PN-AAY-166

Institut Pertanian Bogor * University of Wisconsin

GRADUATE EDUCATION PROJECT

Aid Project 497-0290

Report No. 31

KITCHELL

REPORT

to

INSTITUT PERTANIAN BOGOR
Bogor, Indonesia

February-March 1984

by

James F. Kitchell
Professor of Zoology
University of Wisconsin-Madison
Madison, WI 53706

USAID Project No. 497-0290

Report on Curriculum and Research Program Review of the Faculty of Fisheries, Institut Pertanian Bogor, (IPB)

by

James F. Kitchell

Professor of Zoology

University of Wisconsin-Madison

Introduction

This consultancy was arranged as a component of the USAID-sponsored Institut Pertanian Bogor-University of Wisconsin (IPB-UW) project. I arrived in Bogor on 13 February and departed on 3 March 1984. The primary goals of the program were to:

1. Review teaching and research components associated with the development of graduate programs within the Faculty of Fisheries (Fakulas Perikanan).
2. Assist the faculty in strengthening teaching and research programs in fish population dynamics.

Most of my activities were conducted in conjunction with those of Dr. Richard Bishop, Department of Agricultural Economics, UW-Madison, who visited Bogor during the same period. Although Dr. Bishop's goals were more specifically directed toward evaluating the prospects for research programs, our interests in the curriculum and fisheries research projects were complementary. My counterpart and host was Ir K. A. Aziz, Chairman, Department of Aquatic Resource Management, and Bishop's was Ir. Sahat M. H. Simandjuntak, Chairman, Department of Fishery Socio-economics. Shortly after we arrived, we developed a schedule of lectures, visits, and interviews designed to aid in accomplishing our goals.

This report is largely directed to the activities and programs administered through the Department of Aquatic Resource Management as this is the largest department within the Faculty of Fisheries and is the first to have developed a graduate program. The report draws heavily upon materials presented in greater detail in the catalog for the Faculty of Fisheries (Panduan Pendidikan, Fakultas Perikanan IPB), the recent report of a faculty committee charged with developing a plan for development of the graduate

program (Muluk and Sumawidjaja, editors; 1981), and the report of Dr. Cal McNabb, Michigan State University, who evaluated higher education in fisheries in Indonesia through a more extensive visit during 1980 (McNabb, 1981). Although much of the assessment uses examples drawn from the Department of Aquatic Resource Management, I believe that my recommendations are generally applicable to the curricula and staff of other departments as well.

Activities

Based on discussions with our counterparts, we developed a schedule that would provide opportunities to interact with staff and students, to see teaching and research facilities currently available or under development, and to visit field sites or other institutions where active research programs have been or could be pursued.

Lectures presented were:

Date	Lecture Title	Audience
21 February	New Perspectives in Fish Population Dynamics	S_1 and S_2 students and staff
25 February	Fisheries and Predator-prey Systems in the North American Great Lakes	S_1 and S_2 students and staff
28 February	Multiple Stable Equilibria in Fish Population Dynamics	S_2 students and staff

Sites visited included:

1. Aquaculture facilities at the IPB Darmaga campus

2. Carp culture ponds at Cisarua
3. Fisheries ports and auctions at Muara Angke near Jakarta and at Pelabuhan Ratu on the Indian Ocean
4. BIOTROP facilities in Bogor
5. Marine Sciences Institute of IPB, Marine Fisheries Research Institute, and the Oceanology Institute, all located at Ancol

In addition, we arranged interviews and discussions with staff of the four departments within the Faculty of Fisheries, with staff of the Environmental Studies and Graduate School programs, graduate students (S_2) in the master's degree program of the Department of Aquatic Resource Management and undergraduate students preparing for the thesis work of the S_1 degree.

Current Status of the Department of Aquatic Resource Management Faculty of Fisheries

The Faculty of Fisheries currently has a total of 75 staff members distributed among several departments. The largest is the Department of Aquatic Resource Management with 40 staff members. Other departments are Fisheries Technology (eight staff members), Aquaculture (12 staff members), and a fourth department, not yet defined at this writing, which will include Fisheries Socio-economics and Fisheries Resource Exploitation (Capture Fisheries).

Of approximately 450 students currently pursuing curricula in fisheries, 130 undergraduates are within the Department of Aquatic Resources Management. As administered through the Graduate School, this department also is the home of the sole graduate program in fisheries leading to an M.S. in Aquatic Sciences. Fifteen students are currently enrolled in this curriculum. As

anticipated in the planning document (Muluk and Sumawidjaja, 1981), the number of undergraduates will more than double by 1990; there are to be 60 students enrolled in the M.S. degree program; and a doctoral degree program, which is to open in 1987, will contain 15 students. A table of projected enrollment is reproduced herein (Table 1).

Table 1. Projected student enrollment, scholarship requirements, adviser requirements and cumulative graduates in Aquatic Resource Studies

	1983	1984	1985	1986	1987	1988	1989	1990	2000
No. of students									
Ir degree (4th yr.)	75	75	80	80	100	100	100	100	100
MS degree									
First year	15	15	15	20	25	25	30	30	30
Second year	0	15	15	15	20	25	25	30	30
Total	15	30	30	35	45	50	55	60	60
Dr degree									
First year					5	5	5	5	5
Second year					0	5	5	5	5
Third year					0	0	5	5	5
Total					5	10	15	15	15
Total of grad. stud.	15	30	30	35	50	60	70	75	75
Scholarship grants for grad. stud. (person-yr.)	15	30	30	35	50	60	70	75	75
Adviser requirements*									
Ir degree	15	15	16	16	20	20	20	20	20
MS degree	0	5	5	5	7	8	8	10	10
Dr degree	0	0	0	0	0	0	5	5	5
Total	15	20	21	21	27	28	33	35	35
Cumulative grads.									
Ir degree	75	150	225	305	385	485	585	685	785
MS degree			15	30	45	65	90	115	145
Dr degree			0	0	0	0	0	5	10

* Adviser student ratio for Ir 1 : 5; MS 1 : 3; and Dr 1 : 1.

As proposed, the first class of graduate students began their studies in 1983-84. There are, however, fewer undergraduates than anticipated (Table 2).

Table 2. Current (1984) distribution of undergraduate majors in the Department of Aquatic Resources Management.

Year	Males	Females	Total
II	26	17	43
III	36	13	49
IV	31	9	40
Total	93	39	132

The staff of the department is aggregated by interest and teaching areas into five groups or "laboratories": Marine Biology, Fisheries Resource Management, Ichthyology, Limnology, and Oceanology. The highest degrees held by staff members in these areas are outlined in Table 3. The staff is relatively young: only three are 50 years of age or older, and 33 of the staff are less than 45 years old.

Rank and promotion within the department is based on a combination of degrees attained and accomplishments in service, teaching, and research. The distribution of ranks held within the department is given in Table 4. Fourteen of the staff are currently studying for advanced degrees and will complete their degrees within the next two years. The distributions of those studying abroad and those pursuing Ph.D. degrees in Environmental Studies through IPB are given in Table 5. In two years, nearly one-half of the staff will have doctoral degrees.

Table 3. Highest degrees* held by staff members in the Department of Aquatic Resource Management arranged by laboratory affiliation.

Highest Degree	Laboratory					
	Marine Biology	Fisheries Resource Management	Ichthyology	Limnology	Oceanology	Total
Dr	2	-	1	2	-	5
MS	2	3	1	1	4	11
Ir	4	7	4	7	1	23
SM	1	-	-	-	-	1
Total	9	10	6	10	5	40

* For readers not familiar with these degree designations, the SM degree is equivalent to a four-year bachelor's degree, the Ir degree is a six-year equivalent to a bachelor's degree plus usually a two-year program of research resulting in a thesis. The MS and Dr degrees are post-graduate degrees equivalent to master's and doctoral (Ph.D.) programs, respectively. As the result of a recent revision of university curricula throughout Indonesia, the bachelor's degrees are now based on a four-year program, which includes a thesis conducted during the last semester and is now termed the S_1 program. The master's degree is termed the S_2 program and requires a thesis. A doctoral degree (Ph.D. or Dr) is termed S_3.

Table 4. Ranks* held by current staff in the Department of Aquatic Resources Management arranged by laboratory affiliation.

Rank Held	Marine Biology	Fisheries Resource Management	Laboratory Ichthyology	Limnology	Oceanology	Total
IVe	1	-	-	-	-	1
IVd	-	-	-	-	-	0
IVc	-	-	1	1	-	2
IVb	-	1	-	-	-	1
IVa	4	-	1	3	-	8
IIId	-	1	-	-	1	2
IIIc	1	3	1	-	2	7
IIIb	2	1	2	3	2	10
IIIa	1	4	1	2	-	8
IId	1	-	-	-	-	1
Total	10	10	6	9	5	40

* The equivalent ranks in US/Canadian universities would be Professor = IVe and IVd, Associate Professor = IVc and IVb, Assistant Professor = IVa and IIId, and Instructor = IIIc - IId.

Table 5. Staff of the Department of Aquatic Resource Management currently studying for doctoral degrees abroad or at IPB arranged by laboratory groups.

	Laboratory					
Currently Studying	Marine Biology	Fisheries Resource Management	Ichthyology	Limnology	Oceanology	Total
Abroad	1	3	3	1	2	10
IPB (Env. Studies)	1	1	1	-	1	4

Assessment of the S_1 Curricula

The Ministry of Education requires a minimum of 144 credits for the S_1 degree. During their first year at IPB, all S_1 students are required to take the same suite of courses totaling 35 credits. After choosing a major area all students that have selected to pursue a degree within the Faculty of Fisheries have a common curriculum of 18 credits during the first semester of their second year. Each student then pursues the curricular requirements of their chosen department which requires an additional 87-97 credits within that department. All curricula require independent work and a thesis for the last semester, thus, the S_1 degree requires 139-149 credits in total.

The curricula are highly structured. The Aquaculture option, for example, offers students no electives among the 26 courses required during the first four semesters after completion of the common courses of first semester, second year. In Aquatic Resource Management, students may choose two

electives to complete the required 26 courses. The electives available are specified as courses within the Faculty of Fisheries. No department curriculum allows more than two electives (Appendix II).

Although the result of these curricula is a rigorous and remarkable breadth of exposure to the many facets of fisheries, I believe the requirements are overly developed. This is not an unexpected consequence of the nation-wide revision of curricula altering the former six-year degree program (Ir) and developing a four-year degree such as the S_1 at IPB. Although the time for completion of the degree is reduced, the expectations of staff, who are alumni of the six-year program, are obviously not equally reduced. There will continue to be some inequities as the transition of expectation and curricula progress. I believe that the goals of future curriculum changes in fisheries should be: (1) to reduce the total credits required within the departments by about 20%; (2) to reduce the number of required courses; and, (3) to increase the number of electives both allowed for and available to S_1 students.

I recommend these goals because I feel that students would benefit from having more time to study outside the classroom. They currently spend at least 25-30 hours per week in lectures and laboratories directly associated with their departmental major. I also feel that their general educational exposures would be enhanced if they were allowed greater freedom to choose from among other courses available in the Faculty of Fisheries and other Faculties at IPB. A secondary benefit might derive in the improvement of quality of instruction for the elected courses. I believe that these changes would enhance the educational process by developing greater emphasis on Mastery-of-concept learning and reducing the use of rote learning practices now required by the heavy burden of each curriculum.

A major requiring 120-125 credits, including 20-25 credits of electives within the department, and allowing students to select 10-25 credits from other faculties would, in my opinion, be more desirable.

Although there was little time for detailed evaluation of course content, I did have the opportunity to discuss specific components of the syllabus for each of several courses. My general impression is that the textbooks used are current and among the more rigorous available. Course content also seems balanced and standards are high. Most students, however, cannot afford the costs of hard-bound texts and rely on photocopy centers to create their own copies of texts available either through the instructor or from the several libraries in Bogor.

Based on my discussions with fourth year S_1 students, those that I interviewed had a good recall of basic facts. Students at IPB know that they are among a select few afforded the opportunity of higher education. They are dedicated and anxious to develop professional skills. The costs of text and reference books remains a major limitation for both students and staff. There is, however, a variety of current reference books available in the campus bookstore and the list of library holdings is reasonably good. Education in Indonesia is rapidly developing and has derived from an oral tradition. This is apparent in the lecture halls and will likely continue as the primary pedagogic method until economic constraints are relaxed.

Assessment of the S_2 Curriculum

The Graduate Program in Aquatic Science at IPB accepted its first students last year. There are three fields of concentration: Aquatic Resource Management, Aquatic Environmental Science, and Aquaculture (Appendix II).

Fifteen students are currently enrolled. All are staff members from other institutions or IPB. All that I talked with were interested in the Aquaculture field. This is laregely due, as I understand it, to the potential availability of governmental funds as a source of extramural support after they've returned to their home institution. All are currently supported through government scholarships.

Fifteen of the IPB staff particpate as faculty of the graduate program. All hold master's and/or doctoral degrees (Appendix II). The S_2 degree requires a total of 39 credits, which is required by the Ministry of Education. Although less closely specified than the S_1 curriculum, 24 of the total credits are from required courses, leaving only three elective courses plus a seminar, colloquium, and a six-credit thesis to be completed in a two-year program. In my discussions with the staff, I suggested that more flexibility might be desirable so that students might, with advice of their graduate committee, develop individual curricula more directly pertinent to their chosen research topic. The staff raised two concerns: firstly, they feel obligated to meet the 39 credit requirement through use of formal courses; secondly, they are concerned that because many of their students have S_1 or Ir degrees from other institutions, there will be substantial differences in student preparation. They feel that a well-defined core of courses will help assure uniformity of preparation.

These concerns are valid, but I feel that a more flexible curriculum can both develop the background of those who need it and provide new opportunities for those (e.g., IPB S_1 graduates) who already have substantial course training. My suggestion is that each student's program should be designed to individual needs. This would be accomplished through consultation with the

student's advisers early during their first year of study. Those who need more extensive course work within the Fisheries departments would develop their curriculm accordingly. Those with strong backgrounds should be encouraged to elect courses from other departments that would be most pertinent to their thesis research. In addition, a variable credit (e.g., 1-6 credits) course in Independent Study could be available and used to advantage either in strengthening deficiencies or in establishing cognate skills (e.g., computer science, water chemistry, animal nutrition, statistics, etc.) which would be pertinent to the development of background for the thesis research. This would probably be best effected by reducing the number of required courses in the current curriculum to those now specified for the first semester. During the second semester the student would concentrate on elected courses in fisheries and deficiencies or cognate areas while beginning the process of developing a thesis topic. The third and fourth semesters could then be focused on additional cognate courses and the thesis research. Using a variable-credit Independent Study course would assure fulfillment of the minimum credit requirement.

The likely result of this suggestion would be that some students would have more time to devote to research than others. I feel that this heterogeneity may be more desirable in the long run than requiring that students already well trained in certain areas be required to duplicate components of previous course work or experience. All students would be expected to meet the fundamental quality requirements of good thesis work; some would have opportunity to develop cognate skills and/or conduct a more extensive research project. In either case all students would gain much the

same relative intellectual growth. Given that the admission requirements at IPB are rigorous, I am confident that a more flexible S_2 curriculum would be both desirable for the faculty and most beneficial to the students.

Much of graduate education can occur outside the classroom. Contact and discussion with other graduate students and staff is, in my opinion, a major component of graduate education. As the facilities at the Darmaga campus are developed, I strongly encourage the staff to allocate some space to graduate students. This could be either associated with their laboratory groups or provided as a group of desks and offices for graduate students. They should be made to feel at home and as functional members of the academic family. Their discussion and camaraderie will be a major adjunct to their education.

Program and Faculty Development

Three topics came up in nearly every discussion with staff members:

1. The desperate need for improved teaching and research facilities, equipment, and supplies.
2. The need for support administered through IPB to the extramural research activities of staff members.
3. The need for a continuing faculty development program.

Although the move to the Darmaga campus will substantially increase space available to teaching and research programs, there is immediate and substantial need for equipment and supplies. This was most apparent in our visit to the Marine Sciences building at Ancol where a facility that opened two years ago does not yet have even the basic glassware, wet labortory equipment, microscopes, etc., necessary to adequate teaching. The sea water system and wiring remain non-functional. Although the faculty do their best

under the circumstances, there is woeful underutilization of the building simply due to the fact that little exists other than chairs, benches, blackboards, and chalk. The laboratories at the IPB campus in Bogor are also quite under-equipped. Students and staff must have access to equipment and supplies if effective education is to go beyond the spoken word and a few precious books. Resources must be committed to education if education is to create resources.

There are several ways to develop research facilities but the provision of teaching equipment and supplies can derive only if budgetary resources are created within IPB. Fisheries science education requires lecture, laboratory, and field experience. Only the first and last are reasonably developed at IPB. In addition, the field experiences of students are heavily constrained by the lack of access to equipment and supplies. These strong statements echo those made in Dr. McNabb's (1981) evaluation. Several years later there is little evidence of improvement.

Departmental resources available to the development and support of faculty research are equally inadequate. Staff are forced to focus their research programs off campus (e.g., in the field or at BIOTROP) or to use other laboratories (e.g., Chemistry) on campus. Again, development of well-equipped laboratories at the Darmaga campus is a key to both undergraduate and graduate education in that staff members will have opportunity to conduct their research activities in proximity to students and other staff. All will benefit as a result.

Many staff members feel that a means for developing institutional channels and resources in support of their research would yield major improvements in their professional effectiveness. If training programs or grants could be

established and administered through the university as a substitute for the current practices based on extramural contracts or consultancies, faculty could secure the required salary supplements in ways that would keep them on campus beyond the minimum requisites of teaching and administrative duties.

It is a fact that base salaries for staff are simply inadequate. Every staff member I talked with felt that direct institutional support to their research activities is an essential key to improvement of teaching, research, and service activities. How can this be accomplished? I suggest three steps:

1. Establish and equip the new facilites at the Darmaga campus.
2. Develop administrative initiatives in conjunction with fisheries staff that would create both mechanisms and institutional resources in support of staff research (e.g., training grants, coordinated large-scale research programs involving groups of staff members, etc.).
3. Continue efforts to increase the base salary support to faculty in direct compensation for the expectation that they focus their research and service activities on campus.

As an initial step in this process, I suggest that the departments be afforded greater resources and encouraged to establish the means for substantial merit awards to those individuals taking the leadership in developing the desired steps.

Lastly, there is need for development of a corrdinated plan for staff training and improvement. As recommended by a staff committee, key individuals would be selected to go abroad for short-term or advanced degree programs. Their selection would be based on the need for increased strength

in certain "labortory" programs as well as their merit and accomplishments at IPB. The consensus of our discussions was that preference should be given to developing support to Ph.D. programs for junior staff.

Recommendations: Immediate Goals

As discussed in the preceding, I recommednd the following short-term goals:

1. Reduced levels and greater flexibility in the courses required for both S_1 and S_2 degree programs in the Faculty of Fisheries.

   Some difficult decisions need to be made (i.e., which courses are no longer required). A faculty committee should be appointed as soon as practical to begin these considerations.

2. Increased commitment to the development of supplies, equipment, and facilities in support of teaching and research.

   This is essential if students are to be adequately trained in the uses of contemporary methods. It is equally important that faculty and graduate students have access to functioning laboratories as a focus of their activities. Some impediments exist in the prospect for acquisition and use of high-technology electronics apparatus in that services, maintenance, and parts are difficult to secure. Short-term gains can be made with commitment to providing greater amount of basic apparatus (e.g., microscopes, lamps, dissecting trays, etc.) at the Marine Sciences Laboratory at Ancol, and through more effective use of BIOTROP facilities which seemed underutilized to me. As the Darmaga campus facilities are developed, attempts should be made to have laboratory apparatus in place as the teaching program expands there.

3. Development of microcomputer expertise and facilities as aids to instruction and research.

This, in my view, offers the greatest cost/benefit gains in the short term. Microcomputers are readily available through local markets and services are available in Jakarta. The availability of educational and research software is growing at an incredible rate and floppy disks are a lot less expensive than hard cover books. Through hands-on experience students will learn the logic required in programming and develop the problem-solving skills they need to augment their extensive factual knowledge (Pauly, 1983). An all-campus computer laboratory will gradually develop at IPB. I feel, however, that a small computer lab with a few machines such as the Apple IIe or its equivalent can be of immediate value in Fisheries. In fact the fisheries field could provide campus-wide leadership in this area. This has been the case over the past three years in North America and Europe. Full-day sessions on microcomputer educational and research applications in fisheries are now components of the major professional meetings in North America. The growth of interest and development of software is phenomenal.

I suggest that a member of the Faculty of Fisheries be selected and supported for a trip to specific U.S. and Canadian universities that have become the centers of microcomputer software development. That person should also be encouraged to attend a workshop or short course designed to train college teachers in the use of microcomputers. Several summer programs are now available. In addition, that individual could attend one or more of the North American fisheries meetings where microcomputer

workshops and symposia are held. The most logical candidate is K. A. Aziz of the Department of Aquatic Resource Management. His interests, teaching, and skills seem most appropriate. He would also be in an influential position to see that this new teaching and research aid is developed for the Faculty of Fisheries.

Recommendations: Long-term Goals

Many of the insufficiencies in the Fisheries programs are the not-unexpected result of the rapid growth of IPB. Enrollment has outpaced the availability of resources for development of teaching and research facilities. If the Tridarma is to be fully developed at IPB and if IPB is to be the center for excellence of RI universities, then I feel that certain major changes need to be effected and that sustained policies develop in support of the growth and maintenance of an excellent faculty. My recommendations are:

1. Base salaries and the expectation of greater campus-centered research and service obligations must increase in concert. Faculty should be expected to focus more of their activity on campus and should rightfully expect to be compensated for that effort through unversity channels. If academic quality is to keep pace with the quantitative changes in enrollment, as projected for the year 2000, this is essential.
2. A plan for continued faculty enrichment through study and degree programs abroad must be developed. A goal for the year 2000 is to have the majority of faculty trained at the doctoral level. This is essential to the development of IPB as the national center for graduate education in fisheries.

Acknowledgements

I am most grateful to Dr. John Murdock and the staff of the IPB-UW Project for providing both the opportunity and support services that facilitated accomplishment of the objectives of my program. K. A. Aziz and his colleagues in the Faculty of Fisheries were most helpful, candid, and generous with their valuable time.

In particular, I wish to thank Sahat Simandjuntak, Kiagus Aziz, Johan Basni, Pong Suwignyo, and Richardus Kaswadji for their aid and generosity in arranging our tour of off-campus sites and facilities. The enthusiasm, friendliness, and help of all staff and students in the Faculty of Fisheries was most appriciated. Their accomplishments, commitment, and enthusiasm are admirable and I hope that my suggestions will offer some aid to the attainment of their objectives.

References

McNabb, C. 1981. Aspects of higher education programs in Fisheries in Indonesia. MUCIA-AID-Indonesia Higher Agricultural Education Project Report No. 79. 116 pp.

Muluk, C. and K. Sanawidjaja (eds.). 1981. The Faculty of Fisheries Bogor Agricultural University (IPB). The Road to the Year 2000. Developing a graduate program in aquatic resources studies. 32 pp. and Appendices I, II.

Pauly, D. 1983. Some simple methods for the assessment of tropical fish stocks. FAO Fisheries Technical Paper No. 234. UNFAO, Rome. 52 pp.

Appendix I. Curriculum of Ir Degree Program at the Faculty of Fisheries, Bogor Agricultural University

1st Year

Semester 1		Credits	Semester 2		Credits
1.	General Chemistry I	3	1.	General Economics	3
2.	Indonesian	3	2.	General Biology	3
3.	Mathematics I	3	3.	Rural Sociology	3
4.	Physics	3	4.	General Chemistry II	3
5.	Religion	2	5.	Mathematics II	3
6.	English	3	6.	Intro. to Agric. Sci.	1
7.	Pancasila	-	7.	Military Training	2
	TOTAL	17		TOTAL	18

Note: Common first year for all students

2nd Year

Semester 1

		Credits
1.	Intro. to Fish. Sci.	2
2.	General Ecology	4
3.	Aquatic Invertebrates	3
4.	Ichthyology I	3
5.	General Climatology	3
6.	Management Principles	3
	TOTAL	18

Note: 1st semester at the 2nd year is common for fisheries students before choosing study options in Aquaculture, Fishing Technology, Aquatic Resource Management, and Fisheries Product Management.

AQUACULTURE

2nd Year

Semester 1		Semester 2	
			Credits
		1. Statistical Methods I	3
		2. General Microbiology	3
		3. Oceanography I	2
Common		4. Limnology I	3
		5. Aquatic Animal Physiology	3
		6. Introduction to Biochemistry	3
		TOTAL	17

3rd Year

Semester 1		Semester 2	
	Credits		Credits
1. Water Quality Management	3	1. Experimental Designs	3
2. Soil & Water Chemistry	3	2. Oceanography II	3
3. Planktonology	3	3. Fisheries Product Tech. I	3
4. Limnology II	3	4. Fisheries Product Marketing	3
5. Fisheries Biology	3	5. Principles of Aquaculture	4
6. Fisheries Enterprise	3	6. Aquaculture Engineering	4
7. Fisheries Extension	3	7. Fisheries Management I	3
TOTAL	21	TOTAL	23

4th Year

Semester 1		Semester 2	
	Credits		Credits
1. Fish Nutrition	4	1. General Field Work	6
2. Fish Disease	3	2. Field Practice	4
3. Aquaculture Systems & Techniques	4	3. Seminar	1
4. Hatchery Management	3	4. Special Problems	6
5. Aquaculture Development	2		
TOTAL	16	TOTAL	17

FISHING TECHNOLOGY

2nd Year

Semester 1	Semester 2	
		Credits
	1. Statistical Methods I	3
	2. Marine Biology I	3
	3. Oceanography	2
	4. Fisheries Product Tech. I	3
Common	5. Ichthyology II	3
	6. Fishing Gear I	4
	7. Fishing Methods I	3
	TOTAL	21

3rd Year

Semester 1	Credits	Semester 2	Credits
1. Fisheries Biology	3	1. Aquatic Products of Commerce I	3
2. Statistical Methods II	3	2. Fishing Ground	3
3. Fishing Gear II	4	3. Fishing Vessels	3
4. Fishing Methods II	3	4. Navigation II	3
5. Navigation I	3	5. Physiology of Aquatic Animals	3
6. Fisheries Product Technology II	3	6. Fisheries Economics	3
		7. Elective	3
TOTAL	19	TOTAL	21

Electives:

1. Oceanography II	3
2. Experimental Designs	3
3. Fisheries Product Marketing	3

4th Year

Semester 1	Credits	Semester 2	Credits
1. Fishing Management	4	1. General Field Work	6
2. Capita Selecta	2	2. Field Practice	4
3. Onboard Training	3	3. Seminar	1
4. Seamanship	4	4. Special Problems	6
TOTAL	13	TOTAL	17

AQUATIC RESOURCE MANAGEMENT

2nd Year

Semester 1	Semester 2	Credits
	1. Statistical Methods I	3
	2. Marine Biology I	3
	3. Oceanography I	2
	4. Limnology I	3
Common	5. Ichthyology II	3
	6. Physiology of Aquatic Animals	3
	7. Fishing Methods I	3
	TOTAL	20

3rd Year

Semester 1	Credits	Semester 2	Credits
1. Fisheries Biology	3	1. Aquatic Products of Commerce I	3
2. Statistical Methods II	3	2. World Fisheries and its Development	3
3. Water Quality Management	3	3. Oceanography II	3
4. Limnology II	3	4. Tropical Marine Fish Ecology	4
5. Planktonology	3	5. Fisheries Management I	3
6. Fisheries Law & Regulation	2	6. Fisheries Economics	3
7. Elective	3-4	7. Elective	3-4
TOTAL	20-21	TOTAL	22-23

Electives:		Electives:	
1. Aquaculture System & Techniques	4	1. Fish Product Technology I	3
2. Fisheries Extension	3	2. Principles of Aquaculture	4

4th Year

Semester 1	Credits	Semester 2	Credits
1. Population Dynamics	3	1. General Field Work	6
2. Sampling Methods	3	2. Field Practice	4
3. Fisheries Management II	4	3. Seminar	1
4. Capita Selecta	2	4. Special Problems	6
5. Aquatic Products of Commerce II	3		
TOTAL	15	TOTAL	17

FISHERIES PRODUCT MANAGEMENT

2nd Year

Semester 1	Semester 2	Credits
	1. Statistical Methods I	3
	2. Principles of Aquaculture	4
	3. Fishing Gear I	4
Common	4. Introduction to Biochemistry	3
	5. General Microbiology	3
	6. Fishing Methods I	3
	TOTAL	20

Major Option in Fisheries Product Technology

3rd Year

Semester 1		Semester 2	
	Credits		Credits
1. Fisheries Biology	3	1. Marine Biology I	3
2. Aquatic Products of Commerce II	3	2. Industrial Nutrition	2
3. Fishing Methods II	3	3. Physiology of Aquatic Animals	3
4. Fisheries Law & Regulation	2	4. Fisheries Product Tech. I	3
5. Food & Industrial Microbiology	3	5. Fisheries Economics	3
6. Fisheries Extension	3	6. Elective	2-3
TOTAL	17	TOTAL	16-17

Electives:

1. Oceanography I	2
2. Fisheries Product Marketing	3

4th Year

Semester 1		Semester 2	
	Credits		Credits
1. Fisheries Product Tech. II	3	1. General Field Work	6
2. Fisheries Quality Control	2	2. Field Practice	4
3. Factory Designs	3	3. Seminar	1
4. Fisheries Enterprises	3	4. Special Problems	6
5. Capita Selecta	2		
6. Fisheries Industry Management	3		
TOTAL	16	TOTAL	17

Major Option in Fisheries Product Management

3rd Year

Semester 1	Credits	Semester 2	Credits
1. Fisheries Biology	3	1. Fisheries Economics	3
2. Micro Economics	3	2. Fisheries Product Marketing	3
3. Macro Economics	3	3. Fisheries Product Tech. I	3
4. Fisheries Law & Regulation	2	4. Production Management	3
5. Fisheries Extension	3	5. Accounting Management	3
6. Fisheries Cooperatives	3		
TOTAL	17	TOTAL	15

4th Year

Semester 1	Credits	Semester 2	Credits
1. Aquaculture System & Techniques	4	1. General Field Work	6
2. Research Methodology in Sociology	3	2. Field Practice	4
3. Fisheries Enterprises	3	3. Seminar	1
4. Fisheries Industries Management	4	4. Special Problems	6
5. Fisheries Development Policy	2		
6. Elective	2-3		
TOTAL	18-19	TOTAL	17

Electives:

1. Aquaculture Development	2
2. Fisheries Management II	3
3. Fisheries Product Tech. II	3
4. Demography	3

Appendix II. Graduate Program in Aquatic Science

STAFF

AHMAD, Sutomo. Ir (IPB); MS (Miami)

AZIZ, Kiagus Abdul. Ir (IPB); MS (Queensland)

DANA, Darnas. Ir (IPB); MS (Simon Fraser)

EFFENDIE, Mochamad Ichsan. Drs (ITB); MS (Iowa State)

EIDMAN, Muhammad. MS (Miami); Ph.D. (Texas A&M)

KASWADJI, Richardus. Ir (IPB); MS (Louisiana State)

KOESOEBIONO. MS (Miami)

MULUK, Chairul. BS, MS (Auburn)

PRAPTOKARDIYO, Kardiyo. Ir (IPB); Dr (Innsbruck)

PURWANTO, Joko. Ir (IPB); DEA, Dr (Montpellier II)

RAHARDJO, Santoso. Ir (IPB); MS (AIT)

SANUSI, Harpasis Selamet. Ir (IPB); MS (AIT)

SASTRAKUSUMAH, Sumardi. Drs, Dr (UI); MS (Miami)

SUMANTADINATA, Komar. Ir (IPB); MS (Kochi)

SUMAWIDJAJA, Kusman. Ir (UI); MS, Ph.D. (Auburn)

SUWIGNYO, Pong. Ir (UI); MS (Kentucky)

WARDOYO, Supomo T.H. Ir (IPB); MS (Kyushu)

CURRICULUM

At present there are three fields of interest in the Aquatic Science curriculum, namely:

1. Aquatic Environmental Science
2. Aquatic Resource Management
3. Aquaculture

First Semester

STK 511 Statistical Analysis (3)

AIR 501 Aquatic Ecosystems (3)

AIR 502 Water Quality (3)

AIR 503 Ecosystem Dynamics (3)

Second Semester

AIR 504 Population Dynamics of Aquatic Animals (3)

AIR 520 Aquaculture (3)

AGR 590 Research Methodology (3)

Elective

Third Semester

AIR 601 Colloquium (1)

AIR 630 Aquatic Resource Management (3)

Elective

Elective

Fourth Semester

AIR 690 Seminar (1)

AIR 699 Research and Thesis (6)

Electives

AIR 540 Biological Characteristics of Waste Water (3)

AIR 620 Reproductive Biology of Aquatic Organisms (3)

AIR 640 Water Management (3)

AGM 541 Hydrometeorology (2)

BIO 553 Comparative Physiology (3)

BIO 654 Ecophysiology (3)

PSL 505 Environmental and Natural Resource Management (3)

STK 512 Applied Regression Analysis (3)

STK 514 Sampling Techniques (4)

STK 613 Linear Models and the Designs of Experiment (3)

TNH 532 Soil Chemistry (3)

TNH 561 Soil Fertility (4)