students are given exposure in private farms. Private sector also supports institutions by granting financial support for conduct workshops and training programs.

The Institutes are free to invite qualified teachers from the private sector to give lectures. They are also granted honoraria for this work.

Linkages

All fisheries colleges have excellent linkages with consultants and companies. They undertake consultancies for this type of work for which ICAR has formulated guidelines. 85% of the consultancy fee obtained are distributed to the Scientists who undertake the work. But the whole private consultancy period is restricted to 45 days in one year.

Future Needs

All ICAR Institutes and Agricultural Universities have formulated a vision 2020 under which future needs on all aspects of HRD are finalized.

Inter-country Cooperation.

The ICAR has granted financial support to all Agricultural Universities under its umbrella to set up international hostels to accommodate foreign students. Some of them have already completed the work.

India has been regularly admitting candidates in Agricultural Universities. Currently there are number of students from Africa, Asia and South East Asia (including China) undertaking studies and research in ICAR Institutes and State Agricultural Universities. The address of the nodal agency for getting admission is given below:

Mode of Submitting Application

The candidate has to submit application through their Embassy in India to:

Director General, Indian Council of Agricultural Research and
Secretary, Department of Agricultural Research & Education
Ministry of Agriculture, Dr. Rajendra Prasad Road
Krishi Bhawan, New Delhi – 110 001
INDIA

FEE : US $ 3000-4000/annum (Rate varies for different Universities)
Boarding & Lodging – US $ 100 to 120 / month

Note : Reasonable accommodation is given @ US $ 10/month in most hostels. All expenses for electricity, cooking gas, washing etc. have to be met separately.

Annex D19: Aquaculture Education in Bangladesh: An Overview

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Introduction

The fisheries resources play a very significant role in Bangladesh economy. Fish contributes about 60% of the nation's animal protein intake, nearly 5.3% of the GDP, which is about 18% of the agriculture, and 10% of the total export earnings of the country. This sub-sector provides full time employment for about 1.2 million people or about 3% of the active population and 12 million for part-time working (DoF, 1999).

In spite of its such vital contribution to the nation's economy, for a long time there was hardly any scope for fisheries education in the country. The vastness of our fisheries resource was so great that it took quite a long time to realize that this resource needs protection from destruction. Even in the recent past many did not consider it necessary to have a separate institution for fisheries studies.

However, age long exploitation of the fisheries resources and practically no management has driven this sector towards severe jeopardy. A considerable number of commercially important aquatic species started to vanish from the waterbodies due to overfishing, habitat destruction, pollution and multiple other reasons. It was only then the need of fisheries education and creation of expertise in fisheries science was realized. At present 5 universities are offering education in different dimensions of fisheries sectors.

The universities have three pronged activities aimed towards the development of fisheries, namely teaching, research and extension. These activity regimes are complementary to each other although not all of them are equally developed or are given equal priority. All these three together make what can be called fisheries education (Fig. 1).

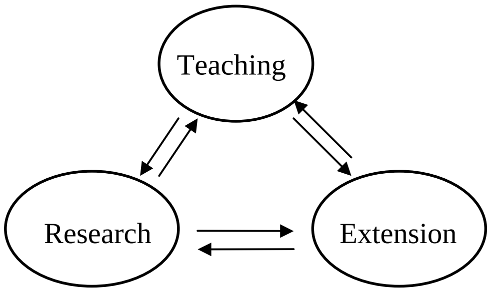

Fig. 1: The complementary activity regimes of universities offering fisheries education

Before discussing the scope and aims of the above mentioned activities it would be better to define these terms.

Teaching is nothing but leading the mind of a person we teach, to the knowledge of our inventions, in that track by which we attained the same.

Research is the careful, systematic, patient study and investigation in some field of knowledge undertaken to establish facts or principles. It can also be defined precisely as application of human intelligence in a systematic manner to a problem whose solution is not immediately available.

Extension is a service or system which assists farm people through educational procedure in improving farming methods and technique increasing farm production efficiency and income, bettering their levels of living and lifting the social and educational standards.

Of these three teaching and research programs are given priority whereas the extension program of the universities is least developed.

Teaching program encompasses the offering of undergraduate and graduate degrees. Every year about 150 graduates, in total, emerge from these universities as expertise in fisheries science.

Apart from teaching, the universities also undertake many research programs. In fact, conducting some sort of research is an essential pre-requisite of obtaining Masters or Doctoral degrees offered by the universities. The teachers and the students of these universities are making their active participation in research in almost all frontiers of fisheries science. In most cases the research topics are demand-driven *i.e.* selected on the basis of various problems arising in field levels. Almost all the universities have their journals to publish research findings.

Disseminating the knowledge achieved through academic learning and research to the working people is the major aim of the extension activities of universities. In most cases however, the extension programs are not direct. In three ways the universities are contributing to extension of technologies to farmers' level.

Firstly: Many of the graduates emerging from the universities take job in NGO's or in Government extension organizations.

Secondly: A good number of teachers are frequently involved in consultancy with projects whose activities are mostly extension-oriented.

Thirdly: Sometimes the universities arrange workshops, seminars and training programs that directly or indirectly are extensional in nature.

However, that universities should strengthen their extension programs is yet to get appreciation.

Fishery Resources and Fish Production

Bangladesh has the vast and highly diversified fisheries resources both in type of production systems and of commodities. The inland fisheries are made-up of rivers, estuaries, canals, floodplains, oxbow lakes, reservoirs and inundated paddy fields and ponds covering an area of 4.3 million ha. The culture fisheries include ponds – 0.15 million ha, oxbow lakes – 5,488 ha and coastal shrimp farms – 0.14 million ha. It has a coast line of 480 km along the Bay of Bengal with an area of 16.61 million ha.

Based on the diversity of resource base, the fisheries of Bangladesh can be classified as follows:

a. Inland freshwater capture fisheries
b. Inland freshwater culture fisheries
c. Brackish water and shrimp culture fisheries
d. Marine capture fisheries

The biological resources of Bangladesh fisheries are also very rich. The vast and varied aquatic ecosystems support a wide variety of artisanal and commercial fisheries as well as offer opportunities for aquaculture development. There are a total of 260 species of freshwater fish (Rahman, 1989), 63 species of prawn and shrimps, 25 edible tortoises and turtles, 40 species of molluscs, 17 species of crabs. In addition, 475 species of fish have been reported from the Bay of Bengal, of which 65 species are commercially exploitable. About 15 exotic culturable finfish species have also been introduced in the country.

The current (1995-96) level of fish production has been estimated to be about 1.26 million tonnes (Table 1). Out of this total, inland open water capture fisheries generate 47%, inland fresh and brackish water aquaculture 31% and marine capture 22%, inland total coming to about 80%.

Table 1: Area under different fisheries production systems with their contribution to total fish production.

Source	Water area (ha)	Production in 1995-96 (million tonnes)	Contribution to total production (%)
A. Inland openwater capture fisheries			
Rivers and estuaries	10,31,563	0.14	11.30
Floodplains	28,34,008	0.07	5.62
Beels & haors	1,14,161	0.005	0.40
Reservoir	68,800	0.38	29.75
Total inland capture	40,48,532	0.59	47.07
B. Freshwater culture fisheries			
Ponds	1,51,916	0.29	23.34
Oxbow lakes (Baors)	5,488	0.03	2.22
C. Brackishwater culture fisheries	1,40,000	0.07	5.30
Total culture	2,97,404	0.39	30.86
Total inland (A+B+C)	43,45,936	0.98	77.93
D. Marine capture fisheries	1,66,07,000		
Industrial		0.02	1.50
Artisanal		0.26	20.57
Total marine capture		0.28	22.07
GRAND TOTAL	**209,52,936**	**1.26**	**100**

Fisheries Education

Evolution of University Fisheries Teaching and Research Activities

Fisheries education and research support is currently supplied by five Universities *i.e.* Dhaka University (DU), Bangladesh Agricultural University (BAU), Rajshahi University (RU), Chittagong University (CU) and Khulna University (KU). Dhaka University was set up in 1921 and the start of fisheries education was in 1954 when Zoology courses were begun, with the MSc having a fisheries option from late fifties. A decade later in 1967 the first-ever full-fledged Faculty of Fisheries in the subcontinent was established in BAU. Zoology Department of RU also started offering fisheries option in MSc from 1972. CU set up its Department of Marine Biology in 1973 (Later changed into Institute of Marine Science: IMS) and started offering MSc in Marine Biology. Some 20 years later, KU began Fisheries education at undergraduate level under the umbrella of the Fisheries and Marine Resource Technology Discipline. In 1998 DU opened up the Department of Aquaculture and Fisheries providing fisheries education in a 4 years course.

Table 2: Development of Fisheries education at 5 Universities of Bangladesh.

Year of establishment	Name of Department/Faculty/Discipline
1954	Department of Zoology (DU)
1967	Faculty of Fisheries (BAU)
1972	Department of Zoology (RU)
1973	Department of Marine Biology (CU)
1993	Fisheries and Marine Resource Technology Discipline (KU)
1998	Department of Aquaculture and Fisheries (DU)

Organization and Structure

1. The University Grants Commission (UGC) has the delegated authority from the Ministry of Education (MoE) to manage and approve all developments in the universities. The UGC sets the budget for the universities following negotiation with the MoE and government. The administration of the universities is controlled by the UGC who must approve all new courses and appointments, but in effect the Vice-Chancellors are to a large extent autonomous and accountable only internally. General policies such as promotion and student selection criteria, course structure and university administration are controlled by the Vice-Chancellor and the academic councils made up of all Professors and Associate Professors, and by the syndicates. The UGC is particularly responsible for the upgradation, expansion and development of university education.

2. The paramount body overseeing the university is the syndicate. The syndicate is made up of a number of appointed members, usually local dignitaries, (MPs etc) and the deans of the faculties on a rotational basis. University administration is governed by a set of ordinances that describe aspects of the operation of the university, staff recruitment and duties, student selection and examinations, course structure and design.

3. The chief university administrator is the Vice-Chancellor selected by the Prime Minister from a short-list of senior academic staff. The Chancellor is the Prime-Minister in some universities and the President in others and changes with the change of administration. The Vice-Chancellors control the administration of the university and all the funding which comes from central government to the university.

4. Each Faculty is headed by a dean and each department by a head. In Bangladesh, universities appoint staff to senior administrative posts on the basis of seniority and appointments are usually for two years and posts can be held only once, unless under exceptional circumstances. The dean administers the faculty.

5. Each faculty is made up of a number of departments that offer Bachelor degrees. The exception is BAU where the Faculty consists of four departments but offers only one BSc with each department contributing part of the course. The delivery of teaching and allocation of resources to support teaching is the responsibility of the head of department while the dean co-ordinates teaching, resolves disputes and chairs the decision making faculty committee.

6. Each department also offers a master’s course. In the two general universities students can choose from options and specialize in one subject, thus both Dhaka and Rajshahi offer a MSc fisheries option.

7 The departments and faculties have in general no explicit statement of their training or research objectives and no strategy for meeting these objectives. Although there is a broad understanding as to what the aims of the departments and faculties might be there is room for improvement to meet the objectives. The SUFER Project[5] can play a vital role to specify the goals, purposes and outputs of the faculties/departments.

Role of Universities in the Fisheries Sector

1. Fisheries studies in the universities have been expanding at a rate similar or faster than the general expansion of higher education in Bangladesh

2. The primary role of universities in the fisheries sector has been to supply graduates to the labor market. Major clients are the Directorate of Fisheries, Fisheries Research Institute, Universities and University Colleges, NGOs, donor organizations and the private sector (principally commercial aquaculture and banks involved in financing aquaculture development).

Courses Offered by Different Universities

Undergraduate courses of four years duration are offered as BSc (Hons) in Fisheries in three universities (BAU, DU& KU) and BSc (Hons) in Marine Science at IMS/CU while RU plans to introduce such a course under a new department in a new faculty, within a year (Table 3).

Postgraduate training is given for MSc, MS, MPhil & PhD degrees in Fisheries, or Zoology with fisheries, at different universities but never all in a single university. MSc courses in Zoology with fisheries are offered by the two general universities: DU & RU. The MS in fisheries is available in the two technical universities, BAU & KU and an MSc in Marine Biology is offered at IMS/CU. At BAU, each of the four departments within the Faculty of Fisheries offers a specialist MS course (Aquaculture, Fisheries Biology & Genetics, Fisheries Management, Fisheries Technology)

Post-MSc degrees, MPhil/PhD, are offered at the Dept. of Zoology and Institute of Biological Sciences of RU and by the Dept. of Zoology of DU. BAU offers the PhD as a post MS degree in its four departments of the Faculty of Fisheries. IMS/CU has announced degree programs in M.Phil. & PhD in Marine Sciences but has no intake yet.

[5] DFID/GOB funded “Support for University Fisheries Education and Research” (SUFER) project.

Table 3: Fisheries courses offered at different universities.

Course Offered	BAU	CU	DU	KU	RU
BSc (Hons) Fisheries	+	-	+	+	-
BSc (Hons) Marine Science	-	+	-	-	-
MSc Zoology with Fisheries	-	-	+	-	+
MSc Marine Science	-	+	-	-	-
MS Fisheries	+	-	-	+	-
MPhil Zoology (Fish)	-	-	+	-	+
PhD Fisheries	+	-	+	-	+

Undergraduate Programs

Curricula and syllabuses of the four-year BSc (Hons) fisheries courses at BAU, KU and DU (Dept. of Fisheries & Aquaculture) and that of BSc (Hons) Marine Biology of CU (IMS) have some similarities and dissimilarities. However, BAU syllabuses are more inland fishery oriented, DU's is really a copy of BAU, KU has a few additions to BAU's syllabuses and CU's is more Marine Science oriented (Table 4).

The mode of execution and monitoring of the courses is the "annual-mark" system (BAU & CU), integrated annual system (DU), and semester credit system (KU), although the duration of the undergraduate courses are the same (four years) in all universities. However, the number of courses given (22-47) and grading marks (3200-9000) vary widely from one to another (Table 4). Typically, there is a 9-month teaching period for undergraduate courses, followed by two months revision, and a one month examination period. At BAU and DU, one course unit usually consists of 60 hours lecturing and associated practicals (usually 20-30 hours).

Transferable skills. Non-fishery subjects (auxiliary readings) of the undergraduate programs of the different universities include Maths, English, Computer Science, Biostatistics, Sociology, Economics, Biochemistry, Agricultural Extension, Environmental Impact Assessment, Research Methodology, Soil Science, Geology, Remote Sensing but not all of these at any one university. (Table 4).

Table 4: Certain aspects of undergraduate curricula & syllabuses of university Fisheries teaching programs.

University	Courses	# of Subjects taught	Unit credit hrs.	Mark for grading	Non-Fishery subject taught
BAU	BSc (Hons) Fisheries	29		3950	Statistics, Biochem., Econ., Rural Sociology, Ag. Extension.
CU	BSc (Hons) Marine Science	22		4000	Eng., Math, Computer Science, Biometry, Environmental Impact Assessment, Research Methodology
DU (AQ&F)	BSc (Hons) Fisheries	26	32 units	3200	Same as BAU
KU	BSc (Hons) Fisheries	47	191.5 Cr. hrs	9000	Eng., Statistics, Computer Science, Sociology (0) Eco (0), Remote Sensing (0), Soil Science, Geology.
RU	BSc (Hons) Zoology				Not a fisheries course, but does cover much of the basic zoology & ecology given in other courses

Table 5: Syllabuses of undergraduate programs in fisheries in different universities in Bangladesh.

Yr	BAU	IMS, Chittagong	Zoology, Dhaka	AQ & F, Dhaka	Khulna	Rajshahi
1	Fishery zoology Aquatic ecology General ichthyology Harvesting & preservation of fish Statistics Biochemistry	General biology Marine Inverts Ichthyology & other marine verts Mathematics Functional English	Animal Diversity I Animal Diversity I Animal Diversity I Botany Biochemistry	Fisheries zoology Aquatic ecology General Ichthyology Biostatistics Biochemistry 1	Marine & Coastal Env Zoology Chemistry Mathematics English Word processing and spreadsheets Marine & Coastal Aquatic Resources Planktology Botany Physics Statistics	Introduction to Zoology Animal world 1 – 3 Plant world 1 – 2 Biochemistry Chemistry
2	Fish physiology Fishery systematic Physico-chemical limnology Fish parasitology Fisheries microbiology Fish population dynamics Freshwater aquaculture	Marine Ecology Marine fisheries Physical oceanography Chemical oceanography Marine plankton Marine botany	Animal Diversity II Comparative Zoology Embryology, Human reproduction, Family planning Botany Microbiology	Fish physiology Fisheries systematic Limnology Aquaculture 1 (freshwater) Fish nutrition Fisheries microbiology Biochemistry 2	Coastal Aquaculture Management Fish Biology & culture Shell fish biology and culture Fish biochemistry Soil science Databases and statistical packages Coastal Aquaculture Management 2 Fish physiology Fish nutrition and food formulation Aquatic engineering Economics Sociology	Nonchordata: structure and function 1 – 2 Chordate: S & F 1 – 2 Function in plants Nutrition & metabolism Inorganic chemistry
3	Fish nutrition Biological limnology Fish processing Coastal aquaculture Hatchery management Fish pathology Agriculture extension Rural sociology	Coastal aquaculture Marine Microbiology Computer Science Sedimentary & geological oceanography Marine Pollution Estuarine and coastal process	Ecology, human population studies, and environmental biology Genetica and biostatistics Zoogeography and palaeontology Animal physiology and ethology Economic zoology I: Entomology and wildlife biology Economic Zoology II: Fisheries and parasitology Taxonomy	Fish population dynamics Aquaculture 2 (Coastal) Hatchery and pond management Fisheries extension Fisheries economics & rural sociology Fish harvesting & handling	Marine ecology Oceanography 1 Craft and gear technology Genetics Marine botany GIS Aquaculture planning Oceanography 2 General microbiology Post-harvest technology Fish population dynamics	Chordata: Anatomy and evolution Cytology, histology and cytogenetics Genetics Evolution Ecology Environmental biology
4	Oceanography and marine biology Fishery products and quality control Fisheries management Preservation and control of fish diseases Genetics and fish breeding Fish feed technology Fish farm design and construction Fishery economics	Aquaculture planning & engineering Fish and shellfish diseases Fish and shrimp nutrition Biometry Environmental impact assessment Research methodology	Fish taxonomy, behavior, biology, ecology, limnology Aquaculture and fish diseases Fish population dynamics, resources, management, extension, marketing Fish process and handling, nutrition, technology and harvesting.	Oceanography & marine biology Fisheries resources and management Genetics and fish breeding Fish preservation and processing Fish pathology and parasitology Aquaculture engineering Fisheries impact, assessment & planning Fisheries marketing & co-operatives	Fisheries management Fish diseases Marine pollution 1 Post harvest technology 2 Maritime navigation and communication Research methodology Fisheries conservation and management Meteorology and remote sensing Marine pollution 2 Aquaculture extension Intro Biotechnology and genetic engineering	Human physiology Genetic engineering Systematic and biodiversity Economic zoology and parasitology Farmed animals Research methods Microbiology and immunology

Practical and field work in teaching. Most departments recognize the importance of practical laboratory work and field visits, and there is a commendable effort to incorporate both types of teaching in a wide range of courses. Resource constraints are usually the reasons for not doing more. SUFER teaching awards would be of much help in this regard.

Another method of giving students field experience is through internships with other organizations involved in the fisheries sector (future employers for some). Some Departments have built up links with NGOs and with BFRI or DoF to allow this, usually between graduation and masters' level. This practice needs to be encouraged as it will immensely help developing practical skill of the students.

Masters Programs

The Masters programs in fisheries offered by the universities may be categorized into two types i.e. MSc in Zoology with Fisheries, offered by the general universities (DU(Z) and RU) to students with BSc Hons in Zoology, and the second category (MS at BAU, MSc at CU) by the technical universities (BAU, KU & CU), to students with BSc Hons in Fisheries (BAU & KU) and Marine Biology (CU) as shown below in Table 6:

Category of Masters programs in fisheries at the universities

MSc | **MS**

	RU, DU	**CU**	**BAU, KU**
Pre.req.:	**B.Sc. Hons Zool.**	**B.Sc. Hons Marine Biol.**	**B.Sc. Hons. Fish**
Duration :	**1 Year**	**1 Year**	**1.5 Year**
Theses :	**Yes or Not**	**Yes or Not**	**Yes**

Table 6: Certain aspects of the courses of the Masters program in Fisheries in different universities of Bangladesh.

	Courses	**Duration (yr)**	**Unit / Credit**	**Mark**	**Type/ groups**	**Prerequisite**
BAU	MSc Fisheries	1.5 (3 Sem)	22 Credit	1600	Theses must	BSc Hons Fisheries
CU	MSc Marine Biology	1.5 (3 Sem)	-	600	Thesis & non-thesis	BSc Hons Marine Biology
DU (Z)	MSc Zoology (with Fisheries)	1	8 unit	800	Thesis & non-thesis	BSc Hons Zoology
DU (AQ&F)	MSc Fisheries	1			Not yet established	
KU	MSc Fisheries	1.5 (3 Sem)	-	-	-	BSc Hons Fisheries
RU	MSc Zoology (with Fisheries)	1	-	600	Thesis & non-thesis	BSc Hons Zoology

MPhil & PhD Programs in Fisheries

The structure of the research-based post-MS/MSc courses is as follows:

DU, RU : **M.Sc. Zoology with Fisheries** — **M.Phil. 2 Years** — **Ph.D.(3 years)**

BAU : **M.S. Fisheries** — **Ph.D.(3 years)**

Teaching Faculty

The structure and composition of the teaching faculty in each university departments are summarized in Table 7.

Table 7: University-wise particulars of teachers engaged in fisheries education.

	Dept or Faculty	Total # of faculty teacher	Number according to qualification			# of faculty teachers (position wise)				# of BSc (Hons) students	Teacher: student ratio
			Ph.D	M.Sc	Bsc	P	A P	AsP	L		
BAU	(4 dep)	45	31 69%	14 31%		25 56%	5 11%	5 11%	10 22%	70	1: 1.55
CU	IMS	15	6 40%	9 60%		7 47%	3 20%		5 33%		
DU	Zool	13	11 85%	1 15%		9 69%		3 23%	1 8%	15	1: 1.2
	Aqua. Fish	4	3 75%	1 25%		1 25%			3 75%	15	1:3.8
KU		19	3 19%	13 68%	3 16%	1 5%	1 5%	8 42%	9 48%	35	1: 1.8
RU	Zoology	7	4	3		3		2	2	15	
	Total	103	58 56%	42 41%	3 3%	46 45%	9 9%	18 17%	30 29%	135	1 : 2.1

Examination of the above Table 7 reveals that the older departments have a higher ratio of Ph.D and professorial teachers to non-Ph.D and junior teachers than do the newer departments. On average, 56 percent of the teachers of fisheries teaching universities are Ph.Ds mostly with overseas training (86 percent) in various countries (Table 8), mainly the UK (31%) and Japan (36%)

Table 8: Training locations of Ph.D of faculty members of the universities.

Univ.	Bang.	India	U.K	USA	Japan	M'sia.	Others
BAU	02	01	10	01	12	04	01
CU	03	01	01	-	-	-	01
DU	02		04	01	07		
KU		-	02	-	01	-	-
RU	01	01	01		01		
Total	8 (14%)	03 (6%)	18 (31%)	02 (3%)	21 (36%)	04 (7%)	02 (3%)

These indicators reveal that DU and BAU have relatively more trained teachers and KU has the least number of trained and senior teachers. Nowhere except at KU, do BSc (Hons) teachers teach the BSc (Hons) course.

Looking at qualifications and publication records, it may be concluded that a number of the teachers of some of the universities need more training particularly to teach the specialized subjects at final year and MSc\MS level. In particular, many of the faculty members teaching in the marine sector need to undertake more specialized training.

Teaching Facilities: Physical Infrastructure

In almost all the universities, lecture rooms are of adequate space but lack modern teaching facilities. However, OHP and slide projectors are available in almost all the departments but they are not widely used for maintenance problems.

With the increasing number of students, BAU is facing problems of space. However, a new extension building is on its way of completion. The classrooms of DU (Z) need renovation while DU (AQ & F) will need to make more space for teaching soon. There must be rational planning to equip the classrooms and maintain them for fisheries teaching. Only the BAU-Link project-equipped classrooms, and the new ones at KU are in reasonably good state.

However, for more creative and effective teaching, adequate numbers of improved types of appliances are required. Proper arrangements for maintenance and servicing of the equipment is of paramount importance before acquiring any equipment and appliances.

The outdoor fisheries facilities are relatively more suitable and adequate for fisheries teaching at BAU; some of them were created by the BAU Link project and recently BAU obtained a sizeable grant from the GoB to establish a hatchery for student field work. In addition, BAU has about 200 ponds of different sizes for students' use. At DU, field facilities have not been adequately developed, though fisheries has been taught for a long time; this reflects the nature of indoor oriented teaching at this university. RU has similar laboratory facilities to DU, but better experimental pond facilities. KU has no outdoor facilities. However, all these universities have access to nearby fish farms and diverse kinds of aquatic and fisheries systems to use for their field teaching.

Information Sources

Students are given selected textbooks, often to a group, for using during a semester or year. Reference books can either be borrowed for a stipulated period (1 or 2 weeks) or made available for study in the library during the working days from 8 am to 8 p.m. Relevant magazines and journals are also available for study but at times are limited in number. Besides the general or central library, every faculty or department maintains a small 'seminar' library (with sizeable collections in older universities), which can be used by postgraduate students. The number of international fisheries journals vary from university to university.

Electronic information sources (bibliographic databases) are also available in some universities. Students at DU have more access to these information sources for several reasons. Firstly DU is the oldest university and has accumulated richer information sources over time. Secondly, DU is well placed for access to several other information sources like the libraries of BANSDOC, DoF, DFID FMS office, BARC and others. Thirdly they can consult the DoF and NGOs concerned with fisheries, whose headquarters are in Dhaka. Fourthly they have easy and cheap access to electronic information sources through Dhaka-based internet service providers.

Information about the different aspects of local fisheries and allied matters are lacking because there are few books in these areas that are suitable for undergraduate students. So there is a great need of books covering the different aspects of fisheries and aquaculture of Bangladesh.

Funding for libraries comes from the central budget of the University. Departments/Faculties also receive from time to time some grants to buy books, journals, magazines and other publications as exchange materials from overseas institutions. BAU has received a number of fisheries books from DFID through the BAU Link project.

Teaching Methods

Modern teaching methods using appliances like slide projector, OHP and audio-visual aids are followed wherever available.

Well-planned and strategic development in this area will be useful for the overall progress in fisheries teaching at the university level in Bangladesh. The SUFER project can be of utmost help in adopting effective teaching methods.

Students

The minimum qualification for admission to undergraduate courses in fisheries is Higher Secondary Certificate (HSC). Admission testing is administered by the concerned faculty in all universities except in BAU where the admission test is monitored by a central body of the university. Top listed students in the admission test generally prefer to get themselves admitted in the faculty of fisheries at BAU, while fisheries gets 3rd, 7th, & 2nd preference respectively at RU, DU and KU.

All students get accommodation in the university halls at BAU, a part of them do so at DU, CU and RU, while there is no accommodation available for students at KU.

Students are supposed to manage their educational expenses. Government grants, ranging from Tk.200 to 300 (per month) are received by all students at BAU, but only by some students in other Universities. Some charitable institutions offer stipends to University students.

Staff Development and Training

The provision of training in teaching methods, course and curriculum development, and specific technical skills to aid teaching and research (e.g. computer skills) is available to varying degrees within the universities.

BAU has a Graduate Training Institute (GTI) which runs courses in teaching methods and extension techniques which teachers can attend voluntarily. At Dhaka, newly appointed lecturers are now required to attend a two-week induction course. This course introduces lecturers to the administrative structure of the university, explains their roles and responsibilities and provides basic information on how to carry out their job effectively. The course includes 3 days training on teaching methods. Junior lecturers also receive training at RU. There is no teacher-training at KU or IMS/CU. Students in these last universities begin teaching with experience only of giving departmental seminars based on their MSc thesis work. However, there is no continual and effective staff development program in any of the universities. Initiative can be taken to introduce such staff development strategy in all the Universities in order to make teaching more effective.

Outcome and Contribution to the Fisheries Sector

Currently around 150 graduates with specialist fisheries background are produced per year. Graduates with fisheries degrees are mostly employed in the DoF, BFRI, NGOs and private banks, farms and the fisheries industry besides academic employment in universities.

The performance of the fisheries graduates from different universities is not equal. In some cases graduates are unable to apply known principles to solve practical problems of the sector (SUFER, 1998). BAU graduates are in a better position since they have the opportunity to involve themselves with fieldwork in almost every year.

Fisheries Research

Bangladesh is well suited to fisheries production. Most of the people of Bangladesh depend on fish as principle source of food that provides 60% of animal protein. Fish and rice are the main diet in the country. In recent times the per capita consumption of fish has declined from 12 to 7 kg per annum, because the supply could not keep pace with a fast growing population. Just to maintain present fish consumption levels however, the total fish production of Bangladesh must increase by over 40% by the year 2000. A target of 2 million metric tonnes has been set in the Fifth Five-year Plan

In order to meet the need for a vast increase in protein viable aquaculture technology to enable production to keep pace with increasing demand would be necessary for the farmers.

Research is the first link in the chain that reaches to the users/farmers. Usually the connection is made through extension workers. This linkage goes to and from the users, because this is the channel through which the researchers learn about farmer's new problems and try to solve them. Scientists improve their ability to serve farmers better by listening from them, and by treating them as their colleagues, co-operators, innovators and teachers. The new technology must pass its final test on the farmer's pond. These trials put the farmer in personal touch with the research work.

Fisheries research is a comparatively new sector in Bangladesh. Fisheries research started as basic studies in ichthyology during the early fifties. This was followed by the realization that fisheries had to be dealt with as a quantitative science, particularly in the investigation relating to capture fisheries and the management of open water fishery resources. The formal fisheries research in Bangladesh had its beginning in 1964 with the establishment of the Freshwater Fisheries Research Station at Chandpur. Research of freshwater fishes started with the inception of the station. Education is an important element of the fisheries research process. Higher education in the fisheries made a significant advance in 1967 with the establishment of the Faculty of Fisheries (FF) in Bangladesh Agricultural University. The Faculty is the institute for professional fishery scientists in the country. It offers graduate and postgraduate level degrees as well as a modest research program. In addition to that there are three more general universities in the country: University of Dhaka, University of Rajshahi and University of Chittagong, who also offer fisheries education in under graduate and post graduate level. There is a very new department at Khulna University; Department of Fisheries and Marine Resource Technology Discipline that also offer graduate and post graduate level degree in the field of fisheries .The role of these universities is primarily to train the professionals who occupy technical position in the fisheries sector .In addition the universities have a research role, running programs which address the researchable constraints limiting sector development. Most of the fisheries research was being carried out by the research institute under the administrative control of DoF. After establishment of Bangladesh Fisheries Research Institute during 1984, it became the prime institute in the country to undertake adaptive research aimed at increasing fish production for domestic consumption and export and creation of more and better jobs. BFRI was established with the following mandate.

a. carrying out and coordinating of all fisheries research activities in Bangladesh;
b. concentrating attention to programs of adaptive research in development and optimum utilization of all fisheries resources in the country;
c. experimenting and standardizing the technique for increased production and for better management of fisheries resources; and

d. evolving methods for import substitution and cost reduction and for improvement of processed fishery products for domestic consumption and for export.

Presently, the Institute in addition to its Headquarters at Mymensingh has four research stations: i) The Freshwater Station at Mymensingh, ii) Riverine Station, Chandpur, iii) Marine Fisheries and Technological Station, Cox's Bazar and iv) Brackish water Station, Paikgacha (Khulna).

Independent fisheries research programs are also being undertaken by various universities within their fisheries departments. Research work carried out in educational institutions frequently remain unpublished and listed as thesis or reports. This hampers dissemination of information. Research works carried out in various educational institutions to fulfil the requirements of research degrees, are often abandoned, once these academic requirements are met. Therefore, there is no continuity of many high quality research works (Allison *et al.* 1999). There are many highly qualified aquaculture scientists engaged in teaching and research in different universities of Bangladesh but due to lack of co-ordination among research organization, universities and other institutions involved in aquaculture and fisheries research is still the serious bottleneck in the planned growth and development of fisheries research as well as development of fisheries sector in the country.

According to Chua (1990) the purpose of research in aquaculture is to provide scientific information that will lead to: (a) sound formulation of development strategies, policies and management for sustainable aquaculture development at national or regional levels; (b) improvement of aquaculture techniques technologies, the application of which will lead to economic production and hence increase the efficiency of the production systems; (c) information on the appropriateness and potential of species or strains that could improve yields through genetic selection and germplasm development; and (d) information on the social acceptability and economic viability of various forms of aquaculture.

The ultimate objective of aquaculture research is to transform aquaculture from traditional, experience-dependent practices into a technologically packaged system based on scientific principles. Scientific research in aquaculture, like in any other branches of science, is a continuous process. Its focus varies according to the current status and magnitude of the problems and the urgency of the information needs. Thus, short-term research on specific localized problems may be a continuous process while strategic research should be able to resolve major issues which may require collaborative efforts of research teams over an extended period of time.

Since financial resources are always limited, research efforts and the allocation of research funding must focus on areas that are most critical to aquaculture development and the results of which will benefit the most number of people, especially the rural poor.

Aquaculture or farming of aquatic organisms of commercial importance has already been recognized even in Bangladesh as an "industry" and is expected to become a major industry of the country in the near future.

Research Programs

Students of Masters programs, MSc and MS, and those of the higher M.Phil and PhD levels undertake research for the fulfillment of their degree requirements. Students' research is usually funded by the university. Some research works are also carried out through donor funding by the leaders.

The duration of student research depends on the type of course being studied, and in most cases research is discontinued after the completion of the degree work of the students. However, faculty members do continue their research pursuits.

Facilities and Resources for Research

Most of the physical and material facilities created for teaching are shared for research work. As mentioned before, most universities have limited facilities to carry out fisheries research except at BAU where reasonable good facilities have been created with donor and government assistance (Allison *et al.* 1999). Significant facilities for postgraduate research are available only at BAU. Fisheries research in some needed subjects faces less problems because there are huge gaps in the area and much fisheries research work can be carried out with quite small resources. Students carry out all indoor and outdoor support activities and can provide competent support to faculty research.

Research Funding

Limited funds are available from the university for student research. Grants for faculty research are limited, with none being available in some universities. At BAU, there is a body called the Bangladesh Agricultural University Research System (BAURES) to manage and support university research. In other universities there are similar committees to manage research activities. Besides internal funding, some national (e.g. BARC, UGC, Ministry of Science &

Technology) and international agencies (EU, DFID, IFS, NORAD, DANIDA etc) provide funds for fisheries research at the universities.

Table 9: Examples of external sources of funding for research-related activities in the five universities.

Institution	Main recent externally funded research programs and funding sources
Faculty of Fisheries, BAU	BAU-Stirling Link Project, DFID BARC IFS DANIDA
IMS, CU	CIDA BARC Ministry of Science & Technology FAO
FMRT, KU	British Council Link – University of Wales Current applications: Asian Fisheries Society, Darwin Initiative, DETR, UK.
Z, RU	Unknown
Z, DU	University of Bergen, Norway BARC And many others
AQ&F, DU	None

Research Supervision

Procedures for supervision and selection of research topics for postgraduate students seem well established and standardized. MSc students often have two supervisors. Where relevant research expertise is not available in the students' department, co-supervision with teachers from other institutes is possible. This is one of the main ways in which institutes interact with one another in a research context. BAU has much more interaction with the lone national research institute i.e., Bangladesh Fisheries Research Institute (BFRI) than others. This is because of the fact that BFRI Head Quarter and one of its 4 stations (Freshwater Station) is established in BAU campus with the understanding of sharing the research facilities and better co-ordination between the Faculty and BFRI.

All the departments offer MSc thesis programs. Only BAU, Dhaka and Rajshahi offer PhD programs. There is some experience with joint supervision of PhDs with international institutes, through split-center research programs.

International Collaboration in Research

There are relatively few international links evident in fisheries and aquaculture research in Bangladesh. It appears that the universities are not taking full advantage of the opportunities available to them. This situation is changing gradually.

Many of the links described as 'joint research' by universities are in fact teaching links, with the postgraduate training of Bangladeshi university teachers in international institutes constituting the 'research'. While PhD research is often of publishable standard, a science PhD from an international research institute is often, in practice, primarily an apprenticeship and not a collaboration among research partners. With a few exceptions, continued research collaboration beyond the student-supervisor relationship does not happen.

One exception appears to be the University of Wales-Khulna University link, which has led to a project proposal, submitted to the UK DTER's Darwin Initiative for Biodiversity Conservation. Stirling University's Institute of Aquaculture and BAU Faculty of Fisheries also have incidences of post doctoral level collaboration.

Table 10: University research publications on fisheries (summarized from Allison et al., 1999).

University	Faculty/Dept. Member	Total Publication	International Journals	International Refereed Journals	# of publications on rural fish farming
BAU	45	249	48 (19%)	11 (4%)	17 (7%)
CU	15	83	23 (28%)	3 (4%)	-
DU	17	155	20 (13%)	0	9 (6%)
KU	19	19	4 (21%)	0	2 (10%)
RU	7	62	5 (8%)	0	1 (2%)
Total	103	568	100 (18%)	14 (3%)	29 (5%)

Research Outputs

Research Papers

Faculty research outputs are mainly in the form of journal papers. These are published in mostly in-house journals. Few (19%) of the publications are made in out of the country journals and these are mostly in Indian and Pakistani journals or the in-house journals of Japanese universities. Publications in international rated journals are few (3%). Publications of studies on rural fish farmers are also scanty (5%) (Table 10).

Dissertations

Student research is done to prepare dissertations. A large number of dissertations have been produced by the students of the Masters programs but MPhil & PhD theses are few. Figures are available for BAU, where 551 MS theses have been prepared since the program started, but only 8 PhD theses have been completed. At DU (Z), only 6 PhD theses (and 1 MPhil) in fisheries have been completed since the department began offering a fisheries PhD program. The low numbers of PhDs reflects the importance of study abroad for higher research degrees.

A copy of the dissertation is placed in the central or departmental library of the concerned university for availability to future researchers. Some of the dissertations do get published, however, some remain unpublished and thus are unlikely to be discovered by researchers outside the university.

Impact and Relevance of University Teaching and Research to Fisheries Activities of the Rural Poor

In principle, fisheries education should be imparted at the university level to provide technology-based and needs-oriented higher education that prepares graduates to meet sectoral development requirements. In Bangladesh this is not happening as manpower needs are subordinated to degree course requirements.

Research is carried out to fulfil the needs of the degree and/or promotion, not to address sectoral and national needs, except a few. The facts do not back up the quotations, because the researchers are not getting out into the field and identifying and addressing the relevant issues. Bangladesh has a rural-based economy and most of the fisheries activities are based in the rural areas. Unfortunately, there has been very limited effort to directly involve resource users and managers in the process of teaching and research at the university level. More research work should be based ‘on-farm’, rather than in campus fish ponds. Only then will the universities change the current situation, where only five percent of publications directly involve or relate to the fish farmers of the country (Allison *et al.* 1999).

Teachers are qualified, but in some cases lack imagination or spirit of innovation in teaching and research. They do not operate under however, the best conditions, admittedly, since facilities are often inadequate and not much money is available.

Thus the impact of university teaching and research on and relevance to, the fishing and fish-farming activities in the poor rural areas is more limited than it should be. This is where the SUFER project can contribute to improve the teaching and specially the research activity.

Strategic Plan for the National Agricultural Research System to the Year 2010 and Beyond (Published 1995)

The goal is to improve the well-being of present and future generations of farmers and consumers in Bangladesh, particularly those with low incomes.

BFRI has generated appropriate technologies for improved breeding and nursery management of carps, fish culture in seasonal and perennial ponds, fish culture in pens, integrated poultry fish/duck-fish/rice-fish farming. These technologies are disseminated through NGOs. The levels of fish production, as a result, have gone up to 1300-2600 kg/ha in seasonal ponds and 3000-4000 kg/ha in perennial ponds. However, production could go up to 5000-6000 kg/ha/yr through application of BFRI-developed technology that includes polyculture of compatible species of major carps, or carps with silver barb, *Tilapia* and catfish. Also advances in low cost feed formulations and cheaper fertilization procedures for a number of fish species including carps and shrimp.

Shrimp production has increased to 250 kg/ha/yr through stocking with post-larvae and supplementary feeding. There is a growing debate about the detrimental environmental consequences of shrimp culture.

The overall objectives of the fisheries sub-sector are to:

1. Increase and sustain fish production for both domestic consumption and export.
2. Bring all available public water bodies having perennial as well as seasonal waters and derelict village ponds under fish culture.
3. Meet the basic requirement for animal protein at the household level by integrating fish culture with other components of the farm enterprise.
4. Generate employment opportunities in fisheries and allied industries.
5. Promote the adoption of technologies to optimize production while conserving the environment and sustaining the natural resource base.
6. Conserving fisheries and species biodiversity.

Programs of NARS

Program area # 1. Inland open water systems

1. Develop methods for stock assessment and conservation of traditional and cultivable fish species.
2. Improve the understanding of population dynamics and production ecology as a basis for developing management principles.
3. Study the biodiversity of oxbow lakes and flood-plains and identify threatened fish species and fish food organisms.
4. Study the stocking strategies for floodplain rehabilitation and its impact on the socio-economic condition of fisherfolk.
5. Develop capture technologies for inland fisheries.

Program area # 2. Inland closed water culture fisheries

1. Develop culture systems with a focus on:
    a. feeding, fertilizing and selecting optimum dose of application for intensive, semi-intensive and traditional systems;
    b. input and output analysis with social implications;
    c. viability of fish culture in seasonal water bodies;
    d. inventories of aquatic resources and their rational utilization; and
    e. stock manipulation and management of culture fisheries in different water bodies.

2. Develop seed production and fingerling raising techniques to:
    a. improve induced spawning of catfish, small fishes and shrimps, fry and juvenile production techniques;
    b. develop feed for fry/fingerlings with various stocking rates;
    c. develop techniques of seed production of non-traditional species such as koi, pabda, magur and other endemic small fish and flood-plain resident species;
    d. generate hatchery management technology to improve production; and
    e. develop techniques for the transportation of fish seeds.

3. Develop methods and production management practices for integrated culture (poultry/duck/fish, rice/fish) and polyculture (shrimp/carp, shrimp/catfish)

Program # 3. Fish feed and nutrition

1. Identify potential indigenous fish feed ingredients based on their availability and nutritional value.
2. Develop cost-effective feed mixes for different cultivated fish species .
3. Develop simple fish feeding systems and techniques for adoption by fish farmers.

Program # 4. Brackish water aquaculture

1. Develop induced spawning and rearing techniques.
2. Develop techniques for intensive and semi-intensive culture of shrimp.
3. Generate technology to sustain shrimp-cum-rice rotations at higher levels of productivity.
4. Generate technology for culture of shrimp and *Artemia* in salt pans.
5. Design management techniques for polyculture of shrimp and coastal fin fish.
6. Develop culture technologies for crab, turtle and other non-traditional species.

Program area # 5. Marine fisheries

1. Develop methods for the assessment and conservation of marine fishes of economic importance (pelagic and demersal).

2. Develop capture technologies (craft and gear development) for marine fisheries.
3. Devise production management systems for marine fisheries.
4. Develop appropriate technologies for the utilization of by-catch in shrimp and marine fisheries.
5. Investigate the possibilities of mariculture of edible species.
    a. develop pen and cage culture technology;
    b. develop induced spawning of various species of economic importance; and
    c. develop culture techniques of oyster, pink pearl, mussels, and mollusc in the marine environment.

Program area # 6. Fish disease and control

1. Monitor the incidence and prevalence of diseases and parasites.
2. Develop an understanding of the production environment and establish culture and sanitary measures to prevent outbreak of diseases.
3. Identify locally available drugs for controlling diseases and parasites.

Program area # 7. Processing and preservation of fish and fish products

1. Assess the extent of losses due to spoilage in traditional fish marketing.
2. Develop sanitized and cost effective processing and preservation techniques for fishery products, by-products, refrigerated, non-refrigerated and salt preservation, drying, smoking, canning, etc.
3. Develop packaging, handling, and storage technologies to improve marketability and ensure competitive quality for fish and fish products.
4. Develop fish-based novel food products.
5. Standardize quality control measures, including microbial standards and sanitary requirements for processing of fish products.

Program area # 8. Socio-economic research in fisheries sub-sector

1. Socio-economic conflicts over the use of land and water resources for crop production, fish production and navigation.
2. Income distribution and nutrition implication of the declining open water capture fisheries and increasing pond fisheries.
3. Marketing of fish and fish products.
4. Export economics of fish and fish products.
5. Economics of shrimp culture and its income distribution impact.

Fisheries Extension

A common allegation against the universities catering to fisheries education is the indifference to extension activities. The allegation is not fully justified. Since most of the Departments/Faculties of universities relevant to fisheries education and research have little resource for extension activities the initiative has to come from the Department of Fisheries (DoF) to ascertain what technologies are available with the universities. Once it is known, the agencies with field facilities particularly DoF, concerned NGOs and even private entrepreneurs may take those up for extension. However, BAU has a little difference so far as the extension work is concerned. The university has an Extension Department and an Extension Centre called BAUEC i.e. BAU Extension Centre that is meant for doing extension work of the technology developed.

Table 11: Manpower related to fisheries extension activities.

Categories	No. of personnel
TFO/Upazila Fisheries Officer	458
Fish Seed Multiplication Farm Manager	40
Thana Extension Officer (Fisheries)	212

DoF has a very extensive organogram with big manpower starting from DG (Director General) down to Thana Fisheries Officer, Fish Seed Multiplication Farm Manager and Thana Extension Officer. Although Thana Extension Officers are responsible for extension work the job description of Thana Fisheries Officer and Fish Seed Multiplication Farm Manager also include extension activity. In fact they all are technical personnel with a fisheries background and somehow or other related to extension network, through motivation and organizing various training programs.

Technologies to be developed through research must be economically feasible commercially viable and socially acceptable. Once such technologies are developed and refined they are to be transferred to the ultimate users/farmers in the form of simple messages by extension workers. There should be an adequate interaction between researchers, extension workers and farmers in the course of dissemination of viable aquaculture technologies in the field. Such a coordinated approach is really needed for fisheries sector development.

Conclusion and Recommendations

Not many countries of the world have so many fisheries resources as Bangladesh has. Fish and fisheries are the integral part of the Bangalee because of their role in the economy, culture, tradition and finally in employment. There are a sufficient number of universities offering fisheries education by quality teachers having foreign training with some exceptions.

The following recommendations may be put forward for strengthening fisheries education, research and extension activities that might ultimately ensure sectoral development.

a. The present course and curricula of aquaculture and fisheries education at undergraduate and postgraduate levels should be updated and reorganized wherever necessary based on the existing needs emphasizing on practical aspects of diversified resource management and more importantly for giving a homogeneous degree with similar backgrounds from all universities. **Should B.Sc. courses contain more fundamental science and M.S./M.Sc. course be more applied and vocational in nature?**

b. Teaching, research, extension and other development activities of different universities, research institutions and government agencies should be coordinated for proper execution of development plans, setting research priorities and strengthening extension works. **Who should undertake this co-ordination?**

c. It needs to establish and maintain regular co-ordination and co-operation among the research institutions and the users of the research results for continuous monitoring of the field problems and update the research agenda. **Should the Asian Fisheries Society, or another body, facilitate this?**

d. Emphasis should be given on demand-led research problems facing by the farmers, fishermen, entrepreneurs, processors, traders, exporters and consumers in order to assist them resolving their problems. **Who identifies these problems?**

e. On-farm and farmers participatory research should be encouraged. **But can farmers do research?**

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Appendix: List of acronyms and abbreviations

AQ & F	Department of Aquaculture and Fisheries (Dhaka University)
BARC	Bangladesh Agricultural Research Council
BAU	Bangladesh Agricultural University
BAURES	BAU Research System
BFRI	Bangladesh Fisheries Research Institute
CU	Chittagong University
DFID	Department for International Development, U.K.
DG	Director General
DoF	Department of Fisheries (Government of Bangladesh)
DU	Dhaka University
DU(Z)	Dhaka University (Department of Zoology)
FAO	Food and Agriculture Organization (of the United Nations)
FF	Faculty of Fisheries
FMRT	Fisheries and Marine Resource Technology (discipline at Khulna University)
GoB	Government of Bangladesh
IFS	International Foundation for Science
IMS (CU)	Institute of Marine Sciences (Chittagong University)
KU	Khulna University
MoE	Ministry of Education
NGO	Non-Governmental Organization
NORAD	Norwegian Aid Agency
PSC	Public Services Commission (GoB)
RU	Rajshahi University
SUFER	Support for University Fisheries Education and Research (DFID)
UGC	University Grants Commission of Bangladesh
VC	Vice-Chancellor