

Aquaculture Training: Needs and Opportunities

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Background

In 1973, Dr. E.W. Shell of Auburn University stated at a meeting of the Working Group on Aquaculture of the Technical Advisory Committee, Consultative Group on International Agricultural Research (CGIAR): "Agriculture has available to it a legion of trained specialists and large numbers of training institutions. Aquaculture lacks almost entirely such supporting services; yet similar services must be available if aquaculture is to be developed to play a significant role in improving income and alleviating hunger in developing countries."

This statement remains largely true nearly 10 years later, despite the notable achievements of Auburn and other universities in aquaculture training, the advent of the UNDP/FAO Aquaculture Development and Coordination Programme (ADCP) aquaculture centers and the courses developed by a variety of agencies and institutions in, for example, Israel, the Philippines and the United Kingdom. With the exception of a few sustained university programs, the history of aquaculture training is one of sporadic funding and opportunities. Prospective trainees are understandably confused.

Biotrop has modern training facilities in Bogor, Indonesia.



Needs

The discontinuity of many training programs is not surprising. Demand varies greatly both in the nature of the training sought and the numbers of prospective trainees. These depend on national priorities, availability of funds, advice from consultants, etc. Shell's (1973) analysis of training needs is paraphrased here:

1. Higher degree training in developed countries.
2. Short-term training for developing country professionals.
3. Reinforcement of training of developing country professionals by visits of second country experts.
4. On-the-job training for technical staff.
5. Training for administrators by visits to their counterparts in different countries.
6. Continuing education in the developing countries for all (administrators, teachers, professionals, and technical staff) by follow-up programs.
7. Development of university curricula and higher degree programs in the developing countries, with regional and international linkages where appropriate.

This illustrates well the complex nature of training needs. Researchers whether in government service, universities and similar institutions or the private sector, need high level scientific training in the principles of aquatic biology and in research methodology applicable to their cultured species and culture methods. Extension workers, farm managers and technical support staff require more practical training on hatchery and growout methods for specific commodities. Technical training needs are now particularly urgent as governments, bilateral agencies and development banks are attempting large-scale

aquaculture development projects and seeking immediate training for farm and hatchery operatives: for example, the Asian Development Bank has sought aquaculture training for about 70 project personnel in 1982, largely in shrimp and carp culture.

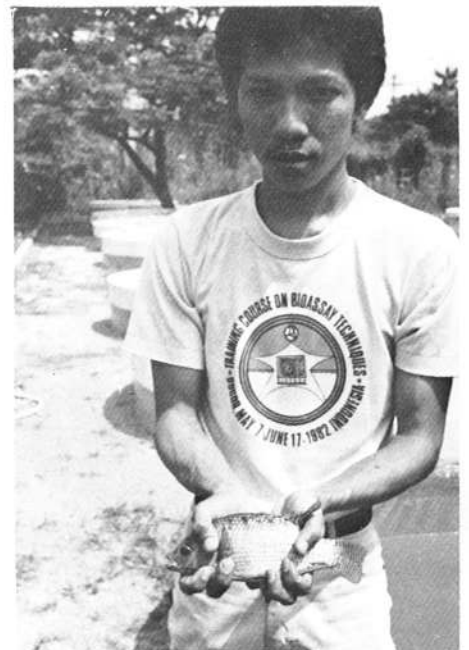
Training needs are also beginning to transcend national, regional and continental boundaries. Examples are the global interest in some of the major fin-fish commodities (tilapias, carp, mullet and catfishes) and the desire of Latin American and African nations to learn and adapt Asian culture methods, particularly integrated aquaculture-agriculture systems.

Shell's analysis of training needs does not refer to specific disciplines, but it is worth noting here that genetics (which has been the key discipline in increasing agricultural production) and economics (essential for policymakers and planners) have been neglected in many curricula.

Meeting Needs

Over at least the past ten years, developed country universities and research institutions have shouldered most of the burden of aquaculture training. This has inevitably limited the value of some of the training given. First, most of it has been given *outside the tropics*, remote

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from tropical farm situations. Second, and related to this, universities have attempted to cope with virtually all types of training needs from technical training to Ph.D. programs. Some bias towards academic achievement over the skills needed for commercial farming is almost inevitable in a university environment.

While training in developed country universities has been and remains vital in providing higher degree programs for overseas students, and in teaching laboratory skills using facilities less available in the developing countries, it is clear that more training should be done in contact with real farm situations in the tropics. The Network of Aquaculture Centers in Asia (NACA) has made an excellent contribution to this with a multidisciplinary 12-month training course for senior aquaculturists from Asia and the Pacific (see article p. 17). However, the

need for more specialized training courses is still not being addressed on a coordinated basis and there remains a lack of modern curricula for *tropical* aquaculture, particularly modern textbooks and farm manuals.

Texas A and M University is taking a lead here in developing a program of short (1-2 months), intermediate (4-6 months) and longer (up to one year) courses within an aquaculture training program designed to be flexible and to meet such needs. The first course will be a 3-month nutrition course.

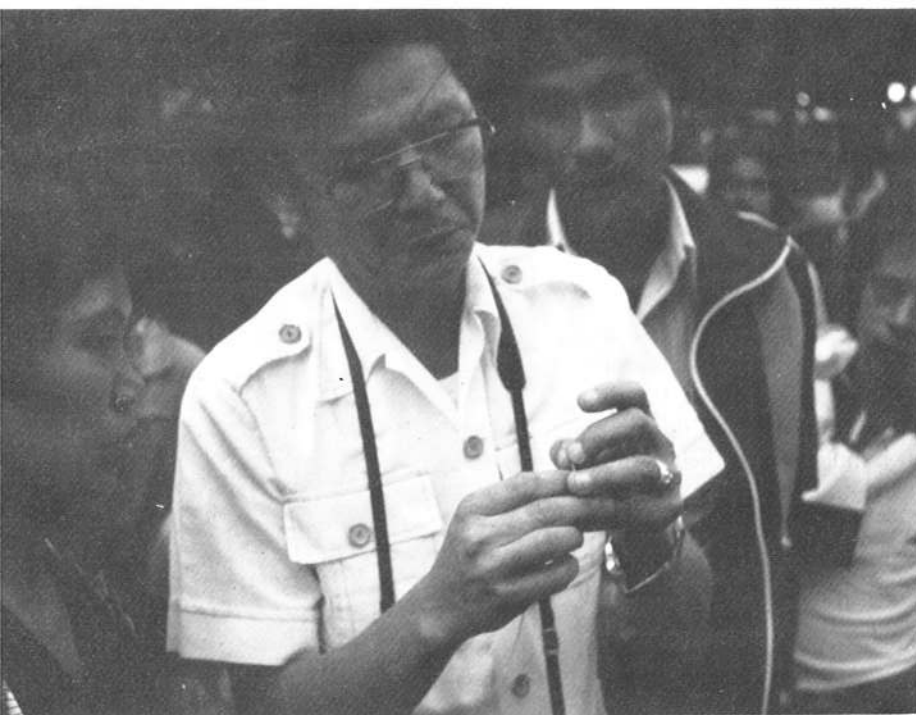


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1. Dr. Jimmy Kuo, ICLARM, demonstrating the method of sampling eggs in mullet to 2. a group of fisheries project personnel in the Philippines. Emphasizing the value of training in the field. 3. Dr. Kevin Hopkins of ICLARM advising Mexican biologists on research methodology for integrated farming systems at Buenavista, Vera Cruz. 4. The value of international cooperation: delegates from the People's Republic of China on an excursion tour of aquaculture facilities in Japan, during the United Nations University Workshop on Water-Land Interactive Systems, Kagoshima University, Sept. 1980. Photographs by the author.



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Future Directions

Undoubtedly, the key to closing most of the gaps between training needs and opportunities is for developing country universities, trade schools and other institutions to continue to upgrade their research and teaching programs and ultimately to train their own technicians and professionals in graduate programs and technical courses. This is a long-term process and will depend on developed country universities continuing to offer overseas study opportunities and to participate in staff exchanges and study visits. However, the developed countries must continue to assess the impact of their training programs and be fully aware of their influence on trainees. John Ziman (1976)* paints a depressing picture of the fresh Ph.D. awardee returning from abroad to the mythical developing country of "Saturnia", which has no graduate schools awarding the Ph.D.:

His Ph.D. is hard-earned, but well-justified: his name appears amongst the authors of several papers in the most reputable journals. . . . Returning, thus intellectually and psychologically equipped, to his native country, he sets himself enthusiastically to further research in the same line. Alas, the resources of Saturnia are quite inadequate. Scientific apparatus is crude and obsolete. Laboratory technicians are no better than bottle-

*Ziman, J. 1976. The force of knowledge: the scientific dimension of society. Cambridge University Press, Cambridge, N.Y., 374 p.

washers. Money for equipment and materials comes in derisory sums. Foreign exchange regulations delay for months the expenditure of a few dollars on minor spare parts for imported instruments. New books and journals arrive years late. Bureaucratic administrative procedures hamper every initiative and waste half his working day. Although the courses are out-moded in content and style, teaching duties are heavy, and less enterprising colleagues are jealous of his research achievements. Nepotism, political pressure, professional favouritism and internal university intrigues deny him the promotion he deserves, and sour his spirit. He is continually aware that his research interests have no roots in his own country; worst of all is the isolation from the competitive, critically exacting, but stimulating scientific community to which, for a while, he had belonged.

There are many aspects to such problems and no easy solutions. For example, the salaries of professional fisheries scientists need to be upgraded in many tropical developing countries to foster the development of effective research and training schools.

Another long-term 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 a few important commodities we may see similar developments. The ADCP centers have a different orientation with, in most cases, a regional focus. The conclusion of the Ad Hoc Consultation on Aquaculture Research, FAO, 1980 was that a global tropical aquaculture research center is still needed. Such a center should also be involved in training.

In the end it all comes down to money, manpower and facilities. Increased expenditures on aquaculture research and development, including training programs, can only be justified by increased production. For this reason, the cooperation of the private sector in training programs should also be encouraged. It is often lamented that highly trained aquaculturists are prone to quit government and university posts to join the more lucrative private sector. However, the end objective of training is production. The only cause for lament is the *short-age* of well-trained professionals in all sectors in developing countries. The private sector, for example feed companies in Taiwan, will often support research and training programs if their investment brings a feedback of new technology and technical staff. This argues for a closer future relationship between universities and other training institutions and the farmers and companies which their programs should ultimately be serving. ●

Table 1. A selected list of aquaculture higher degree programs and other courses in developed countries, based on information currently available to ICLARM.¹

University/Institution	Program and Course Details			
	1. Higher degree program level;	2. Other aquaculture courses (type, duration);	3. Willing to offer special short courses/individual training on request;	4. Specialization and other comments.
Canada Biology Department, Dalhousie University, Halifax, N.S. B3A 4J1	1. M.Sc., Ph.D.; 2. No; 3. Yes; 4. Genetics of cultured organisms; bivalves encourage overseas students.			
France Centre National pour l'Exploitation des Océans (CNEXO), 66 Avenue d'Iéna, 75116, Paris	1. No (unless through university links?); 2. No; 3. Yes (individual; in special skills); 4. Has cold-temperate culture stations in France and marine tropical stations in Tahiti and New Caledonia; hatchery and culture systems technology for finfish and shellfish.			
Hungary Fisheries Research Institute 5541, Szarvas	1. Yes (?); 2. Yes (2-6 month courses, May-Sept); 3. No; 4. Advanced post-graduate training in aspects of hydrobiology, freshwater fish culture, integrated farming, etc.; trainees must be self-financed.			
Warm-water Fish Breeding Farm, Százhalombatta	1. No; 2. Yes (various; on request); 3. Yes; 4. Will organize special short courses only at the request of international organizations and with their financial support.			

University/Institution	Program and Course Details
	1. Higher degree program level; 2. Other aquaculture courses (type, duration); 3. Willing to offer special short courses/individual training on request; 4. Specialization and other comments.
Israel	
Fish and Aquaculture Research Station, DOR, D.N. Hof Hacarmel	1. No (unless through university links?); 2. No; 3. —; 4. Freshwater pond aquaculture.
Foreign Training Department, Ministry of Agriculture, P.O. Box 7054, Tel Aviv	1. No; 2. Yes (3 months, April-July, annual); 3. —; 4. A general course on carp, tilapia and mullet culture based at Netanya.
University training	1. Yes; 2. No; 3. Yes (individual; in special skills, e.g., electrophoresis); 4. Bar-Ilan University, Ramat Gan, Tel Aviv and the Hebrew University of Jerusalem both have strong links with Israeli aquaculture; details must be sought on a case-by-case basis.
Netherlands	
Department of Fish Culture and Inland Fisheries, P.O. Box 338, 6709 PC., State Agricultural University, Wageningen.	1. Yes; 2. No; 3. Yes (individual); 4. Carp and <i>Clarias lazera</i> culture; regular university courses are in Dutch.
United Kingdom	
Fish Culture Unit, Department of Biological Sciences, University of Aston, Birmingham B4 7ET	1. Yes; 2. Yes (various; on request); 3. Yes (individual or small groups); 4. Reproduction and nutrition of salmonids, cyprinids and other freshwater fish.
Institute of Aquaculture, University of Stirling, Stirling FK9 4LA, Scotland	1. M.Sc., Ph.D. and Diplomas; 2. Yes (various e.g., fish diseases, health control; vary in timing and duration); 3. Yes (will consider any training needs); 4. M.Sc. courses in Aquaculture and Fishery Management, Aquatic Veterinary Studies, Aquatic Pathobiology; Diploma courses in Aquaculture; cold- and warm-water aquaculture; pathology and nutrition; links with Scottish Marine Biological Association, Oban for marine work; encourages foreign students and fields training staff in developing countries.
Plymouth Polytechnic, Drake Circus, Plymouth PL48AA	1. M.Sc.; 2. No; 3. —; 4. Fulltime 12-month M.Sc. (Oct-Sept) in Applied Fish Biology concentrating on fish culture, nutrition, fish health and economics.
Department of Genetics and Center for Development Studies, University College of Swansea, Singleton Park, Swansea SA2 8PP	1. M.Sc.; 2. No; 3. No; 4. M.Sc. course (21 months, commencing October) on Applications of Genetics in Developing Areas; scope for project work on cultured aquatic organisms; relevant socio-economic studies possible in the Center for Overseas Development.
Training Services Manager, White Fish Authority, Industrial Development Unit, St. Andrew's Dock, Hull, HU3 4QE	1. No; 2. Yes (25 days, repeated several times each year); 3. —; 4. Short course entitled Introduction to Mariculture
U.S.A.²	
University of Alaska, Corlasier Highway, Juneau, Alaska 99803	1. M.Sc.; 2. No; 3. —; 4. Salmonid aquaculture and ranching.
Department of Fisheries and Allied Aqua- cultures/International Center for Aqua- culture, Auburn University, Auburn, Alabama 36849	1. M.Sc., Ph.D. and Diplomas; 2. Yes (annual 3.5 month training course, March-July); 3. Yes (will consider any training needs); 4. Freshwater pond culture, tilapias, catfish, carps, nutrition, water quality, reproduction; the short course and higher degree programs are specifically designed for foreign students from developing countries; frequently fields training staff in developing countries.
University of California/California State University Systems—interests depend on campus, e.g., Davis, California 95616	1. M.Sc., Ph.D.; 2. —; 3. —; 4. Multidisciplinary programs, aquacultural engineering, water quality, wastewater use, genetics, larval rearing, marine and freshwater.
Consortium for International Fisheries and Aquaculture Development (CIFAD), Extension Hall 330, Oregon State Univer- sity, Corvallis, Oregon 97331	1. Yes; 2. Yes; 3. Yes; 4. A consortium of 5 universities—Arkansas (Pine Bluff), Hawaii, Michigan State/Michigan and Oregon State—see separate listings for details; CIFAD is aimed at international work and has already conducted an aquaculture course for USAID in Zaïre (in French).
Department of Entomology, Fisheries and Wildlife, Clemson University, Clemson, South Carolina 29631	1. Yes (M.Sc.); 2. —; 3. —; 4. A wildlife biology course including formal courses in aquaculture; encourages overseas students on a new International Agriculture Program.
College of Marine Studies, University of Delaware, Newark 19711, Delaware	1. M.Sc., Ph.D.; 2. —; 3. —; 4. Controlled environment mariculture.
Fisheries Academy, National Fisheries Center, RE3, Box 41, Kearneysville, West Virginia 25430	1. —; 2. Yes (a wide range of short courses); 3. Yes; 4. Typical courses include coldwater fish culture (11 days), pond management (4 days); warmwater ponds available.

Table 1 (continued)

Program and Course Details

1. Higher degree program level; 2. Other aquaculture courses (type, duration);
3. Willing to offer special short courses/individual training on request;
4. Specialization and other comments.

University/Institution

Department of Medicine Microbiology, College of Veterinary Medicine, University of Georgia, Athens, Georgia 30602	1. M.Sc.; 2. —; 3. —; 4. Fish health management for graduate veterinarians; encourages overseas students.
College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow, Idaho 83843	1. M.Sc., Ph.D.; 2. —; 3. —; 4. Nutrition, reproduction and production systems; freshwater fish, mainly salmonids.
Oklahoma State University, Stillwater, Oklahoma 74074	1. —; 2. —; 3. —; 4. Reproduction, nutrition and feed technology, genetics, production systems; mainly catfish.
University of Hawaii, Honolulu, Hawaii 96822	1. M.Sc., Ph.D.; 2. —; 3. —; 4. Marine and freshwater aquaculture especially <i>Macrobrachium</i> and tilapias.
Department of Agricultural Engineering, College of Agriculture, University of Maryland, College Park 20742	1. M.Sc., Ph.D.; 2. —; 3. —; 4. Aquaculture engineering.
Department of Fisheries and Wildlife, Michigan State University, East Lansing, Michigan 48824	1. M.Sc., Ph.D.; 2. —; 3. —; 4. Fish nutrition, fish physiology and limnology; new aquaculture courses are being developed; encourages overseas students.
The Oceanic Institute, Makapuu Point, Waimanalo, Hawaii 96795	1. No; 2. —; 3. Yes; 4. Experienced in hatchery work, especially marine prawns and mullet.
Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon 97331	1. Master of Agriculture; M.Sc., Ph.D.; 2. —; 3. —; 4. The non-thesis Master of Agriculture emphasizes aquaculture; topics include resource economics, coldwater marine and freshwater aquaculture.
Aquaculture Science and Pathology Department, University of Rhode Island, Kingston, Rhode Island 02881	1. M.Sc. and Ph.D.; 2. —; 3. —; 4. M.Sc. in Fisheries Science, Advanced Aquaculture Systems and Fish Nutrition. Ph.D. in Marine Pathology (including virology).
Fisheries Research Laboratory, Southern Illinois University, Carbondale, Illinois 62901	1. M.Sc., Ph.D.; 2. —; 3. —; 4. Freshwater aquaculture including <i>Macrobrachium</i> and tilapia studies; encourages overseas students.
Department of Forestry, Wildlife and Fisheries, University of Tennessee, P.O. Box 1701, Knoxville, Tennessee 37901	1. M.Sc., Ph.D.; 2. —; 3. —; 4. M.Sc. in Fisheries and Wildlife; Ph.D. in Aquatic Biology or Ecology; courses have some aquaculture bias.
Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, Texas 77843	1. Master of Agriculture, M.Sc., Ph.D.; 2. Yes; 3. Yes; 4. A wide range of programs and topics on freshwater and marine systems (tilapias and crustaceans); encourages overseas students; fields training staff in developing countries; requests information on training needs from developing countries.
College of William and Mary, Virginia Institute of Marine Science, School of Marine Science, Gloucester Point, Virginia 23602	1. —; 2. + (2-3 week bivalve culture course); 3. —; 4. The bivalve culture course is run at the Eastern Shore Laboratory; overseas trainees can opt for longer stays.
College of Fisheries, University of Washington, Seattle, Washington 98195	1. M.Sc., Ph.D.; 2. —; 3. —; 4. A wide range of topics in coldwater aquaculture including fish nutri- tion, biochemistry, hatchery and culture systems.

¹This table omits opportunities in Australia, Austria, Belgium, Czechoslovakia, Denmark, Eire, Finland, East and West Germany, Greece, Iceland, Hong Kong, Italy, Japan, South Korea, Kuwait, Norway, Poland, Portugal, Singapore, Spain, Sweden, Switzerland, Yugoslavia and the USSR—all of which have aquaculture industries and research programs and therefore associated training needs/opportunities. This list also omits universities and institutions with training interests in the aquatic sciences but not concentrating on aquaculture *per se* (e.g., in the U.K., Aberdeen, Bangor, East Anglia and Liverpool universities) and government institutions which have no regular involvement in training foreign students.

²The following universities and institutions also list some research and training interests in aquaculture in their literature: Colorado State, Connecticut, Cornell, Duke, Florida, Guam, Houston, Kansas State, Louisiana State, Maine, Massachusetts, Massachusetts Institute of Technology, Miami, Mississippi State, National Marine Fisheries Service Centers (La Jolla, Miami, Woods Hole, Seattle), New Hampshire, North Carolina State, Purdue, Rutgers, South Carolina, South Carolina Marine Resources Research Institute, State University of New York, U.S. Fish and Wildlife Service Laboratories (Reservoir Research Program, Fayetteville, Arkansas; Great Lakes Fishery, Ann Arbor, Michigan; Southeast Cultural Laboratory, Marion, Alabama; National Fishery Research Center, Seattle, Washington; Fish Farming Experiment Station, Stuttgart, Arkansas; Fish Control Laboratories; La Grosse, Wisconsin; Tunison Laboratory of Fish Nutrition, Cortland, N.Y.; National Fisheries Research and Development Center, Wellsboro, Pennsylvania; National Fisheries Research Laboratory, Gainesville, Florida; Eastern Fish Disease Laboratory, Kearneysville, West Virginia; National Fish and Wildlife Health Laboratory, Madison, Wisconsin; National Fish Laboratory, Washington, D.C.), and Woods Hole Oceanographic Institution.

Table 2. Selected aquaculture higher degree programs and other courses in the developing countries of Asia.¹

University/Institution	Program and Course Details 1. Higher degree program level; 2. Other aquaculture courses (type, duration); 3. Willing to offer special short courses/individual training on request; 4. Specialization and other comments.
Asia and the Pacific Region	
Network of Aquaculture Centres in Asia (NACA), Regional Head Office, National Inland Fisheries Institute, Bangkok 9, Thailand	1. Master of Aquaculture or Diploma in Aquaculture; 2. Yes (various; see comments); 3. Yes (individual and courses); 4. Activities of national lead centers within NACA are listed below; NACA's main training course is a 12-month course for senior aquaculturists based at the Philippine lead center—see page 17.
FAO/UNDP South China Sea Fisheries Development and Coordinating Programme, P.O. Box 1184, MCC, Metro Manila, Philippines	1. No; 2. Yes (various); 3. —; 4. This program has offered a variety of courses, e.g., small-scale pen and cage culture for finfish, Laguna, Philippines, 26-31 October 1981 and Aberdeen, Hong Kong, 1-13 November 1981; seabass spawning and larval rearing, June 1-21, 1982, in Songkhla, Thailand in cooperation with the Department of Fisheries, Ministry of Agriculture and Cooperatives, Thailand (see p. 6).
People's Republic of China	
Asian-Pacific Regional Research and Training Center for Integrated Farming, Wuxi, Jiangsu Province	1. —; 2. Yes (4-month courses, 2/year); 3. —; 4. Integrated farming and freshwater pond aquaculture; highly practical courses; Wuxi is the China lead center for NACA.
Pearl River Institute, Kuangzhou (Canton)	1. —; 2. Yes (content unknown); 3. —; 4. Inland fisheries and freshwater aquaculture; has undertaken training for FAO.
India	
Indian Council for Agricultural Research (ICAR), Krishi Bhavan, New Delhi 110001	1. Yes (various; see comments); 2. Yes (various; see comments); 3. Yes; 4. ICAR is the umbrella research organization over all government aquaculture research and training centers; coordinates/approves all training programs at centers listed individually.
Central Inland Fisheries Institute, Barrackpore 743101, West Bengal	1. No; 2. Yes (various); 3. Yes (individual or courses); 4. Freshwater aquaculture, especially composite culture of carps.
Central Institute of Fisheries Education, Versova, Bombay 40061	1. Yes (various certificates and diplomas); 2. Yes (various; 9-10 months); 3. —; 4. Freshwater and pond aquaculture; culture of carps.
Freshwater Aquaculture Research and Training Center, Dhauli, Bhubaneswar, Orissa	1. No; 2. No (no fixed courses); 3. Yes (individual or courses); 4. Freshwater pond aquaculture; all aspects of carp culture; the Indian lead center of NACA.
Centre of Advanced Studies in Mariculture, Central Marine Fisheries Institute, Cochin 682019	1. M.Sc. through the University of Cochin; 2. —; 3. —; 4. M.Sc. in mariculture; has details of other marine and brackishwater training.
Indonesia	
Biotrop, P.O. Box 17, Bogor	1. —; 2. Yes (short (6 week) and longer (10 month) courses); 3. Yes (individual); 4. Freshwater biology and associated laboratory skills; pathology, bioassay, water quality, etc.
Malaysia	
Universiti Pertanian Malaysia, Serdang, Selangor	1. M.Sc. in Resource Economics in June 1983; 2. —; 3. —; 4. Fisheries and aquaculture economics.
Philippines	
Central Luzon State University, College of Fisheries/Freshwater Aquaculture Center, Muñoz, Nueva Ecija	1. M.Sc., M.P.S. (Master of Professional Studies); 2. Yes (various); 3. Yes (individual or courses); 4. Freshwater pond aquaculture, especially integrated farming and tilapias, rice-fish culture; Master's degree either by thesis or non-thesis.
Aquaculture Department, Southeast Asian Fisheries Development Center (SEAFDEC), Tigbauan, Iloilo	1. M.Sc. through university links; 2. Yes (various); 3. Yes (individual or courses); 4. Freshwater, brackishwater and marine aquaculture especially milkfish, penaeid prawns and tilapias; short courses differ annually according to demand; the Philippine lead center of NACA.
University of the Philippines in the Visayas, Iloilo City	1. M.Sc., Master of Aquaculture, Diploma in Aquaculture; 2. Yes; 3. —; 4. Brackishwater finfish and crustacean culture training through the Brackishwater Aquaculture Center, Iloilo City; currently developing a new campus.
Thailand	
Asian Institute of Technology, Division of Agricultural and Food Engineering, P.O. Box 2754, Bangkok	1. M.Sc., Diplomas; 2. —; 3. —; 4. Exceptionally well situated for graduate training in freshwater aquaculture, particularly engineering and waste utilization; takes students from all Asian countries.
National Inland Fisheries Institute, Kasetsart University Campus, Bangkok 9	1. ? (through university links); 2. Yes (various); 3. —; 4. Freshwater aquaculture; the Thailand lead center for NACA.

¹ICLARM is keen to supplement this table and invites readers to send further information from Africa, Asia and Latin America. The language of instruction (where other than English) must be stated. Information on activities of ADCP (FAO/UNDP) centers in Latin America and Africa is obtainable from FAO, Rome.