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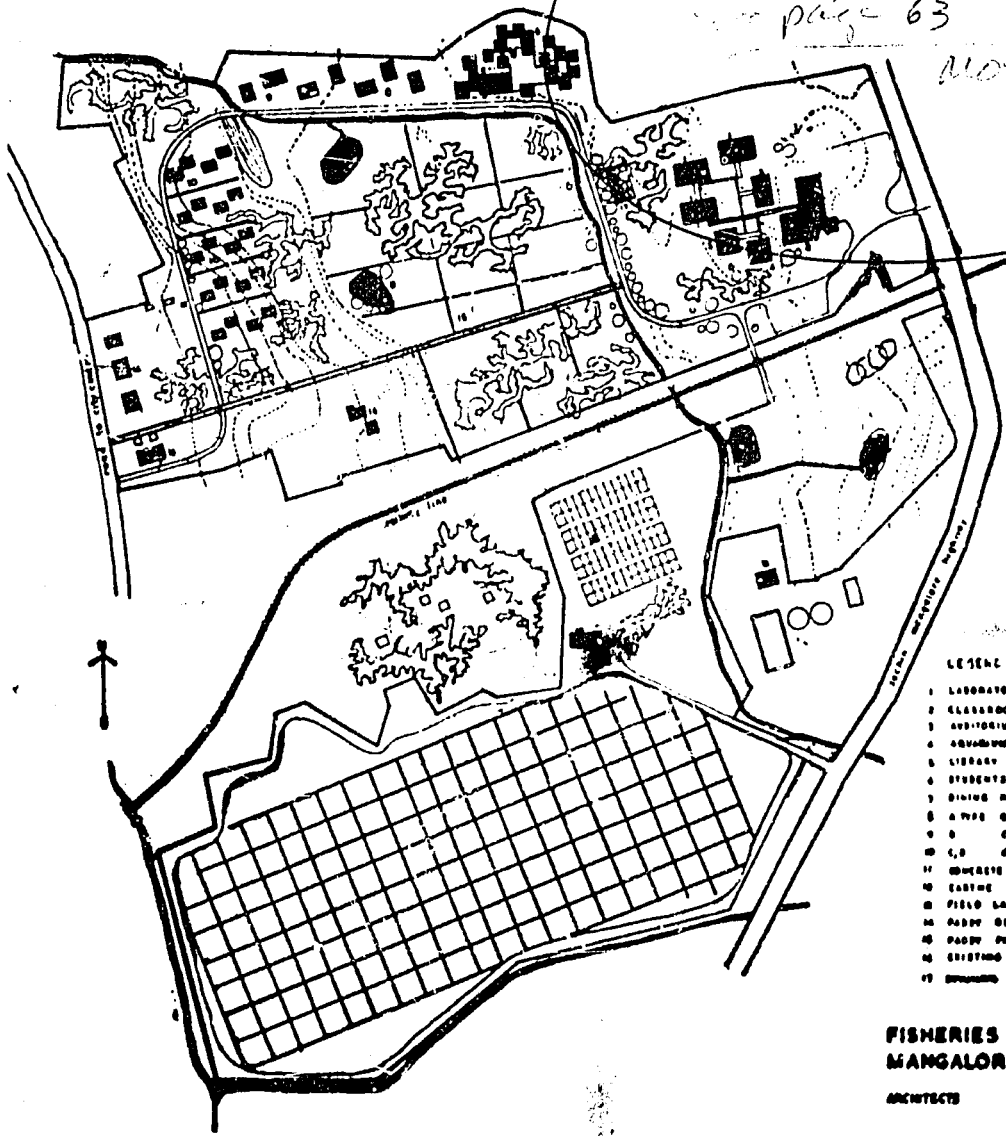
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REPORT ON THE DEVELOPMENT COLLEGE OF FISHERIES, MANGALORE.

*Don't forget to check
Campus Development Special
page 63
MOSS*



- LEGEND
- 1 LABORATORIES
 - 2 CLASSROOMS
 - 3 AUDITORIUM
 - 4 GYMNASIUM
 - 5 LIBRARY
 - 6 STUDENTS HOSTEL
 - 7 DINING HALL
 - 8 A HALL QUARTERS
 - 9 O. C.
 - 10 C. O.
 - 11 CONCRETE POOL
 - 12 SAND POOL
 - 13 FIELD LABORATORIES
 - 14 POND RESEARCH PLANT
 - 15 POND FIELDS
 - 16 EXISTING BUILDINGS
 - 17 SWIMMING POOL

**FISHERIES COLLEGE CAMPUS
MANGALORE.**
ARCHITECTS KARLSON AND SINGRAM

D. D. MOSS
Consultant in Fisheries
University of Tennessee/India Agricultural Programs
August 31, 1971

SECOND REPORT ON THE DEVELOPMENT

OF THE

FISHERIES COLLEGE AT MANGALORE

UNIVERSITY OF AGRICULTURAL SCIENCES, BANGALORE

by

D. D. MOSS

Consultant in Inland Fisheries

University of Tennessee/India Agricultural Programs

August 31, 1971

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ACKNOWLEDGEMENTS

The cooperation exhibited by officials of the University of Agricultural Sciences is gratefully acknowledged with the consultant expressing particular appreciation to Dr. K.C. Naik, Vice-Chancellor and Mr. B. Venkataswamy, Estate Officer, who with their continuing high interest in rapidly developing and excellent fisheries research and training facility, made available services of various offices of the University. The Coordinator of the Fisheries College, Mr. N. Sreenivasan with other staff of the College provided much of the information included in the report. Dr. K.V. Devaraj kindly proofed the report for content of factual information.

The architectural firm of Karekar and Sundaram, retained by U.A.S. to develop building plans for the Fisheries College graciously made available several illustrations that appear in the report. Mr. K.R. Ganapathy, Assistant Editor of U.A.S., kindly cooperated by preparing prints of several of the illustrations used herein.

As during my first tour in 1970, both Indian and American personnel affiliated with the University of Tennessee- India Agricultural Programs provided excellent logistical support.

The author borrowed information freely from the publications and other materials, including his own consultant report issued in 1970, listed under the section entitled references. It was felt that by consolidating information from these and other sources that this report would be especially useful to administrative personnel of the College and University and particularly valuable to short-term consultants and fishery advisors who may be associated with the Fisheries College in the future.

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ITINERARY

D.D. MOSS*

Consultant in Inland Fisheries

University of Tennessee/India Agricultural Programs

- 18 July 1971 Arrived Bangalore
- 19 July 1971 Conferences with Chief of Party, University of Tennessee Team, Vice-Chancellor and Administrative Board, University of Agricultural Sciences; Estate Officer, University of Agricultural Sciences, Karekar & Sundaram, Architects for Fisheries College, Mangalore.
- 20 July 1971 Conferences with personnel of Fisheries Research Unit, Bangalore; Karekar & Sundaram, Architects for Fisheries College, Mangalore.
- 21 July 1971 Conferences with Vice-Chancellor, UAS; Estate Officer, UAS.
- 22 July 1971 Travel to Mangalore; Meeting with the Coordinator of the Fisheries College.
- 23 July 1971 Tour of Marine Products Processing Training Center and new campus site of Fisheries College; Conferences with Coordinator and various staff of Fisheries College.
- 24 July 1971 General meeting with entire staff of College of Fisheries; Group discussions with staff of Departments of Fishery Biology and Fishery Oceanography and Limnology.
- 26 July 1971 Group discussions with staff of Departments of Fishery Resources and Economics, Fishery Engineering, Fishery Technology (Canning) and Fishery Technology (Ham and Sausage); Participated in graduation exercises for the Diploma course in fishery technology at the Marine Products Processing Training Centre.

*On leave from the Department of Fisheries, Auburn University, Alabama, U.S.A.

27 July, 1971 Return to Bangalore; meeting with Estate Officer and USAID Campus Development Advisor

28 July 1971 Chief of Party, University of Tennessee Team; USAID Campus Development Advisor and Karekar & Sundaram Architectural Firm.

29 July, 1971 Office at U.A.S. Hebbal.

30 July 1971 Office at U.A.S. Meeting with Estate Officer, USAID Campus Development Advisor and Karekar & Sundaram Architectural Firm.

2 Aug 1971 University of Tennessee Staff meeting, with the American Consul General, Madras; Director and Administrative Staff, Mysore State Department of Fisheries, Bangalore.

3 Aug 1971 Office at U.A.S.; Meeting with staff member selected for Participant Training in Aquatic Microbiology.

4 Aug 1971 Attended ceremony in which U.S. Ambassador Dedicated New Mobile Soil Testing Quality Unit and toured U.A.S. New Campus with University of Tennessee Team.

5 Aug 1971 Office at U.A.S.; Served on Selection Committee for the Position of Director of Instructor, Fisheries College.

6 Aug 1971 Office at U.A.S.; Karekar & Sundaram Architects; Coordinator, Fisheries College, Mangalore; Registrar UAS.

9 Aug 1971 Office at UAS; Estate Officer, UAS.

10 Aug 1971 Travel to Mangalore with Construction Engineer, UAS and Mr. R. Sundaram of Karekar & Sundaram Architectural Firm; Inspection of New Fisheries Building Complex Site.

11 Aug 1971 Group Meeting with the Coordinator and Department Heads of the Fisheries College; Construction Engineer, U.A.S. and Representative of Architectural Firm to discuss layout, needs and arrangement of various laboratories, classrooms and other buildings.

12 Aug 1971 Concluded Group Meetings on Layout and Needs relating to New Fisheries College Buildings; Group discussions with Coordinator and staff of Departments of Fishery Technology (By Products) and Fishery Technology (Freezing) and staff affiliated with the I.C.A.R. program on utilization of trash fish.

13 Aug 1971 Group discussion with Coordinator and staff of Department of Fish Culture; Inspection tour of Fisheries Library; General Staff Meeting to discuss major areas of specialization and other aspects of the teaching and research programs.

14 Aug 1971 Return to Bangalore

16 Aug 1971 Office at UAS; Karekar & Sundaram Architectural Firm.

17 Aug 1971 Office at UAS: Acting Director of Extension, UAS; Assistant Director of Fisheries, Mysore State; Administrative Officer UAS.

18 Aug 1971 Travel to Vanivilas Sagar Fish Farm with Planning Officer, Mysore State Department of Fisheries and Associate Professor of Fish Culture, Fisheries College, Mangalore.

19 Aug 1971 Travel to Bhadra Fish Farm and Reservoir near Shimoga; return to Bangalore.

20 Aug 1971 Office at UAS; Conference with Assistant Professor of Fish Culture, Fisheries College, Mangalore.

21 Aug 1971 Travel to Mysore with Assistant Professor of Fish Culture, Fisheries College, Mangalore to visit K.R. Sagar Fish Farm.

23 Aug 1971 USAID Agricultural Conference; Office at UAS; meeting of staff member for Participant Training in Fishery Pathology, Assistant Professor of Fish Culture, Fisheries College, Mangalore.

24 Aug 1971 Office at UAS.

25 Aug 1971 Office at UAS, Acting Chief of USAID University Development Division, New Delhi; Assistant Professor of Fish Culture, Fisheries College, Mangalore.

26 Aug 1971 Office at UAS, Assistant Professor of Fish Culture, Fisheries College, Mangalore.

27 Aug 1971 Office at UAS, Assistant Professor of Fish Culture, Fisheries College, Mangalore, Vice-Chancellor, Acting Chief Agricultural University Development Division, USAID, New Delhi, Acting Chief of Party, University of Tennessee/India Agricultural Programs, Bangalore.

28 Aug 1971 Departed Bangalore for Bombay.

29 Aug 1971 Departed Bombay for the United States.

SECOND REPORT ON THE DEVELOPMENT OF THE FISHERIES COLLEGE

Introduction

The University of Agricultural Sciences, Bangalore, is a young institution. It was inaugurated in 1964 and became functional in 1965 when the Mysore State Government administratively consolidated an existing veterinary and two agricultural colleges plus a number of research stations under the present University System.

The Chancellor and Pro-Chancellor of the University respectively are the Governor of the State of Mysore and the State Minister of Agriculture. The Vice-Chancellor is the principal executive officer and, with concurrence of the Board of Regents, exercises full control over all aspects of the teaching, research and extension functions of the University. The Dean is the principal assistant to the Vice-Chancellor and is concerned primarily with administrative and academic matters. The Directors of Research and Extension respectively coordinate all research and extension activities sponsored by the University and they report directly to the Vice-Chancellor. The Estate Officer is in charge of maintenance of the physical facilities and supervises the building construction program. The Administrative Officer is the chief administrative assistant to the Vice-Chancellor, while the Librarian is in charge of all branch libraries as well as the Central Library on Main Campus at Bangalore. Each college of the University has a Director of Instruction who supervises activities carried out by that particular college and who is responsible to the Dean and Vice-Chancellor.

Although the University of Agricultural Sciences has been in operation for a relatively short period of time, the institution has expanded rapidly to encompass several new colleges and disciplines. The general location of Mysore State and its size in relation to the country as a whole can be seen in Fig. 1, while the present dimension of the University in terms of the various colleges and research stations with their locations can be observed in Fig. 2.

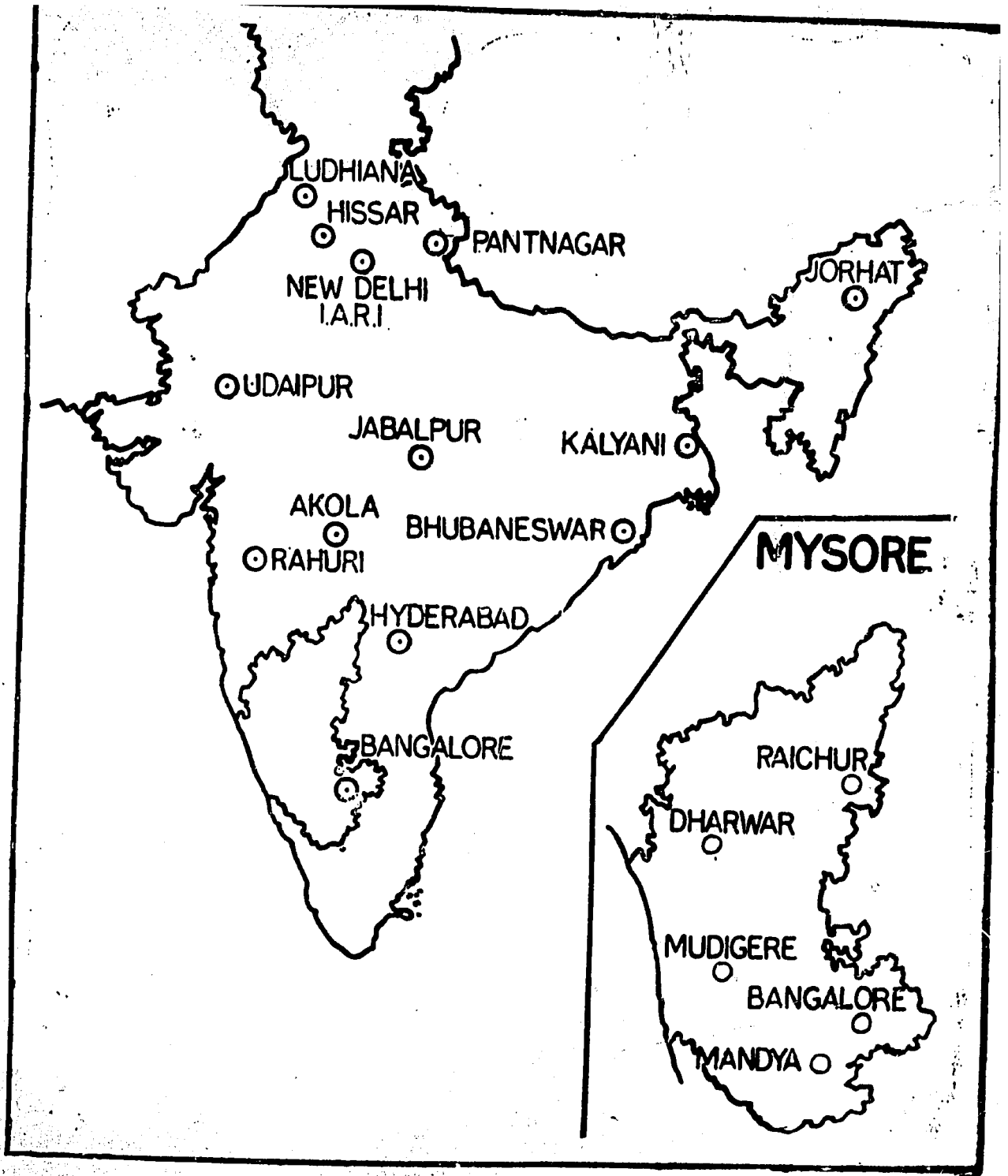


Figure 1. Map of India showing Location of Mysore State

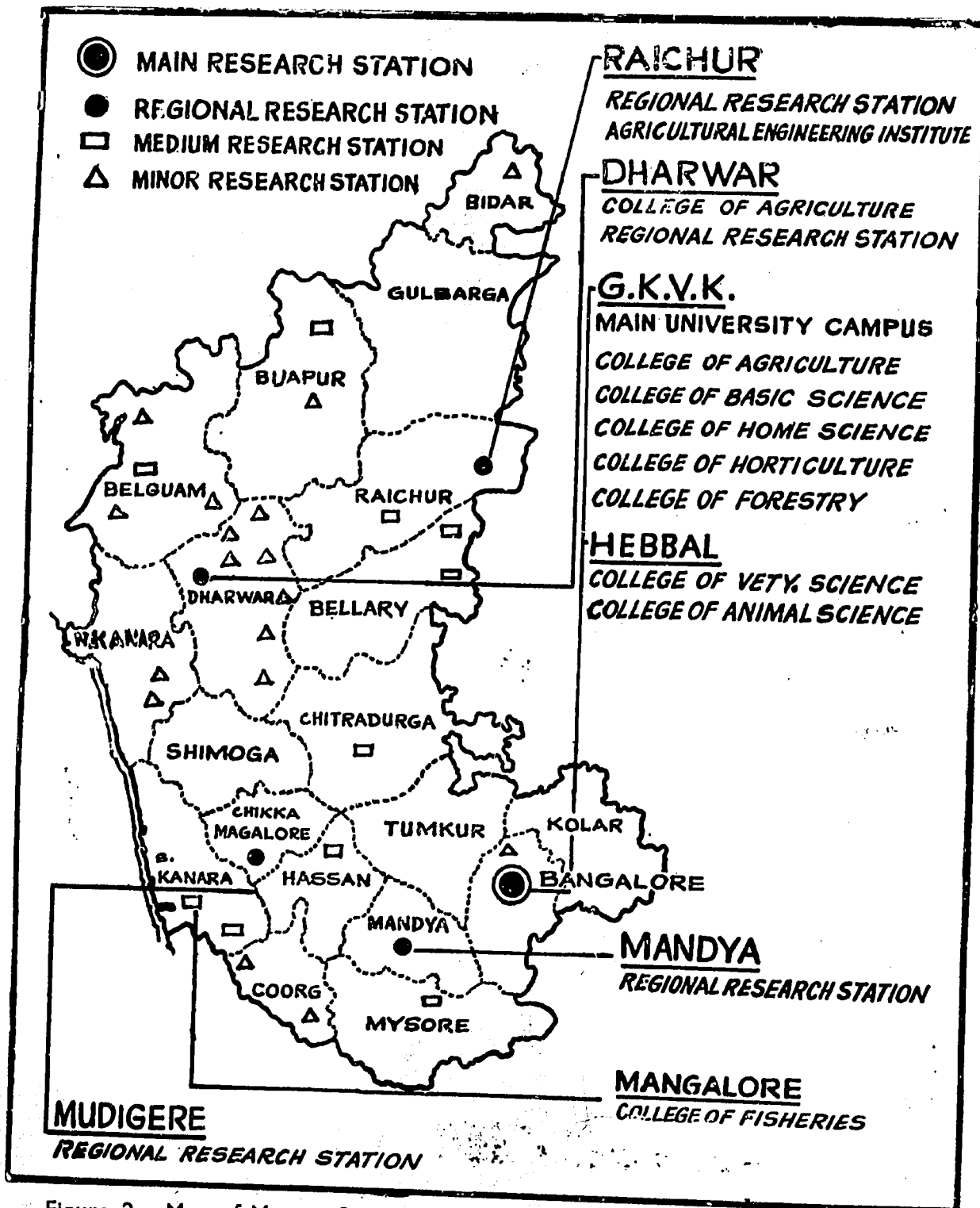


Figure 2. Map of Mysore State with Locations of Various Colleges and Research Centres of the University of Agricultural Sciences, Bangalore.

The Fisheries College

Background Information

The State of Mysore has a coast line of approximately 320 kilometers (200 miles) with an off-shore fishing area encompassing about 25,900 square kilometers (10,000 square miles). In addition, the State possesses some 6,080 kilometers (3,800 miles) of rivers and streams, over 30,000 minor tanks, 2,700 major tanks and 17 reservoirs for a combined total of over 412,966 hectares (1,020,000 acres) of inland waters.

The total fish harvest from marine and inland waters, as estimated by the Mysore State Department of Fisheries, increased from 102 thousand metric tons in 1956 to 141 thousand metric tons in 1966. The corresponding value of the fishery increased from 184 to 213 lakhs of rupees (2.45 to 2.84 million U.S. dollars) during this 10-year period with over 19,000 persons being gainfully employed in the fishing enterprise.

These fishery resources not only have contributed significantly to the economic growth of the State, the sixth largest in India with a total area of 192,155 square kilometers (74,191 square miles), but also have provided a valuable source of high quality protein for a number of its present 29.3 million inhabitants.

The outstanding potential existing for the further development of these valuable fishery resources has been recognized by officials of both the Central and State Governments. In this regard, the Fisheries College - the first such institution in the Nation - was established within the University of Agricultural Sciences for the express purpose of providing well-trained and qualified graduates. Upon completion of the 4-year degree program, the graduates then will become professionals in fishery agencies in the various states and Central Government as well as in commercial and private sectors. In India there are approximately 2,500 professional fisheries workers presently employed by the Central and the various State Governments. Assuming an annual turnover rate of 5 percent due to retirements, resignations and new positions that are sanctioned, there will be a need for 125 fisheries graduates each year.

History of the College

Instruction in fisheries was initiated at the University of Agricultural Sciences, Bangalore, in 1966 when a general fisheries course was offered on an annual basis to students in the College of Veterinary Science. Realizing the importance of fisheries and the increasing need for trained fisheries personnel, University officials in 1968 established a Department of Fisheries with expanded teaching and research functions.

The University of Agricultural Sciences, with cooperation and support of the Central and Mysore State Governments, formally inaugurated the College of Fisheries at Mangalore in 1969. The College is particularly unique in that it, when fully developed, will possess the physical and field facilities to provide academic instruction as well as practical field experience to students in aspects of marine, brackish water and freshwater fisheries, including fish culture, as well as fishery technology. It is one of the very few educational institutions in the world that can provide such a broad program of training in fisheries.

Under the capable guidance of an Advisory Committee consisting of several of the most distinguished and qualified fisheries scientists of India representing well established fishery agencies, a four-year curriculum culminating in a Bachelor of Fishery Science degree and a professional staff of approximately 40 teaching and research personnel have been developed.

The present status of the College of Fisheries, including the organizational structure, instructional and research programs and physical facilities are presented in the following sections of this report, followed, in turn, by a section concerned with critiques and recommendations. The latter section, it is hoped, will provide suggestions which will improve the various functions of the College and thus enable the College to proceed more rapidly in achieving the goal of excellence toward which it is striving.

Organizational Structure of the College

As in other colleges of the University, the administrative and executive function of the College of Fisheries rests with the Director of Instruction who, in turn, is responsible to the Dean and Vice-Chancellor. Efforts to fill this highly responsible position have been unsuccessful to date although this situation may soon change if recommendations made by the Selection Committee in a meeting held on August 5, 1971, are approved by the Vice-Chancellor and Board of Regents.

Originally six departments were established within the College of Fisheries. Recently however, the Department of Fishery Technology, formerly an extremely large department comprising most of the technical staff associated with the Marine Products Processing Training Center, was divided into three new departments. At the present time, therefore, there are nine departments as indicated in the following organizational chart (Fig. 3).

The number of staff with the rank of instructor and above varies from department to department, with Fishery Engineering having only two staff while three, Fishery Biology, Fishery Oceanography and Limnology, and Fishery Technology (By Products), each have six. A breakdown of positions authorized for each department is given below while the names of the staff presently employed with their respective title and highest academic degree are included in the Appendix.

UNIVERSITY OF AGRICULTURAL SCIENCES, BANGALORE

VICE-CHANCELLOR

DEAN

FISHERIES COLLEGE, MANGALORE

DIRECTOR OF INSTRUCTION

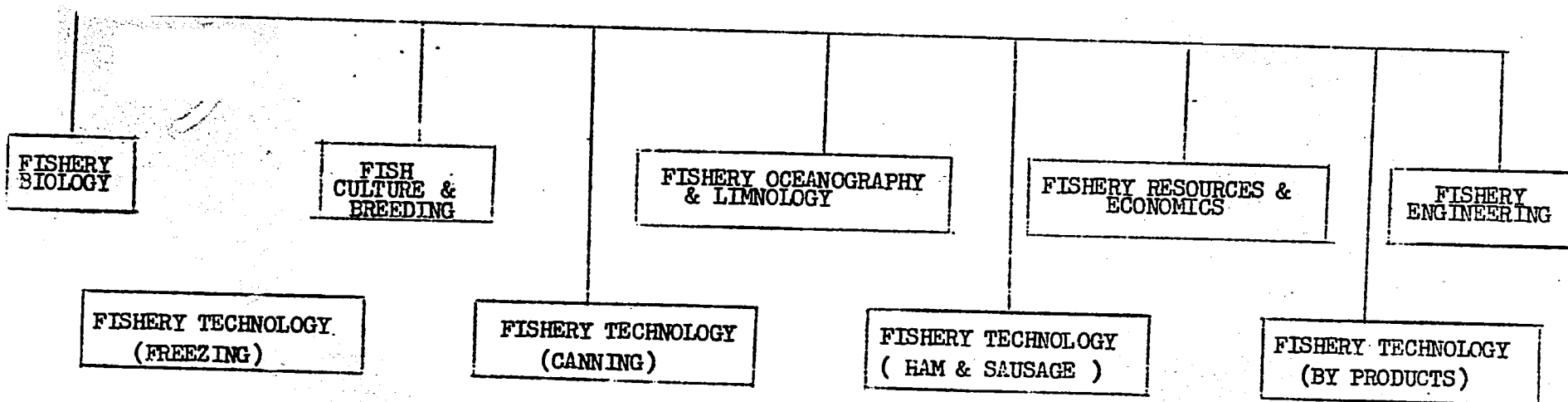


Figure 3. ORGANIZATIONAL STRUCTURE OF THE COLLEGE OF FISHERIES, MANGALORE INDICATING THE NEW DEPARTMENTS

FUNCTIONING AS OF AUGUST 1971

Department of Fishery Biology

Head of Department and Professor		(vacant)
Assistant Professors	(6)	(4 vacant)
Instructors	(5)	(2 vacant)

Department of Fish Culture and Breeding

Head of Department and Associate Professor		
Assistant Professors	(2)	(1 vacant)
Instructors	(2)	(1 vacant)

Department of Fishery Oceanography and Limnology

Head of Department and Associate Professor		
Assistant Professors	(3)	
Instructors	(2)	

Department of Fishery Resources and Economics

Head of Department and Associate Professor		
Assistant Professors	(2)	(1 vacant)
Instructors	(2)	(1 vacant)

Department of Fishery Technology (Freezing)

Head of Department and Associate Professor		
Assistant Professor	(1)	
Instructor	(1)	

Department of Fishery Technology (Canning)

Head of Department and Associate Professor		
Assistant Professor	(1)	
Instructor	(1)	

Department of Fishery Technology (Ham and Sausage)

Head of Department and Associate Professor		
Assistant Professor	(1)	
Instructor	(1)	(1 vacant)

Department of Fishery Technology (By Products)

Head of Department and Associate Professor		(vacant)
Assistant Professors	(3)	(1 vacant)
Instructors	(4)	(1 vacant)

Department of Fishery Engineering

Head of Department and Associate Professor		
Assistant Professors	(3)	(2 vacant)
Instructors	(2)	(2 vacant)

At present there are 52 authorized teaching positions consisting of the Director of Instruction; 1 Professor; 8 Associate Professors; 22 Assistant Professors; and 20 Instructors, whose teaching activities are limited to assisting in laboratories. Positions remaining to be filled, in addition to the post of Director of Instruction, include: 1 Professor, 1 Associate Professor, 9 Assistant Professors and 8 Instructors. Two of the teaching staff are presently on study leave while four additional staff members of the College of Fisheries have been selected for advanced studies abroad under the USAID/University of Tennessee participant training program. Of the 32 staff presently employed in teaching positions, 5 possess the Ph.D. degree, 17 are trained at the Masters' level and 10 are with Bachelor degrees.

Instructional Program - B.F.Sc. Degree

The Instructional program of the Fisheries College consists of 4 years of course and field work after which, if successfully completed, students are awarded the degree of Bachelor of Fishery Science (B.F.Sc.).

Curriculum

The initial year of academic training is given by the College of Basic Sciences and Humanities at the main University Campus, Bangalore. It is the identical course of study available to first year students enrolled in Bachelor of Agricultural Science and Bachelor of Veterinary Science degree programs. A total of 54

Credit hours of instruction is provided, with emphasis on the biological and physical sciences and, to a lesser extent, the humanities. An outline listing the various courses and the amount of credit that each carries follows while the course descriptions may be found in the University Calendar and Catalog.

Upon the completion of the first year of basic studies at the main University Campus, students in fisheries move to Mangalore where courses for the remaining 3 years are taught. During their 3-year program of study at the Fisheries College, Mangalore, the students take courses encompassing three broad areas of fisheries: marine fisheries; inland fisheries; and fishery technology. Students receive a total of 138 credit hours of instruction comprising theory, practicals and field experience in an area of specialization, with 47, 43 and 48 credit hours for courses given in Year II, Year III and Year IV respectively. Thus, the 4-year degree program provides a grand total of 192 credit hours of academic and field work. The subjects for Years II, III and IV with indication of the department offering the course and number of credits for each are presented on pages 14, 15 and 16 while description of the courses are included in the Appendix. The schedule of courses listed for Years II and III with the appropriate course descriptions, has been approved by the Academic Council and Board of Studies of the University of Agricultural Sciences.

CURRICULUM FOR BACHELOR OF FISHERY SCIENCE

COLLEGE OF FISHERIES, MANGALORE

YEAR I*

A. HUMANITIES

Credit Hours

English
Sociology
Basic Economics
General Psychology

9
2
2
2

—
15

B. BASIC SCIENCES

Chemistry
Botany
Zoology
Microbiology
Mathematics
Physics and Meteorology
Statistics
Human Nutrition
Physical Education

9
4
4
3
5
5
3
3
3

—
39

Total credit hours ... 54

*Courses in Humanities and Basic Sciences (Year I) are given at the UAS Main Campus, Bangalore.

CURRICULUM FOR BACHELOR OF FISHERY SCIENCE

COLLEGE OF FISHERIES, MANGALORE

YEAR II

Dept.	Subject	Credit Hours Per Trimester			
		I	II	III	Total
FB	Ichthyology	4	-	-	4
"	Fish Biology	3	3	-	6
"	Ecology and Zoogeography	-	-	4	4
"	Capture Fisheries	-	3	-	3
FC & B	Fish Culture	-	-	5	5
FO & L	Marine Biology	-	3	-	3
"	Limnology	5	3	-	8
FT(BP)	Biochemistry	4	-	-	4
"	Microbiology	-	-	3	3
FT(F)	Freezing	-	-	4	4
FE	Craft Engineering	-	3	-	3
Total		16	15	16	47

FB : Fishery Biology
 FC&B : Fish Culture & Breeding
 FO&L : Fishery Oceanography &
 Limnology

FT(BP) : Fishery Technology
 (By Products)
 FT(F) : Freezing Technology
 FE : Fishery Engineering

: 15 :

CURRICULUM FOR BACHELOR OF FISHERY SCIENCE

COLLEGE OF FISHERIES, MANGALORE

YEAR III

Dept.	Subject	Credit Hours Per Trimester			
		I	II	III	Total
FB	Capture Fisheries	3	-	-	3
"	Population Dynamics	-	-	4	4
"	Fish Pathology and Parasitology	-	-	3	3
FC & B	Fish Culture	5	-	-	5
"	Breeding	-	-	5	5
FO & L	Marine Biology	-	3	-	3
"	Physical and Chemical Oceanography	3	3	-	6
FT(C)	Canning Technology	-	2	-	2
FT(H & S)	Ham and Sausage Technology	-	-	2	2
FT(BP)	Microbiology	3	-	-	3
FE	Fish Farm Engineering	-	-	2	2
"	Gear Engineering	-	5	-	5
"	Refrigeration Engineering	3	-	-	3
"	Navigation and Seamanship	-	2	-	2
Total		17	15	16	48

FB : Fishery Biology

FC&B : Fish Culture & Breeding

FO&L : Fishery Oceanography & Limnology

FT(C): Fish Technology (Canning)

FT(H&S) : Fish Technology(Ham & Sausage)

FT(BP) : Fish Technology(By Products)

FE : Fishery Engineering

I.C.A.R. Research Project on Trash Fish

An all-India coordinated research project concerned with increased utilization of trash fish has been sanctioned by the Indian Council of Agricultural Research. For the portion of the research to be carried out at Mangalore, I.C.A.R. has allocated the Fisheries College a sum of Rs.4.29 lakhs (approximately \$57,000) to extend over a five-year period.

In addition to the technical staff, the Fisheries College will provide laboratory and office facilities and make available processing machinery of the Fishery Technology Center. Over all coordination of the Trash Fish Utilization Project, with related projects to be established at two other institutions, will be under I.C.A.R.

Surveys first will be conducted to determine availability of trash fish species during different seasons along coastal regions of Mysore State. Subsequently, the principal objective will be to develop methods resulting in greater utilization of trash fish, either for human consumption or in fishery products of industrial importance. Trash fish comprise 50 to 70 per cent of the total trawl catch in India, with a return to the fisherman of about 25 paise per kilogram (1.5 cents per pound).

To date a technologist, a senior research assistant and a junior assistant have been appointed, but several other staff have yet to be recruited. Field work in this important project will be initiated at the conclusion of the present monsoon season.

Physical Facilities of the College

Presented in this section are descriptions, supplemented with appropriate illustrations, of the physical facilities of the Fisheries College, which may conveniently be considered as follows:

1. Existing facilities
2. Facilities under construction
3. Facilities scheduled for future construction

Existing Facilities

Existing facilities of the College, in which instruction and research presently are carried out include the Fishery Technology Center, a field laboratory and 18 concrete pools. The former is located at Hoige Bazar in Mangalore, while the latter are located at Kanakanady, where the new buildings of the Fisheries College are being constructed. Over all views of the Building Complex and the Pond Research Area are presented in Figures 4 and 5 respectively and, in smaller scale, in the illustration on the report cover.

Fishery Technology Center

The Fishery Technology and Processing Center was constructed and equipped in 1963, through a cooperative assistance program with Japan, at a cost of Rs.46 lakhs. It is estimated that the replacement value of this facility at present is Rs.77 lakhs (approximately \$ 1,000,000). Initially operated by the Department

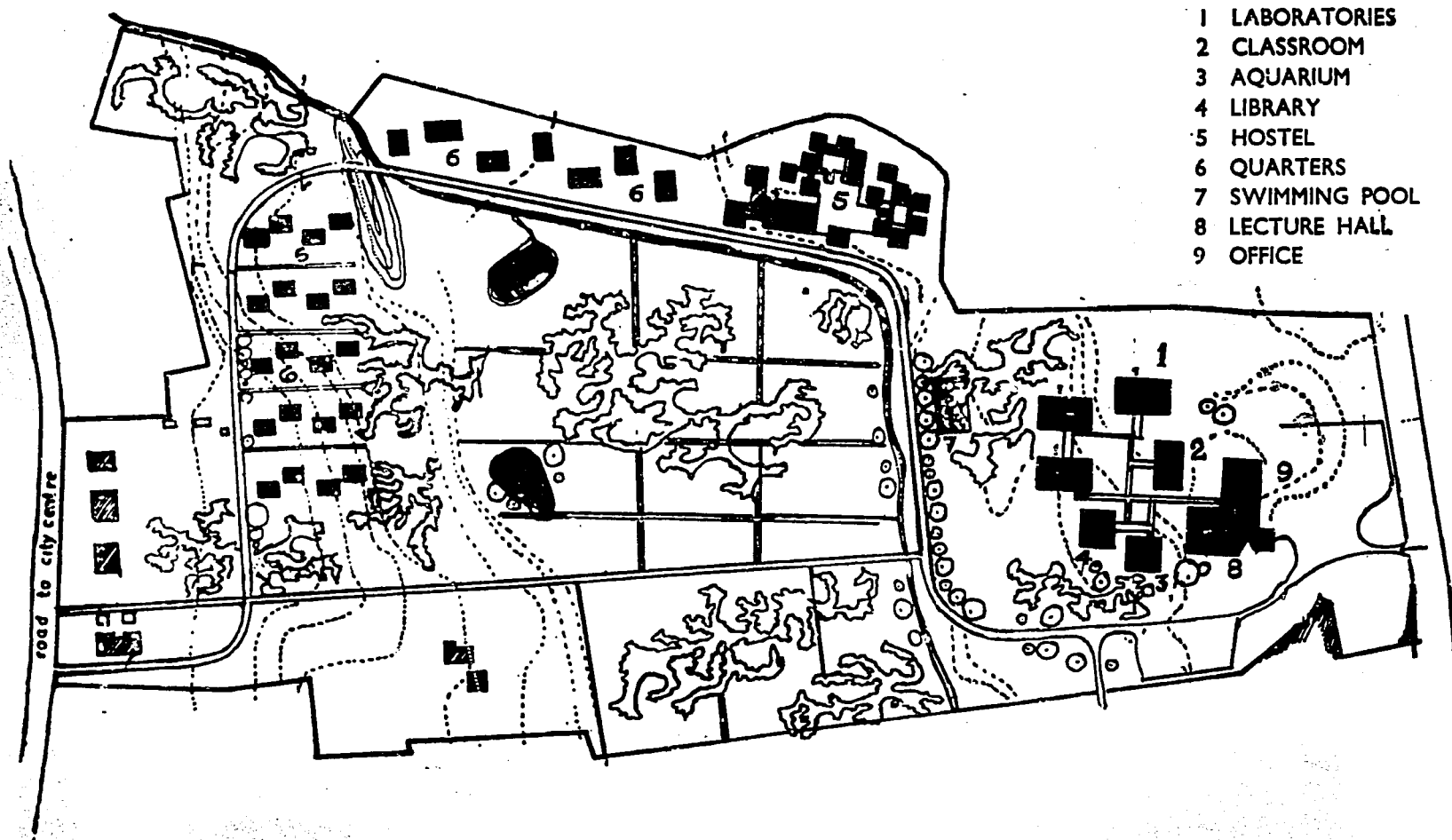
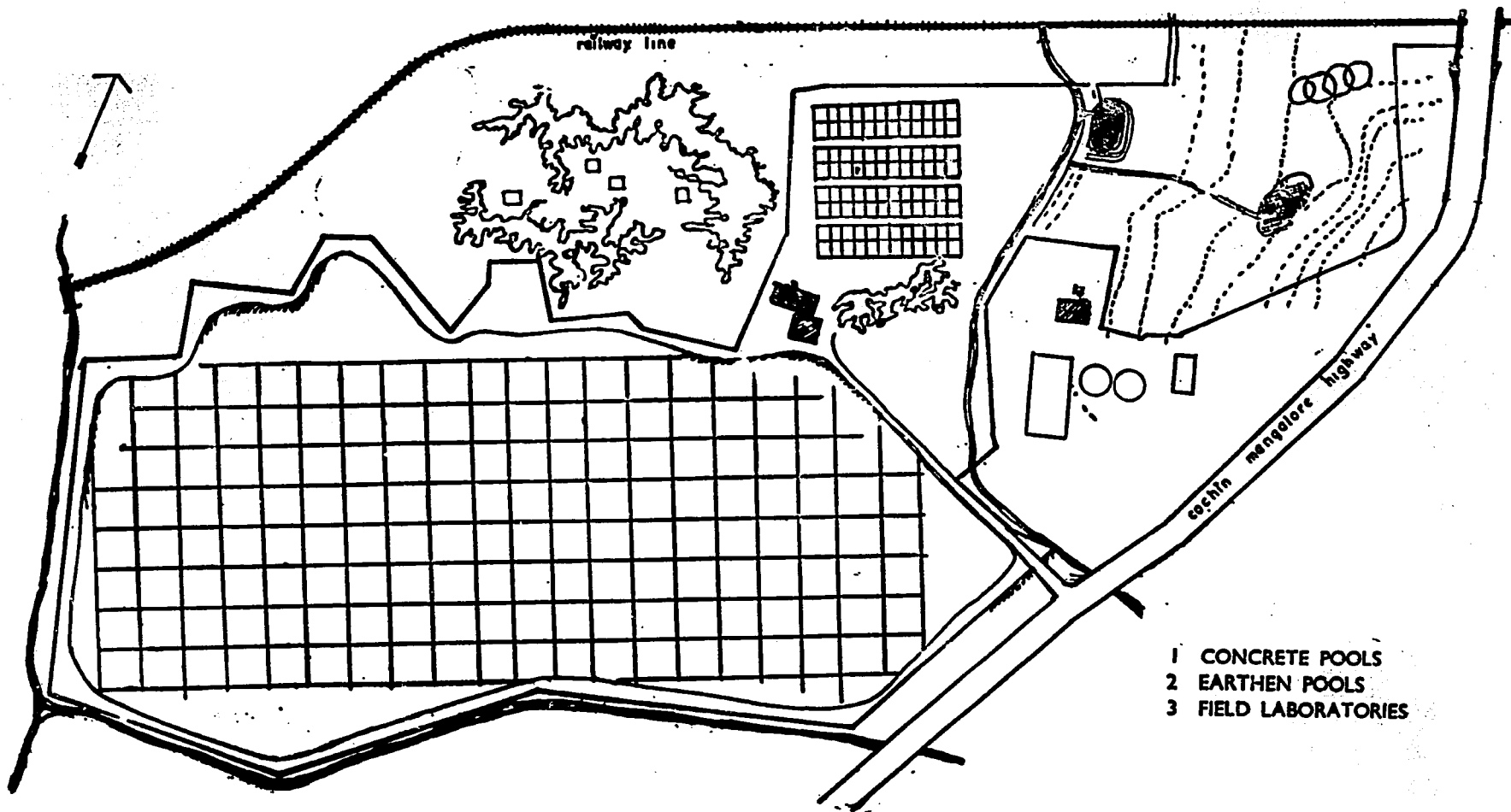


Figure 4. Illustration of Building Complex, College of Fisheries Mangalore.



- 1 CONCRETE POOLS
- 2 EARTHEN POOLS
- 3 FIELD LABORATORIES

Figure 5. Illustration of Pond Research Area, College of Fisheries, Mangalore.

of Fisheries of Mysore for the purpose of training technicians in the field of fish food processing technology, the excellent facility was later turned over to the University of Agricultural Sciences as the contribution of the State Government toward the establishment of the Fisheries College. The Center, with a total area of 2,220 square meters (23,887 square feet) initially is well equipped for work in fishery technology with particular capability in aspects of freezing, canning, ham and sausage preparation and fishery by products.

The pronounced advances evidenced during the past year in rapidly developing the Fisheries College and formalizing a good academic program were in no small way due to the efficient functioning of the Fishery Technology Center and the cooperative attitude of its staff. The increasing demands placed upon the Center as the result of implementation of the B.F.Sc. degree program have been great; but these have been alleviated, in part, by expansion of facilities and addition of new staff. In this regard, four additional classrooms have been constructed with a total area of 296 square meters (3,185 square feet). Also constructed was a cafeteria comprising 159 square meters (1,711 square feet). The additional classrooms and the dining area required the expenditure of 1.25 lakhs of rupees (\$16,625) by the University of Agricultural Sciences. Further improvement obviously will occur upon the completion of the educational buildings now under construction at the Kananady site, and with the subsequent transfer to this area of much of the teaching effort.

Field Laboratory

During the past year a field laboratory with an area of 100 square meters (1076 square feet) was constructed at a cost of Rs.32,800 (\$4,373). This laboratory, constructed south of the railway line for ready accessibility to the Pond Research Area, is utilized for storage of equipment and supplies such as fertilizer, fish feed, nets and other materials routinely used in fish farming operations. The laboratory also has counter top space to accommodate analytical equipment for chemical analysis of pond waters and soil and mud samples. Although construction was basically completed in July, 1971, electrical and water services to the laboratory have yet to be connected.

Concrete Pools

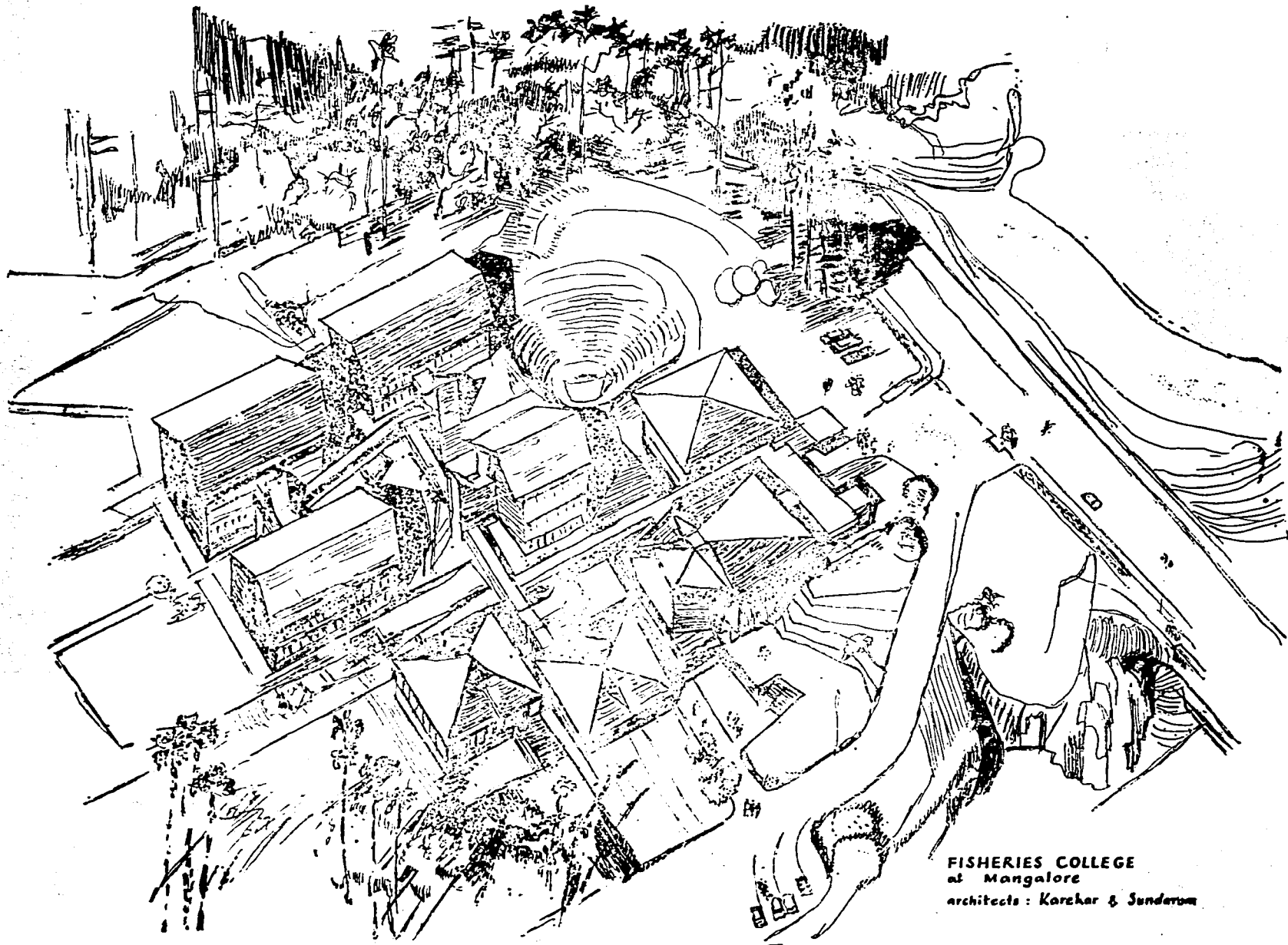
A series of 18 concrete pools, each having a total surface area of 25 square meters and a depth of 1 meter, were constructed at the cost of Rs.42,000 (\$5,600). The pools were constructed according to plans given in the consultant's earlier report, although at a cost considerably higher than was estimated (Rs.29,000). The major item resulting in higher construction costs apparently was the large quantity of earth fill that was required to build the foundation of the pools to a level sufficient to afford protection from flood waters. Research involving the use and operation of the concrete pools has now been initiated.

Facilities under Construction

Under construction at present is the principal educational complex of the College consisting of four buildings: three laboratory blocks and a classroom block. Architects' drawings illustrating these facilities are presented in Figures 6 and 7. Construction on this first phase of the new building complex was started in April, 1971, and it is anticipated that these buildings will be completed by April, 1972, at a cost of approximately Rs.16.5 lakhs (\$220,000). Thus, instruction for the B.F.Sc. degree program, presently being carried out at the Fishery Technology Center, will be transferred to these new facilities at Kanakanady beginning with the 1972-73 academic year.

Laboratory Blocks

The three laboratory buildings, each consisting of two levels, are identical in size and have the same general floor plan. Each story, with a total area of 279 square meters (2,905 square feet), has the following designated space allocations in square meters: teaching laboratory, 108; research laboratory, 72; professors' office, 19; staff offices, 57; preparation room, 17; storage room, 19 (Figure 8). One of the laboratory buildings has a partial basement with an area of about 217 square meters. A section of this basement area was constructed and partitioned to accommodate equipment and machinery as may be required to air condition the entire or selected areas of the building.



FISHERIES COLLEGE
at Mangalore
architects : Karehar & Sunderam

Figure 6. View of Educational Complex, College of Fisheries, Mangalore.

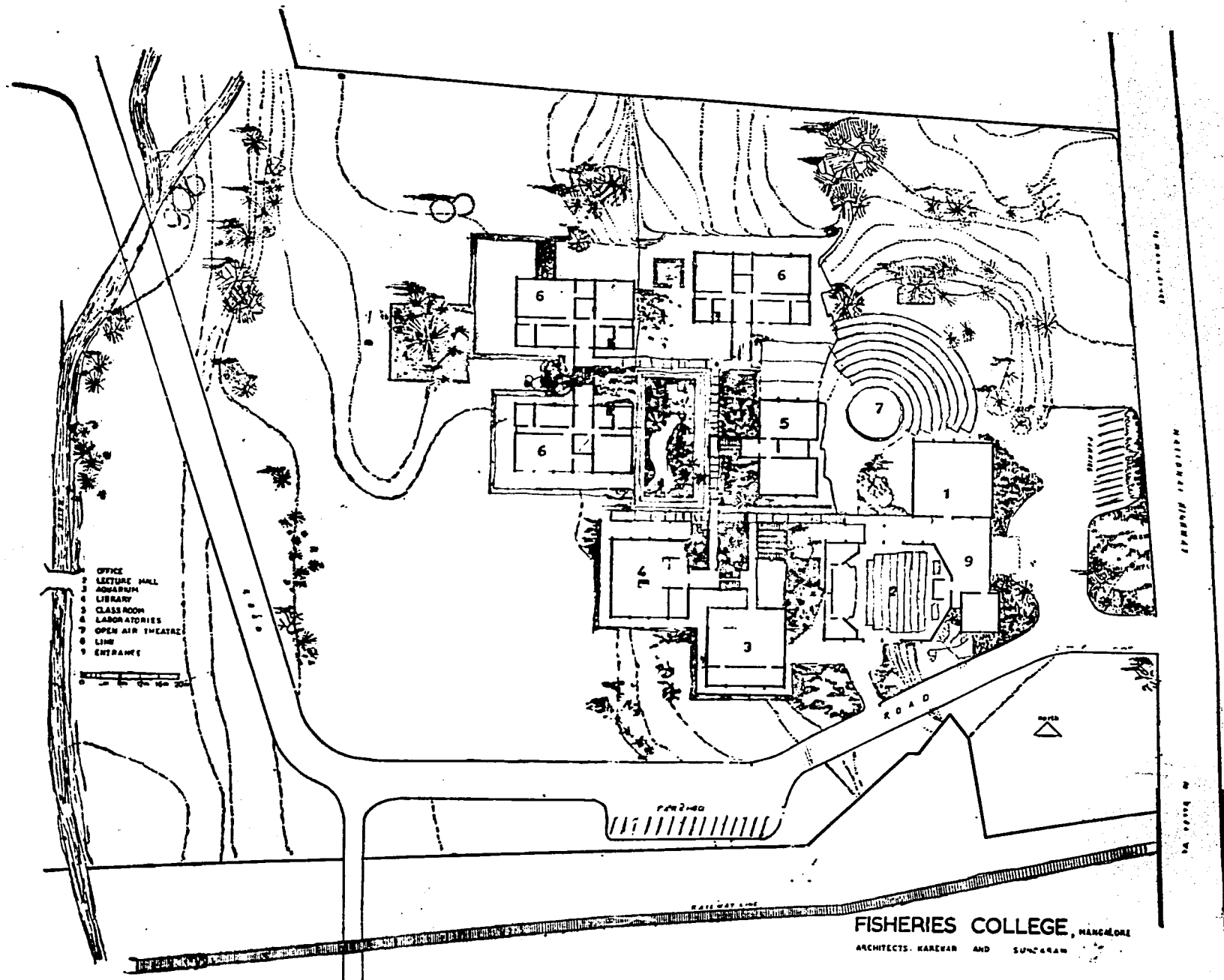


Figure 7. Plan View of Educational Complex, College of Fisheries, Mangalore.

The teaching laboratories are of sufficient size to accommodate 20 to 30 students, depending upon arrangements of tables, while a maximum of 6 students can work in the research laboratories. The primary use of the latter, however, will be by the staff. There is sufficient office space on each floor to comfortably accommodate 8 to 10 staff although, with the exception of the professor or head of department, none will have private offices.

Classroom Block

The classroom building also consists of two levels each of which contains two large classrooms separated by an entrance hall and a preparation room (Figure 9). Each story has a total floor area of approximately 262 square meters (2,819 square feet), with an entrance hall, preparation room and each of the classrooms comprising respectively 18, 27 and 108 square meters. Also in the classroom building is a partial basement encompassing an area of 162 square meters (1,743 square feet). Each classroom can easily seat 60 students and probably up to 80 could be accommodated when necessary. The basement area has been designated as a lounge for students.

Facilities Scheduled for Future Construction

Administrators of the University have planned that construction of the new building complex of the Fisheries College including student hostels, library, aquarium, administration building,

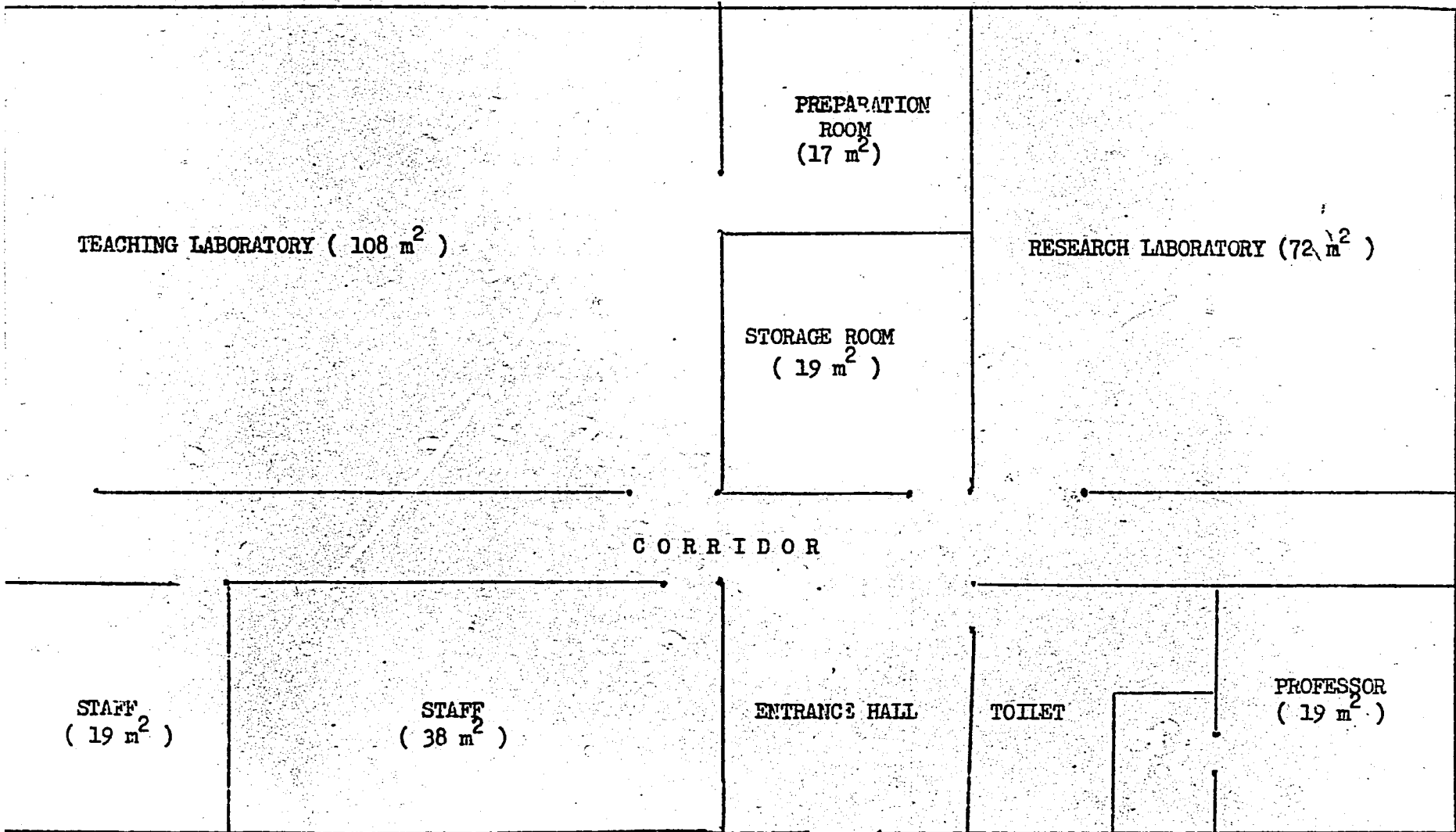
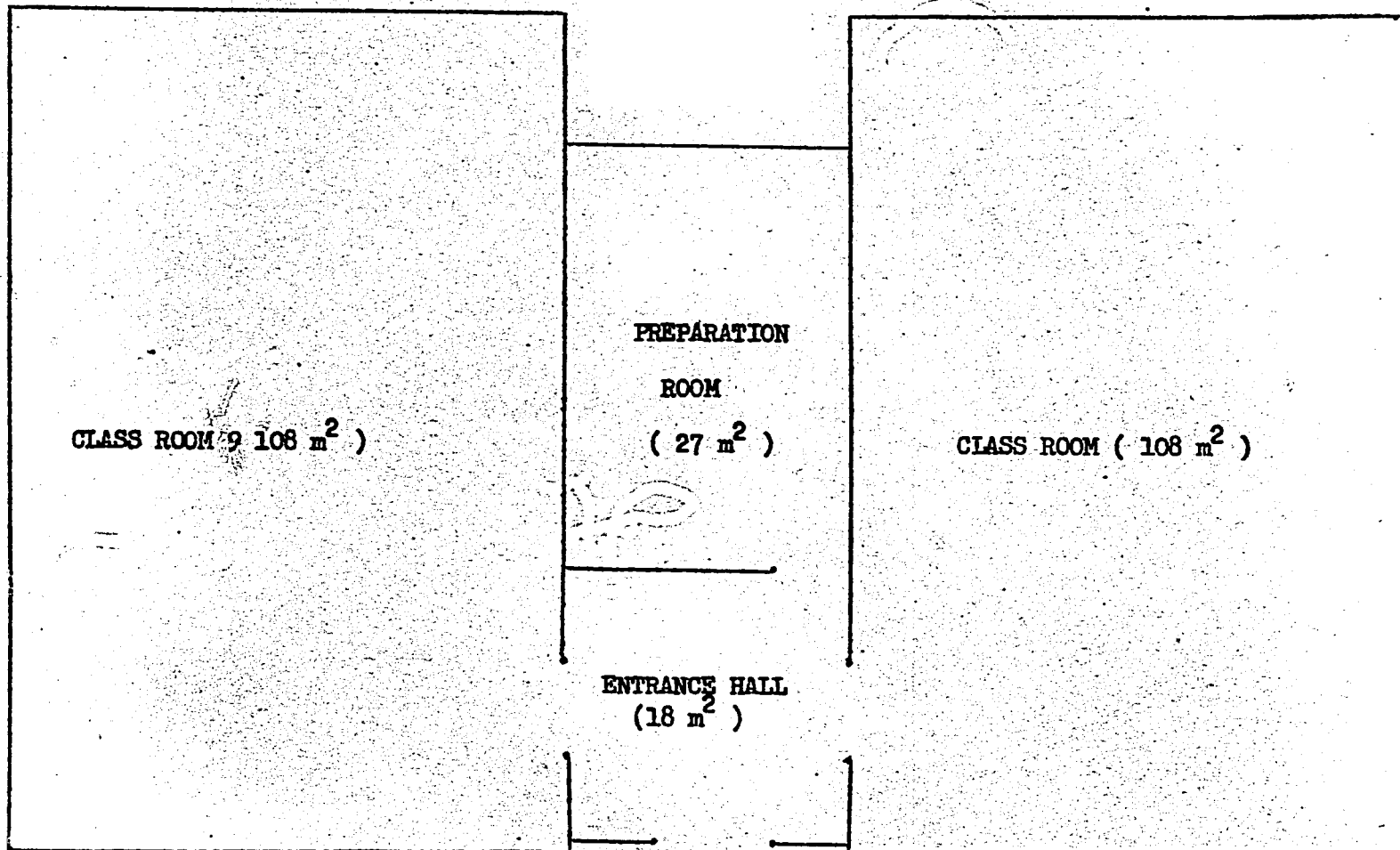


FIGURE 8. GENERALIZED FLOOR PLAN OF A TYPICAL LABORATORY SECTION WITH A TOTAL AREA OF 279 Sq.m.
(2,905 Sq.Ft.)



: 31 :

FIGURE 9. GENERALIZED FLOOR PLAN OF A TYPICAL CLASS ROOM SECTION WITH A TOTAL AREA OF 262 Sq.m (2,819 Sq.ft.)

auditorium, staff quarters, guest house, sports stadium and swimming pool and experimental ponds be completed by 1975. The consultant is doubtful that such an ambitious program of construction can be completely realized in such a short period. It certainly is possible, however, that the more essential elements of the College can be completed in that period of time --- providing the University continues to view the development of the College as a project of very high priority.

The next immediate construction project to be taken up includes a hostel that will house 60 students with an adjoining dining hall to accommodate 150 persons. The contract for this phase of the construction program is expected to be awarded in September, 1971, with construction to begin immediately thereafter. Construction of these facilities will be completed by mid-year, 1972, at an estimated cost of Rs.6.2 lakhs (\$82,665). Construction of other units of the building complex, including a second hostel for students, library and administrative building is tentatively scheduled to begin later this year with other construction to be implemented during the following years.

The over all magnitude of the construction program of the Fisheries College, with information relating to area, cost and construction period is summarized in the following table. It should be noted that the total construction cost figure amounting to approximately 56.8 lakhs of rupees (\$757,314) does not include furniture, equipment and supplies as will be required to make the college fully

functionable; nor does it include a factor for the rising cost of building construction, which is increasing 10 to 15 per cent annually in the Mangalore area.

Summary of the Construction Program for the Fisheries College

Item	Area Sq.m	Date of Construction		Cost in lakhs of Rs.*
		Initiated	Completed	
<u>Fishery Technology Center</u>				
Laboratory Buildings	270	1961	1962	0.40
Main Building	1,950	1962	1963	15.00
Water Storage Tank (25,000 gallons)		1968	1970	0.30
New Classrooms	296	1970	1971	0.90
Cafeteria	159	1970	1971	0.35
<u>New Building Complex Kanakarady Site (Existing Facilities)</u>				
Field Laboratory	100	Oct. 1970	Mar. 1971	0.328
Concrete Cisterns (18)	540	Sept. 1970	May. 1971	0.42
<u>(Facilities under Construction)</u>				
Laboratory Buildings	2,490	Apr. 1971	Apr. 1972	11.50
Classroom Buildings	750	Apr. 1971	Apr. 1972	5.00
<u>(Facilities Scheduled for Future Construction)</u>				
Hostel and Dining Hall	1,850	Sept. 1971	Apr. 1972	6.20
Hostel	1,320	Nov. 1971	Jun. 1972	4.50
Library	620	Nov. 1971	Aug. 1972	2.50
Aquarium	620	Mar. 1972	Feb. 1973	2.50
Administrative Building	600	Nov. 1971	Aug. 1972	2.50
Auditorium	500	Feb. 1972	Nov. 1973	2.25
Cement Cisterns (54)	1,620	Nov. 1971	Jan. 1972	1.26
Earthen Pond Complex (77)(10 hectares)				5.483**
Staff Quarters (30)	2,680	Nov. 1971	Nov. 1972	10.25
Guest House	300	Jun. 1972	Feb. 1973	1.00
Sports Stadium & Swimming Pool	1,500	Feb. 1972	Apr. 1973	5.00
Water Storage Tank (30,000 gallons)		Nov. 1971	Apr. 1972	0.35
Roads, water supply, drainage and related services				6.00

* Cost figures are for basic construction only and excludes equipment;
one lakh = 100,000 rupees = \$13,333.

** Excludes cost of land that must be acquired.

Critiques and Recommendations

In this section of the report are critiques and recommendations that were developed principally as the result of conferences held with administrative officials of the University, architects, engineers and staff affiliated with the Fisheries College. Group discussions were held with the head of department and respective staff of each of the nine departments of the College. In these group meetings, particular effort was made to define problem areas deleteriously affecting instructional and research programs of the College and, equally important, to seek probable solutions culminating in an improved program. Attention also was given in establishing priorities for correcting such deficiencies. It is felt, therefore, that the following recommendations should be implemented as soon as practical in order that the momentum, so successfully developed to date in establishing this unique fisheries institution, can be maintained and perhaps even accelerated in the future.

Construction Program

The construction program of the Fisheries College is progressing about as well as could be expected. Certainly if the University can keep to the construction schedule, presented earlier in this report, even more rapid progress will be evident in the future. The major fault the consultant finds with the construction program as presently planned by the University is that of priorities.

For example, an urgent need exists for the Library Building, and this should be air conditioned throughout to protect books and other library materials from mould damage. The extremely high humidity prevailing in the Mangalore area, particularly during the three-month monsoon period, makes it imperative that the new library building be air conditioned (dehumidified). The existing library room at the Fishery Technology Center is nearly filled to capacity and additional space will be required in the near future. It is recommended, therefore, highest priority be given for early construction of the Library, which should be completed prior to the 1972 monsoon season.

The Aquarium, on the other hand, should be regarded as an item of lower priority. Aquariums generally are notoriously expensive to construct and maintenance costs also are inordinately high. Most are constructed with built-in display tanks each of which has its individual light source, water supply, air supply and water over-flow pipe. Normally water passes through the various aquaria continuously. Hence, a rather high order of sophistication is

required including: air compressors and air lines; water pumps and supply lines; an abundant water supply which may require special treatment and filtration to remove chlorine; and probably a recirculating salt water system if marine fish are to be displayed. The consultant feels that such a sophisticated aquarium set-up will be far too costly for the University to construct and maintain. Hence it is recommended that the live fish display be limited to individual glass aquaria supported on steel aquarium stands of the type already utilized by the College. These aquaria can be alternatively arranged in groups or clusters on the first floor level of the building with major emphasis given to freshwater fish species because of difficulties associated with providing adequate quantities of sea water for marine fish species. The second storey of the aquarium building should be reserved for a museum. Here adequate facilities should be included for proper preservation and storage of field specimens. The essential elements for both the live fish display and the fish museum were discussed in detail with architects who are presently finalizing plans for this building.

One of the laboratory buildings presently under construction has a basement area designed to accommodate the necessary machinery required to air condition the entire building. Also certain sections of other laboratory blocks are tentatively scheduled to be air conditioned. Rather than relying upon window units, which over the long-run are expensive to maintain, it is strongly recommended that one laboratory block be air conditioned

throughout. Then those departments having greatest need for air conditioning could share this particular building. Microscopes and analytical equipment are especially subject to damage as the result of high humidity. Therefore, highest priority for space in the air conditioned Laboratory Building should be given to those programs of the College having greatest need for air conditioning.

High priority also should be given to the development of the Pond Research Complex. This is essential if a sound research program in inland fisheries and fish culture is to be implemented within the near future. To date only 18 of the 72 cement cisterns have been completed. It is recommended that two additional blocks of cisterns, consisting of 36 pools, be constructed this year with the remaining block of 18 pools to be completed the following year. Construction of the experimental earthen ponds, of course, cannot be initiated until the University acquires the land. Hence, the University should complete these acquisition formalities at an early date. Construction on the earthen pond complex should be initiated in 1972 and completed by 1975. Details on the construction of these important field facilities were given in the consultant's earlier report and, hence, are not repeated here. Discussions were held with appropriate staff of the College regarding various design features that may be incorporated in the concrete cisterns to reduce construction costs.

As emphasized in my earlier report great care must be taken in the construction of the earthen ponds since pockets of sand were found in the sub-soils of this laterite soil region (Figure 10). In view of the extremely high rainfall in the Mangalore area (see Figure 11), it is recommended that the earthen ponds be constructed with reinforced concrete sides to prevent severe erosion of the pond bundhs. Obviously, this will increase cost of construction for the experimental pond complex, but this also will substantially lower annual maintenance costs.

Directly in front of the Field Laboratory is an excavated pond which presently is serving no useful purpose. As the pond is located on lands controlled by the Railway Department, the University should take necessary steps to acquire this property. With some renovation, this earthen pond could be utilized for holding brood fish or other work in fish culture. It is recommended that the pond be excavated to a uniform depth and that the pond edges lined with stone masonry to reduce loss of water through seepage and to prevent damage by erosion resulting from the heavy rains. Since it is probable that completion of the experimental earthen pond complex will require some time, this pond will be extremely useful to the Department of Fish Culture.

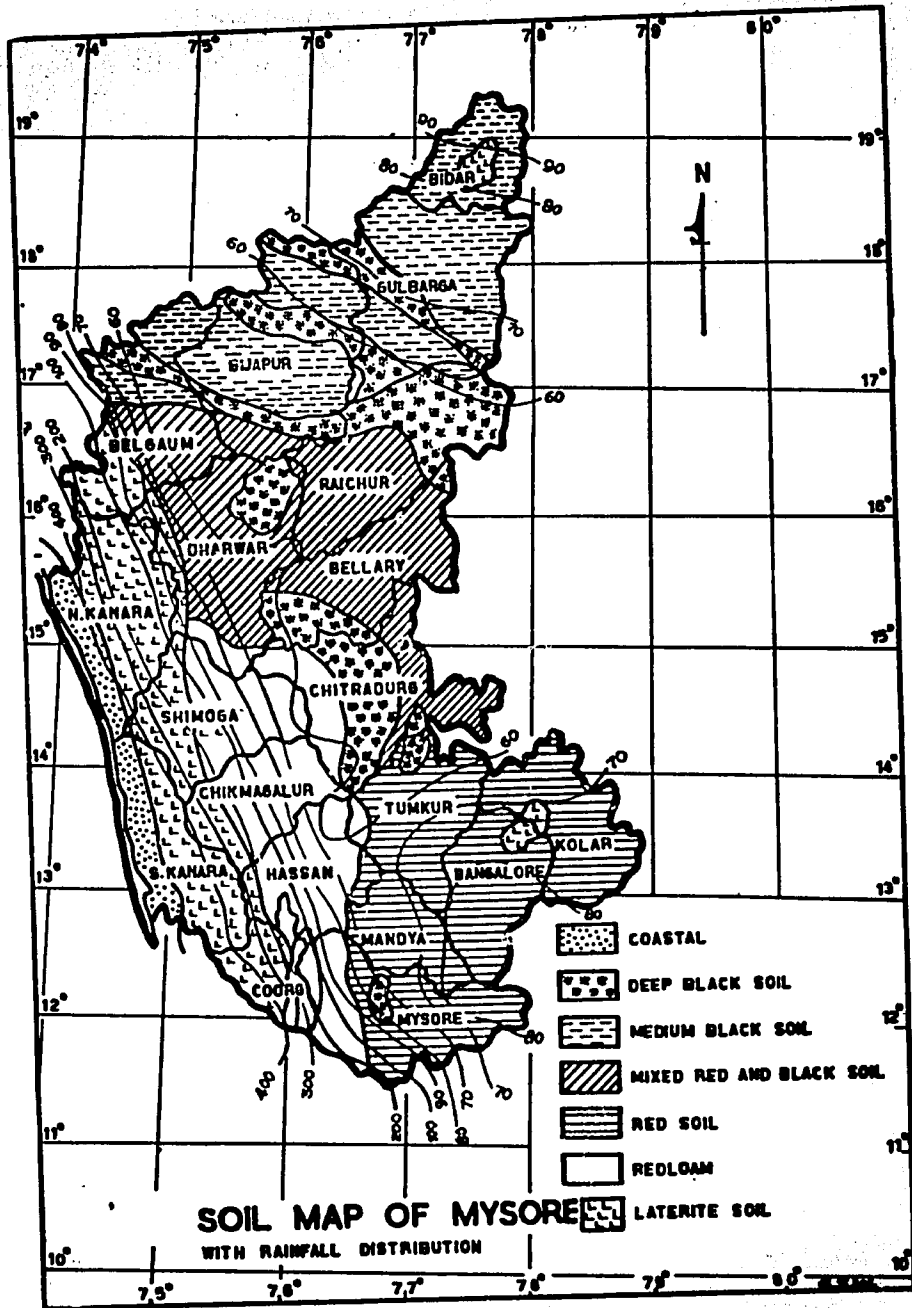


Figure 10

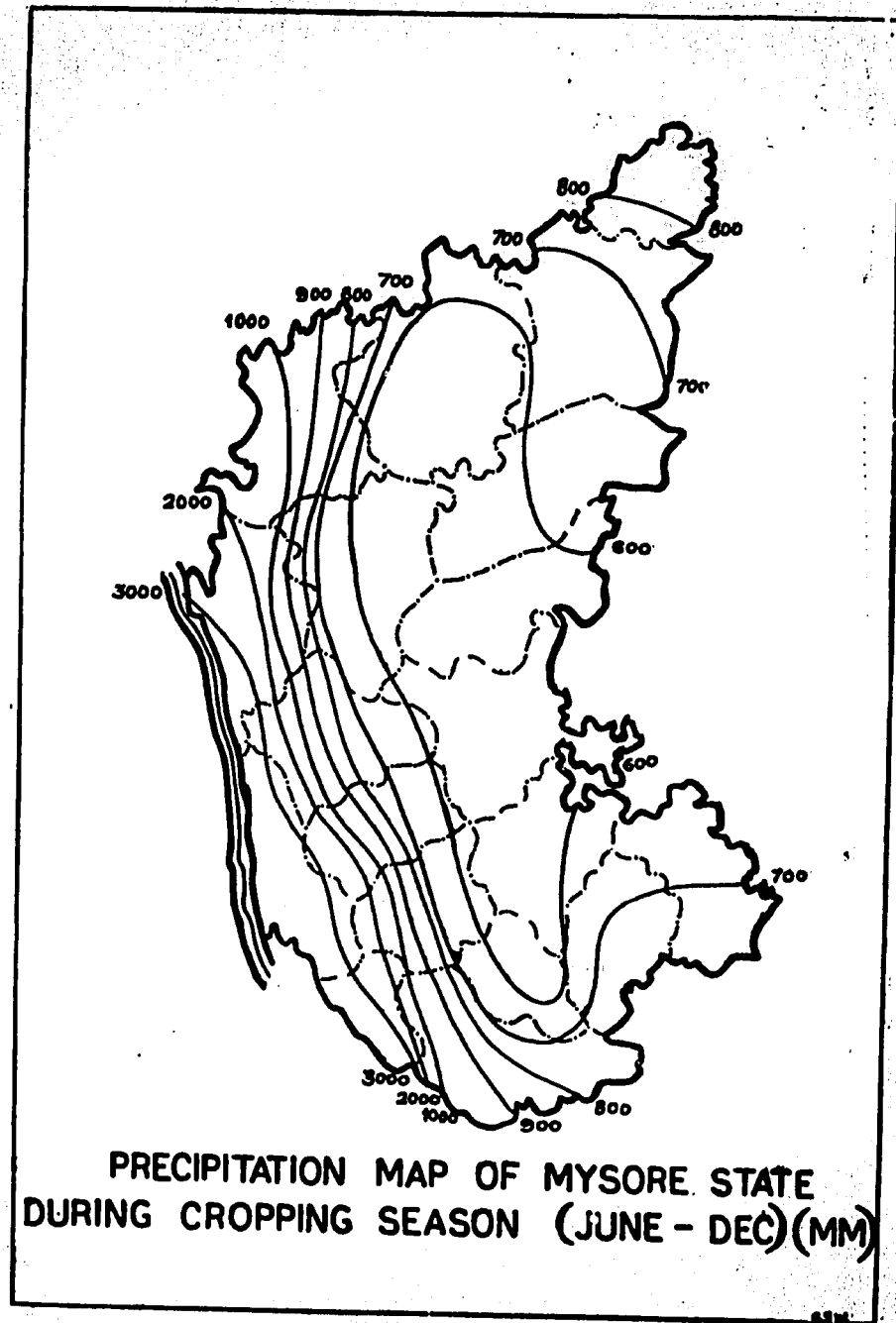


Figure 11

Instructional Program

Curriculum

An examination of the curriculum with appropriate course descriptions (see Appendix) indicates a broad coverage of general areas of marine and inland fisheries and processing technology. It is rare, in fact, that an educational institution possesses the physical facilities and competent staff to offer academic training in such a diversity of disciplines within the general area of fisheries. Moreover, it is quite unusual for a student to have opportunity to attain training in these three fields, inland fisheries, marine fisheries and fishery processing technology in a single degree program. Certainly if good instruction, including both theory and practicals, is given in the subject matter areas as included in the syllabus, graduates of the Fisheries College will have a working knowledge in fisheries which can be provided by few similar institutions in the world.

There are various aspects relating to curriculum, however, that should be improved. In reading through the descriptions of various courses, one finds duplication of subject matter, both in theory and practicals, in many courses. For example, variations of the statement "the collection and identification of fish, crustaceans, molluscs" are found in several courses while others specify "the collection and analysis of waters from ponds, rivers, estuaries and the sea". Some repetition of subject matter and procedural methods is desirable, but excessive duplication is

to be avoided. Also, some course descriptions are exceedingly brief while others are unrealistically lengthy and detailed.

The matter of credit hours allocated to a particular course is basically the concern of the appropriate department head and Director of Instruction. However, one should be certain that it is possible to adequately present the materials described in the course description. A specific example is the fish farm engineering course, which is presently set up as two credit hours with one hour of theory and two hours of practicals each week for a trimester period. It is not possible to provide students with other than a very casual or cursory exposure to the fundamentals of fish farm planning and construction in the time allotted for this subject.

Each department head with the appropriate teaching staff should carefully review course descriptions for each subject offered in a particular department. Subsequently, all heads of departments with the Director of Instruction should meet as a group and jointly decide what revisions should be made. Certainly, a more uniform and consistent format should be followed in preparation of the syllabus for both the degree and diploma programs.

Field Training for Students

Fisheries, unlike many academic programs, is highly oriented toward work that must be carried out in the field. Several of the departments of the Fisheries College give courses in which students should spend appreciable amounts of time in the

field gathering data on abundance and catch of fish, collecting specimens, carrying out biological investigations, observing and participating in fishing operations, visiting fish farms and other fishery facilities.

To date, the University has provided no budget for transporting and maintaining students and their teachers while carrying out work in the field. The University should take necessary steps to correct this situation. This need will become even more acute next year when students of the Year IV class will be in the field for extended periods while acquiring practical training in a major area of specialization. Provision must be made to ensure that fishery students receive adequate practical experience in the field if they are to be qualified for the majority of employment opportunities that will be available to them.

Student Deficiencies

In the ranks of both batches of students now enrolled in the B.F.Sc. degree program of the Fisheries College, that is the present Year II and Year III classes, there are a few who have failed to satisfactorily complete all courses in the basic sciences and humanities given at the Main Campus at Bangalore for first year students. This is extremely unfortunate in as much as these particular students subsequently are excluded from enrolling in various of the advanced courses which require passing marks in the prerequisite courses.

The end result is that those students who have been permitted to transfer to the Fisheries College without first completing all course requirements for Year I, presently are out-of-phase with either the Year II or Year III teaching schedules, and the students are rather confused regarding their status and the solution of their problem. Presumably such students, before being eligible to graduate, must return to the Main Campus at Bangalore to remove the deficiency or, alternatively, teachers in the appropriate subject matter areas must be detailed to Mangalore from the Main Campus to provide make-up instruction. Neither option appears to be very practical. The best solution would be for the UAS administration to adopt and strictly adhere to the policy of disallowing students to transfer to the Fisheries College without first having satisfactorily completed all courses included in the Year I curriculum. If the present Year I students were informed of such a policy now, it is quite likely that more time would be spent in study, with fewer subjects failed. This is a serious matter and should be immediately considered by appropriate University officials.

Selection of Students for the College

Enrollment in the one-year diploma program in Processing Technology and the four-year B.F.Sc. degree program presently is limited to approximately 30 and 25 new students annually. The former program is now well established, with 8 batches of students to date, and it has acquired a sound reputation for the excellence of training in the area of fish processing technology. Subsequently

graduates of the diploma technology program experience minimal difficulty in securing employment. The new B.F.Sc. degree program has yet to achieve such a reputation. It is likely that first graduates in the degree program will find greatest opportunity for employment in Mysore and adjacent States where administrators of agencies employing fisheries workers will have, hopefully, more knowledge of the B.F.Sc. program of the Fisheries College. It is obvious, however, that Mysore State, over the long-run, can absorb only a limited number of graduates of the College. In view of the strong tradition in India for state agencies to give preference in filling vacancies to residents of their respective states, it is quite important that the University of Agricultural Sciences immediately broaden its present admission policy for the Fisheries College.

The University should actively recruit qualified applicants from adjacent states and throughout India. The first three classes in the degree program, the present Year I, II and III groups, are comprised of students of which the great majority are from Mysore State. It is recommended, therefore, that approximately one-half of the total number of 25 student positions be reserved for out-of-state applicants beginning with the 1972-73 academic year. Should a lesser number of highly qualified student applications be received, the balance of positions could then be given to students of Mysore State. Such admission policy not only will increase employment opportunities for the graduates, but this also will assist the College to more rapidly acquire a good reputation.

In view of the significant budgetary inputs required to develop an adequate fisheries training and research facility, it is not possible nor desirable that each state have its own fishery educational institution. Therefore, there is an urgent need to quickly establish the Fisheries College as an all-India institution.

Orientation Program for Year II Students

Fishery students moving to Mangalore following completion of the initial year of study in basic sciences and humanities at Bangalore in the past have started formal course work immediately. Consequently they have had no previous opportunity, except indirectly to gain information regarding the Fisheries College, with its various departments and programs. It is recommended that with future classes a program of orientation be given at the College prior to the start of formal courses. This would enable the new students to be clearly informed of the general nature of the instructional program, the type of activities carried out by each department and what is expected of them as students in the B.F.Sc. degree program. At least one staff member of each department, possibly more if the scope of work of a particular department is sufficiently broad, should participate in the orientation program. Adequate time should be allowed for answering questions and discussing aspects of the program that may be of interest to the students. Hence, second-year students should complete their registration at Mangalore two or three days prior to the start of formal classwork in order to provide adequate time to complete this orientation program.

Research Program

As might be expected with an institution still very much in its initial stages of development, the research program of the Fisheries College is perhaps, its weakest element. The majority of the staff members are young with limited experience in research prior to joining the Fisheries College. Also, there is a definite lack of research facilities and equipment, a condition that will improve with time, which presently handicaps staff eager to do research. The teaching program is new, with some courses yet to be organized. These features make it particularly difficult to do good research. However, even under these conditions, certain research and investigational programs can be initiated, depending upon the ingenuity and resourcefulness of the staff. It must be recognized that research with subsequent publication of results is a prime requisite for establishing a sound reputation for the Fisheries College, collectively as well as for its staff individually.

Hence, particular effort must be made to involve as many staff as possible in some meaningful research projects. So far as practical, the research should be organized so that relevant data can be secured in a relatively short period of time. It is recommended that the University provide an increased budget for fisheries research. It is further recommended that all research projects, including those carried out at Hebbal, be reviewed periodically by an outside fisheries committee appointed by the University to be certain that the College is getting the best usage possible from the limited research budget.

Library Program

Considerable progress was apparent in the acquisition of journals and books for the Fisheries College Library. Only a few periodicals, mostly trade journals concerned with fishery processing technology and practically no reference or text books were in evidence at the Fish Processing Technology Center during the consultant's previous visit to Mangalore. Also, relatively few books and other materials in areas of fisheries were present in the Central Library at Bangalore.

At the present time there are over 1350 books in the Library at the Fisheries College with 26 journals and periodicals, including 12 from foreign countries, being received on a regular basis. Additional journals and books have been ordered. The improved situation with regard to the Library has certainly resulted in better training opportunities for students enrolled in the B.F.Sc. degree and Fish Processing Technology programs. However, much improvement must yet be made. There are, for example, excellent journals dealing with marine and inland fisheries and fishery technology that are published in India which have not been ordered.

Immediate steps should be taken by the Librarian of the University of Agricultural Sciences not only to subscribe to these valuable journals but also it is important that back issues be obtained for the previous ten-year period, where those are available. The journals and periodicals of primary importance that are not presently being received and should be acquisitioned immediately are listed in the Appendix.

During an inspection of the Library at the Fisheries College, it was observed that many of the books were mouldy. The library staff should clean the volumes of each case or shelf on a more frequent schedule than is presently being followed. An adequate library is one of the essential ingredients of a good training program in any scientific field. Books and journals are expensive and often are difficult if not impossible to replace. Hence, particular care must be taken to see that these valuable library materials are maintained in good condition. In this regard, it is essential that the new library building be constructed at an early date and that it be fully air conditioned. Mangalore has an extremely high rainfall averaging 3000 mm (120 inches) annually, with most occurring during the three-month monsoon period. The resulting extremely high humidity is especially damaging to books. Hence, highest priority for air conditioning should be given to the Library.

Major Departmental Needs

The specific needs of the various departments with particular reference to staffing pattern, space allocation, equipment and supplies and teaching and research programs were examined in depth. The University has done an amazingly good job of recruiting qualified staff for the new Fisheries College during the past year. A major deficiency exists, however, in that the prime administrative position of the College, the Director of Instruction, has not been appointed. When this key position is filled, hopefully this will

be soon, rapid progress should be achieved in developing logical solutions for many of the minor difficulties that several of the departments are facing. In reference to staffing, the Department of Fishery Engineering appears to be in the most critical condition. With only two staff members at present, this department offers six courses in the B.F.Sc. degree program and three courses in the diploma program in Fish Processing Technology. It also should be noted that one of the staff member has been selected to study abroad under the participant training program. Immediate attention should be given to recruit qualified staff to overcome this deficiency.

The arrangement of courses in the Department of Fishery Resources and Economics is such that all three subjects are given during the fourth year. This likely should be changed in order that students could receive an introduction to this important discipline early in their training program. Otherwise it will be difficult for a student to decide if he might like to take his major area of specialization in this discipline.

The Department of Fish Culture, presently consisting of three staff members, has no space allocations for offices and teaching and research laboratories. Much of the research of this Department will be carried out in the field facilities, including the field laboratory. The teaching of laboratory portions of certain courses given in this Department should be carried out in the primary teaching block where more adequate laboratory facilities

and equipment will be available. It is suggested that this Department share a teaching laboratory with one of the other departments. Also, there presently has been no space allocation for offices for the staff of this Department. If no better solution can be found, it is recommended that one of the four classroom areas be divided to provide office space.

Several staff of various departments felt strongly that a walk-in cold room was needed at the new College. This would be expensive and difficult to add at this time. It is recommended instead that refrigerators, thermostatically controlled to maintain the desired temperature, be purchased for those laboratories specifically requiring such facilities.

The University has supplied the College this past year with a variety of laboratory supplies such as chemicals and glassware, and some equipment. However, the need for equipment will increase significantly upon completion of the three Laboratory Buildings. Lists of equipment as will be required for proper functioning of the various departments have been prepared and submitted to the University. It is recommended that the University purchase the more essential pieces of equipment, which has been indicated on a priority basis, in order that more effective research and teaching can result.

Each department submitted its needs and preferences relative to arrangements and furnishings of teaching and research laboratories now under construction to the Architects and Construction Engineer (UAS). These needs were duly noted and the Architects are now incorporating these into the final design plan. It should be noted that Dr. James, Fisheries Officer, and Dr. Varghese, Associate Professor of Fish Culture, were present with the consultant throughout the entire period during which the departmental group discussions were held. These staff made extensive notes during these proceedings, recording the various problems brought up along with possible solutions. An attempt was made to include in this report only those points which warranted rather immediate action on the part of the University of Agricultural Sciences. Many of the problems and difficulties brought out in the group meetings, although not unimportant, were of a nature that can best be solved after a Director of Instruction is appointed.

Central Supply and Store Room

There is need as indicated by most departments for a central supply and store room. Such an area logically could be included in the basement area of the Administrative Building. This area would serve the purpose for receiving and verifying all shipments of equipment and supplies received by the College. Small quantities of supplies then could be distributed as needed to the various departments. It would be best if a small service road could be provided to expedite the unloading of parcels from vans.

Photography and Darkroom

Most departments indicated a need for a photography and darkroom in which film could be processed and prints produced. A facility such as this would be quite useful for preparation of illustrations to be incorporated in research publications. In such an area, charts and visual aids as may be needed in the teaching program also could be prepared. In this connection, it is likely that the services of a photographer cum artist eventually will be needed. A photography and darkroom could be located in the basement area located under the stage of the Auditorium.

Work Shop

A work shop area where small equipment can be made or repaired is highly desirable. The shop should be equipped with hand tools and a few basic hardware supplies. This will permit staff to improvise much of the small equipment needed for field use. A shop area could be set up in the basement of the Auditorium as there is sufficient space for both a work shop and a photography darkroom.

Preparation of a Brochure

A brochure that concisely describes the Fisheries College with sections dealing with essential elements of the instructional and research programs of various departments should be prepared.

Such a brochure, attractively prepared and appropriately illustrated with a few well chosen photographs of College buildings and field facilities, would be especially useful for distributing to fishery departments of the various states and other agencies having occasion to employ students successfully completing either the B.F.Sc. degree program or the Diploma course in Fish Processing Technology. The responsibility of the University to the student should not end until the graduate has secured employment commensurate with the level of training acquired. If steps are taken to adequately publicize the College and inform potential employers of the quality of its training program, job opportunities undoubtedly will be adequate to place all graduates for years to come. A brochure also would serve a useful purpose for recruitment of highly qualified staff and outstanding students to the College from various states of India. This is extremely important in achieving a reputation of excellence for the Fisheries College.

Annual Work shop on Fisheries

The University through the Fisheries College, should sponsor an annual workshop concerned with fisheries development in Mysore State. Such a function would be especially useful in providing opportunity for staff of the College to exchange ideas on problems, research investigations and academic programs in various areas of fisheries with biologists and technicians working with the Mysore State Department of Fisheries, I.C.A.R. and other agencies carrying out fisheries work within the State.

Meeting places should be alternated between Bangalore and Mangalore and a limited number of nationally recognized fishery scientists should be invited to chair various work sessions and to lead discussion groups. Abstracts of papers presented during the annual meeting should be published in booklet form by the University Press and distributed to those attending the annual work shop. Also a number of these annual proceedings should be placed in the Library of the College.

A carefully arranged program of 2 to 3 days duration carried out on an annual basis would be mutually beneficial to representatives of the various agencies participating. This, needless to state, would provide good publicity for the University and the Fisheries College.

Participant Training Program

Training of staff at advanced levels is receiving increasing emphasis under the USAID-University of Tennessee participant training program. To date one staff member of the Fisheries College has been trained in the United States under this program while several other members of teaching staff have completed special training programs and advance degrees in various European and Asian countries.

Continued priority must be given to upgrade the academic qualifications of staff of the Fisheries College. In view of this need, a total of six participant positions in various areas of fisheries has been authorized by the University and approved by the Government

of India. Concerted effort now is being exerted by the University of Tennessee to secure admission of the selected candidates to appropriate institutions in the United States. A list of the participants with indication of the subject area and period and level of study is given in the following table.

Name	Field of Training	Period and Level of Training
Mr. S.L. Shanbhogue	Marine Biology	36 months; Ph.D.
Mr. V. Hariharan	Oceanography	" " "
Mr. G.B. Puttanniah	Fish Pathology	" " "
Mr. M.G. Wadayar	Fish Gear Technology	" " "
Mr. S. Krishnaswamy	Aquatic Microbiology	" " "
Mr. M.G. Shenoy	Fish Processing Technology	18 months; M.S.

Two of the staff, presently affiliated with the Veterinary College, have no background in fisheries and very little knowledge of the present training program of the Fisheries College at Mangalore. It is recommended that the University of Agricultural Sciences detail these staff to the College for a sufficient period of time to allow them to become thoroughly acquainted with the instructional and research programs of the College, and to enable them to learn how they can best contribute to the development of the College.

It is becoming increasingly difficult to place foreign (and American) students in graduate programs at the relatively few U.S. universities offering substantial programs in fisheries. This is due in part to the severe financial limitations that many institutions presently are encountering — thus effectively limiting the number of professors and, indirectly, the number of graduate students. Then too, admission requirements have been substantially increased for graduate programs at most institutions during the past year. Hence, it is important that the University select staff of superior capability for the participant training program.

Technical Services

In the consultant's first report on the development of the Fisheries College it was recommended that advisory positions in both marine and inland fisheries be provided through auspices of the USAID/University of Tennessee contract. Subsequently an advisor position in inland fisheries was approved by all concerned agencies and recruitment is presently underway to secure a qualified person experienced in design and construction of ponds to fill this one-year position. Although it would certainly be advantageous to secure the services of the advisor in inland fisheries in the near future, this will not become a crucial item until the University acquires the land area of approximately 10 hectares on which the earthen pond research complex will be constructed.

The University should press forward in finalizing approval for a short-term consultant in marine fisheries.

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MEETINGS AND CONFERENCES

Officials - Government of India

- Dr. R. Raghu Prasad Assistant Director-General (Fisheries),
Indian Council of Agricultural Research,
New Delhi.
- Dr. B.S. Bhimachar Scientist, Central Institute of Fisheries
Education, Bombay.
- Dr. V.G. Jhingran Director, Central Inland Fisheries Research
Institute, Barrackpore (West Bengal)

Officials - University of Agricultural Sciences

- Dr. K.C. Naik Vice-Chancellor, University of Agricultural
Sciences, Bangalore.
- Mr. R. Krishnappa Registrar, University of Agricultural Sciences,
Hebbal, Bangalore.
- Mr. B.J. Nanjundappa Administrative Officer, University of
Agricultural Sciences, Hebbal, Bangalore.
- Mr. B. Venkataswamy Estate Officer, University of Agricultural
Sciences, Hebbal, Bangalore.
- Mr. B.N.M. Hegde Asst. Administrative Officer, University
of Agricultural Sciences, Hebbal, Bangalore.
- Mr. Dase Gowda Construction Engineer, University of
Agricultural Sciences, Hebbal, Bangalore.
- Mr. K.R. Ganapathy Asst. Editor, University of Agricultural
Sciences, Hebbal, Bangalore.
- Mr. N. Sreenivasan Coordinator, Fisheries College, Mangalore,
with Department Heads and staff of the
College.
- Dr. P.S.B.R. James Fisheries Officer, Fisheries College,
Mangalore.
- Dr. T.J. Varghese Associate Professor, Fisheries College,
Mangalore.
- Dr. K.V. Devaraj Assistant Professor, Fisheries College,
Mangalore.

Officials - Government of Mysore

Mr. N.A. Murthanna	Deputy Commissioner, South Kanara, District, Mangalore.
Mr. G.L. Rao	Director of Fisheries, Mysore State, Bangalore.
Mr. H. Honnappa Gowda	Deputy Director of Fisheries, Mysore State, Bangalore.
Mr. V.C. Badami	Planning Officer, Mysore Department of Fisheries, Bangalore.
Mr. C.G. Krishna Murthy	Assistant Director of Fisheries, Bangalore.
Mr. H.N. Siddaiah	Superintendent of Fisheries, Mysore.
Mr. B.H. Gowda	Assistant Director of Fisheries, K.R. Sagar.
Mr. M.N. Venkatagiri	Superintendent of Fisheries, Shimoga.
Mr. K.S. Thimma Reddy	Assistant Director of Fisheries, Chitradurga.
Mr. G.S. Sangit	Senior Assistant Superintendent of Fisheries, Vanivilas Sagar Fish Farm.
Mr. K.B. Hanumantharao	Assistant Superintendent of Fisheries, Bhadra.
Mr. M.R. Ramegowda	Fisheries Inspector, K.R. Sagar.
Mr. B.K. Bhaskar	Assistant Superintendent of Fisheries.
Mr. K.M. Gurusiddaiah	Assistant Superintendent of Fisheries, Chitradurga.

University Architects

Mr. S.K. Karekar	Karekar and Sundaram Architects, Bangalore.
Mr. R. Sundaram	Karekar and Sundaram Architects, Bangalore.

Officials of the U.S. Government and the University of Tennessee

His Excellency Ambassador
Kenneth B. Keating

U.S. Ambassador to India, New Delhi.

Mr. Stephen E. Palmer, Jr.

American Consul General, Madras.

Dr. Ronald Pollock

Chief (Acting) Agricultural University
Development Division, USAID, New Delhi.

Mr. H. James Miller

Campus Development Advisor, USAID,
New Delhi.

Mr. M.G. Welling

Chief of Party, University of Tennessee/
India Agricultural Programs, with
resident staff of the University of
Tennessee.

APPENDIX

- A. Staff of the Fisheries College.
- B. Description of Courses for the B.F.Sc.
Degree Program.
- C. Description of Courses for the Diploma Program in
Fishery Processing Technology.
- D. List of Essential Journals Required for the
Fisheries Library.

Appendix A

Staff of the Fisheries College by
Departments

Pages

A 1 - A 3

DEPARTMENT AND STAFF COMPRISING THE
COLLEGE OF FISHERIES, MANGALORE

August 31, 1971

Coordinator	Mr. N. Sreenivasan	
<u>Department of Fishery Biology</u>		
Head of Department and Professor	Vacant	
Assistant Professor	K.V. Rajagopal	M.Sc.
Assistant Professor	B.H. Manohara Ram	M.Sc.
Instructor	Mohan Joseph	M.Sc.*
Instructor	Miss P. Shantha Kumari	M.Sc.**
Instructor	S.L. Shanbhogue***	M.Sc.*
<u>Department of Fish Culture</u>		
Head of Department and Associate Professor	T.J. Varghese	Ph.D.
Assistant Professor	K.V. Devaraj****	Ph.D.
Instructor	Shantharam Bengre	M.Sc.
<u>Department of Fishery Oceanography and Limnology</u>		
Head of Department and Associate Professor	M.P.M. Reddy	Ph.D.
Assistant Professor	V. Hariharan***	M.Sc.
Assistant Professor	N.G.S. Rao	M.Sc.
Assistant Professor	N. Ravindranatha Menon (on study leave)	Ph.D.
Instructor	V. Ravindranathan	M.Sc.
Instructor	T.R. Chandrasekhara Gupta (on study leave)	M.Sc.

* Research for the Ph.D. degree has been completed but dissertation must be written and submitted.

** Research for the Ph.D. degree has been completed and the dissertation has been submitted.

*** Staff has been selected for advanced studies abroad under USAID- University of Tennessee Participant Training Program.

**** Staff member studied abroad under USAID - University of Tennessee Participant Study Program.

Department of Fishery Resources and Economics

Head of Department and Associate Professor	P.S. Rao	M.A.
Assistant Professor	Srikanta Udupa	M.Sc.
Instructor	G.K. Kulkarni	M.Sc.

Department of Fishery Technology (Freezing)

Head of Department and Associate Professor	N. Sreenivasan	B.Sc.
Assistant Professor	G.G. Hiremath	B.Sc. (Hons).
Instructor	Srinivas Ullal	B.Sc.

Department of Fishery Technology (Canning)

Head of Department and Associate Professor	B. Shantharam Rai	B.Sc.
Assistant Professor	K.V. Saralaya	M.A.; B.T.
Instructor	P. Parashuram	B.Sc.

Department of Fishery Technology (Ham and Sausage)

Head of Department and Associate Professor	J. R. Yermal	B.Sc.
Assistant Professor	T.S.M. Desai	B.Sc. B.Ed.
Instructor	Vacant	

Department of Fishery Technology (By Products)

Head of Department and Associate Professor	Vacant	
Assistant Professor	T. Krishnakumar Reddy	Ph.D.
Assistant Professor	L.N. Srikar	M.Sc.
Instructor	M. Gopalakrishna Shenoy*	B.Sc.
Instructor	N.R. Vishwanath	M.Sc. (Agri.)
Instructor	B.R. Srinivasa	M.Sc.

Department of Fishery Engineering

Head of Department and Associate Professor	P.K. Jalien	B.E.
Assistant Professor	M.G. Wadgaonkar*	B.E.

* Staff has been selected for advanced studies abroad under USAID University of Tennessee Participant Training Program.

RESEARCH SECTIONSFishery Research Wing - Mangalore

Fisheries Research Officer	P.S.B.R. James	Ph.D.
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Fishery Research Wing - Hebbal Campus, Bangalore

Research Assistant	Miss. S. Vijayalakshmi	M.Sc.
Research Assistant	Miss. Dwaraka S. Rao	M.Sc.
Research Assistant	P.M. Abdul Aziz	M.Sc.

I.C.A.R. Coordinated Research Project for Utilization of Trash Fish

Technologist	V. Muddanna	M.Sc.
Senior Research Assistant	T.C. Chandrashekar	B.Sc.

ESTATE SECTION

Assistant Engineer	D. Rame Gowda	B.E.
Junior Engineer	D.C. Thammanna	B.Sc.; B.E.
Supervisor	Thimme Gowda	L.C.E.

ADMINISTRATIVE SECTION

Administrative Assistant	K. Bhaskar Rao	M.A., LL.B.
Office Superintendent	B.G. Venkateshaiah	M.Com. B.L.

DESCRIPTION OF COURSES - DIPLOMA IN FISHERY TECHNOLOGY

COLLEGE OF FISHERIES - MANGALORE

Can. Tech. 401 General Principles and Methods
of Canning

theory 3, practical 1:
4 credit hours

History and development of canning methods and technology; General requirements of a cannery; Raw materials used, their characteristics and quality considerations; The general canning process including preparation of materials, packing, exhausting, seaming, sterilization, cooling and warehousing; Microbiological and heat penetration aspects of thermal processing; Methods of canning mackerel and sardine; Different styles of pack; Indian standards for canned mackerel and sardine. Practicals: Study of exhausting methods; Effects of headspace; Filling temperature and exhaust time on vacuum in cans; Practice in "cut-out" tests; Practice in the canning of mackerel and sardine in brine and oil.

Can. Tech. 402 Canned Foods and Sea Foods
Canning

theory 3, practical 1:
4 credit hours

Containers; Tin plate and can making; Can coatings and corrosion; Chemical and other changes in canned foods; Spoilage in canned foods; Inspection and quality control; Statistical methods; Canning of Tuna, different styles of pack; Standards; Problems; Canning of shrimp in brine; Indian standards; Canning of pomfret and seer; Canning of fruits including orange and pineapple. Practicals: Study of can capacities and their measurement; Practice in the canning of tuna, shrimp, pomfret and seer; Canning of orange and pineapple; Practice in large scale continuous production.

Can. Tech. 403 Cannery Sanitation and
Planning Canning of Agricultural
Products

theory 2, practical 2:
4 credit hours

Water for a cannery; Sanitation and disposal of waste in a cannery; Sources of contamination; Planning for a canning plant; Economics of Canning; Methods of packing crab, clam, oyster and other shell-fishes; Canning of mango in syrup; Making of jams, jellies and marmalades; Canning of vegetables including tomato, potato and beans. Practicals: Study of agitated sterilization; Study of heat penetration in common foods; Canning of crab, clam and mussels; Canning of mango in syrup; Practice in the canning of fruit jams and marmalades; Practice in the canning of fish in curry; Large scale continuous production; Study of canned food inspection methods.

DESCRIPTION OF COURSES BY DEPARTMENTS FOR YEAR II

COLLEGE OF FISHERIES - MANGALORE

Department of Fishery Biology

F.B. 101 Ichthyology and General Systematics theory 2, practical 2:
4 credit hours

Introduction to the study of fishes; Classification of fishes, crustaceans, molluscs; Structural and functional morphology; General anatomy and biology; Distribution; Life-history; Fishes of the world; Fish fauna of India; Review of world literature on fish systematics. Practicals: Collection and identification of commercially important fishes, crustaceans and molluscs.

F.B. 102 Fish Biology I theory 2, practical 1:
3 credit hours

Study of the internal organization and various systems of Elasmobranch and Teleost fishes; Oral region and Alimentary canal and associated glands, their structure and function; Circulatory system; Nervous system and urinogenital system; Osteology; Biology of fishes crustaceans and molluscs. Practicals; Dissection of different types of fishes, crustaceans and molluscs to understand the internal organization.

F.B. 103 Fish Biology II theory 2, practical 1:
3 credit hours

Study of the food and feeding mechanisms; Growth; Age; Reproduction; Embryonic and larval development; Juveniles; Migration and raciation. Physiology of fishes, crustaceans and molluscs. Practicals: Study of the food and feeding habits of fishes crustaceans and molluscs, (plankton feeders, carnivores, bottom feeders); Examination and classification of the maturity stages; Fecundity estimation; Oviduct studies to study spawning habits; Life history stages; Study of age determination techniques; Experimental techniques in fish physiology.

F.B. 104 Ecology and Zoogeography theory 3, practical 1:
4 credit hours

The biological and physical environment of fishes; The diversity in structure, function and habits of fishes; Factors affecting survival and migration; Distribution of freshwater and marine fishes with special references to historical and ecological factors governing present distribution; Review of recent research and concepts in ethology as it relates to fish; Factors which limit and regulate the natural abundance of fishes; Impact of environmental factors: Food, temperature and predators upon size and structure of populations; Rise and decline of

species with time. Practicals: Study of ecology and distribution of fishes and other organisms in limited regions of streams, ponds, lakes, estuaries and the sea.

F.B. 105 Capture Fisheries

theory 2, practical 1:
3 credit hours

Survey of the capture fisheries of the world; The fisheries of India, inland and marine; Inland fishes and fisheries, riverine, estuarine, lacustrine and pond fisheries; Major carps, common carps, Chinese carps, cat fishes, air breathing fishes, feather backs, hilsa, pond fishes and brackish water fishes. Practicals: Collection of species of fishes and prawns, especially fry and fingerlings.

Department of Fish Culture and Breeding

F.C. & B. 101 Fish Culture I

theory 3, practical 2:
5 credit hours

Coverage of soils, including formation, structure, classification, chemistry and conservation; Techniques of water and soil analysis; Different types of waters, soils and their distribution; Water and soil conditions for optimum production; History of fish culture; Fish culture practices in India; General principles of fish culture, its scope and importance; Pond construction; Layout of an ideal fish farm; Reclamation for pond construction; Pond Productivity. Practicals: Collection and analysis of water and soil samples for physico-chemical characteristics.

Department of Fishery Oceanography and Limnology

F.O. & L. 101 Marine Biology I

theory 2, practical 1
3 credit hours

Oceans of the world; Classification of marine habitats: pelagic, littoral, abyssal oceanic and coastal zones; Zonation: rocky shore, sandy shore, estuaries, backwaters, lagoons, marshes and mud banks; Chemical and physical factors of marine environment; Sea as a biological environment; Life in the sea; Plankton, nekton, and benthos; Organic production in the sea; Nitrogen and phosphorus cycles; Factors regulating production. Practicals: Study of the physical and chemical characteristics of marine habitats; Oceanographic cruises.

F.O. & L. 102 Limnology I

theory 3, practical 2:
5 credit hours

Introduction to limnology; Physical and chemical characteristics of lake waters; Reservoirs, lakes, tanks and ponds as environments for fish; Biological, chemical and physical factors affecting aquatic

life; Biological and chemical measures of water quality in streams and impoundments in relation to fisheries; Lakes and their origin; Physical and chemical properties of water in lakes; Light, colour and turbidity; Thermal stratification and thermal exchange; Bottom deposits, salts and gases. Practicals: Collection and analysis of water samples for study of temperature, turbidity, pH, oxygen, carbon dioxide, alkalinity, nit-rates, phosphates and chlorides.

F.O. & L. 103 Limnology II

theory 2, practical 1:
3 credit hours

River and stream waters, their physical and chemical properties; Problems of stream pollution; Characteristics of brackish waters, lagoons, backwaters and estuaries; Tidal influence; Biological communities and their interrelationships in lakes, ponds, reservoirs, rivers, streams, estuaries, brackishwater, lagoons and backwaters; Suitability and improvement of these areas for pisciculture. Practicals: Study of the production of different lakes, reservoirs, ponds, tanks, brackishwaters, lagoons and estuaries; Comparison of relative rates of production in relation to physico-chemical characteristics.

Department of Fishery Technology (By Products)

F.T.(BP). 101 Biochemistry

theory 2, practical 2:
4 credit hours

Chief components of food; Importance of balanced diet; Study of carbohydrates, occurrence, classification, physical and chemical properties; Body uses of carbohydrates. Study of fats and oils, occurrence, classification, physical and chemical properties; Rancidity and oxidation; Antioxidants and their uses; Body uses of fats.

Study of proteins, occurrence and classification. Amino acids and their importance, physical and chemical properties; Protein denaturation; Intermediary metabolism of fats and proteins; Body uses of proteins. Study of minerals and their functions; Study of vitamins, occurrence and properties, significance in human nutrition; Study of enzymes, occurrence, properties, importance in nutrition; Role of enzymes in food preservation and processing. Practicals: Analysis of food constituents; Freshness tests; Fish composition, protein, fat, ash and moisture content; Trimethylamine and total volatile base in fish muscle; Determination of total nitrogen in fish and prawns; Saponification, acid and Iodine values; Determination of peroxide value; Determination of reducing sugars in fruit products; Examination of food products with reference to quality control standards.

F.T.(BP). 102 Aquatic Microbiologytheory 2, practical 1:
3 credit hours

Microorganisms in well, river, estuarine, sea and sewage waters. Enumeration, isolation and study of microorganisms; Presence of coliform, iron, manganese and sulphur bacteria in waters; Actinomycetes and fungi in various waters and their role; Unicellular algae, protozoa and other organisms in different waters; Decomposition of organic matter in water; Microorganisms in sanitation and Public Health. Practicals: Techniques for collection of water samples for microbiological assays; Methods of enumeration and pure culture of bacteria, actinomycetes, fungi and algae from different water sources; Study of the morphological and physiological properties of coliform, iron and sulphur bacteria; Representative forms of actinomycetes, fungi, algae and protozoa.

Department of Fishery Technology (Freezing)F.T.(F). 103 Freezing Technologytheory 2, practical 2:
4 credit hours

Principles of fish preservation; Handling and storage of fresh fish; General methods of preservation and processing of fish including smoking, curing, pickling, chilling, drying, dehydration, irradiation and freeze-drying; Cold preservation of foods; Characteristics of frozen food; Effects of low temperature, chilling, freezing; Principles of food freezing, fish and fishery products, fruits and vegetables; Phenomena and changes in refrigerated foods; Mechanical and colloidal damage; Process of food freezing; Treatment before and after freezing; Use of anti-oxidants; Packaging of frozen products and storage; Transportation and distribution; Utilization of frozen products; Organoleptic evaluation; Inspection and quality control standards. Practicals: Freezing of fish, shrimp and other food products; packaging and storage; Preparation of freezing and thawing curves; Estimation of drip loss; Preparation of breaded fish, fish steaks and fish sticks; Study of different types of freezing equipment, including blast and plate freezers.

Department of Fishery EngineeringF.E. 101 Craft Engineeringtheory 2, practical 1:
3 credit hours

Types of fishing boats, country craft and mechanised boats, factory ships; Boat building, design and construction; Timbers, seasoning and treatment; Machines and tools for boat building; Care and maintenance of boats; Corrosion, marine fouling and boring; Prevention and control of fouling. Practicals: Drawing practices; Design exercises, construction details; Engine installation, deck navigational equipment; Study of the design and construction of modern types of fishing boats in selected boat building yards.

DESCRIPTION OF COURSES BY DEPARTMENTS FOR YEAR III

COLLEGE OF FISHERIES - MANGALORE

Department of Fishery BiologyF.B. 201 Capture Fisheries IItheory 2, practical 1:
3 credit hours

Marine fishes and fisheries of India; Definitions of neretic, pelagic, demersal and oceanic fisheries; Sardines, mackerel, tunas, Bombay-duck, ribbon-fishes, whitebaits, seer fishes, flying fishes, pomfrets, sharks, rays, sciaenids, polynemids, soles, catfishes, mullets, prawns, lobsters, crabs, squids, pearl oysters, mussels, chanks, turtles and ancillary fisheries. Practicals: Collection and identification especially of the fry and fingerlings of economic species of estuarine and marine fishes, prawns and molluscs.

F.B. 202 Population Dynamicstheory 3, practical 1:
4 credit hours

Principles of population dynamics; Importance of the study of fish populations; Bearing of fish biology on population studies; Unit stocks; Problems of age, rates of growth, recruitment and mortality; Catch, effort and stock; Simple analytical approaches to population management, problems of overfishing; Mathematical models. Practicals: Study of mathematical models for analysis of exploited populations and their application to population data.

F.B. 203 Fish Pathology and Parasitologytheory 2, practical 1:
3 credit hours

Study of bacterial and fungal diseases and pathological conditions in fishes; Viral diseases of fishes; Isolation, culture and identification of the pathogens; Control of the diseases; The external and internal parasites of fishes, their identification and control. Practicals: Isolation, cultivation and identification of more common bacterial and fungal pathogens; Laboratory studies on common parasites and their control in ponds or other bodies of water.

Department of Fish Culture and BreedingF.C. & B. 201 Fish Culture IItheory 3, practical 2:
5 credit hours

Management of nursery and rearing ponds; Principles of pond preparation; Predators and their eradication; Aquatic plants in general; Common weeds in ponds and their control; Algal blooms; Manuring to enhance production; Stocking rates; Artificial feeding; Survival, growth.

Management of production ponds; Control of predators and weeds; Manuring; Compatible species; Stock density; Survival, growth and production. Brackish water and marine fish culture; Tidal range; Present practices and species of fishes and prawns cultivated; Seed resources, collection and transport; Sewage fed fisheries. Practicals: Collection and identification of fry and adults of cultivable species of fishes; Study of fish food organisms; Study of the common predators; Weeds and their control.

F.C. & B. 202 Fish Breeding

theory 3, practical 2:
5 credit hours

General principles of genetics. Modern trends in genetics. Reproduction in fishes; Hybridization in fishes; Present methods of seed production and their status. Neurohormonal influence on breeding; Maturity and fecundity in relation to breeding; Riverine seed collection and burdh breeding; Hypophysation, pitutary preparation and other agents in relation to environmental factors as temperature, rainfall and light; Hatcheries; Handling of eggs and spawn. Practicals: Problems in genetics, preparation of genetic material; Selection of breeders; Location and removal of pituatry gland; Preservation of glands; Preparation and administration; Hatching techniques; Care of eggs and spawn; Transportation.

Department of Fishery Oceanography and Limnology

F.O. & L. 201 Marine Biology II

theory 2, practical 1:
3 credit hours

Fish eggs and larvae; Animal communities in the sea; Interrelationships of organisms; Food chain; Adaptive radiation; Phytoplankton and Zooplankton; Adaptation to planktonic life; Factors influencing distribution and abundance of plankton; Marine bacteria; Bioluminscence; Marine products of commerce; Sea weeds, their distribution and economic importance. Practicals: Methods of collection, preservation and analysis of plankton; Study of different types of plankton nets; Collection and identification of other fauna and flora.

F.O. & L. 202 Physical and Chemical Oceanography

theory 2, practical 1:
3 credit hours

History of oceanography; Important oceanographic expeditions and oceanographic institutions of the world; International Indian Ocean Expedition; Physical and chemical characteristics of sea water: salinity, temperature, pressure, density, light penetration, sound transmission, water masses - their formation and classification; Water masses and currents of the world oceans with special reference to Indian ocean; Oceanographic instruments and their use. Practicals: Operation of common oceanographic equipment.

F.O. & L. 203 Physical & Chemical Oceanography II theory 2, practical 1:
3 credit hours

Composition of sea water; Factors influencing the composition; Principle of dynamic equilibrium; Major and minor constituents and their biological role; Nutrients in the sea, their distribution; Dissolved oxygen, carbon dioxide and calcium carbonate systems. Ocean floor and its topography; Topography of Indian Ocean floor; Marine sediments and their formation; Deep sea deposits; Biology of the sediments; Marine geology with special reference to the Bay of Bengal and Arabian Sea. Practicals: Collection of sea water samples and their analysis and determination of temperature, salinity, phosphates, nitrates, silicates, oxygen and pH.

Department of Fishery Technology (By Products)

F.T.(BP). 201 Food Microbiology

theory 2, practical 1:
3 credit hours

General account of beneficial and harmful microorganisms in the food industry; Microorganisms used in dairy industry; Food processing; Fermentation; Harmful microorganisms and different types of food spoilage including botulism; Spore-forming and thermophilic organisms in food spoilage; Bacteriology of fish; Source of fish and microbial load; Microbial spoilage of fish; Influence of environmental factors on spoilage; Plant sanitation and its importance in reducing microbial spoilage of processed food; Regulatory measures and their importance in food processing; Chemical and physical preservatives in food processing; ~~Chemical and physical preservatives in food processing and~~ their effect on spoilage organisms; Use of antibiotics in food preservation. Practicals: Study of microorganisms associated with fish from different waters; Microorganisms causing different types of spoilage of processed food, with particular reference to fish and other marine products; Effects of chemical and physical preservatives on spoilage organisms.

Department of Fishery Technology (Canning)

F.T.(C). 202 Canning Technology

theory 1, practical 1:
2 credit hours

General principles and methods of canning; History and development of canning methods and technology; General requirements of a cannery; Raw materials required; Characteristics of fish and fish products; Containers; Use and limitations of additives and preservatives, their quality consideration; The general canning process; Preservation of materials, packing, exhausting, steaming, sterilization, cooling and warehousing; Storage of canned foods; Principles of thermal processing of foods; Nutritive value of canned foods; Canning of fishes, crustaceans, molluscs and other marine materials; Planning for a canning plant; Economics of canning;

Inspection and quality control; Indian and International standards for canned foods. Practicals: Practice in canning of fish, shell fish and other foods; Canning fruits; Study of canning machineries; Exhausting methods and principles; Effect of head-space; Filling temperature and exhaust time of vacuum in cans; Study of heat penetration in cans; Practice in canning food and inspection; Study of spoilage in canned foods.

Department of Fishery Technology (Ham and Sausage)

F.T.(H & S). 203 Fish Ham and Sausage Technology theory 1, practical 1:
2 credit hours

Fish Ham and sausage preparation; History and situation; General method of fish ham and fish sausage preparation; Suitability of main fish materials; Fish meat protein; Myosin groups of protein; Elasticity formation; Settling phenomena; Processing; additives and preservatives; Spoilage of the products; Storage and utilization; Inspection and quality Control. Practicals: Preparation of fish sausages; Practice in handling of machineries used; Studies of moisture content, pH, jelly strength and keeping quality of sausages.

Department of Fishery Engineering

F.E. 201 Fish Farm Engineering theory 1, practical 1:
2 credit hours

Fish farms, their objectives and significance; Fresh water, brackish water and marine farms; Location; Design and construction; Soil and water conditions; Sluices and gates; Tidal influence; Maintenance. Practicals: Visit to fish farms to study their construction and operation; Designing of fish farms.

F.E. 202 Gear Engineering theory 2, practical 3:
5 credit hours

Fishing gear and their classification; Different types of nets, shore seines, boat seines, cast nets, gill nets and trawl nets; Other gear, hooks and lines, long lines, trolling lines and fish traps; Types of hooks and common baits used on hooks; Angling, suitable places for angling; Types of fishes caught in angling; Angling in freshwater, brackishwater and the sea; Sport fishing in India and elsewhere; Gear fabrication; Properties of fibres (natural and synthetic); Floats, sinkers, buoys and anchors used in fishing; Design of fishing gear; Net designs, knots, hitches and bends in fishing gear and fabrication; Mending of fishing gear; Operation, care and maintenance of fishing gear; Modern methods of fishing; Detection of fishes. Practicals: Construction and mending of different fishing gear; Fishing practice; Operation of fishing gear in the sea and inland waters; Testing of strength of gear materials.

F.E. 203 Refrigeration Engineeringtheory 2, practical 1:
3 credit hours

Principles of refrigeration; Refrigeration systems; Basic thermodynamics; Refrigerants and insulation materials; Basic and auxiliary equipment and their operation and maintenance; Applications of refrigeration; Ice making; Types of freezing; Principles of construction and maintenance of cold store and storage; Refrigerated transport. Practicals: Refrigeration equipment and its use; Refrigeration practices; Study of the various processes of freezing and frozen food products under commercial conditions.

F.E. 204 Navigation and Seamanshiptheory 1, practical 1:
2 credit hours

Principles of navigation and seamanship; Chart reading and fixing positions; Regulations for fishing vessels; Life saving devices. Practicals: On board experience and study of principles of navigation; Practice in proper use of life saving equipment.

DESCRIPTION OF COURSES BY DEPARTMENTS FOR YEAR IV

COLLEGE OF FISHERIES .. MANGALORE

Department of Fishery BiologyF.B. 301 Fishery Managementtheory 3, practical 2:
5 credit hours

Principles of conservation, management and development; Ecology of rivers and streams and its effect on fishery resources; Explanation of resources; Fish stocks and hatcheries; Case studies; River improvements; Improvements affecting fish stocks, spawning facilities, fish passes, silt formation and its removal; Dams and their functions, types of dams; Weeds and their control; Pollution of rivers and of estuaries; Sewage and tradewaste disposal; Water supply and drainage in relation to fisheries; Fishery administration, protection, preservation and improvement of resources; Planning and finance; Personnel management; Statistics of commercial fisheries; Fisheries research and teaching institutions in India and their work; The FAO and other International Fisheries organizations; Fishery legislation; Laws of the Sea; Territorial Waters; International Conventions. Practicals: Study of the fishery development programmes in the states; Study of the pollution of rivers and estuaries and sewage disposal problems; Study of the effects of dams on fisheries.

Department of Fishery Resources & EconomicsF.R. & E. 301 Survey, Statistics and Biometrytheory 3, practical 2:
5 credit hours

Survey of the Indian fisheries; Methods and techniques employed in survey of fishery resources; Statistical methods of sampling; Methods of collection and interpretation of data on catches, fishing operations, manpower, equipment, processed and marketed products; Prices, costs and earnings. Basic statistical concepts, scope and objective of fisheries statistics; Collection and interpretation of data; Frequency curves and histograms; Calculation of mean, median, mode, variance and standard error; Concept of sample and population; Characteristics of a sample; Probability calculations. Normal and binormal distribution. Standard biometrical procedures and methods; Application of biometrical methods to fishery biological studies; Tests of significance; Linear regression; Correlation coefficients; Test of independence; Fitting of curves; Index numbers; Analysis of variance. Practicals: Preparation of frequency curves and histograms from fish landing statistics. Calculation of mean, median, mode, variance and standard deviation from samples; Tests of significance by T, F and Chi-square tests; Calculation of coefficient of correlation;

B 11

Test of independence; Fitting of a linear curve; Calculation of standard error of data from sampling designs; Analysis of variance in the design of experiments; Biometrical analysis of fishery biological data; Collection of statistics of fish landings, including biological data, total catch, effort, socio-economic conditions and fish processing in selected areas.

F.R. & E. 302 Economics

theory 3, practical 1:
4 credit hours

Introduction to fishery economics; Principles of economic definition; Role of economics in fisheries; Wants and their classification; Laws of diminishing utility; Laws of returns; Consumer's surplus; Elasticity factors of production; Theory of distribution; Fiscal systems; Exchange rates; Inflation and deflation. National income from fisheries; Classification of fishery and ancillary industries, their history, structure, dynamics, composition and organization; Economic features of fishery industries with particular reference to employment; Economics of fishing vessels, gear, operations, fish processing, fish culture, fish seed industry, riverine and lacustrine fisheries, fish farming; Marine fisheries; Aquatic products; Rationalization in different phases of fishery industry; Case studies from India and abroad. Planning and financing practice in Indian fisheries; Investment by private sector, cooperatives and public sector; Institutional finance and Government credit (loans and grants); Financial systems relevant to fishing industry in selected countries such as Japan, United States, United Kingdom and Norway. Practicals: Assessment of economics of fishing, fish processing, operation of vessels, fishing companies; Assessment of management of fish farms and reservoirs; Participation in field operations at selected centres. Preparation of projects and project reports.

F.R. & E. 303 Marketing and Cooperation

theory 2, practical 1:
3 credit hours

General principles of marketing; Law of demand and supply; Fish markets; Fish trade; Sales organization; Marketing agencies; Wholesale and retail fish trade; Regulation of markets; Marketing legislation; Regulation of fish marketing in other countries like Japan, Norway, United Kingdom and the United States; Prices and price support measures; Marketing schemes in Government programmes; Fish in international trade; Import and export of fish and other products; Quality control; Selected foreign markets and their demands; Fish marketing in India, trends and scope for improvement. General cooperative principles; Cooperative movement in India and elsewhere; Cooperative legislation; Fishery cooperatives in India and elsewhere; Products and consumers cooperatives; Marketing, processing and handling cooperatives; Cooperatives in relation to other sectors;

State undertakings, corporations and private enterprise; Socio-economic conditions of fishermen. Practicals: Study of the working of marketing agencies; Marketing procedures; Price structure; Market surveys; Cooperative societies and the socio-economic conditions of fishermen in specified localities.

Department of Fishery Technology (By Products)

F.T. (BP). 301 Fishery By Products

theory 2, practical 2:
4 credit hours

Fish guano, fish manure and fish meal; Factors affecting quality of fish meal and its value in animal feeds; Fish protein concentrate; Fish hydrolysate; Ensiled products; Fish oils - body oils and liver oils and their uses; Shark skins; Minor products and Isin glass; Utilization of sea weeds for food, manure, production of agar and alginic acid. Practicals: Experimental laboratory scale preparations; Study of samples, analysis and quality standards.

Department of Fishery Engineering

F.E. 301 Equipment Engineering and Plant
Maintenance

theory 1, practical 1:
2 credit hours

Marine engines: selection, operation and maintenance; Dock gear; Mechanical, hydraulic and electronic equipment, Fish finding equipment; Important processing equipment, operation and maintenance. Practicals: Operation, dismantling, overhauling and assembling marine engines and auxiliary equipment; Practice in use of electronic equipment.

MAJOR FIELD OF SPECIALIZATION

20 credit hours

Appendix C

Description of Courses for the Diploma

Pages

Program in Fish Processing Technology C 1 - C 7

Appendix B

Pages

Description of Courses for the B.F.Sc.

Degree Program

B 1 - B 12

Frz. Tech. 401 General Food Freezing,
Principles and Methods

theory 2, practical 1:
3 credit hours

Refrigeration field and food refrigeration; Recent developments in Japan, America and India; "Cold chain" and its importance in India; Characteristics of frozen food; Methods of Freezing; Heat units; Food spoilage factors including microbial, chemical and physical; Phenomena and changes in food caused by refrigeration; Refrigeration methods; Cooling and Freezing; Changes during freezing; Freezing point and depression of freezing point; Freezing of salt solution and eutectic point; Process of food freezing; Refrigeration zone and zone of maximum ice crystal formation; Refrigeration curve; Ice crystal growth; Vapour pressure and temperature change; Volume change; Turgor pressure; Mechanical and colloidal damage and changes during cold storage; Drying; Protein denaturation; Changes of fat, colour and nutrition value; Thawing methods and changes during thawing; Thawing curve. Basic Practice (in batches of 4-5): Drawing up freezing and thawing curves; Estimation of drip loss; Freezing of fishes. Shop Practice (full batch as a Team): Freezing of mackerel, sardine (round), seer (semi-dressed and stick) and croaker (dressed).

Frz. Tech. 402 Refrigeration of Fish

theory 2, practical 1:
3 credit hours

Nature of marine products; Estimation of freshness of fish; Outline of freezing process; Treatment before and after freezing; Brining; Use of anti-oxidants; Glazing; Packaging of frozen products; Prawn freezing; Freezing of lobster tail and frog legs; Freezing of special fish meat as sausage material; Preparation of fish sticks. Basic Practice (in batches of 4-5): Preparation of pomfret fillets; Breaded fish and fish sticks; Freezing of shrimp; Organoleptic test of fish for freshness. Shop Practice (full batch as a Team): Shrimp freezing in different styles, headless and shell on, peeled and deveined, peeled and cooked; pomfret fillets; seer steaks; shark, semi-dressed.

Frz. Tech. 403 Refrigeration of Animal Meats
and Agricultural Products

theory 1, practical 1:
2 credit hours

Refrigeration of fruits and vegetables; Cooler storage and life phenomenon of fruits and vegetables; Blanching; Freezing of fruits and vegetables; Refrigeration and freezing of poultry, eggs and animal carcasses; Accelerated freeze drying. Shop Practice (full batch): Freezing of shrimp, poultry and eggs, prepared and pre-cooked foods; Freezing of fruit juices and fruits and vegetables.

F.H. & S. Tech. 401 General Methods and Raw
Materials

theory 2, practical 1:
3 credit hours

History and situation; General method of fish ham and sausage preparation and main materials, with particular emphasis on tuna, marlin, mackerel, sardine, croaker, lizard fish, cod-like fishes, sharks and skates, cuttle fish, shrimps, whales and animal meat; Frozen materials, including preparation of frozen minced meat; Science of the fish meat; Structure of fish muscle; Fish meat protein; Elasticity formation and factors influencing elasticity; Setting phenomena. Basic Practice: Handling of different machineries concerned with fish ham and sausage preparation; Study the gelly strength of croaker, shark, cat fish, ribbon fish and mackerel; Water bleaching and preparation of frozen minced meat; Preparation of sausage and study of its moisture content, pH, gelly strength and keeping quality. Shop Practice: Preparation of fish sausages on large scale basis including operation of all machineries.

F.H. & S. Tech. 402 Processing for Ham and
Sausage

theory 2, practical 1:
3 credit hours

Taste of fish meat; Meat colour; Colour fixation and meat curing; Meat separation, manually and by machines; Picked meat; Changes of picked meat during storage; Meat mincing, processing, mixing and grinding; Changes in meat during mixing and grinding; Additives including salt, sugar, starch, flour, gelatin, gluten, fat, smoke extracts, monosodium glutamate, sodium succinate, spices, polyphosphates, antiseptics and anti-oxidants; Stuffing and packaging materials. Basic Practice: Study of the keeping quality of fish sausage; Control with different antiseptics; Heat curing, colour fixation and preparation of fish ham; Study of the gelly strength, fixture of sausages by using gelatin and protein concentrate. Shop Practice: Preparation of fish ham and sausages on large scale basis and study of the shelf life of sausages in incubators and at room temperature.

F.H. & S. Tech. 403 Sterilization and Quality
Control

theory 1, practical 1:
2 credit hours

Sealing, different methods of sealing; Boiling, for the purpose of elasticity and sterilization of the product; Proper temperature of heating; Cooling, purpose and effects; Cooling process; Reboiling, purpose of reboiling; Drying, wrapping and storing; Denaturation of fish ham and sausage products; Inspection for quality control. Basic Practice: Preparation of fish balls, fish cakes and Kamaboks; Study of sterilization of sausages at different temperature; Measure of the centre temperature of sausages during boiling process; Preparation of animal meat sausages by using natural casing. Shop Practice: Preparation of fish ham and sausages on large scale basis; Determination of economics of sausage preparation.

Biochem. 401 General Food and Analytical
Chemistrytheory 2, practical 0:
2 credit hours

Introduction to nutrition; Importance of balanced diets; General chemical components; Food deterioration; Necessity and methods of food preservation and processing; Study of carbohydrates, occurrence, classification, physical and chemical properties; Sugars and artificial sweeteners; Nutritional importance of carbohydrates in the body. Study of fats and oils, occurrence, classification and physical and chemical properties; Rancidity; Anti-oxidants of fats in the body; Study of proteins, occurrence and classification; Amino acids, their importance and physical and chemical properties; Protein denaturation; nutritional importance of proteins in the body; Study of minerals and their functions; Study of vitamins, occurrence, classification and properties and their significance in human nutrition; Study of enzymes, classification and properties and their importance in nutrition; Food deterioration and food processing.

Biochem. 402 Fish Chemistrytheory 2, practical 1:
3 credit hours

Structure of fish muscle; General chemical composition of fish and other marine animals and variation of components by species, sex and season; Fish protein; Nitrogen in relation to protein; Intracellular and extracellular protein; Differentiation between protein and non-protein nitrogen; Nutritive value of fish proteins; Fish lipids, their content and distribution; Composition and rancidity of fish oils; Nutritive value of fish lipids and their importance with reference to fat soluble vitamins; Study of muscle extracts of fish; Nitrogenous and non-nitrogenous extracts; Importance of extracts in spoilage of fish and other marine products; Role of extracts as taste components; Changes in fish muscle after death; Mechanisms of rigor mortis, autolysis, and putrefaction, and their significance in fish spoilage. Practicals: General analytical methods; Estimation of main components of food including moisture, crude protein and ash; Estimation of freshness of fish by chemical methods including pH, VBN, TMAN, and protein precipitation test; Analytical tests to determine hardness of water, specific gravity, and sugar Bx, total acid content in fruits, ascorbic acid in fruits; NaCl content in processed foods like salted fish and brines; Reducing sugar and total sugar in fruits; Iodine value, acid value, saponification number and peroxide value of fats.

Microbiol. 401 Microbiologytheory 2, practical 0:
2 credit hours

Study of microorganisms including bacteria, moulds, yeasts; Morphology, growth and reproduction; Enzymes; Practical toxins and colour pigment spores of bacteria; Resistance of bacterial spores against various environmental factors as temperature, pH and moisture; Moulds and yeasts; Environments influencing growth of moulds; Metabolism of carbohydrates; Assimilation of carbohydrates; Metabolism of protein in bacteria; General formula and decomposition of amino acids; Assimilation of nitrogen compounds. Bacteria responsible for putrefaction of food; Denaturation of fish meat; Quality changes of fresh fish; Bacteria and fish; Rigor Mortis; Autolysis; Chemical mechanisms during putrefaction of red meat, prawn, sepia, octopus and shark.

Microbiol. 402 Microbiologytheory 2, practical 1:
3 credit hours

Denaturation of fat and oil; Determination of freshness of fish; Organoleptic, chemical and microbiological examinations; Food poisoning by bacteria, plants and animals; Chemical food preservation; Food plant sanitation; Prevention and control of growth of bacteria against low temperatures; Drying; Salting; Moisture content; Growth of moulds; Dehydration by salting; Halophilic and halophobic bacteria; Dry salting; Brine salting; Changes in salted fish during storage; Smoking, Pickling; Preservation with sugar; Effect of smoking to control growth of bacteria; Canning and bottling; Factors effecting sterilization; Bacteria found in putrefied tinned foods; Bacteria found in natural water and waste water; Spoilage of well water; Cleaning of water by chlorine bleaching powder; Food plant sanitation; Spoilage of food during the manufacturing process; Sanitary conditions of fresh fish at fishing time, during transport and landing place. Practicals: Test for coliform organisms (B.G.L.B.) and desoxycholate method and E. Coli tests on fresh fish, market samples, frozen samples and well water; Acquaintance with microbiological equipment, such as incubators, autoclaves, hot air driers, colony counters and microscopes; Preparation of culture media; Bacteria plate count of various samples such as fish, spices, starch and canned foods; Staining of bacteria, spores and capsules; Detection of anaerobic spore formers; Thyoglycodate media; Salmonella tests; Anteroecoccus tests.

Refri. Tech. 401 Refrigeration and Food
Processing Machinery I

theory 2, practical 1:
3 credit hours

Theory of refrigeration including basic concepts and principles; Purpose of refrigeration; Primary and secondary systems; Introduction to heat and pressure; Laws of gases; Study of simple refrigeration cycle: evaporation, compression, condensation and pressure reduction; Basic equipment including evaporators, compressors, condensers and throttling devices; Refrigerants; Auxiliary equipment including separators, liquid receivers, cooling towers, gas purgers, accumulators, dryers, boosters, heat exchangers and intercoolers; Automatic control devices, Flow control devices; Pressure control devices; Temperature control devices; Capacity control devices; Solenoid valves; Defrosting and gas purging methods; Theory of machines. Transmission of power using friction wheels, gears and belt drivers; Principles of machine drawing and Blue Print reading. Practicals: Starting of refrigeration plants; Charging of gas and lubricating oil; Draining of oil from oil separator, oil drum receiver, evaporators and compressors; Purging of non-condensable gases in the gas purger; Defrosting of evaporator coils; Study of oil circulation and water cooling systems; Operation of can testing and seam testing instruments; Machine drawing; Starting, running and shutting down of boiler and retorts; Operation of food processing machinery in canning and sausage section.

Refri. Tech. 402 Refrigeration and Processing
Machinery II

theory 2, practical 1:
3 credit hours

Brines used in refrigeration systems; Secondary refrigeration systems; Lubrication; Insulating materials and methods of insulation; Heat transfer fundamentals; Thermodynamic functions; Temperature, entropy, pressure and enthalpy diagrams; Carnot cycle; Coefficient of performance; Compression ratio; volumetric efficiency; Heat load and calculations; Two-stage and multi-stage refrigeration systems; Boilers and auxiliary equipment; Feed water treatment; Theory of can seaming, seaming defects and its cause; Fundamentals of electricity and precautions to be taken in handling machines. Practicals: Disassembling, overhauling and reassembling compressors; Study of shaft seals; Opening and cleaning of float valves; Study of different automatic controls and their maintenance; Operation of ice making plant and contact plate freezer; Visit to cold storage plants and study of constructional details at site; Dismantling, adjusting and assembling of different food processing machinery in Canning and Sausage Section.

Refri. Tech. 403 Refrigeration and Processing Machinery III

theory 2, practical 0:
2 credit hours

Air cuttains; Design calculations and estimation of refrigeration load of a plant; Selection of equipment required and its orrection; Applications of refrigeration; Ice making; Tunnel freezing; Contact plate freezing; Cold Storages and the constructional details; Dry Ice production; Refrigerated transports.

G.F.T. 401 World Fisheries and Fish Classification

theory 1, practical 0:
1 credit hour

A general account of fisheries of the world; Classification of fishes; Ccmercially important groups of world fishes with examples and characteristics.

G.F.T. 402 Capture and Utilization of Fish

theory 1, practical 0:
1 credit hour

Fishing methods; Fisheries in India; Food and commercial fishes; Fishing craft and gear; Utilization of fish.

G.F.T. 403 Fish Marketing and Fishery By Products

theory 1, practical 1:
2 credit hours

Marketing of fish; Fish marketing cooperatives; Economics; Fishery by products; Fish oils; Fish meal. Practicals: Dissection of fish and study of viscera and other internal organs; Classification and identification of fishes; Study of inland and marine fishes and their different characteristics; Food fishes of India; Fish landing Centres; Trash fish; Fishing methods; Fishing Craft and Gear; Indigenous and mechanized boats; Nets and net-making, Preservation and care of nets; Aids to fishing operation of trawl nets and rampon nets; Fish markets; Fish transport; Fish curing including salting, dehydration and pickling; Fish oils; Fish meal and other products; Study of fish marketing cooperatives.

Refri. Tech. 403 Refrigeration and Processing Machinery III

theory 2, practical 0:
2 credit hours

Air cuttains; Design calculations and estimation of refrigeration load of a plant; Selection of equipment required and its erection; Applications of refrigeration; Ice making; Tunnel freezing; Contact plate freezing; Cold Storages and the constructional details; Dry Ice production; Refrigerated transports.

G.F.T. 401 World Fisheries and Fish Classification

theory 1, practical 0:
1 credit hour

A general account of fisheries of the world; Classification of fishes; Commercially important groups of world fishes with examples and characteristics.

G.F.T. 402 Capture and Utilization of Fish

theory 1, practical 0:
1 credit hour

Fishing methods; Fisheries in India; Food and commercial fishes; Fishing craft and gear; Utilization of fish.

G.F.T. 403 Fish Marketing and Fishery By Products

theory 1, practical 1:
2 credit hours

Marketing of fish; Fish marketing cooperatives; Economics; Fishery by products; Fish oils; Fish meal. Practicals: Dissection of fish and study of viscera and other internal organs; Classification and identification of fishes; Study of inland and marine fishes and their different characteristics; Food fishes of India; Fish landing Centres; Trash fish; Fishing methods; Fishing Craft and Gear; Indigenous and mechanized boats; Nets and net-making, Preservation and care of nets; Aids to fishing operation of trawl nets and rampon nets; Fish markets; Fish transport; Fish curing including salting, dehydration and pickling; Fish oils; Fish meal and other products; Study of fish marketing cooperatives.

Appendix D

List of Essential Journals Required for
the Fisheries Library

D 1 - D 5

List of Important Journals Required for Fisheries College Library

I. Journals available in India

<u>Sl. No.</u>	<u>Title</u>	<u>Address</u>
1	Annual Reports and Fishery Bulletins (Inland) All back volumes	Director, Central Inland Fisheries Research Institute, Barrackpore (W.B.)
2	Annual Reports & Fishery Bulletins (Marine) All back volumes	Director, Central Marine Fisheries Research Institute, Mandapam P.O. (Tamil Nadu)
3	Bulletins and Reports of C.F.T.R.I.	Director, Central Food Technological Research Institute Mysore
4	Bulletins and News letters of C.I.F.T.	Director, Central Institute of Fishery Technology, Cochin-16
5	Bulletins and Reports	Department of Marine Biology and Oceanography, University of Kerala, Trivandrum
6	Bulletins and Reports of N.I.O.	Director, National Institute of Oceanography, Panjim, Goa
7	Bulletins and Reports	Director, Department of Fisheries, Calcutta
8	The Cooperator	Editor, Cooperator Publication Section, National Cooperative Union of India, 72 Jourbaugh, New Delhi
9	Eastern Economist	Eastern Economist Ltd. United Commercial Bank Bldg. Parliament Street, New Delhi-1
10	Food Industries Journal	Editor, Food Industries Journal 3-A, New Queen's Road, Bombay-4.B.R.
11	Indian Journal of Agricultural Economics	Indian Society of Agricultural Economics, Esplanade Mansion, Bombay-1

<u>Sl. No.</u>	<u>Title</u>	<u>Address</u>
12	Indian Cooperative	Manager, National Cooperative Union of India, 72, Jourbagh New Delhi
13	Indian Journal of Microbiology	Microbiologist's Assoc. Calcutta
14	Indian Journal of Scientific and Industrial Research	Publications and Information Directorate, Hillside Road C.S.I.R., New Delhi-12
15	Journal of Asiatic Society	Journal of Asiatic Society Calcutta
16	Journal of the Association of Technologists	Association of Technologists C.F.T.R.I., Cochin-11
17	Journal of Bombay Natural History Society	Bombay Natural History Society Hornbill House, S.B. Singh Road, Bombay-1(B.R.)
18	Journal of C.I.F.E.	Director, Central Institute of Fisheries Education, Jayaprakash Road, Versova, Bombay-58(A.S.)
19	Journal of Inland Fisheries Society of India	Director, Central Inland Fisheries Research Institute, Barrackpore (W.B.)
20	Journal of Indian Fisheries Association	Taraporewala Aquarium, Marine Drive, Bombay-2
21	Journal of Marine Biological Association of India	Secretary, Marine Biological Association of India, C.M.F.R.I., Cochin-11
22	Journal of Zoological Survey of India	Zoological Survey of India Calcutta
23	Madras Journal of Fisheries	Directorate of Fisheries, Madras
24	Marketing of Fish in India	Directorate of Marketing and Inspection, Food and Agriculture, Nagapur (Maharashtra)
25	Proceedings of the National Academy of Sciences (Section on Biological Sciences)	National Academy of Sciences, Lala Lajpat Rai Road, Allahabad-2

<u>Sl. No.</u>	<u>Title</u>	<u>Address</u>
26	Proceedings of the National Institute of Sciences	National Institute of Science New Delhi
27	Proceedings of the Symposium Series on - Scombroid fishes (1962) - Crustacea (1965) - Mollusca (1968) - On the living resources of seas around India (1968) - Corals and Coral reefs (1969) - Indian Ocean (1971)	Secretary, Marine Biological Association of India C/o C.M.F.R.I.. Cochin-11
28	Quarterly Bibliography of Inland Fisheries	Director, Central Inland Fisheries Research Institute Barrackpore (W.B.)
29	Quarterly Bibliography of Marine Fisheries	Director, C.M.F.R.I. Cochin-11
30	Records of Indian Museum	Zoological Survey of India Calcutta
31	Reports on the Marketing of Fish in Indian Union	Directorate of Marketing and Inspection, Food and Agriculture, Nagpur
32	Sankhya - Indian Journal of Statistics (Series A and B)	Indian Statistical Institute Calcutta
33	Science and Culture	Editor, Science and Culture Calcutta
34	Science Today	Times of India, Bombay

<u>Sl. No.</u>	<u>Title</u>	<u>Address</u>
<u>II Foreign Journals</u>		
1	Bamidgeh	Israel
2	Biological Abstracts	U.S.A.
3	Bulletin of the Tokai Regional Fisheries Laboratory	Tokai Regional Fisheries Lab. 5, Kachedoki, Chuo-Ku, Tokyo
4	Bulletin, National Canners Association	U.S.A.
5	Bulletin, of Japanese Society of Scientific Fisheries	Secretary, Biochemical Section 5, Kachedoki, Chuo-Ku, Tokyo
6	Bulletin, Fresh Water Fisheries Research Laboratory	Tokyo, Japan
7	Bulletin of the Ocean Research Institute	University of Tokyo, Tokyo Japan
8	Bulletin of Scripps Institute of Oceanography	La Jolla, California, USA
9	Bulletin of Woods Hole Oceanographic Institute	Woods Hole, Massachusetts, USA
10	Copeia	USA
11	Canner & Packer	Vance Publ. Cop. 300 West Adam, St. Chicago, USA.
12	C.S.I.R.O. Food Preservations	Division of Food Preservation and Transport, CSIRO, Sydney, Australia
13	Current Bibliography for Aquatic Sciences and Fisheries	F.A.O. Fisheries Division Rome, Italy
14	Fish Culture Bulletin	F.A.O. Fisheries Division Rome
15	Food Industries	Kosai Shujan, Tokyo
16	Ham and Sausage News	Ham and Sausage, Shimbunsha Tokyo

<u>Sl. No.</u>	<u>Title</u>	<u>Address</u>
17	Journal of American Statistical Association	810, 18th St. N.Y. Avenue Washington, D.C. 20006 U.S.A.
18	Food Technology (Food Trade Review)	7, Garrick Street, London, W.C.2
19	Journal of Zoological Society of London	London
20	Progressive Fish Culturist	U.S. Fish and Wild Life Service, Washington, D.C. U.S.A.
21	Quick Frozen Foods	205, East 42nd Street, New York, N.Y. 10017
22	Review of International Cooperation	International Cooperative Alliance Office, London
23	Reports of Indo-Pacific Fisheries	F.A.O. Fisheries Division, Rome, Italy
24	The Canning Trade	Canning Trade Inc. 2619, Maryland Ave. Baltimore, MD.U.S.A.
25	Technical Papers, Oceanographic Institute, Florida State University	Tallahassee, Florida 32306, U.S.A.
26	U.S. Naval Oceanographic Publications	U.S. Naval Oceanographic Institute, Suitland, MD. U.S.A.
27	World Fisheries Abstracts	F.A.O. Fisheries Division Rome, Italy