1976

ANNUAL REPORT

CENTRAL INLAND FISHERIES
RESEARCH INSTITUTE

BARRACKPORE

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CENTRAL INLAND FISHERIES RESEARCH INSTITUTE

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ANNUAL REPORT

FOR THE YEAR

1976

ICAR

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
BARRACKPORE, WEST BENGAL
INDIA

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This report includes unprocessed or semiprocessed data which would form the basis of scientific papers in due course. The material contained in the report, therefore, may not be made use of without the permission of this Institute, except for quoting it for scientific reference.

ANNUAL REPORT 1976

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE

BARRACKPORE

1. Director's Introduction

History :

The Central Inland Fisheries Research Institute was formally established in March 1947 under the Ministry of Food and Agriculture, Government of India for the purpose of conducting scientific studies on inland fisheries of the country. The Institute is since June 1959, housed in its own buildings at Barrackpore on the left bank of the river Hooghly on an area covering about 5·2 ha. It came under the administrative control of the Indian Council of Agricultural Research on October 1, 1967.

Objectives :

The main objective of the Institute is to elucidate the scientific principles which can be applied for full utilisation of all available inland waters of the country for maximising fish production. Such an objective entails evolving sound fish husbandry techniques along modern concepts of aquaculture ; acquiring understanding of the biology of food fishes ; conducting investigations on hydrology and ecology of different types of fishery waters ; performing research on population dynamics of fish in natural capture fishery waters, like those of rivers, lakes, reservoirs, estuaries, etc.; formulating artificial feeds of high converson values and evolving feeding techniques ; besides, developing fishery management techniques relating to both fresh- and brackishwater environments. While the investigations are conducted on long range research projects that are of a continuing nature, in consideration of the ever increasing consumer demand of fish in the country, due emphasis has also been laid on short term production oriented research projects, the solutions of which are apt to lead to rapid development of inland fisheries, specially

in the field of aquaculture in rural areas of the country where both perennial and seasonal water bodies abound and which can be effectively utilised for fish production through pisciculture. The scientific work of the Institute is divisible basically into two aspects— (a) Culture Fisheries Research and (b, Capture Fisheries Research. The former involves researches on culture of fish in impounded fresh- and brackishwater bodies, like ponds, tanks, *beels*, *bheries*, etc., whereas the latter is mostly observational in nature, the data being drawn mainly from the commercial fishing units operating in lakes, reservoirs, rivers and estuaries.

With a view to achieving these objectives, three major divisions ; *viz* . Freshwater Aquaculture Division. Riverine & Lacustrine Fisheries Division and Estuarine Fisheries Division were established and they are presently located at Bhubaneswar, Allahabad and Calcutta respectively to deal with the research problems of freshwater pond culture, riverine & lacustrine fisheries and estuarine culture & capture fisheries. Freshwater Aquaculture Division will be shifted to Dhauli near Bhubaneswar (Orissa) when the experimental fish farm and the laboratories are constructed.

Organisational structure :

The aforesaid three divisions of the Institute with their research centres at Kakinada & Tadepalligudem in Andhra Pradesh ; Gauhati in Assam ; Bhagalpur & Buxar in Bihar ; Srinagar in Jammu & Kashmir ; Bangalore in Karnataka ; Bhubaneswar & Cuttack in Orissa ; Madras in Tamil Nadu ; Allahabad in Uttar Pradesh ; and Barrackpore, Bokkhali, Calcutta, Kakdwip & Rahara in West Bengal continued to function. Freshwater Aquaculture Research & Training Centre ; Krishi Vigyan Kendra (Matsya) ; and the Trainers' Training Centre (Fisheries) at Dhauli in Orissa were established during the year. Besides, Economics, Statistics, Extension, Library & Documentation, Administrative, Accounts, Audit and Stores Sections situated at the Headquarters of the Institute at Barrackpore, the Kalyani Research Centre and the Krishnanagar Operational Research Centre in West Bengal functioned under the direct control of the Director.

Institute based All India Co-ordinated Research Projects ; *viz*., (i) Ecology & Fisheries of Freshwater Reservoirs (with main centre at Allahabad and subcentres at Bhavanisagar, Bilaspur, Hazaribagh, Kangsabati, Nagarjunasagar, Ranchi, Rihand and Ukai). (ii) Composite Fish Culture & Fish Seed Production of Indian & Exotic Fishes (with main centre at Bhubaneswar and subcentres at Badampudi, Barrackpore, Bhavanisagar, Durg, Gauhati, Godhra, Jaunpur, Kalyani, Karnal, Kausalyaganga, Pune, Ranchi and Sathnur) ; (iii) Propagation & Stocking Seed of Air-breathing Fishes for Culture in Swamps (with main centre

at Barrackpore and subcentres at Bangalore, Darbhanga, Gauhati, Kalyani and Palair) and (iv) Brackishwater Fish Farming (with main centre at Barrackpore and subcentres at Earnakulam, Kakdwip, Kakinada, Keshpur, Madras, Maharashtra and Panaji) continued to function during the year. Diagrammatic representation of the organisation of the Institute is presented in the Organisation Chart appended to this report (Appendix II).

Library & Documentation :

During the year under report, 132 books, 100 reprints, 65 miscellaneous publications and 1,208 issues of periodicals were added to the library of the Institute. 33 foreign and 40 Indian journals were subscribed. The library obtained either as free gift or in exchange additional 153 Indian and foreign journals. The present library holdings inclusive of the year's arrivals comprise 3,371 books, 3,493 reprints, 1,684 miscellaneous publications excluding the stock of journals, pamphlets, maps, departmental publications, etc. Besides maintaining exchange relationship with 345 institutions and organisations, 19 new exchange relationships were established during the year. "Accession Lists" for the period November-December 1975 & January-August 1976 and "Current Awareness Lists" for October 1975-June 1976 were brought out and circulated for the benefit of the Scientists of the Institute. 57 technical and non-technical enqueries from India and abroad were attended to by the Library & Documentation Section. The Institute supplied a number of publications to the Deputy Director (Air-breathing Fish Culture), Govt. of West Bengal, Kalyani ; the Scientist-in-Charge, Document Procurement Section, Indian National Scientific Documentation Centre, New Delhi ; Professor, Department of Zoology, Aligarh Muslim University, Uttar Pradesh ; Senior Scientific Officer, Regional Research Laboratory, Jammu ; Regional Fisheries Development Officer, Aurangabad Division, Maharashtra ; Superintendent, Dept. of Fisheries, Govt. of Meghalaya, Shillong ; the Scientist-in-Charge, National Environmental Engineering Research Institute, Nehru Marg, Nagpur ; the University, Librarian, Dr. V. S. Krishna Memorial Library, Andhra University, Waltair and the Deputy Secretary, Dept. of Forest, Fisheries & Animal Husbandry, Govt. of Orissa, Bhubaneswar on inter-library loan service.

During the year, 62 reports on progress of research were compiled and sent to the ICAR. Bibliography of Indian Fisheries, Vol. 14(1-4), 1975 ; Half-yearly Technical Progress Report, January-June 1975 ; Bulletin Nos. 21-23 entitled "Studies on the distribution in time and space of the periphyton of a perennial pond at Cuttack, India", "List of Publications of the Central Inland Fisheries Research Institute, 1948—1976" and "First 138 case studies of composite fish

culture in India" and Miscellaneous Contribution Nos. 11 & 12 entitled "Report on the freshwater fish culture industry of Japan" and "Report on the International Conference on Prawn Farming, Vung Tau, South Viet-Nam 31st March to 3rd April, 1975" were compiled, edited and brought out. The 1975 Annual Report, a brochure entitled "Freshwater aquaculture research and training in India and the role of the fish farm at Dhauli, Orissa" and an information booklet "Central Inland Fisheries Research Institute" were brought out in printed form during the year. Lecture notes delivered to the participants of the Summer Institute on "Fish Seed Production and Mobilisation for Culture Fisheries of Inland Waters" held during 1976 were brought out in mimeographed book form for distribution to the participants. Quarterly publication of the "CIFRI Newsletter", as an effective information medium of the highlights of research to the urban as well as rural readers was initiated during September 1976 and the two quarterly issues of Vol. 1 were brought out during September and December. 60 scientific papers emanating as a result of researches conducted at this Institute were published in different Indian as well as foreign journals. Besides the above, 145 sketches/diagrams, 100 posters charts, 2,000 photographs, 350 slides, 8 cover designs and 400 miscellaneous reproductions of photographs of various research activities and achievements of the Institute were prepared.

Honours, Awards, etc. :

The Rafi Ahmed Kidwai Memorial Prize for Agricultural Research for the biennium 1972-73 was awarded jointly to Drs. Viswa Gopal Jhingran, Hiralal Chaudhuri and Viswa Raman Prasad Sinha, all working at the Central Inland Fisheries Research Institute, Barrackpore for their outstanding contributions in the field of inland fisheries (Photograph 1).

The work of the three Scientists has converged on the central theme of improved fish culture in inland waters which has resulted in technologies for increasing per hectare fish production. Their findings, especially on induced breeding by hypophysation and on composite fish culture have been of immense practical importance and represent a major breakthrough in aquaculture in India. They have also made important contributions to the development of new concepts of fish culture. Their work on better rearing, induced breeding, improved nursery practices, composite culture, hybridisation and extraneous feeding of Indian and exotic carps has led to the initiation of rural aquaculture projects in West Bengal and Orissa.

They have participated in several national and international conferences and have on many occasions been invited by international organisations as specialists

and consultants. They have provided leadership and guidance to a band of enthusiastic and devoted workers in the country in the field of inland fisheries.

Photograph 1—Dr. V. G. Jhingran, Director of the Central Inland Fisheries Research Institute, Barrackpore receiving the Rafi Ahmed Kidwai Memorial Prize from the Union Minister for Agriculture & Irrigation, Shri Jagjivan Ram, in New Delhi on Friday, January 30, 1976.

Dr. V. G. Jhingran, Director and Dr. V. R. P. Sinha, Scientist S-3 of the Institute attendend the FAO Technical Conference on Aquaculture held in Kyoto, Japan during May 26 to June 2, 1976. Dr. Jhingran acted as a panel member for Session IV on "Artificial Recruitment and Transplantations" and Dr. Sinha for Section I of the Session II on "Pond Culture of Fin-fish".

Dr. Jhingran, Director of the Institute was the Chairman/Convenor of the FAO Symposium on the "Development and Utilisation of Inland Fisheries Resources" held in Colombo (Sri Lanka) during October 25-30, 1976. Dr. P. V. Dehadrai, Scientist S-3 of the Institute also participated in the symposium.

Shri D. D. Halder, Scientist S-1 of this Institute has been deputed to Philippines for training in the field of Brackishwater Fish Farming under the Colombo Plan for a period of six months.

Sarvashri P. Ray and B. B. Ghosh, Scientits S-1 of the Institute participated in the Seminar entitled "ACMRR/IABO Expert Consultation on Bioassays with Aquatic Organisms in Relation to Pollution Problems" held during November 16-19, 1976 in Dubrounik, Yugoslavia.

Distinguished visitors :

The following scientists and distinguished persons visited the Institute and its various establishments during the year under report :—

Mr. Bernt I. Dydorn	Institute of Marine Research Lyackil, Sweden
Mr. P. Y. Paradis	I.D.R C., Ottawa, Canada
Mr. & Mrs. J. R. Maybea & Mr. R. N. Haug	Canadian High Commission, Canada
Mr. Mare Steyaert	UNESCO, Division of Marine Sciences, Paris
Mrs. N. Vannucci	Programe Scientist in Basic Science, United National Education, Science & Cultural Organisation, New Delhi
Dr. D. Homer Buck	Illinois Natural History Survey, U.S.A.
Dr. B. Entz, Dr. J. Bokos, Dr. J. Kovans, Dr. J. Olah, Dr. E. Barki & Dr. A Ruttkay	Fish Culture Research Institute, Hungary
Mr. A. Lily	International Foundation for Science, Stockholm, Sweden
Prof. N. Onbe	Hiroshima University, Fukuyama, Japan
Dr. T. O. Shimazaki	Japan
Dr. J. C. Madamba	Member, International Bank for Rural Development & Philippines Council for Agriculture & Resources Research, Los Banos. Laguna, Philippines
Dr. P. E. Osborn	FAO UNDP Consultant, Rome
Dr. Takashi Onbe	Hiroshima University, Fukuyama, Japan
Dr. William Edusidson	University of Strathclyde, Glasgow, Scotland
Dr. T.V.R. Pillay	Senior Fishery Resources Officer (Aquaculture), Department of Fisheries, FAO, Rome

Dr. W.H.L. Allsopp	International Development Research Centre, Canada
Dr. T.G. Pillai	Project Manager (Fisheries), FAO at Kathmandu and Fishery Officials of Nepal
Mr. Coche	FAO/UNDP, Rome
Dr. D. N. F. Hall	Principal Fisheries Adviser, Ministry of Overseas Development, London, U. K.
Mr. & Mrs. E. Nicholson	UNDP/ICAR, Krishi Bhavan, New Delhi
Dr. N. Kemp & Dr. Partha Ghosh	British Council Division, British High Commission, Calcutta
Shri B. Sivaraman	Member, Planning Commission, Govt. of India, New Delhi
Shri P. P. Mukhiya	Member, Provincial Fisheries Co-operation Ltd., Laheriasarai, Darbhanga
Shri K. Roy	Project Executive, Agricultural Finance Corporation, Calcutta.
Shri S. G. Pawar	Hon'ble Minister of Agriculture, Govt. of Maharashtra, Bombay
Shri Tusar Kanti Ghosh	Hon'ble Minister of Industries, Govt. of West Bengal, Calcutta
Shri I. E. Soares	Officer-on-Special Duty (Rural Development), ICAR, New Delhi
Shri A. S. Khan	Deputy Secretary, Planning, Govt. of Orissa
Shri H. Paiz	Secretary, Department of Fisheries, Govt. of Assam, Gauhati
Shri Nagendra Singh	Under Secretary, Department of Agriculture, Govt. of India, New Delhi
Dr. C. M. Singh	Director, Indian Veterinary Research Institute, Izatnagar, U.P.
Shri Shah Nawaz Khan	Hon'ble Union Minister of State for Agriculture & Irrigation, New Delhi
Dr. J. S. P. Yadav	Director, Central Soil Salinity Research Institute, Karnal

Shri R. Nagarajan	Director of Fisheries, Govt. of Tamil Nadu Madras
Shri K. T. Rathod	Hon'ble Minister for Fisheries, Karnataka, Bangalore.
Shri B. P. Singh	Production and Personal Director, The Gramophone Co. of India Ltd., Calcutta-28
Shri Nanda	Collector, Puri
Dr. T. A. Mammen	Deputy Commissioner (Planning), Ministry of Agriculture and Irrigation, New Delhi
Shri Mallick	Additional Secretary (Fisheries), Govt. of Orissa

Important events of the year :

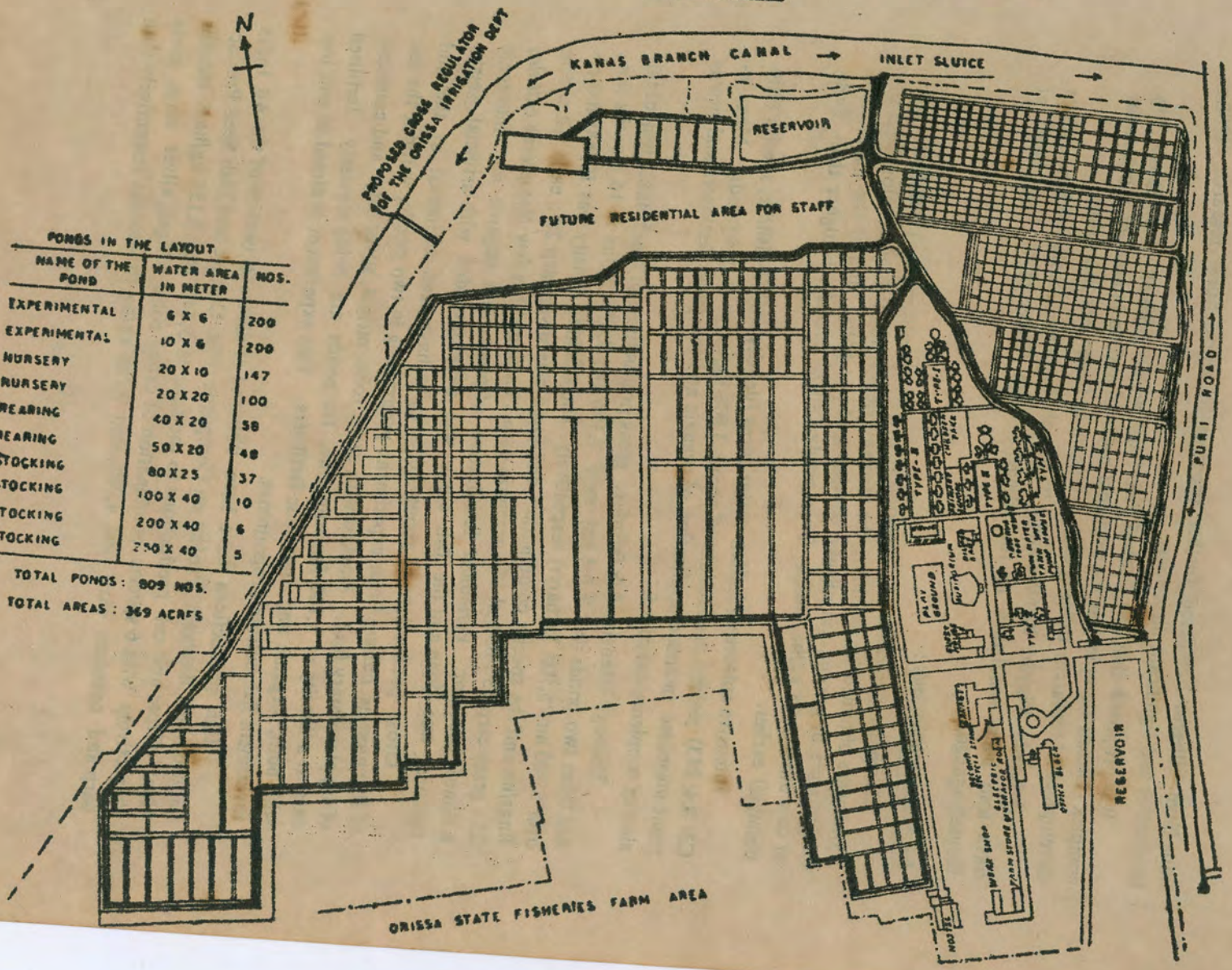
Important events :

CIFRI Film "Induced Breeding" Bags International prize : At the International Festival of films on Aquaculture, organised by the FAO of the United Nations in conjunction with the FAO Technical Conference on Aquaculture held in Kyoto, Japan, during May 26 to June 2, 1976, the Indian Film entitled "Induced Breeding" based on the work of the Central Inland Fisheries Research Institute, won the First Prize under the instructional category of films. Dr. V.G. Jhingran, Director, Central Inland Fisheries Research Institute, who attended the conference received the award on behalf of the country.

Freshwater Aquaculture Research & Training Centre, Dhauli, Orissa : The many notable scientific contributions by the Cuttack Research Centre of the CIFRI were made under limited field facilities ; *viz* , a small improvised fish farm having less than 50 experimental ponds very kindly placed at the disposal of the Institute by the Fisheries Department of the Government of Orissa against the requirement of about 800 experimental ponds of different sizes. This limitation of the basic field facility for developmental research has been fully recognised and the need for establishing large well-designed modern fish farm for the CIFRI has been given top priority by the Indian Council of Agricultural Research. For setting the new fish farm, the Institute has acquired about 144 ha of land at Dhauli in Orissa. The proposed farm (Photograph 2) will have about 800 experimental ponds of different sizes wherein statistically designed experiments on fish production, fish hybridisation & selective breeding, fish genetics, fish nutrition, etc. to improve the stocks of fish would become possible. These limita-

Photograph—2

C.I.F.R.I (ICAR)
TENTATIVE LAYOUT OF THE EXPERIMENTAL FISH FARM AT DHAULI



PONDS IN THE LAYOUT

NAME OF THE POND	WATER AREA IN METER	NOS.
EXPERIMENTAL	6 X 6	200
EXPERIMENTAL	10 X 6	200
NURSERY	20 X 10	147
NURSERY	20 X 20	100
REARING	40 X 20	58
REARING	50 X 20	48
STOCKING	80 X 25	37
STOCKING	100 X 40	10
STOCKING	200 X 40	6
STOCKING	250 X 40	5

TOTAL PONDS : 809 NOS.

TOTAL AREAS : 369 ACRES

tions have hitherto hampered further progress in aquacultural research along productive and significant directions.

It is proposed that this Central Fish Farm would gradually grow into a big complex (Dhauli Complex) as the principal national and an international centre for developmental research, training and extension in freshwater fish culture.

A Krishi Vigyan Kendra and a Trainers' Training Centre for fish culture have also been established at the adjacent State Government Fish Farm at Kausalyaganga.

Important achivements :

Composite fish culture : Stocking spawn at 2·8 million/ha, 1·4 million catla fry/ha were obtained by providing the micronutrient cobalt chloride alongwith the feed mixture of ground-nut oilcake powder and rice polish and by the application of cow dung at 25 kg/ha daily. This production of catla fry is higher than those obtained earlier.

Intensive culture of Indian major carps (density 6,000 fish/ha; species ratio C3: R4: M3) yielded productions of about 3,600 kg/ha'yr in two ponds. Management measures included application of organic and inorganic fertilisers and provision of supplementary feed.

Through intensive fish farming, gross productions of marketable fish obtained from two ponds (0·5 & 0·4 ha) were 7,196 and 7,679 kg/ha in 16 months (*i.e.*, over 5,300 and 5,700 kg/ha/yr) respectively. The stocking density was 10,000 fingerlings/ha and the species combination employed was silver carp 20 : catla 10 : rohu 25 : grass carp 15 : mrigal 15 : common carp 15 alongwith a few *Notopterus chitala*, a minor predator. Periodical fertilisation of ponds with organic and inorganic manures was done and the fish stock was daily provided with artificial feeds.

Gross productions of about 3,000 kg/ha have been estimated at the end of five months' culture in an experiment progressing in two ponds, without the use of supplementary feed. Stocked with catla, rohu, mrigal, silver carp and common carp at a density of 5,100 fingerlings/ha, the ponds are being regularly fertilised with both, organic and inorganic fertilisers. This experiment is aimed to suit low investment fish culture programmes.

High productions have been obtained at different centres of the All India Co-ordinated Research Project on Composite Fish Culture and Fish Seed Production. Gross and net productions to the tune of 5,446 and 5,155 kg/ha/8 months respectively with 6 species combination of catla, rohu, mrigal, silver carp, grass carp and common carp and 4,072 and 3,788 kg/ha 10 months respectively with

4 species combination of catla, rohu, mrigal and common carp have been obtained at the Pune centre.

Operational Research on Rural Aquaculture : The strenuous efforts put in to demonstrate the effectiveness of high fish yielding technology of composite fish culture of Gangetic and Chinese carps which have resulted in yields as high as 3,000-9,000 kg/ha/yr constituted the central theme of the coverage of achievements of CIFRI by the Calcutta Centre of Doordarshan in their programmes on 2nd and 4th October, 1976. The activities of the Krishnanagar Operational Research Centre of the Institute at Anjana Fish Farm, Krishnanagar, in collaboration with the State Fisheries Department where efforts have been put to produce yields of high magnitudes from large sheets of water, were telecast. At this centre, from three experimental ponds (2·15, 1·93 and 1·48 ha in area), in 1973-74 season, a total of 20, 32 kg of fish ranging from 2, 54-4,290 kg/ha/yr have been produced as against the previous production record of only 62 kg/ha/yr. Fish production from these ponds has been increased to about eight times by adopting the technique of composite fish culture. A total sum of Rs. 58,576/- (including all inputs and salary of watchman and fishermen) was spent to produce 20,332 kg of fish from the three ponds, the cost of production being Rs. 2.94 kg. The fish was sold to the public at Krishnanagar @ Rs. 4·50/kg during that year.

The fish produced under this project in the second experiment was sold to the general public of Krishnanagar @ Rs. 6 to Rs. 7/kg depending upon the size of fish, through four different fish sale counters especially set up at Krisnanagar and Ranaghat for the purpose by the Nadia District Fishermen Co-operative Federation, under the direct supervison of the District Magistrate, Nadia. Such a sale of fish produced in a State Government Fish Farm by the Central Inland Fisheries Research Institute, Barrackpore to the people, was a unique activity in West Bengal.

Sewage-fed fish culture : To obtain optimum per hectare production of carps from ponds fertilised with domestic sewage, an experiment on mixed culture of Indian and exotic carps was conducted in a pond (0. 70 ha) at Rahara, 24-Parganas, West Bengal. The pond, initially fertilised with 0.78 million litres of domestic sewage effluents in June 1975 and later diluted with 1.56 million litres of freshwater during July and August 1975 was stocked with the Indian and exotic carps ; *viz*, *Catla catla* (31.2%), *Labeo rohita* (17.5%), *Cirrhinus mrigala* (3 .7%), *Cyprinus carpio* (7·9%) and *Hypophthalmichthys molitrix*(6.7%)@ 24,000 fiingerlings per hectare in August 1975. Fertilisation with sewage effluents @ 0.034 to 0.168 million litres per month was resorted to. No artificial feeding was done during the course of experiment. Harvesting of fish initiated in February, 1976 was continued up to May 1976. Actual gross and net productions from the above pond were

10,96 and 971 kg respectively thus giving estimated gross and net productions of 6,452 and 5,711 kg/ha within a period of nine months.

Rearing of Macrobrachium rosenbergii : The larval rearing of the giant freshwater prawn, *Macrobrachium rosenbergii* (deMan), has been successfully done at the Kakinada Research Centre of the Central Inland Fisheries Research Institute, Andhra Pradesh. Freshly hatched larvae were released in earthen pot with 30 litres of aged and diluted sea water (20%) containing rich plankton. After attainment of the sixth stage, the larvae were transferred to a round and flat bottomed trough of 10 litre capacity with facilities for continuous aeration and circulation of water. The larvae were fed with freshly hatched *Artemia* nauplii and minced algae for a week and later with freshly hatched *Artemia* nauplii alone for the next three days and finally for the remaining days of the experiment, the feed for the larvae was finely sliced and cleaned *Tubifex* worms. After 10 moultings in 38 days, the larval rearing was completed. In the second experiment, success was achieved in rearing the prawn larvae even when no *Artemia* nauplius was fed to the larvae. The larvae were allowed to develop in the earthen pot itself even after the sixth stage and the larval development was completed in 42 days.

Subsequently in another eight sets of experiments where 40% sea water (with 35·19‰ salinity) was used, varied types of feed were tried and the larval development was successfully completed in 38 to 51 days. The larval development was quicker at a temperature range of 24.5° to 30.5°C. During the experiments, DO for the ambient water was between 3.95 and 6.55 ppm. Photograph 3 depicts the young ones of *M. rosenbergii* raised in the laboratory at Kakinada Research Centre.

Seed thus raised in the laboratory was stocked in a 0·02 ha pond at Balabhadrapuram in July, 1976 @ 5,650/ha. Harvesting was done on 5th November, 1976 and gross & net productions of 284 & 243 kg/ha/4 months respectively were obtained with a survival rate of about 74%.

The maximum size attained by prawn during 4 months, rearing was 250 mm/220 g (Photograph 4). This is a significant achievement since at a low stocking density and short period of rearing in pond, a net production of 243 kg/ha was obtained.

Culture of magur, Clarias batarchus, as a component in carp culture : An experiment on composite culture of carps with magur, *C. batrachus*, as a component in place of common carp in a 0.06 ha pond in village Amgachhia, district 24-Parganas, West Bengal indicated tremendous possibility of such a culture in

Photograph 3—Macrobrachium rosenbergii (juveniles) raised in the laboratory.

Photograph 4—A haul of *M. rosenbergii* from the experimental pond at Kakinada Research Centre

rural ponds. A production of 1,975 kg of carps/ha/8½ months and 1,200 kg of magur/ha/4½ months was obtained from the experimental pond, showing a receipt of Rs 15,528/- per hectare, magur alone contributing Rs. 10,312/-.

In the above experiment, the Indian and Chinese major carps were stocked at 5,000 fingerlings/ha whereas magur at 20,000 fingerlings/ha. Supplementary feeding was done with mustard oilcake and rice-bran mixture for carps, cauliflower leaves for grass carp and low grade dried marine trash fish for magur.

Control of submerged vegetations : As a long term control measure of rooted submerged weeds ; *viz.*, *Ottelia* sp., *Vallisneria* sp., etc., a technique suitable for rural conditions obtaining in India has been evolved. Dry brick pellets soaked in aqueous solution of 2,4-D sodium salt formulation were broadcast judiciously amongst clusters of weed infestations in ponds. Prolonged clearence of chronic infestations of *Nelumbo* sp., *Nymphoides* sp., *Ottelia* sp., *Vallisneria* sp., etc. in perennial ponds has been achieved when 2 to 4 instalments of 2,4-D @ 10 kg/ha in each instalment have been applied in the above stated manner. Phytotoxicity, as tested by growth of sensitive land plants, was not detectable in soil and water samples, 4 weeks after the application of each dose.

Pelleted feed for trout : The experiments conducted at the Srinagar Research Centre of the Institute have shown the possibility of commercialising trout culture in the country by formulating pelletised feeds having crude protein content ranging from 28 to 39%.

In over 60 trials conducted with brown and rainbow trouts as test animals, using feeds having 28, 35 and 39% crude protein levels, conversion ratios obtained ranged between 1.4 and 2.0. The manufacturing cost for commercial production of the pelleted feed containing crude protein ranging from 35-40% has been worked out to be Rs. 2·25 per kg.

Catfish culture in running water : The hatchlings of the catfish, *Mystus seenghala*, commonly known as "Tengra" were cultured in nylon cages in running waters and attained an average size of 139 mm in 144 days of rearing. In nature, there is distinct parental care exhibited in this species and the hatchlings (av. size 15 mm) are known to feed on a whitish scum oozing from the body of the male parent guarding the nest. The significant feature of the experiment was that in captivity, the developing hatchlings could be successfully fed on chironomid egg mass and semi-boiled fish flesh. No mortality of fish occurred during the course of experiment. To improve the technology and make it commercially viable, further experimental trials are being conducted.

Carp spawn rearing in floating cages in lentic environment : Fish spawn is usually reared in specially prepared nursery ponds where mortality of the developing spawn often occurs due to the accumulation of metabolites in the pond. Recently, experimental trials of rearing carp spawn in floating nylon cages (2.5 x 2 x 2 m) released in pond waters, have been made successfully. The spawn before being stocked in the flaoting cages, were acclimatised to artificial feed in plastic pools. A mixture of soyabean powder, ground-nut oilcake and rice-bran in the ratio of 1 : 1 : 1 was fed to the developing spawn @ 20% of the body weight during the 45 days' rearing period. Young fry with an average length of 59.4 mm were obtained towards the close of the experiment and their retrieval was easier.

Mass culture of zooplankter, Moina dubia, as a fish food organism : Mass culture of planketer *Moina dubia* has been successfully achieved in plastic pools by utilising freshly cultured phytoplankter, *Scenedesmns obliquus*, as feed in yard trials. The alga was introduced in suspension as food for *Moina dubia* at the rate of 0.250 ml per individual per day. The density of *Moina dubia* could be increased to 10,000 organisms per litre from an initial inoculum of 10 organisms/1 within a culture period of eight days, leading to possibilities of its large scale production in field conditions. *Moinas* sp. constitutes a major natural food item of carps in polyculture.

Research collaboration with Institutes, Universities, Colleges and other Organisations at national level :

Through a net work of centres under the Institute based All India Co-ordinated Research Project on Composite Fish Culture of Indian and Exotic Fishes & Fish Seed Production, operating in different agroclimatic conditions, the State Governments continued the joint investigations on composite fish culture and fish seed production. Experiments were continued at Badampudi (Andhra Pradesh), Gauhati (Assam), Ranchi (Bihar), Godhra (Gujarat), Karnal (Haryana), Durg (Madhya Pradesh), Pune (Maharashtra), Kausalyaganga (Orissa), Bhavanisagar & Sathnur (Tamil Nadu), Jaunpur (Uttar Pradesh), and Kalyani (West Bengal).

With a six-species combination at Karnal subcentre, gross and net productions of 6,267 and 6,199 kg/ha/8 months respectively were obtained from a 0.23 ha pond, whereas in a five-species combination (excluding silver carp), gross and net productions obtained were 3,068 and 3,023 kg/ha/8 months respectively. At Jaunpur subcentre, gross production, using fiarticial feed & fertilisers, ranged

from 5,110 to 5,887 kg ; with artificial feed but without fertilisation, from 3,612 to 4,330 kg ; with fertilisation but without supplementary feeding, from 1,581 to 2,743 kg ; and without feed & fertilisation the production obtained was 1,422 kg/ha/yr. At Pune subcentre, four-species combination of catla, rohu, mrigal and common carp gave gross and net productions of 4,072 and 3,788 kg/ha/10 months respectively. The six-species combination at this centre gave gross and net productions of 5,446 and 5,155 kg/ha/8 months respectively. At Gauhati subcentre, six-species combination gave gross and net productions of 3,731-4,083 and 3,534-3,896 kg/ha/yr. Gross and net productions to the tune of 2,818-3,232 and 2,599-2,902 kg/ha/yr respectively have been obtained at Bhavanisagar subcentre in a six-species combination adding a few *Mystus aor* and *Channa striatus* specimens. At Kalyani subcentre five-species combination of catla, rohu, mrigal, silver carp and common carp gave a gross production of 3,393 kg/ha/13 months, whereas a six-species combination yielded a gross production of 3,751 kg/ha/14 months. At Badampudi subcentre, four-species combination of catla, rohu, mrigal and common carp gave gross and net productions of 2,128 and 1,833 kg/ha/yr respectively while a five-species combination (excluding grass carp) gave gross and net productions of 2,076 and 1,763 kg/ha/yr respectively. Gross and net productions of 1,504 and 1,439 kg/ha/yr respectively were obtained at Ranchi subcentre.

Induced breeding of Indian and exotic carps were also done at different centres of the project successfully. Breeding of silver carp has been achieved at Ranchi subcentre, Bihar, for the first time. A total of 39.76 lakhs spawn of Indian major carps and 19.20 lakhs spawn of silver and grass carps were produced during the year.

The All India Co-ordinated Research Project on Air-breathing fishes in its joint investigations formulated with the State Fisheries at different centres coutinued to tackle several production oriented schemes. In Assam, cage culture experiments yielded production of 'koi' *Anabas testudineus* and the murrel, *Channa punctatus* at the rate of 35,000 kg/ha/200 days gross or 32,000 kg/ha/200 days net and 50,000 kg/ha/200 days gross or 42,000 kg/ha/200 days net respectively when computed over the production per unit area of the cage. In mixed culture with magur, koi and singhi stocked at the rate of 8,000, 3,000 and 1,000/ha respectively in a 0.1 ha derelict pond, a production of 916 kg/ha/yr at a total cost of Rs. 1,360/- was obtained Survival of *Clarias* sp. was over 76%. Monoculture of *Channa punctatus* gave 1,678 kg/ha/yr at Uluberia.

In Bihar, mixed culture of 'Singhi' *Heteropneustes fossilis* and 'koi'

Anabas testudineus, in a swamp stocked with induced bred 2-3 months, old fingerlings weighing 2-6 g each yielded 524 kg/ha/8 months gross without either using supplementary feed or fertilisers. However, mixed culture of 'singhi', 'koi' and 'magur' stocked at 25,000 fingerlings/ha in a derelict pond (0.04 ha) yielded a gross production of 1,200 kg/ha in 7 months without supplementary feed and fertilisers.

In Karnataka, a production of 3,152 kg/ha/7 months of the murrel, *C. marulius*, was achieved when fingerlings weighing 10 g each were stocked and fed with low grade dried marine trash fish. During this period, the murrel attained an average weight of 800 g.

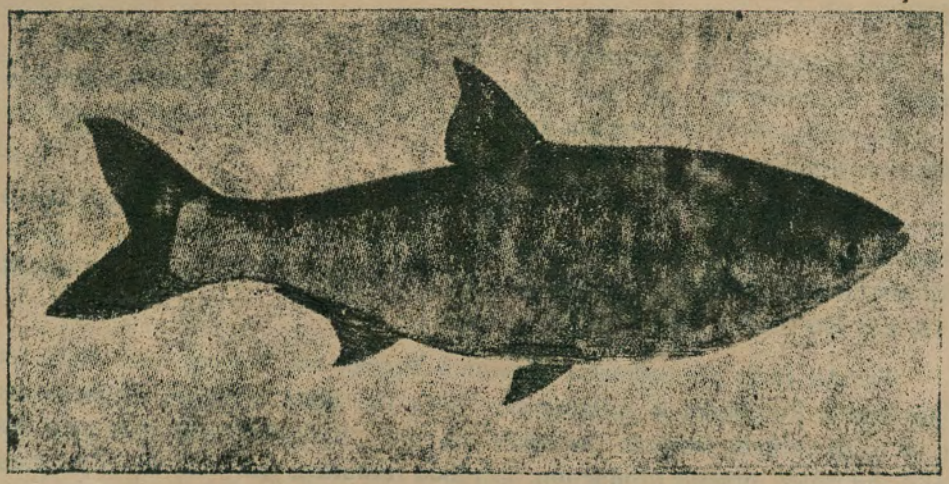
In West Bengal, a production of 5,000 kg/ha/5 months was assessed when 'magur'fingerlings (10-15 g) were stocked at 40,000/ha and fed with low grade dried marine trash fish and rice-bran mixture. Magur attained an average weight of 139 g in five months.

The All India Co-ordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs in collaboration with the State Fisheries Departments continued its various research activities on the physicochemical characteristics of soil and water, organic production, fish food resources, fish yield and dynamics of fish stocks in Bhavanisagar, Nagarjunasagar, Rihand, Getalsud and Govindsagar reservoirs.

Largely through manipulation and intensification of phase-wise fishing effort to 1.67 times over the conventional effort, the yield from the Bhavanisagar reservoir in Tamil Nadu could be raised to 75 kg/ha in 1976 against 19 kg/ha in 1971 when the reservoir was just taken under the project. Investigations at Moolathuria on the Bhavani river, a stretch up-stream of the reservoir revealed the availability of spawn of *C. catla*, *L. calbasu*, *C. mrigala*, *L. fimbriatus* and *L. bata*, indicating thereby the possibilities of natural stocking of the carp seed in the reservoir.

An experimental consignment of 2,860 fingerlings of exotic carp *Hypophthalmichthys molitrix* (60-90 mm/3-10 g) was stocked on March 15, 1974 in Getalsud reservoir, Bihar. A number of recoveries have since been made and it is noted that the fish registered a net growth of 4.3 kg in just 2 years and 4 months. One of the recoveries showed even a higher net growth of 4.7 kg in 2 years and 3 months. These observations not only indicate the potential role of silver carp both in Getalsud and other reservoirs of similar eco-morphological features, but also suggest the paramount need of stocking such reservoirs with a

phytoplankton feeding species, like silver carp— *H. molitrix* (Photograph 5). Only two of the seven recovered specimens could be analysed for gut contents, one of which measured 375 mm and the other, 792 mm. It merits mention that both the specimens showed *Microcystis* sp. as the dominant item of gut contents.



Photograph—5 : Silver carp, *Hypophthalmichthys molitrix.*

Investigations carried out in Rihand reservoir in Uttar Pradesh during 1976 confirmed earlier observations about the existance of 3 subspecies of *Catla catla.* The variations of pectoral length in these subspecies were established and from the studies on food & feeding habits of the fish, it was indicated that two of the subspecies freely consume the phytoplankter (*Microcystis* sp.) which form a major bulk of the plankton in such reservoirs. The findings significantly point out that these subspecies of *Catla catla* have immense role to play in the development of reservoir fisheries in India.

The All India Co-ordinated Research Project on Brackishwater Fish Farming with its Institute based subcentre at Kakdwip in West Bengal and five centrally sponsored subcentres one each in Andhra Pradesh, Goa, Kerala, Orissa and Tamil Nadu continued investigations during the year. One new centre in Maharashtra is being established.

Culture of bhetki, *Lates calcarifer*, has been done in feeder canals of the Brackishwater Fish Farm at Kakdwip. An approximate production of 3,000 kg/ha/yr has been achieved without any extra investment on feeding and other items. The fish fed on the trash fish and prawns which entered the feeder canals in course of ingress of the tidal water.

A significant achievement at the Kakdwip centre has been the development of the technology of mixed culture of prawn and mullets. In a six-species combination of prawns and fishes (*Penaeus monodon, P. indicus & Metapenaeus monoceros* among prawns and *Liza parsia, L. tade & Mugil cephalus* among mullets), a net production of 2,617 kg/ha/yr has been achieved.

In order to strengthen exchange of research publications, new exchange relationships were established with additional sixteen organisations ; *viz.*, Chief Publicity & Public Relations Officer, ICAR, Krishi Bhavan, New Delhi ; Hony. Technical Adviser, Fish Seed Syndicate Ltd., Howrah ; Secretary, North Eastern Council, Shillong ; The Breeder, Central Plantation Crops Research Institute (ICAR), Calicut, Kerala ; Director, Central Statistical Organisation, Department of Statistics, Ministry of Planning, Government of India, New Delhi ; Professor of Agricultural Entomology, Mahatma Phule Krishi Vidyapeeth, College of Agriculture, Kolhapur. Maharashtra ; Head, Department of Marine Science, Andhra University, College of Science & Technology, Waltair, Andhra Pradesh ; Officer-in-Charge, Veterinary College Library, Andhra Pradesh Agricultural University, Rajendranagar, Hyderabad ; Reader, Zoology Department, University of Allahabad, Uttar Pradesh ; Editor, Indian Science Abstracts, INSDOC, Hill Side Road, New Delhi ; Principal, Fisheries Staff Training Institute, Department of Fisheries, Madras ; Dy. Librarian, Bidhan Chandra Krishi Viswa Vidyalaya, P.O. Kalyani, Dist. Nadia ; Director, Central Staff College for Agriculture, C/o. Andhra Pradesh Agricultural University, Rajendranagar, P.O. Hyderabad (A.P.) ; Director of Administration, Directorate of Extension, Ministry of Agriculture, Shastri Bhavan, New Delhi ; Deputy Librarian & Incharge, Bihar University Library, Muzaffarpur ; and Director, Bureau of Economics & Statistics, Trivandrum, Kerala.

Research collaboration at international level with FAO, Ford Foundation, etc. :

Outstanding results of the investigation on culture fisheries conducted at this Institute were regularly communicated to the Food and Agricultural Organisation of the United Nations, Rome for publication in the "FAO Aquaculture Bulletin".

In order to further strengthen exchange of research publications, new exchange relationships at international level were established with three additional organisations ; *viz* , Project Co-ordinator, International Task Force, Centre for the Biology of Natural Systems, Washington University, St. Louis, Missouri (USA) ; Fisheries Development Authority, E.P.F. Building, Jalan Gasing,

Petaling Jaya, Malaysia ; and Librarian, Aquaculture Department, South-East Asian Fisheries, Development Centre, Iloilo, Philippines.

In collaboration with the International Development Research Centre, Canada, the "CIFRI/IDRC Project on Rural Aquaculture in India" was taken up at four centres in two States ; *viz.*, West Bengal and Orissa.

West Bengal Centres :

In West Bengal, the two centres were located at Hanspukur-Bishnupur (24-Parganas) in South Bengal and Harishchandrapur-Khasimari (District Malda) in North Bengal. A preliminary survey of soil and water qualities of ponds of these areas was undertaken before initiating the work. While composite fish culture was undertaken at all the centres, fry and fingerling rearing techniques were also demonstrated at the Hanspukur-Bishnupur Complex.

Hanspukur-Bishnupur Complex (District 24 Parganas) : Breeding of common carp was undertaken in March and the fry raised was utilised for monoculture of common carp in Bratacharigam. While the survival up to fry stage was over 50%, fingerling production in the rearing ponds was as low as 30% as some murrels had inadvertently entered the pond from the adjacent drain.

About 12,099 kg of fish was harvested from the stocking ponds by May/ June 1976, showing a production ranging from 3,264 kg/ha/11 months to 6.033 kg/ha/11¼ months. The cost of fish production based on total inputs in the form of feed, fertilizer and labour worked out to Rs. 2.34 to 3.24 per kg.

A total of 16 small ponds (0.97 ha) for fry/fingerling rearing and 16 large ponds (4.70 ha) for composite fish culture, covering a total area of 5.685 ha in 10 villages were taken up by the Project from July 1976.

Techniques of induced breeding of Indian major carps were demonstrated in 4 villages ; *viz.*, Amgachhia, Bishnupur, Keorapukur and Jokha. 0.1 million spawn, produced by inducing a set of rohu to breed at Siksha Sangha (Mission School) at Bishnupur, was handed over to the school authorities. The spawn (2·2 lakhs) produced at Hada Textiles from a single set of rohu was raised to fry size in a 0.045 ha pond stocked at 5 million spawn/ha at Khariberia. A survival of over 77.7% was obtained (as 9,000 fingerlings were also harvested after a month in addition to the fry) and the fry thus raised was utilised for stocking 15 rearing ponds @ 1 to 1·6 lakhs fry/ha for demonstrating techniques of fingerling rearing to the fish farmers in the Complex. A production ranging from 333.3 to 1,830 kg of fingerlings/ha/three months with a survival from 13.3 to 91.1% was

obtained. However, the average survival and production worked out to 59.3% and 794.4 kg/ha/3 months respectively.

In a 6-day training course organised for the workers of the Socio-Economic Development Project, Keorapukur (West Bengal), lectures and practical demonstrations on composite fish culture, fish breeding and fry & fingerling rearing were given.

Harishchandrapur-Khasimari (District Malda) : About 0.31 million common carp spawn were produced and reared to the fry stage, of which 33,000 fry were distributed to the fish farmers in the nearby villages through the Fisheries Extension Officer, Harishchandrapur Block. The remaining fry were left in the pond for the use of the pond owner.

A total of 6,032 kg of fish was harvested. The fish production ranged from 1,038 kg/ha/7 months to 2,793 kg/ha/8 months and the cost of production, from Rs. 2.53 to 4·89 per kg.

The centre has since been shifted to Malda where 12 ponds covering 5·95 ha in area have been taken up for composite fish culture. The stocking density and proportion of various species are the same as at Hanspukur-Bishnupur Complex.

Orissa Centres :

Investigations under the Rural Aquaculture Project was continued in Orissa at two centres ; *viz.*, Aska (Ganjam District) and Birahare Krishnapur—Gopinathpur Complex (Puri District), covering 28 ponds located in 16 villages. The total water area under the project was 5·92 ha in Puri district. The necessary pond preparations were done in scientific lines and the seed of six species of Indian major and exotic carps were stocked @ 5,000/ha. Regular fertilisation and artificial feeding were also continued.

A total quantity of 30,703 kg of carps was harvested from 10·01 ha area of ponds during the year, giving an average production rate of 3,067 kg ha/yr. Thus, the production target set for the Orissa centres was achieved. The average cost of production of fish at two centres worked out to be Rs. 2·58 and Rs. 2.81/kg.

The confidence generated among the rural community on the soundness of the technology and high economic viability as demonstrated through the Rural Aquaculture Project is reflected from the growing demand for learning the techniques and construction & renovation of ponds in village areas.

Seeds of *Mugil cephalus* collected in limited numbers from the mouth of the river Mahanadi were also stocked in a few ponds in Aska centre, to observe the rate of survival, growth and production potential of the mullet.

Fellowship and Studentship :

The undermentioned ARS Probationers joined the Institute and are undergoing training :—

Sarvashri L. H. Rao, K. J. Rao, S. N. Mohanty, P. K. Aravindakshanan, B. C. Tyagi, A. Mukherjee, Hardyal Singh, Jagadish Chandra, Kuldip Kumar, Manash Kumar Das, Y. S. Yadav, Sukriti Ranjan Das, Ashok Kumar Saha, A. K. Laal, Aravinda Sen, Radha Charan Das, S. K. Munnet, V. R. Chitranshi, Utpal Bhowmick, R. Paul Raj, S. M. Pillai, P. Ravichandran, Smt. S. Sivakami, Smt. Kuljeet K. Bhanot, Km. M. Sultana, Km. Usha Bali, Dr. K. Janaki Ram, Dr. P. M. Mathew and Dr. Babulal.

ARS Probationer on fisheries of the Central Rice Research Institute, Cuttack, Shri D. P. Sinhababu is also undergoing training at this Institute alongwith others.

Following Research Scholars who joined the Institute in various disciplines are now posted at different research centres of the Institute to carry out investigations on the problems allotted to them :—

Shri Saibal Saha	Fish and Fisheries
Shri B. R. Belurkar	"
Shri B. R. Vaijinath Rao	"
Shri Satish Asotra	"
Shri R. V. Badre	"
Km. Gouri Chakraborty	"
Km. Santoshini Panigrahi	"
Km. Neelima Sharma	"
Shri Ashis Prasad Mukherjee	Agricultural Chemistry
Shri Salil Kumar Barua	Agricultural Economics

Research Associations :

The scientists and the technical staff took active interest in the organisation and management of the "Inland Fisheries Society of India". During the year, Vol. 8 of the journal was published by the Society.

The Institute continued to have institutional membership of the following societies and associations :

Indian

1. The Asiatic Society, Calcutta
2. Indian Association of Water and Water Pollution Control, Nagpur

3. Indian Science Congress Association, Calcutta
4. Inland Fisheries Society of India, Barrackpore
5. Marine Biological Association of India, Cochin
6. Indian Fisheries Association, Bombay
7. Indian Society of Ichthyologists, ZSI, Madras
8. Association of Agricultural Librarians & Documentalists of India, New Delhi

reign

1. The Fisheries Society of the British Isles, Huntingdon, England
2. Societas Internationalis Limnologiae, Michigan, U.S.A.

Advisory service received and provided :

Information on different aspects of inland fisheries research ; *viz.*, techni-ues of composite fish culture, fish breeding, collection techniques and analyses water samples, cultivability of different fish and prawn species, frog culture, ge culture, control of aquatic weeds, taxonomic studies, etc. were communicated various scientific personnel and to a number of institutions in private and ublic sectors in India and abroad.

Questionnaires on "contamination in aquatic organisms", "water pollution" nd "the work done in tribal areas under the All India Co-ordinated Research rojects", received from the ICAR, New Delhi, were attended to by the Institute nd were replied suitably.

A note on "*Chanos* culture in India" was compiled and furnished to Shri . P. Devasundaram, Deputy Commissioner (IF), Ministry of Agriculture & rigation, Government of India, New Delhi. To meet the demand of Shri M. M. oshi, Director, Department of Animal Husbandry, Government of Rajasthan, ipur (Rajasthan), a write up on the techniques developed by the Institute for timating fish population in a pond was prepared and sent.

Under the regular practice of providing reference services for published terature of the Institute, the publications pertaining to "the bibliography on rass carp", "pisciculture with poultry", "biological control of *Salvinia*" and splashless tank" were sent to the Assistant Research Officer, Gwalior, Madhya radesh ; Director of Fisheries, Government of Maharashtra, Bombay ; irector of Fisheries, Government of Kerala, Trivandrum ; and Regional isheries Development Officer, Aurangabad.

Necessary information and advice regarding the setting up of dolphin pools y the State Fisheries Department were communicated to Dr. D.K. Kaushik, irector of Fisheries, Haryana as per the programme of information service of the stitute's Library.

Under the same programme, Shri H.P.C. Shetty, Director of Instructions, Fisheries College, Mangalore, was informed about the details on the achievements of the Institute in the field of frog culture, besides helping Km. Promodini N. Baradekar, Documentation Officer, City & Industrial Development Corporation of Maharashtra Ltd., Bombay with the supply of know-how about the development of inland fisheries in New Bombay area.

Among various other enquiries attended to during the year, the information on food & feeding habits and other biological aspects of *Tilapia mossambica* was provided to Smt. Rita Bhatia, Head, Technical Information Service (AFRRO), Community Centre, New Delhi.

Besides, advising and furnishing information in response to the queries put in by the scientists, government officials and general public of the country, necessary assistance was also rendered to the foreign organisations and individuals in providing information on various aspects of inland fisheries of India.

Information on breeding of *Mugil cephalus* alongwith the literature and on the fishery biology of penacid prawns were provided to Mr. Nasar Mourad Shefik, Asstt. Researcher from Egypt and to Mr. Biol Danial Lluck Belda, Institute Nacional de Pesca, Mexico, respectively. Information on trout sperm preservation, fertilisation, etc. was furnished to Dr. W. Holtz, Institut Fur Tierzucht, Gottengen, West Germany.

Among other noteworthy foreigners, Dr. Pierre Lasserre, Institute of Marine Biology, France and Miss D. S. Fernando, Research Officer, Galle Face, Colombo were provided with the information on problems of lagoons in India and with the achievements of the Institute in monoculture of *Daphnia* sp. respectively.

A list of scientific papers of this Institute was forwarded to Mr. E. W. McCoy, Department of Fisheries and Allied Aquaculture, Alabama (USA) for inclusion in their Bibliography.

Institute's publications and reprints on "carp cuiture", "role of algal bloom in fish ponds", "aquatic weed control", etc. were sent to Mr. Alphonse Collart, Fishery Advisor, UNDP/FAO, Madagascar ; Dr. K.T. Augusthy, Lecturer in Fisheries, Chitwan, Nepal and Mr Waheeb Labub Daoud, Kanater Fish Farm, Egypt and others.

Extension and nation building activities :

For dissemination of results of research of practical value, emerging from the research activities, various extension pamphlets printed by the

Institute in the past and an illustrated pamphlet on "Glass Jar Hatchery" produced during the year were distributed to all the State Fisheries Departments ; Union Territories, Agricultural Universities ; ICAR ; the Ministry of Agriculture & Irrigation, Government of India ; and other enterprising fish farmers for their use. A brochure on the Central Inland Fisheries Research Institute brought out during the year was also distributed.

Dr. V.G. Jhingran, Director, CIFRI, presided over the inaugural function of the Assam Science Society's Annual Conference on February 22, 1976 and in his presidential remarks, Dr. Jhingran apprised the audience of the recent developments of inland aquaculture in the country and its bearing on the intergrated rural development programme. While delivering the Second H. K. Mukherjee Memorial Lecture at the Department of Zoology, Calcutta University on August 11, 1976, Dr. Jhingran highlighted the significant achievements of the Institute made during the past few years in inland aquaculture in the country, laying particular emphasis on the modern technology of composite fish culture developed by the Institute.

On February 24, 1976 in a discourse with the members of the Bombay Natural History Society in Bombay, Dr. Jhingran apprised them of the recent advances in freshwater aquaculture in the country. He expressed his view that the adoption of the composite fish culture technology developed by the CIFRI will not only boost the production of fish from culturable waters but will also help establishing fish culture as a sound industry in the country. He also stressed the importance of developing air-breathing fish culture in swampy and derelict waters with profitable returns as has been demonstrated in the States of Assam, Bihar and Karnataka by the Institute based All India Co-ordinated Research Project on Air-breathing Fish Culture.

Under the joint auspices of the Calcutta chapter of the Indian National Science Academy and the Indian Institute of Experimental Medicine, Dr. V. G. Jhingran, Director of the Institute and Dr. V. R. P. Sinha, Project Co-ordinator were feliciated for winning the Rafi Ahmed Kidwai Memorial Prize of the ICAR at a meeting held at the IIEM auditorium, Calcutta on June 26, 1976. On this occasion Dr. Jhingran delivered a profusely illustrated talk on "Breeding and culture of cultivable carps".

The concept for the technology of aquaculture was explained to the students and teachers of the Department of Zoology, Kalyani University, Kalyani, West Bengal by Dr. V. G. Jhingran on August 21, 1976. A colour film, "Composite Fish Culture", produced under the technical advice of this Institute

by the Films Division, Govt. of India and which had won international acclaim was also screened for the benefit of the students.

On December 7, 1976 at the auditorium of the Indian Institute of Experimental Medicine, Calcutta, Dr. V. G. Jhingran gave another illustrated lecture on "Recent Advances in Carp Culture in India" which was followed by two educational films entitled "Induced Breeding" and "Composite Fish Culture", the former had won the first prize amongst the educational films presented at the FAO International Conference held in Japan.

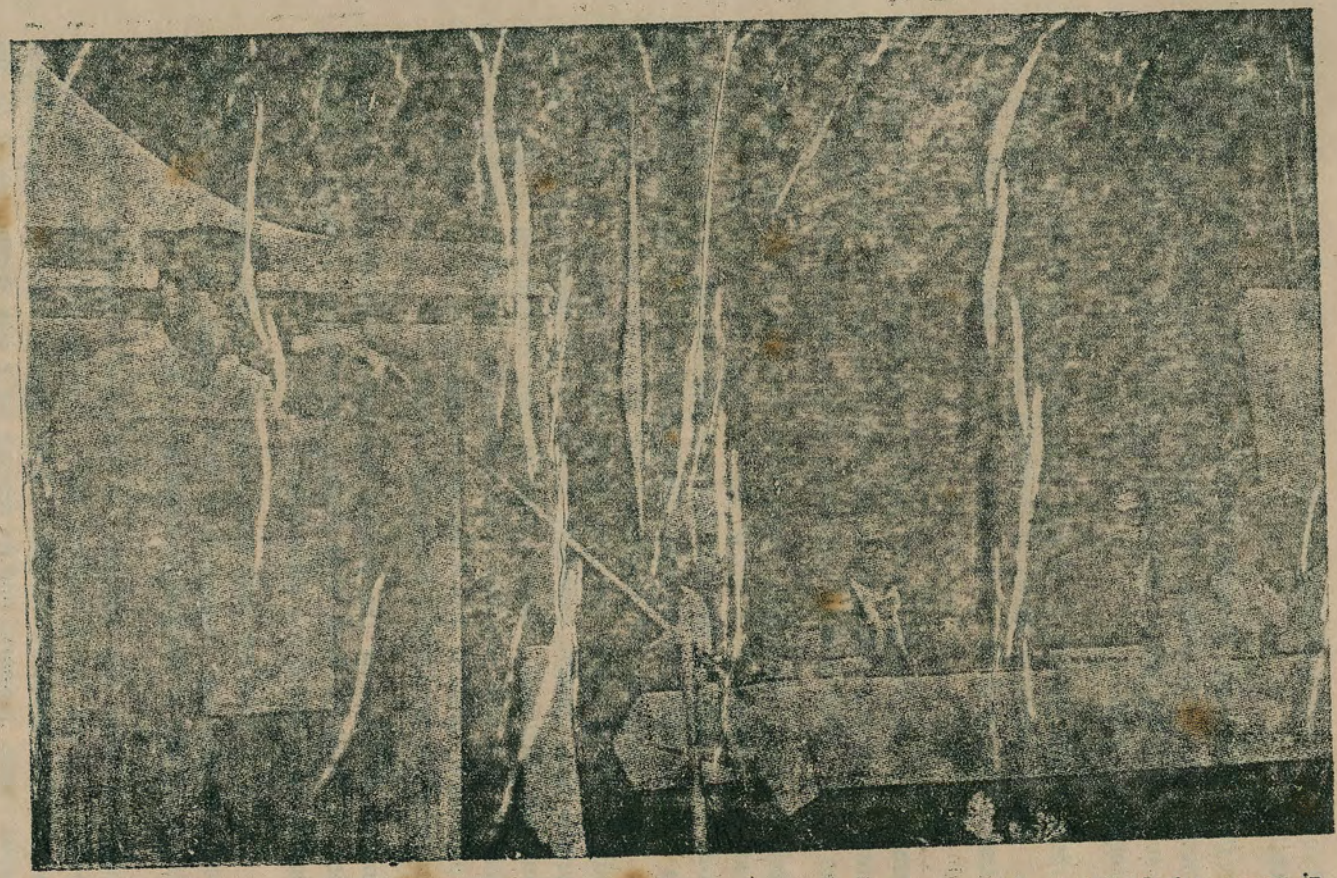
A ten-day training course from April 1 to 10, 1976 on "Composite Fish Culture and Fish Seed Production" for Fish Farmers' Development Agency Officials was organised by this Institute. In all 9 officers from different centres participated in this training.

For the benefit of fishery operatives in West Bengal and Orissa, an eight-day training course in "Brackishwater Prawn and Fish Culture" was organised jointly by the Institute and the Marine Products Export Development Authority India, during June 21 to 28, 1976 at the Kakdwip Research Centre of the CIFRI. Thirtysix trainees (28 from West Bengal and 8 from Orissa) participated in the training. Brochure incorporating lectures, both in English and Bengali, on different aspects of brackishwater fish and prawn farming were presented to the trainees on the inaugural day of the training course at Barrackpore (Photograph 6).

A Summer Institute on "Fish seed production and mobilization for culture fisheries of inland waters" sponsored by the Indian Council of Agricultural Research was held at the Central Inland Fisheries Research Institute, Barrackpore from June 14 to July 13, 1976. The first session of the Summer Institute was held at Barrackpore from June 14 to June 30 and the second session from July 1 to 13 at Cuttack Research Centre of the CIFRI. Twentyfour participants from various Universities, Institutions and State Fisheries Departments attended the same.

Shri P. Das, Extension Scientist delivered a talk on "Induced breeding and composite fish culture and their economics" to the Field Officers of the State Bank of India, Calcutta at the refresher's course on "Agricultural Finance" on December 12, 1976. Films entitled "Induced breeding" and "Composite fish culture" were also screened for the benefit of the participants.

An eight-month core-training course for the first batch of 29 ARS Probationers was arranged at the Institute and was inaugurated on November 1, 1976. Since then training in different aspects of inland fisheries was imparted



Photograph 6—Shri A. N. Ghosh, Scientist S-2, speaking on the occasion of inaugural day of the training course in "Brackishwater Prawn and Fish Seed Culture". Shri K. Chidambaram, Director, MPEDA, Shri B. Sivaraman, Member, Planning Commission and Dr. V. G. Jhingran, Director, CIFRI, are seen on the dias

to the ARS Probationers at the Headquarters and at different research centres of the Institute.

Under the Operational Research Project functioning at Krishnanagar Fish Farm, District Nadia, West Bengal, the second set of experiment on composite fish culture in three large ponds measuring 2.15, 1.93 and 1.48 ha in area was conducted during the year.

The three ponds yielded 21·15 t of fish, corresponding to an average of 3,854 kg/ha. About 2 million spawn of common carp was also produced and distributed free of cost to the local fish farmers of the area and State Fisheries Department.

An amount of Rs. 64,780 which included all inputs, wages of watchmen, etc. was spent to produce 21,150 kg of fish and 20 lakhs spawn. The average cost of production of fish inclusive of all inputs and wages came to Rs. 3·06/kg.

The fish produced from these operational research ponds was sold to the local public at a Government fixed rate of Rs. 6—7/kg, depending upon the size of the fish, through four different fish sale counters especially set up for the purpose by the Nadia District fishermen Co-operative Federation. The sale of fish started towards the end of August and continued for over two months. Such a sale of farm produced fish at a very low rate fixed by the Government has been an unique activity in West Bengal, especially during the Durgapuja days when the fish price touch the maximum. Long queues of men, women and children in the morning near the fish sale counters were exhilarating scenes in the town. The enthusiasm and local demand was so heavy that the entire operations had to be personally supervised by the District Magistrate, Nadia.

The immediate impact of the project has been, a considerably lowering of fish prices in the local markets, thus directly contributing to the Government's policy of reducing the prices of consumer items.

What has been achieved and demonstrated at Krishnanagar can be easily extended to other water areas, especially in West Bengal. If this is done, it will greatly reduce the scarcity of fish and its prices in the State.

In order to train the villagers in the scientific methods of fish culture, several meetings of the pond owners were organised in different villages of Jagannathpnr and Kandarpur Panchayats. Two ponds each in Jagannathpur and Kandarpur were prepared and fry rearing work was demonstrated to the

villagers. A total of about 29,000 fry of rohu and mrigal raised in these ponds was sold to other fish farmers of the area. The fish farmers realised an income ranging from Rs 112.50 to Rs. 588.00 and the other farmers of the area were benefited by getting the quality fish seed within their village area itself at comperatively much cheaper price than the usual exorbitant price prevailing in the rural area In order to extend the technique of scientific fish culture, seven ponds have been prepared and stocked with fry of Indian and exotic carps @ 5,000/ha. The fish farmers are provided with technical guidance for the preparation and manuring of their ponds and supplementary feedings of the fishes.

Besides organising meeting in the villages, the technique of fish culture has been explained to the participants of 'Kishan Mela' organised by Central Rice Research Institute, Cuttack. The officials of the Orissa University of Agriculture and Technology were given technical assistance in the selection of suitable ponds in their Operational Research Project area for raising fry.

Shri Shah Nawaz Khan, Union Deputy Minister for Agriculture and Shri Radhanath Rath, Editor of "Samaja" were among the persons who visited this to note the impact of fish culture programme under the Operational Research Project of the Institute in Orissa.

A six months' specialized training on different aspects of inland aquaculture was imparted to Mr. Agyeman Ofori Badu of Ghana and Mr. A. N. Rouma of Tunisia during their stay at this Institute.

Comprehensive training on different aspects of inland fish culture was imparted to different batches of fishery trainees from (i) Central Institute of Fisheries Education, Bombay ; (ii) Inland Fisheries Training Unit of the Central Institute of Fisheries Education, Barrackpore ; (iii) Regional Training Centre of Fisheries Operatives, Agra ; (iv) Regional Training Centre for Fisheries Extension Workers, Hyderabad and (v) Fisheries College, Mangalore.

Laboratory and Library facilities were extended to various trainees, visitors, research scholars, Agricultural Research Service probationers and to the participants of the Summer Institute, 1976. Seeds of Indian and Chinese carps were distributed to a large number of organisations, individuals and State Fisheries Departments in persuit of the objective of popularising aquaculture in a big way, besides helping Foreign Governments with their fish seed requirments. The details of spawn, fry and fingerlings of carps supplied are given in table 1.

Table 1—Spawn, fry and fingerlings supplied to various agencies during the year 1976

Agencies	Indian major carps		Exotic carps		Common carp	
	Spawn (lakh)	ry & Fingerlings (No.)	Silver carp Fry & Fingerlings (No.)	Grass carp Fry & Fingerlings (No.)	Spawn (lakh)	Fry & Fingerlings (No.)
1. I.D.R.C.	7.80	15,300	23,270	8,456	—	5,250
2. Orissa Fisheries Department	5.80	10,400	1,500	1,500	—	—
3. Operational Research Project	5.21	2,500	850	50	—	1,400
4. Mauritius Government	—	—	3,300	3,300	—	1,300
5. Karnataka State Fisheries Department	—	—	500	—	—	—
6. Kerapukur Project, Calcutta (SEDF)	—	—	300	300	—	—
7. Rajasthan Fisheries Department	—	—	250	—	—	—
8. Manipur Fisheries Department	—	—	250	250	—	—
9. Burdwan University	0.01	—	—	—	—	—
10. Research Centres of the CIFRI	19.90	8,012	6,444	1,045	2.0	1,020
11. Private Parties	1.80	45,281	23,085	710	1.0	45,100
TOTAL	40.52	81,523	59,749	15,611	3.0	54,070

Finance :

The provision of funds for the financial year April, 1976 to March, 1977 was as under :—

Non-Plan	Rs. 54,98,000/-
Plan	Rs. 75,00,000/-
Total	Rs. 129,98,000/-

Against the above provision, the expenditure from 1.4.76 to 31.12.76 was as follows :—

Non-Plan	Rs. 41,49,738/-
Plan	Rs. 40,38,716/-
Total	Rs. 81,88,454/-

Table 2—The details of problems under various research projects suspended, completed or transferred to other projects during 1969-1976.

Code nos. for problems suspended					Code nos. for problems completed								Code nos. for problems transferred to other project.
1972	1973	1974	1975	1976	1969	1970	1971	1972	1973	1974	1975	1976	1969—1976
4.3	1.15	14·9	1.2	1.28	14·3	1,5	1.8	1.3	1.7	1.20	1.18	1.23	4.1
13.9	2.5		1.14	3.6		2.1	1.16	1.4	1.12	5.11	1.22	1.27	4.2
17.5	3.10		1.17	13.10		3.7	13.3	1.6	1.19	11.1	5.1	2.2	5.3
	3.11		5.25	ABF-6		13.1	14.4	1.9	4.4	11.2	5.8	3.9	5.19
	9.3		13 11	IDRC-6		13 4		1.10	5.2	19.2	5.10	3.12	5.24
	19.3		13.12			13.5		1.11	5.7		5.13	5.20	5·43
	19.6		14.8			13.7		1.13	5.9		5.14	6.1	6.3
	21.1		CFC-5					2.3	8.2		5.15	8·5	7·1
	21.2							3.1	8.3		5.16	11.4	7.2
								3.2	9.1		17.6	11.5	8.4
								3.3	11.3		20.2	12·4	14.2
								3·4	12.1			13.18	16.2
								3.5	12.2			15.1	19.7
								5·4	14.5			16.8	
								5.5	16.1			16.9	
								5.6	16.4			17.9 (b)	
								9.2	17.1				
								12.3	17.2				
								13.6	17.3				
									17.4				
									19.1				
									19.4				
									19.5				
									20.1				

No. of Problems suspended during various years

1962—3
1973—9
1974—1
1975—8
1976—5

TOTAL=26

No. of Problems completed during various years

1969—1
1970—7
1971—4
1972—19
1973—24
1974—5
1975—11
1976—16

TOTAL=87

No. of Problems transferred to other projects up to 1976

TOTAL=13

2. Progress of Research

Research investigations on twentytwo research projects (excluding project 7) of the Institute, twentytwo research problems of the Institute based All India Co-ordinated Research Project and five research problems of the CIFRI/IDRC/WB Project were continued during the year 1976 as per scheduled programme. Each project has several problems to be handled on priority basis. Due to practical difficulties, investigations on the research problems "**1.28** : Commercial production of carps through composite culture in large sized ponds", "**3.6** : Fisheries of Peninsular tanks—assessment of biological productive potentialities", "**13.10** : Food of *Salmo trutta fario* in natural streams", "**ABF 6** : Culture of air-breathing fishes in cages installed in swampy waters", and "**CIFRI/IDRC/WB 6** : Assessment of energy inputs in semi-intensive fish culture" had to be suspended in 1976. Moreover, research work on "Project 7—Murrel and live fish cultures" was discontinued as the investigations are being conducted under the Institute based All India Co-ordinated Research Project on Air-breathing Fish Culture (Table 2).

(a) Research completed :

Since the Institute embarked on time bound project programme in 1976, investigations on 87 problems ; *i.e.*, one problem in the year 1969, seven in 1970, four in 1971, nineteen in 1972, twentyfour in 1973, five in 1974, eleven in 1975 and sixteen in 1976 were completed. Brief reports on those problems completed during the years 1974 and 1975 but finalised later are presented below alongwith the problems completed in 1976.

Project 1 : Optimum per hectare production of fry, fingerlings and fish in culture fishery operations

Problem	:	1.22	Biology of fish food organisms—Cladocera (Water fleas)
Personnel	:		R. D. Chakrabarty, S. Jena, D. R. Kanaujia and B. Dash
Duration	:		Four years

A number of laboratory experiments were conducted to culture *Moina* sp. in experimental jars. The species selected for study is known to occur prominently among gut contents of the cultivable carps.

Organic fertilizers ; *viz.*, mahua oilcake, cow dung and poultry droppings were used separately in the culture media @ 100, 200 and 300 ppm as well as at higher doses. Experiments confirmed that the higher doses of manure resulted in early death of the animalcules. Cow dung and poultry droppings were put into the culture media a day before ; but mahua oilcake was released 13 days prior (in case of 100 ppm level) and 22 days prior (in case of 200 and 300 ppm levels) to the initiation of the culture.

In the jars with lower concentration of mahua oilcake, the multiplication and increase in the number of animalcules were noticed till about the 17th day whereafter these started dying. With the higher dose of 200 ppm the population increased up to the 22nd day, whereafter in 3 to 4 days time all the animalcules died. Results obtained with cow dung and poultry droppings were less satisfactory. Pond water filtered in nylo-bolt proved better medium than tap water.

These experiments revealed that mahua oilcake might be made use of @ 100 ppm for the production of useful fish food organisms, like *Moina* sp. in pits, etc. The animalcules can be inoculated in the ambient water two weeks after the manuring with mahua oilcake and can be harvested before they die. The pits may be replenished with solution containing mahua oilcake. This may help in providing natural fish food organisms to the pond grown fishes in a continuous manner.

Based on the above findings, biological investigations of *Moina* sp. are being undertaken separately under a new research programme.

Problem	:	1.23	Evolving efficient method for capture of bottom dwelling fishes in ponds
Personnel	:		M. Rout, M. A. V. Lakshmanan and D. R. Kanaujia
Duration	:		Three years

The newly designed sinker net for capturing bottom dwelling fishes was further improved by fixing one long detachable cotton net pocket having 30 cm diamater to the main net. Burnt clay sinkers were tied at the foot rope. As a result of the modification, the catch increased by 5% in the pocket-net along with surface, column and bottom dwelling fishes in the main net.

Nylon twine of 210/1/3, 210/2/3, 210/3/3 were tried for improving the gill nets. The catch efficiency decreased with the increase in the diameter of the twine. Bottom dwellers constituted 30-35% of the total catch in the gill nets. The details of the report are being finalized.

Problem	:	1.27	Comparative study of the structure of the gill apparatus of the Indian major carps, catla, rohu and mrigal and its development with age and correlation with feeding
Personnel	:		R. D. Chakrabarty, S. N. Datta and B. Dash
Duration	:		Two years

To study the gill apparatus of pond grown catla, rohu and mrigal specimens of different sizes were examined.

Catla has more closely arranged long filamentous gill rakers presenting a somewhat comb-like appearance, the gill raker length and gill filament length ratio in catla indicates a better filtering ability of the species than that of the other two carps, rohu and mrigal. The average number of rakers in marketable sized catla (*i. e.*, about 1 kg in weight) was about 280, in contrast to the much smaller number of 80 and 85 in rohu and mrigal respectively. The gill filaments are widely apart and short in the latter two species indicating less effective sieving mechanism. This difference among the species is also evident in the fingerling stage where the gill filament number was slightly over 100 in catla in contrast to half the number of filaments in the other two species.

Gut content analysis of catla of various sizes revealed that the food consisted mainly of zooplankton (semidigested cladocerans, copepods and rotifers) and phytoplankton (diatoms, Chlorophyceae, Myxophpceae and *Euglena* sp.)

The gut contents of rohu revealed presence of zooplankton, phytoplankton and semidigested vegetable matters. Broken entomostracan appendages and rotifers among zooplankton and diatoms, Chlorophyceae, Myxophyceae and *Euglena* sp. among phytoplankton were observed.

Analyses of guts of mrigal indicated presence of mud and sand, semi-decayed vegetable and organic matters, besides, phytoplankton comprising diatoms, Chlorophyceae, Myxophyceae and *Euglena* sp.

The planktonic food items encountered in the guts of the three indigenous carps seem to suggest that the fishes are not capable of exerting any selection in the food ingested and as such there is some overlapping in the food spectrum of the species. Such food items are present in all the niches of the pond and the competition for food may be much less than the food picture might indicate.

Project 2 : Induced fish breeding

Problem	: 2.2	Use of various hormones for inducing spawning in carps
Personnel	:	R. M. Bhowmick, G. V. Kowtal, R. K. Jana and S. D. Gupta
Duration	:	Nine years and six months

Homo- or heteroplastic pituitary glands are extensively used in hypophysation of Indian and Chinese carps. The collection of pituitary glands from the donor fishes is very expensive. Further, the required quality and quantity of glands are not ensured. In order to find out a suitable substitute for carps' pituitary glands, cheaply and readily available pituitary glands of freshwater fishes (other than carps), marine and brackishwater fishes were collected to study their efficacy in hypophysation. Fractionated salmon gonadotropins, purified/ synthetic mammalian hormones and chemicals were also tried.

Pituitary glands of freshwater catfishes, like *Pangasius pangasius*, *Bagarius bagarius*, *Silonia silondia*, *Mystus seenghala* when injected @ 8—15 mg/kg, successfully induced spawning in *L. rohita*. Whereas pituitary glands of *Tilapia mossambica*, *Notopterus chitala* and *Channa* spp. @ 8—20 mg/kg gave negative results. Pituitary gland extract from marine and brackishwater fishes belonging to *Sciaena* spp., *Lates calcarifer*, *Sillago sihama*, *Sphyraena* sp., *Caranx* spp., *Pampus* spp., *Mugil cephalus*, *Arius* spp. when injected at a dose range of 8—25 mg/kg failed to induce spawning in rohu. In all the cases the controls yielded positive results.

Human chorionic gonadotropin prepared in the laboratory and Synahorin (HCG extract of Anterior Pituitary) when injected in combination with a low dose (2—4 mg/kg) of carp pituitary successfully induced spawning in rohu. Thus the carp pituitary requirement is reduced by about 50—60%.

Antuitrin—'5' (Chorionic gonadotropin) gave negative results when injected alone or in combination with carp pituitary extract. The controls gave positive results.

Leutocycline alone @ 15—25 mg/kg or in combination with 3 mg/kg of carp pituitary extract failed to induce spawning in rohu and the sets treated with LH & RH in combination also gave negative results. The controls spawned in both the cases.

2,000 mg of salmon gonadotropin in powder form was received from IDRC Canada in 1975. It was tried on other Indian major carps, besides rohu, at dose range of 4—15 mg/kg and 80% success was achieved. The controls in the above dose range gave positive results comparable to the experimental ones.

In 1976, four coded samples of salmon gonadotropins namely S. G. Code 13, 13(B), Code 341 (Acetone dried P. G. Powder) and Chum Salmon 1975 were received from IDRC Canada for testing their efficacy in hypophysation of carps. Code 341 alone gave positive results (64.3%) when injected @ 25—90 mg/kg. The control gave better results.

Clomiphene citrate when administered to *L. rohita* at a dose range of 8—28 mg/kg gave negative results but the controls responded in all the sets of experiments.

To maintain a steady supply of pituitary glands round the year, common carp fingerlings are required to be raised as donor fish in the farm itself. By adopting this procedure it will be possible to meet the requirements of pituitary glands to a great extent before the commencement of fish breeding season. Trials with synthetic hormones and other mammalian hormones have been taken up separately as new research problems.

Project 3 : Reservoir fisheries

Problem	:	3.9	(Final report is being compiled)
Problem	:	3.12	Assessment of primary productivity of tanks
Personnel	:		S. L. Raghavan, B. V. Govind and M. F. Rahman
Duration	:		Six months

Assessment of gross and net primary productivity in irrigational tanks was considered essential for estimating fish productive potential of such water bodies. Based on the objective, a short term investigation was taken up in two tanks (2 ha each), one each at ASC Centre (South) and Bilvardhahalli near Bangalore.

The primary productivity values were observed to range from 429.5—743.4 and 278.2—450.0 mg C/m^3/24 hr at ASC Centre and Bilvardhahalli respectively. Higher values of both the centres ; *i. e.*, 743·4 and 450·0 mg C/m^3/24 hr were recorded in the months of April and June, 1976 respectively. The high value during April in ASC Centre may be appertained to the presence of myxophycean. During monsoon months, the productivity values were observed to be low at both the centres.

It is suggested that further studies on primary productivity of such tanks should be taken up with respect to different seasons and correlated with the distribution of plankton as well as fish production from such water bodies.

Problem 5 : Brackishwater fish farming

Problem	:	5.10	Detailed survey of Mahisani island for designing brackishwater fish farms
Personnel	:		A. Sengupta, B. B.Pakrasi, P. Ray, A. B. Mukherjee and P. N. Bhattacherjee
Duration	:		One year

The detailed contour survey of 320 ha area in Mahisani island has been completed and lay out and design have also been prepared for an area of 600 ha of the island. The important characteristic of the island is that the coastal regions are at a lower level than the interior areas. The difference between maximum and minimum levels is 1.30 m. As such different depth excavations are to be made for taking tide waters up to a depth of 1 m in the brackishwater ponds when constructing a brackishwater fish farm.

It is observed that there is a considerable level difference between different portions of the island and hence it is suggested that for any further designing of a brackishwater farm, a proper contour survay should be made for the site selected in the island where no survey has so far been made.

Problem	:	5.11	Quantitative assessment of brackish-water fish and prawn seed in Bakkhali region
Personnel	:		N. C. Basu, B. B. Pakrasi and A.V.P. Rao
Duration	:		Three years

Based on the preliminary work during 1972, collection centres were selected. As such, two centres on Bakkhali creek and one centre on Kumiraganda canal were prospected for fish and prawn seeds. Standard Midnapore type nets, three in a row in the Bakkhali creek and one in the Kumiraganda canal, were operated to cover the entire cross section of the flowing water. Collections were made for 332, 394 and 73 hours respectively at Bakkhali centres I & II and Kumiraganda centre during April—June '73, January—June '74 and April—June '74 respectively. A total of 37 lakh/620.5 litres of fish fry and prawn larvae were collected and about 77 species of them were encountered in the collections. During spring tides, the catch ranged from 495 to 29,993/net/hr. The major and minor peaks of larval abundance were April to June, February to April, April & June at Bakkhali centres I & II and Kumiraganda centre respectively. Bakkhali centre II was most productive followed by Kumiraganda centre and Bakkhali centre I in order of larval abundance. The major peaks were always in the first fortnight of February or April and were irrespective of the lunar phases or diurnal variations. Year-wise percentage composition of the juveniles of commercially important prawns and fishes encountered in the collection are given in table 3 (placed overleaf).

Physico-chemical parameters as observed at these collection centres were : air temperature (15.5°—33.5°C), surface water temparature (18.6°—32.6°C), transparency (6.5—14.9 cm of Secchi Disc) and surface water salinity (23.9—34.6‰).

With the establishment of these centres as good sources for brackishwater fish and prawn seeds, specially for quality prawn as well as for *Mugil parsia* and *Chanos chanos*, the scope for obtaining sufficient stocking materials for the proposed 200 ha brackishwater fish farm in the area, has increased considerably.

Problem	:	5·16	Culture of *Lates calcarifer*
Personnel	:		A. N. Ghosh, P. K. Pandit and H. C. Karmakar
Duration	:		Three years

Table 3—Year-wise percentage composition of commercially important prawn and fish

Name of species	*1973*	*1974*	*Over all av.%*
Penaeus monodon	0·79	0.30	0.73
P. indicus	57·94	29.86	37.96
Metapenaeus monoceros	0·53	0.04	0·18
M. brevicornis	7.63	1.77	3.46
Palaemon styliferus	0.50	1.48	1.20
Parapenaeopsis sculptilis	1.40	1.23	1.28
Mugil cephalus	0.07	0.01	0.03
Mugil parsia	3.43	47.05	34.47
M. cunnesius	0.04	0.02	0.02
Reinomugil corsula	—	0.01	0.01
Chanos chanos	0.18	0.02	0.07
Elops saurus	0.06	0.003	0.02
Gerres spp.	6.99	1.48	3.07
Pomadasya spp.	0.22	0.91	0.71
Scatophagus argus	0.28	0.17	0.21
Sparus spp.	—	0·01	0.01
Sillago sp.	—	0·06	0.04
Pama pama	—	0·01	0.01
Eleutheronema tetradactylum	2.66	5·67	4.80
Misc. fish	16.25	9.90	11.73

Collection techniques for procurement of Bhetki *(Lates calcarifer)* fry in large quantities have been standardised. It is now possible to collect early fry as small as 8 mm in length.

In laboratory experiments, it has been observed that Bhetki fry up to 65 mm size thrive well on natural food comprising mysis, prawn larvae, gobiids (small), etc. Beyond this size the fry mainly prefer prawns as their food and the rate of growth up to an average size of 90 mm is satisfactory.

L. calcarifer and *M. tade* were found to be compatible in mixed culture in the ratio of 1 : 4. *Lates calcarifer* (35.85 mm/59 g) and *M. tade* (129·20 mm/ 21.75 g) grew to 256·42 mm/231·78 g and 196·50 mm/71·24 g respectively in a period of 360 days with the provision of trash fishes and prawn alongwith tidal ingress and supplementary feeding for mullets. Such a process also enables a subsidiary production of penaeid prawns raising thereby the total production of the pond.

Experiment of inducing gonadial maturity in *L. calcarifer* in captivity indicated that females of even 4 years age did not show any sign of maturity. Hormone injections could induce maturity in the males only but not in the females.

Fry of *L. calcarifer* were reared with live food, like mysis, gemmerus, prawn larvae, etc. Though a carnivorous fish, by judging its commercial value, Bhetki may be cultured in brackishwater impoundments by providing trash fishes and uneconomic varieties of prawns.

Problem	:	5·20	Use of compost as fertiliser in coastal fish ponds.
Personnel	:		R. K. Banerjee, B. B. Pakrasi, S. C. Banerjee and N. C. Basu
Duration	:		Three years

A detailed study has been conducted to work out the efficacy of the compost in fish pond fertilisation. Compost prepared by decomposing mangrove leaves and straw mulch up to a C/N ratio of 12.08 had total N= 1.47% and total P_2O_5=0.35%. The rate of inorganic transformation of compost, as studied, could establish it as a good organic manure. During field trials with different doses and with fishes of various sizes and species it was found that a

charge of 10,000 kg/ha of compost could maintain a productive N/P ratio for a pretty long period. Other productive indices; *viz.*, primary productivity and plankton concentration, were always found to be above the productive level. The growth rates of various species of fish both Indian and exotic, as studied in ponds manured with compost @ 5,000 kg/ha and without any artificial feeding were observed to be highly significant.

It has been established that compost can well replace cow dung in pond fertilisation and its manurial proved to be much higher than that of cow dung. Moreover, the adverse effect of compost on the dissolved oxygen and nitrogen load in any water area has been proved to be less than raw cow dung.

The cost worked out in collection and composting organic wastes was much less than the local price of raw cow dung on nitrogen to nitrogen basis.

The results achieved in compost manuring have been passed on to the Extension Section and the CIFRI/IDRC Aquaculture Project for implementation of the technique with a view to discourging the use of cow dung as pond manure.

It has been experienced that composting of organic refuse specially those having high percentage of cellulose under natural conditions, takes more than six months. The time gap is a hindrance in meeting the demand of large quantities of compost for manurial purposes. Hence a detailed study to accelerate the rate of mineralisation by biological means is essential. Investigations on these lines are proposed to be taken up next year.

Project 6 : Freshwater prawn culture

Problem	:	6·1	Freshwater prawn culture technique
Personnel	:		K. J. Ram and S. R. Ghosh
Duration	:		Nine years and six months

To explore the possibilities of culturing freshwater prawn in ponds and to evolve suitable methods and practices to make the culture of *Macrobrachium malcolmsonii* and *M. rosenbergii* a profitable proposition, investigations on the culture of the above two prawn species, singly and in combination with fishes, were carried out besides, breeding the prawns in the laboratory during the period July 1975 to December 1976. In addition to the above, studies were also made

for evolving a suitable supplementary feed to compensate the food deficiency in prawn culture operations.

In monoculture of *M. malcolmsonii*, juvenile prawns collected from the anicut site of river Mahanadi near Cuttack, were stocked in three ponds (0.012 ha each) @ 20,000/ha. Net productions obtained ranged from 285.4 to 380.0 kg/ha/yr.

In mixed culture experiments of prawns and fishes, juveniles of *M. rosenbergii* (43.5 g), raised from the seeds collected from Jambudeep, Rajnagar and Kendrapara in the north-east of Cuttack, were stocked in a 0.5 ha pond @ 10,000 /ha with Indian and exotic carps as other components. The prawns attained an average weight of 295.15 g in a period of one year.

In both, yard and field trials, prawns fed with a mixture of fish meal, groundnut oilcake and rice-bran in the ratio of 0.5:1:1 gave encouraging results.

Successful breeding of both the species of prawns was achieved in the laboratory and the resultant larvae of *M. malcolmsonii* could be reared up to 20th day after hatching. The larvae were maintained in the saline water (17 ppt) in wide mouthed earthen pots with provision of continuous aeration. The larvae were fed with crushed Cladocera and egg custurd sieved through a bolting silk cloth.

It is evident from the observations that both the prawn species registered encouraging growth in the confined pond environment thereby highlighting the possibilities of their culture, either singly or in combination with other fishes, in freshwater impoundments. The attainment of maturity of the prawns in pond waters and their aptitude of breeding in laboratory conditions signifies the possible artificial propagation.

It is suggested that aspects, like infighting of adults for food deficiency, migrating habit during monsoon months and feeding larvae up to juvenile stage need further investigations.

Project 8 : Estuarine and brackishwater lake fisheries

Problem	: 8.5	Breeding and rearing of the palaemonid prawn, *Macrobrachium rosenbergii*
Personnel	:	M. Subrahmanyam and K. J. Rao
Duration	:	Three years

The larvae of *M. rosenbergii* could be successfully reared by feeding them upon mud-worms and laboratory raised brine shrimp nauplii. Cheap methods of culturing mud-worms and brine shrimp nauplii were developed.

The prawn could be bred almost throughout the year under laboratory conditions, thereby facilitating the production of postlarvae over an extended point of time.

Seed of *M. rosenbergii* attained marketable size in 4 months in a freshwater pond. Supplementary diets ; *viz.*, *Pila* (apple snail), tapioca (*Cassava* root), small shrimp (*Acetes* sp.) broken rice, etc. promoted growth in pond environment.

The larvae could be reared almost throughout the year without any temperature control. Sea-water brought from the offshore regions and diluted to 40% was found suitable for rearing the larvae under the laboratory conditions. Optimum level of dissolved oxygen was maintained by continuous aeration or exchange of rearing medium.

A mass rearing technique for the production of prawn seed can be explicated by the application and further improvement of the technique developed during the project tenure. Large scale culture of the food organisms employed in this technique can also be done for evolving an economic method of seed production. Dependance on the wild brood stock can be dispensed with as continuous breeding could be done under laboratory conditions. Follow up studies on these lines are being formulated.

Project 11 : Economics in fishery investigations

Problem	:	11.1	Economic evaluation of fish culture operation in West Bengal and Orissa
Personnel	:		M. Randhir
Duration	:		Four years

Investigations on the economic aspects in fish culture opertions were carried out in understanding the investment & return ratio and return per unit area for establishing the status of fish culture as an industry, besides determining the dominant cost factors in aquaculture practices needed to be reoriented for bringing down the production cost of fish.

Out of 148 total fish farms covered, data from a total of 128 fish farms, in the public sector and 68 in the private sector were finally taken for analysis to describe the structure of capital as well as the operative costs for existing fish culture practices in the private and public sectors.

The indicators worked out from these data presented the status of traditional fish culture in the country. If a 20 percent rate of net return on capital investments is considered fairly good, then the rate of net return as reflected in the private sector forecast very promising prospects for the development of freshwater fish culture operations in the country. The best proof of this is that as many as 46.5 percent of fish farms obtained a net return of more than 20 percent. The difference in capital structure between fish seed farms and food fish farms were analysed. The data also showed that the total cost requirement decreases with increase in farm size, indicating economics of large scale operations. The requirement of more capital costs in case of fish seed calture is partly due to the requirement of more dikes, as they have a number of small ponds. The structures of production cost/ha for freshwater fish farms has been worked out. The operative costs of all input components were higher for fish seed farms as compared to food fish farms. The differences in the total operative expenditure for public and private sector were clearly stricking. Among fish seed farms, the major item of expenditure was on wages and salaries, amounting to Rs. 2,454/ha (49·3 percent).

Even among food fish farms, the dominant recurrent cost factor was on wages and salaries. The other recurrent cost factors were on stocking material, fertilisers, feed and maintenance of ponds, etc. The net returns obtained by private sector food fish farms are highly encouraging for the spread of aquacultural operations in the country, with 40.7 percent earning a profit margin of more than Rs. 4,000/ha/yr. To cite an example, one of the food fish farms in the private sector reported a net return of Rs. 26,786/ha, indicating the bright prospects of food fish culture in the country.

The Government owned farms suffer from heavy commitment on managerial salaries which reduce the profitability. The causes for losses were examined and these seemed to have their source primarily in low production coupled with excessive labour cost and relatively low costs on stocking materials.

The costs and earnings survey carried out clearly established that even existing traditional aquacultural practices have the status of a viable commercial

activity. Had there been application of intensive aquacultural methods, the profit would have been much more remunerative to the extent of Rs. 12,000—17,000/ha.

Problem	:	11.2	Economic evaluation of various spawn production methods
Personnel	:		M. Randhir
Duration	:		Four years

With the advent of modern techniques of fish culture, additional water areas are now being utilised for fish culture, resulting in considerable increase in the demand of fish seed throughout the country. Besides, natural collection of fish seed from riverine sources, two different techniques ; *i.e.*, bundh breeding and induced breeding, have been developed to step up the production of fish seed to meet the optimum requirement. Since efficacy of these techniques can properly be ascertained by studying the cost and return involved for their implementation, it was felt essential to work out the relative economics of the above mentioned methods and to suggest adequate developmental measures to inflict reduction in the cost under the coverage of this problem. The investigation was carried out for a period of four years in succession and the results obtained have been summarised below :

Data on various economic aspects were obtained from a total of 146 units of which 92 units belonged to riverine source, 41 units to induced breeding and 13 units to bundh breeding. Production of spawn through bundh breeding and induced breeding involved considerably high costs compared to riverine spawn collection. The dominating costs of bundh breeding, induced breeding and of riverine spawn collection were presented. The cost of collection and production of spawn through these different methods were worked out. During the year 1973, the cost of collection of one lakh of spawn was at Rs. 90·40 with a variation from Rs. 24/- to Rs. 328/-. In the same year, the cost of production from induced breeding was Rs. 150/- per lakh and from bundh breeding it was at Rs. 112/- per lakh. Collection of spawn through riverine source appears to be cheaper but on a country wide basis any comparison of production economics with the other two methods may be misleading because productive potential of a riverine stretch, a factor dependent upon so many uncontrolable natural factors, is highly fluctuating from year to year and from place to place. Even many natural or acquired

factors do change a lot in productive potential of bundh breeding and induced breeding. Hence the production strategy through these different sources will have to be planned in the context of a particular regional aquacultural development bearing in mind the need to utilise fully the existing natural resources to the maximum extent possible.

Problem	:	11.4	Assessment of marketable size for fish culture enterprises in West Bengal
Personnel	:		M. Ranadhir and H. K. Sen
Duration	:		Four years

Six fish markets were visited to gather information regarding sizes of fish marketed and their prices. Fish farms at Bontola Duttabad were visited to seek information about the fish sizes at which the farmer begins harvesting. The commercial harvesting on an average started at 600—800 g size. The price-level of small fishes in the size range of 500—750 g varied from Rs. 7.00 to 9.00 per kg. The prices of bigger sized fishes weighing more than 1,000 g were in the range of Rs. 10.00 to Rs. 13.00 per kg.

Problem	:	11.5	Pilot survey on the economic impact of operational research projects, co-ordinated research project and extension activities in West Bengal
Personnel	:		M. Ranadhir, K. K. Ghosh, P. M. Mitra, A. K. Roy and H. K. Sen.
Duration	:		One year

All the adjoining towns and villages forming part of a 15 km circle around Krishnanagar, Kalyani and Nilganj were recorded. 141 villages were identified in Krishnanagar circle, while it was 186 in Kalyani and 143 in Nilganj circles. Following samples of villages were selected from each circle :

1) Nilganj circle : Barasat, Rampur and Sesan
2) Krishnanagar circle : Satgachi, Barakulta and Sonda
3) Kalyani circle : Magra, Kanchiara and Fatepur

Basic information with regard to ownership, area, location, etc. for all the fish ponds present in the sampled villages were collected. A 20% sample for each village was selected for detailed information regarding the impact of high yielding technology. It has been observed that most of the ponds (27%) are utilised for fish culture through treditional culture methods only. About 74% of fish farmers reported the awareness of latest fish culture technology being developed by the Central Inland Fisheries Research Institute and 91% of them are conscious of bank loans and other incentives offered by the State Government in promoting fish culture operations in view of the latest technology developed by the CIFRI.

Project 12 : Exotic fish culture

Problem	: 12·4	Suitable supplementary feeds for grass carp fry and fingerlings
Personnel	:	S. B. Singh, D. S. Murty, R. K. Dey and P. V. G. K. Reddy
Duration	:	Three years

Grass carp, an active associate in composite culture of Indian and exotic carps, has been observed to exercise its preference for certain weeds at different stages of its growth. This feeding habit of the fish ultimately creates difficulties in maintenance of its stock where no adequate weed is available. To overcome the constraints, thus experienced, experiments were initiated in the year 1973 to formulate a suitable supplementary feed for grass carp utilising cheaply available leaves and fruits of some terrestrial plants, common oilcake and rice-bran both separately and in the form of mixtures. During 1973, preliminary experiments were conducted in the laboratory with fry of grass carp. Feeds given were *Wolffia* sp., rice-bran, ground-nut oilcake, plankton seperately and a mixture of ground-nut oilcake+rice-bran in equal ratio by weight. The results obtained showed that while plankton and ground-nut oilcake gave identical increase in the growth, the same with *Wolffia* sp. was poor. Three sets of experiments, each of 15 days duration, with similar food items and mode of feeding as that of the previous year were carried out in the laboratory in 1974 with fry of grass carp in the size range of 29.93 to 35.30 mm and results confirmed the findings of the preceding year.

During 1975, two sets of laboratory experiments, each of 15 days duration, were conducted in glass jars with grass carp fingerlings of 46·10 and 63·12 mm

respectively. In the first set, the feed items were the same as those given in the previous experiments but in the second set, the feed items were *Hydrilla* sp., *Spirodela* sp., *Lemna* sp., *Enhydra* sp. and plankton. All the items of feed given in the two sets were readily consumed by the grass carp fingerlings.

During 1976, observations on feeding of grass carp fry and fingerling with *Lucerne* sp., a green fodder, made in glass jars, plastic pools and nursery ponds showed that the fodder was accepted and consumed by the fish. Further observations on feeding brood grass carp with *Lucerne* sp. also established that the fodder was avidly accepted by the fish.

The studies, so far conducted, revealed that grass carp could accept a wide variety of food items for their maintenance. However, more items of feed could be screened in various parts of the country according to their easy availability. There is ample scope for further detailed investigations in the field preferably in drainable fish ponds, on relative suitability of the feed items screened.

Project 13 : Cold water fish culture

Problem	: 13·18	Water quality and benthic life in Ashiganga trout stream, Uttarkashi (U.P.)
Personnel	:	C.B. Joshi and one Senior Inspector, U.P. Fisheries
Duration	:	One year

To formulate a suitable stocking policy for trouts, a proper understanding of the ecological conditions of the stocking site is of great significance. As such the problem was taken up in late 1975 for a short duration of one year to study the water quality and benthic population of Ashiganga trout stream at Uttarkashi in Uttar Pradesh. The observations were made at two stations one at Kaldhyani and the other at Gangori. The ranges of various physico-chemical parameters studied during the course of the investigation at both the stations are presented below :

Parameter	Kaldhyani	Gangori
Turbidity	nil	nil
Water temperature (°C)	4.0—17.0	8.0—19.0
Dissolved oxygen (ppm)	8.1—10.8	8.0—10.8
Free CO_2 (ppm)	nil—2.6	nil—2.6

pH	7.0—8.0	7.2—8.3
Total alkalinity (ppm)	24.0—46.0	20.0—24.0
Silicates (ppm)	0.375—1.250	0.250—1.250

Observations on the distribution of benthic fauna in the stream revealed that at Kaldhyani, the benthic life was mainly represented by nymphs of Plecoptera & Ephemeroptera (40.18%) followed by larvae of Trichoptera (26.97%), larvae of Diptera (15.54%), miscellaneous group (3.44%), larvae & adults of Coleoptera (2.70%) and the naiads of Odonata (1.17%). Whereas at Gangori, larvae of Trichoptera (50.68%) were found to dominate the inhabiting benthic fauna followed by nymphs of Plecoptera & Ephemeroptera (29.79%), larvae of Diptera (10.48%), larvae & adults of Coleoptera (7.16%), miscellaneous group (1.73%) and naiads of Odonata (0.26%).

The miscellaneous groups at both the stations were represented by Nematoda, Platyhelminthes, Annelida, Neuroptera, fish fry and some unidentified insect pupae. The maximum number of the benthic fauna recorded was 144/2 sq m in January at Gangori and the minimum of 13/2 sq m in the month of August at Kaldhyani.

Project 15 : Fish pathology

Problem	:	15.1	Etiology and control of parasitic diseases of cultured warm water fishes
Personnel	:		A. K. Ghosh and S. R. Ghosh
Duration	:		Eight years

For successful fish culture and healthy growth of fishes, a thorough knowledge of fish parasites and diseases and their control is essential. To control the parasites and diseases at different stages of their life, some cheap and efficient methods were tried.

The biology of *Argulus* sp. was studied to control them at the early stage of infection on fish. It was found that the parasite could breed throughout the year producing on an average 260 egg/adult. But the hatching period was dependant on temperature. It was also possible to rear the larvae of *Argulus* sp. in the laboratory alongwith the host for study purposes.

To control the infection, toxicity tests were conducted in the laboratory using malachite green, methylene blue, benzene hexachlorides, glacial acetic acid and formalin on the fingerlings of catla and rohu infected with Myxosporidae,

monogenetic trematodes and *Argulus*. sp. It was found that formalin, glacial acetic acid and benzene hexachloride at 1 : 10,000 (10 minutes), 250 ppm (30 minutes) and 0.5 ppm respectively helped in curing the infection.

Fish pond heavily infested with *Argulus* sp. could be effectively controlled by using 0.5 ppm of BHC (10% a.i.) with no adverse effect on fish food organisms and bottom fauna. In the early stages of infection substrates, like steel/iron sheets or wooden planks were provided in the pond for egg laying and adhering of leeches. Periodical removal of these planks helped in destroying eggs of *Argulus* sp. and leeches effectively in the initial stages.

The tail and fin rot infection in fishes was cured when the affected fishes were treated with concentrated $CuSO_4$ solution applied by painting it on the affected regions only. This also had no adverse effect on the host.

As a measure of prophylaxis, the ponds were treated with lime @ 200 kg/ha followed by raking to maintain the healthy condition of the fish.

Project 16 : Weed control

Problem	:	16·8	Biodegradation, persistence and the effect of 2,4-D and Simazine herbicide on the productivity and fish life in culturable water
Personnel	:		T. Ramaprabhu, V. Ramachandran. S. Patnaik and K. M. Das
Duration	:		Three years

In view of the present day awareness of chemical pollution, it was felt essential to assess the extent of harmful effects, if any, of sub-weedicidal doses of chemicals upon fauna, flora and productivity of the aquatic ecosystem. The problem was, thus, taken up since the year 1973. The results obtained have been summerised below :

In yard experiments in plastic pools, containing about 450 litres of water with fry of *Cyprinus carpio* @ 1,67,000/ha, it was observed that 2,4-D applied @ 5 and 10 ppm did not affect the fish yield, but Simazine @ 0.2 and 0.5 ppm affected the same. No significant change was evident in plankton, primary productivtiy and bottom fauna by the treatments.

In the field trial, application of Simazine @ 10 kg/ha to the bottom soil of a dry pond suppressed the growth of aquatic weeds whereas in another pond, with the

treatment at a lower rate of 5 kg/ha, considerable regrowth of weeds in comparison to an untreated control pond was observed.

In field trials, brick pellets soaked with 2,4-D and applied @ 10 kg/ha affected the rooted emergent and submerged aquatic weeds adversely. Thus, a complete clearance of the pond could be achieved. However, the water of the treated pond, though initially affected the growing plants in the adjacent field, did not exhibit any harmful effect after about a month, thereby indicating no persistant toxic effect of the herbicide in the water. In soils, collected from treated ponds, the destructive characters of 2,4-D in the treated water were found to have completely subsided after about 17 to 24 days, as bean seedlings planted in the soils continued to thrive well thereafter.

A nursery pond, stocked with spawn of rohu @ 4 million/ha and treated with 2,4-D pellets @ 10 kg/ha for controlling *Ottelia alismoides* and other weeds, indicated 40% survival and satisfactory growth of rohu fry. In another set of field trials, Simazine @ 3 kg/ha was tried; but the survival and growth of fish fry were not satisfactory.

In a number of field experiments, it was observed that pellets soaked with 2,4-D had no harmful effect on bottom organisms (chironomid larvae, *Limnodrilus* sp. and *Pentaneura* sp.) and plankton (diatoms, filamentous & blue green algae).

In a yard experiment, the breeding of *Tilapia* sp. was apparently not affected by the treatment of both the herbicides; *i.e.*, 2,4-D (at 5 & 10 ppm) and Simazine (at 0.5 ppm).

In the light of the results so far achieved, it is suggested that the herbicide residue analysis by T.L.C. and other methods may be attempted to determine the nuture of herbicide in treated waters, soils and fish for further studies on persistence, etc.

Problem	: 16.9	Increasing fish production by conversion of aquatic vegetation into manure *in situ*
Personnel	:	V. Ramachandran, T. Ramaprabhu and K. M. Das
Duration	:	Three years

Repeated experiments conclusively proved the advantages of decomposing aquatic weeds in the fish ponds by herbicide treatment. The killed weeds

when disintegrated, served as a rich organic manure for fish pond, thus enriching the nutrient status of the ecosystem and ultimately enhancing the fish production.

In a precisely controlled yard experiment in plastic pools, *Pistia* sp. was killed and recycled @ 140 t/ha in 5 months. This resulted in about 80% increase in the production of fish as against the production obtained from the pool which contained equal quantity of *Pistia* sp. for a similar period but had the provision of periodical replacement with fresh weeds. The phosphate content of the treated pool (0·53 ppm) was found to be higher than the untreated one (0·4 ppm). Presence of zooplankton was noticed to have an edge over phytoplankton in the weed recycled pool whereas reverse was the case in the pool kept as control.

Another experiment was conducted in a nursery pond where nearly cent percent increase in the production of fish could be achieved by periodically killing and recycling water hyacinth *(Eichhornia* sp.) @ 50 t/ha in 9 months as against the yield obtained from the adjacent and untreated pond containing same quantity of *Eichhornia* sp. with provision of periodical replacement.

In another experiment, an estimated yield of 1,500 kg/ha of fish could be harvested from the pond wherein *Eichhornia* sp. was killed by spraying 2,4-D and recycled @ 30 t/ha as compared to a production of 950 kg/ha from the untreated pond with a similar quantity of *Eichhornia* sp. The average phosphate content of the water of the treated pond was observed to be three times greater than that of the control pond.

In another field trial, from a 0.25 ha pond stocked with common carp, catla, rohu, silver carp and mrigal in the ratio of 1:3:3:1:2 at a stocking density of 6,000/ha, an estimated production of 1,700 kg/ha could be obtained in 10 months recycling about 9,000 kg of weeds consisting mostly of *Pistia* sp. and a small quantity of water hyacinth.

As a part of follow up studies, a detailed project on "Recycling of animal wastes and weeds in fish culture" has been taken up.

Project 17 : Frog farming

Problem	: 17·6	Culture of frog food organisms
Personnel	:	C. R. Das, P.L.N. Rao and S. N. Mohanty
Duration	:	Two years

Investigations on the development of techniques of mass culture of selected tubificid worms and insect larvae were undertaken with a view to having a steady supply of living food organisms for frogs during their different stages of development.

Two species of aquatic oligochaetes, *Limnodrilus socialis* Stephenson and *Tubifex tubifex* (Muller) were found to be in abundance in and around Cuttack. Both these species were available in plenty in the gutters and ditches enriched with organic materials. The flow of water helps them in multiplication and the depletion of oxygen causes them to come out. They are anti-phototrophic and are found in abundance in rainy season.

Pond soil was used as a suitable base for culturing them. Laboratory experiments were conducted with the addition of rice -bran infusion, used & dried tea leaves, dried leaves of *Spirodela* sp. and *Psidium* sp. (Guava) ground-nut oilcake and paper pulp as media. It was observed that the rate of multiplication of worms was directly correlated with the quantity of the nutritive medium added. The rate of multiplication of *Tubifex tubifex* was found to be faster than that of the *Limnodrilus socialis*.

Further experiments have also indicated the utility of sludge base as a medium when added with ground-nut oilcake in different concentrations.

Almost 85-100 times multiplication of *Tubifex tubifex* worms was observed when a mixture of ground-nut oilcake, paper pulp and vegetable wastes in the ratio of 1:2:2 in a sludge base was provided at regular interval of 3 days as a source of nutrition to the growing population of worms. The water level during the experiments was kept constant by adding rain water as and when needed.

Inorganic manuring did not prove satisfactory though the multiplication of *Tubifex tubifex* worms was found to be dependent on pH, total alkalinity and the phosphate content of the ambient water.

As the frogs almost subsist on animal food either throughout their life or during certain stages of their life cycle, the mass culture of tubificid worms is of great importance in frog farming.

Problem	:	17.9 (b)	Food and feeding habits of *Rana hexadactyla*
Personnel	:		C. R. Das, S. N. Mohanty and V. Panigrahi
Duration	:		Two years

Proper knowledge of food and feeding habits of frogs forms an essential pre-requisite for their culture. As such investigations were carried out to understand the natural food and feeding habits of *R. hexadactyla* at different stages ; *viz.*, hatchlings, tadpoles, juveniles and adults. The results have been summerised below :

The tadpoles of *R. hexadactyla* were found to subsist entirely on herbivorous diet especially on plants, like *Hydrilla* sp., *Lemna* sp. and *Spirodeia* sp. The metamorphosed juveniles showed preference for various kinds of insects (like termites, ants, maggots, moths & butterflies), worms (*Tubifex* sp., earthworms, etc.) and other invertebrates. Adults were observed to thrive on earthworms, insects, shrimps, crabs, centipeds and even on snails while parts of carp minnows were also not uncommon. Undigested plant materials were found in the guts of adults especially in collection from ponds heavily laden with floating vegetations.

Based on the studies on food and feeding habits of *R. hexadactyla*, proper management practices are needed to be developed to raise tadpoles, juveniles and adult frogs in culture operations in an economic and profitable manner so that the natural food is utilised to an optimal level and the artificial feed, if any, provided to is fully consumed.

Project 19 : Hilsa fisheries

Problem	: 19·2	Hilsa fisheries of the lower stretch of the Ganga River System
Personnel	:	K. V. Rao, B. L. Pandey, B. N. Saigal, S. N. Sar, R. K. Bhattacherjee, G. N. Mukherjee, R. C. Singh and A. Sarkar
Duration	:	Seven years

To understand the factors responsible for the fluctuating trend of the hilsa fishery of the lower stretch of the Ganga River System with special reference to the role of three sub-populations of *Hilsa ilisha* which exist in the entire stretch commencing from Bhagalpur on the river Ganga to Lalgola on the river Padma, a survey was inforced in 1967 and continued till early 1974. During the course of the survey, besides assessing the total yearly yield of hilsa from the stretch mentioned above, quantitative assessment of larval abundance at selected points was made to understand the magnitude of spawning success of each of the three sub-populations wherever possible.

Hilsa fisheries : The landing of *Hilsa ilisha* was observed to increase abruptly by 86.70% in 1968 over 8.25 t recorded in the year 1967. Though the increasing trend of the production was maintained in 1969 (179.13 t) which may be attributed to the inclusion of Rajmahal and Dhulian on the river Ganga in the sampling schedule, marked inconsistency in the production of individual centres was evident with the decrease in production at Bhagalpur by 22.79% and increase by 1,289.61% at Lalgola over the preceding year. The total landing of hilsa in 1970 from the lower stretch was estimated at 122.45 t thereby registering a decline by 31.64% over that of 1969. During the year, all the centres ; *i. e.*, Bhagalpur, Rajmahal, Dhulian and Lalgola showed a declining trend in the production by 80.55, 38.57, 37.75 and 21.57 % respectively over the previous year.

Since 1971, when two more centres ; *i. e.*, Sahibganj and Farakka, were brought under the purview of the problem, gradual improvement in the trend of production was noticed. The production recorded were 177.44, 207.94 and 361.63 t in 1971, 1972 and 1973 respectively. The centre-wise yield of hilsa during the years 1971—73 is presented in table 4 :

Table 4—Centre-wise yearly production of hilsa (in t) at six centres in the lower stretch of the Ganga River System

(Figures in the parenthesis indicate the percental fluctuation over the preceding year)

Centre	Years		
	1971	1972	1973
Bhagalpur	2·67 (+81·36)	1·71 (—35·95)	1·41 (—17·54)
Sahibganj	1·26	2·17 (+72·22)	1·53 (—29·49)
Rajmahal	9·25 (—33·02)	9·56 (+3·35)	8·02 (—16·11)
Dhulian	37·51 (+7·79)	33·71 (—10·13)	35·44 (+5·13)
Farakka	29·69	47·14 (+58·77)	37·41 (—20·64)
Lalgola	97.06 (+32·12)	113·65 (+17·09)	277·32 (+144·45)

It is evident from the data that the total production during the years 1971-73, though maintained the ascending trend, had virtually no influence in orientation of the production pattern of the individual centres, which was observed to be eratic. In 1974, the programme was terminated after the month of April and the total production during the period was recorded to be 36.29 t only.

The study revealed that the main hilsa fishery existed in the lower stretch of the Ganga River System during monsoon months (July to October) and winter months (November to January), the former being more pronounced. The down-stream areas represented by Farakka to Lalgola are more productive than the up-stream areas.

A study on the yearly pattern of intermingling of the three varieties of *Hilsa illsha* at individual centres revealed that the "Slender" variety exhibited the highest percental contribution at Bhagalpur and the lowest at Lalgola exhibiting the declining trend through the centres in the lower stretch. The contribution of "Broader" variety was highest at Lalgola which gradually declined through other centres and presented the lowest contribution at Bhagalpur. The "Broad" variety showed a little fluctuations at all the centres.

Delimitation of spawning grounds : Investigations relating to larval abundance of hilsa during the year 1967-1973 confirmed the existance of two independent, spawning periods in the stretch— one during the post-winter months and the other during the monsoon months. Two separate spawning grounds were located : one between Sultanganj & Sahibganj and other between Rajmahal & Lalgola.

The bathymetric distribution of hilsa larvae could not be studied due to lack of facilities and other practical difficulties.

Project 20 : Water pollution investigations

Problem : 20.2 (Final report is being compiled)

(b) Research in hand :

Researches on 22 projects of the Institute, 5 problems of the CIFRI/IDRC project and 16, 6 and 1 problems of the All India Co-ordinated Research projects on—"Composite fish culture & fish seed production", "Air-breathing fish culture in

swamps" and "Reservoir fisheries" respectively were continued during the year 1976 and the progress achieved under each project is outlined in the following pages.

Project 1 : Optimum per hectare production of fry, fingerlings and fish in culture fishery operations

Problem	:	1.1	Composite culture of Indian and exotic species
Personnel	:		R. D. Chakrabarty, S. B. Singh, P. R. Sen, D. S. Murty, N. G. S. Rao, S. N. Dutta, S. Jena, C. Selvaraj, K. J. Ram, R. K. Dey, S. R. Ghosh, B. Dash, S. L. Kar and P.V.G.K. Reddy
Duration	:		Continuing since October 1967

Fry of catla, rohu and mrigal were stocked in the ratio of 1:1:1 @ 3 lakh/ha in two 0.08 ha ponds. Pond fertilisation @ 1.75 t/ha with cow dung and artificial feeding of fry with 2.5 t/ha of ground-nut oilcake + rice polish were the measures adopted. At the end of 4½ months' culture, the average weights attained by the fingerlings were : catla—33.76 & 25.71 g, rohu—34.55 & 32.12 g and mrigal—30.30 & 33.33 g in two ponds respectively.

In a field trial, fingerlings of silver carp, grass carp and common carp were stocked in the ratio of 4:3:3 @ 2.5 lakh/ha in two 0.08 ha ponds. After rearing for 3 months (September to December 1976) the overall survival percentage and growth of the respective exotic carps were : 98.50% & 98.03 mm/9 g; 42.31% & 67.56 mm/4 g and 14.92% & 58.97 mm/5 g. Accidental entry of murrels into the ponds is responsible for the low survival of grass carp and common carp.

Through intensive fish farming, gross productions of marketable fish obtained from 2 ponds (0.5 & 0.4 ha) were 7,196 and 7,679 kg/ha in 16 months (*i.e.*, over 5,300 and 5,700 kg/ha/yr) respectively. The stocking density was 10,000 fingerlings/ha and the species combination employed was silver carp 20: catla 10: rohu 25: grass carp 15: mrigal 15: common carp 15 alongwith a few *Notopterus chitala*, a minor predator. Pond fertilisation with 1,750-2,500 kg cow dung, 154-192 kg urea and 134-155 kg triple superphosphate per hectare

and daily artificial feeding of the fish with ground-nut oilcake + rice polish @ 9,198-9,687 kg/ha/yr were provided, besides giving 18.23 t of aquatic weeds/ha/yr for feeding the grass carp. Without replenishment, the fish had to be harvested periodically and the inputs had to be restricted as the levels of water in the ponds were low.

In another intensive fish farming trial with Indian major carps alone, catla, rohu and mrigal were stocked in the ratio of 3:4:3 @ 6,000/ha in two ponds (0.19 & 0.17 ha). Fertilisation of pond with 10.5-11.7 kg urea, 31.5-34.2 kg triple superphosphate, 2,400-3,000 kg cow dung and 80-82 kg lime/ha/yr and supplementary feeding of fish with 13,300-13,900 kg/ha/yr were done. The aggregate survival rate and gross production of fish were 75% and 3,700 kg/ha/yr respectively. Catla and rohu attained more than 800 g each and mrigal, over 650 g at the time of harvest.

For readily adoptable composite culture at a low cost without using any supplementary feed, two sets of experiments— one with the inclusion of grass carp and another without grass carp, were conducted to assess the role of pond fertilisation and to find out the possible output of the fish using natural food only. In the first set, catla, rohu, mrigal, silver carp, grass carp and common carp stocked in the ratio of 1.0 : 2.5 : 1.5 : 2.5 : 1.5 : 1.0 @ 6,000/ha were cultured for one year in a 0.15 ha pond. Aquatic vegetation was provided to the grass carp @ 5 t/ha/yr and the pond fertilisation was done at the rate of 400 kg urea, 3,335 kg cow dung and 335 kg triple superphosphate/ha/yr.

The gross production of fish and their survival were 3,400 kg/ha and 74% respectively.

In the second set of trials, 2 ponds (0.15 ha each) were stocked with catla, rohu, mrigal, silver carp and common carp in the ratio of 1.2 : 2.9 : 1.8 : 2.9 : 1.2 @ 5,100/ha. After six months' rearing the fish productions were 1,930 and 2,400 ka/ha from these ponds while the aggregate survival of fish was recorded as 60.1 to 68.5%. Among the harvested fish silver carp and catla showed noteworthy growth (1.6—1.9 and 0.9—1.2 kg respectively) against average growth of about 600 g each. During the culture period, the ponds were treated with 2,500 kg cow dung, 173.24 kg urea, 146.5 kg triple superphosphate and 67.2 kg calcium ammonium nitrate per hectare.

Problem	:	1.2	(Research work suspended since 1975)
Problem	:	1.3 & 1.4	(Research work completed in 1972)
Problem	:	1.5	(Research work completed in 1970)

Problem	:	1.6	(Research work completed in 1972)
Problem	:	1.7	(Research work completed in 1973)
Problem	:	1.8	(Research work completed in 1971)
Problem	:	1.9 to 1.11	(Research work completed in 1972)
Problem	:	1.12	(Research work completed in 1973)
Problem	:	1.13	(Research work completed in 1972)
Problem	:	1.14	(Research work suspended since 1975)
Problem	:	1.15	(Research work suspended since 1973)
Problem	:	1.16	(Research work completed in 1971)
Problem	:	1.17	(Research work suspended since 1975)
Problem	:	1.18	(Research work completed in 1975)
Problem	:	1.19	(Research work completed in 1973)
Problem	:	1.20	(Research work completed in 1974)

Problem	:	1.21	Carp fry rearing for optimum survival and growth under higher stocking density
Personnel	:		P. R. Sen and D. K. Chatterjee
Duration	:		Six years and six months

Catla spawn were stocked @ 25 lakh/ha in three 0.04 ha nursery ponds and given artificial feed+cobalt chloride (0.01 mg/day/fish). The feed was given at the rate of four times the initial body weight during the first six days and later till the 10th day at the rate of eight times the initial body weight. In about 2 weeks, 12.5 lakhs of fry were raised and the size & weight attained by them were 22.2-24.1 mm/1.573-1.682 g.

Problem	:	1.22	(Research work completed in 1975)
Problem	:	1.23	(Research work completed in 1976)

Problem	:	1.24	Studies on the effect of chemical fertilisers in relation to pond productivity
Personnel	:		G. N. Saha, D. K. Chatterjee and C. Selvaraj
Duration	:		Five years

In the laboratory in glass jar experiments, using slightly acidic (pH 6.3) soil and single & triple superphosphate @ 25, 50 and 80 kg P_2O_5/ha in 3 replicates, rohu fry were raised in 20 days. Among various trials, the survival of fry was the best at the lowest dose of both the type of fertilisers, though the rate of survival was 63.3% with triple superphosphate against 56.7% with single superphosphate.

Similarly in the yard trials using identical soil, the dose of fertilisers at 25 kg P_2O_5/ha gave the best response when the phosphate levels in water were maintained at 0.28 and 0.15 ppm with triple and single superphosphate.

For assessing the effect of pond fertilisation, fry of silver carp, catla, rohu, mrigal and common carp in the ratio of 2.5 : 1.5 : 3.0 : 1.5 @ 7,000/ha are being cultured in 2 ponds (0.25 ha each). One of the ponds was manured with urea + muriate of potash @ 250 kg N+50 kg K_2O and cow dung @ 5,000 kg/ha/yr while the other pond was left as untreated control. Not only the samples of fish harvested from the treated pond showed better growth, but total alkalinity, phosphate and dissolved oxygen levels were also high (*i. e.*, almost double) in the manured pond as compared to those in the control pond.

Problem	: 1.25	Mass culture of phyto—and zooplankton in the fleld to feed fish
Personnel	:	A. C. Nandy, H. S. Raina, P. R. Das, S. K. Mazumder and R. K. Chakraborty
Duration	:	Six years

Both in the laboratory and yard trials, *Daphnia lumholtzi* Sars was cultured with different feeds and culture madia such as Brewer's yeast, freshly cultured *Chlorella vulgaris* and poultry droppings. The result was the best with 0.1% uniform suspension of dried Brewer's yeast. The multiplication rate of the zooplankter was from 10 u/l to 12,650-15,000 u/l in 7 days culture at 22-31°C temperature of the culture medium.

For mass culture of zooplankters in plastic pools, *Moina dubia* Rich were fed with the suspension of freshly cultured *Scenedesmus obliquus* @ 2.25 ml/individual/ day and thus the density of the zooplankter could be raised from 10 u/l to 10,000 u/l in 8 days.

In laboratory, mass cultures of *Navicula cryptocephala*, *N. ryncocaphala* and *Pinnularia acrosphaeria* were done in polythene bags containing water fertilised with urea, single superphosphate and sodium silicate (N-P-Si in the ratio

of 100 : 10 : 5 @ 385 ppm) which yielded 70,000 and 12,00,000 cells/ml in 10 days from an initial inoculum of 5,024, 4,628 and 22,616 cells/ml respectively.

During the studies on growth of *Chlorella vulgaris* cells, the maximum (6.9 μ) and the minimum (2.5 μ) cell diameters were recorded on the 7th and 25th day of culture respectively.

Problem	:	1.26	Nutritional requirements of fry and fingerlings of carps
Personnel	:		P. R. Sen, N. G. S. Rao and S. R. Ghosh
Duration	:		Three years

In the experiment conducted in plastic pools with common carp fry as test fish and with six purified test diets having protein levels of 0, 30, 40, 45, 50 & 60%, the optimum growth of fish was recorded with the diet having 45% protein and 25 % carbohydrate. The above results confirmed the earlier observations. These findings would help in formulating fish feeds for use in carp culture operations.

Problem	:	1.27	(Research work completed in 1976)
Problem	:	1·28	Commercial production of carps through composite culture in large-sized ponds
Personnel	:		M. A. V. Lakshmanan, N. G. S. Rao, M. Rout, D. K. Chatterjee, D. R. Kanaujia and C. Selvaraj
Duration	:		Two years

To evolve techniques for management and exploitation of carps in large water bodies, three ponds (2.25 1.0 and 0.67 ha) were stocked with fingerlings of catla, rohu, mrigal, silver carp, grass carp and common carp @ 7,500/ha for 2 years. During 1975, the feeding and fertilisation programme remained uniform, but in 1976, a change in the fertilisation programme was brought in to study its impact on biotal production. Marketable fishes of 1 kg and above were harvested periodically. Thus during January to April 1976, the fish removals from the former two ponds were 1,634.1 and 551.7 kg respectively which raised the previous year's fish production figures to 7,157 kg (*i.e.*, 3,180 kg/ha) and 4,270 kg (*i e.*,4,270 kg /ha) respectively. The fish removal till April 1976 accounted for 34.1 and 21.5% only of the total fish stock in the former two ponds.

Problem	:	1.29	Comparative study of the efficacy and economics of available fish poisons and their residual effects on the fish pond eco-system
Personnel	:		S. Jena and V. Ramachandran
Duration	:		Three years

To study the efficacy and economics of various fish poisons, the effects of mahua oilcake on plankton and other biotal production were noted while conducting routine fish culture operations.

Among the poisons of plant origin collected so far, the powder of tamarind seed-husk at 8-10 ppm was effective in killing *Tilapia* sp. and common carp fingerlings (50—80 mm) within 2 hours of the application.

Problem	:	1.30	Operational research on fish culture
Personnel	:		M. A. V. Lakshmanan, N. G. S. Rao, M. Rout, D. K Chatterjee, D. R. Kanaujia and C. Selvaraj
Duration	:		Two years

Two ponds each in Jagannathpur and Kandapur were prepared and fry rearing work was demonstrated to the villagers. A total of about 29,000 fry of rohu and mrigal raised in these ponds were sold to other fish farmers of the area. The fish farmers realised an income ranging from Rs. 112.50 to Rs. 588.00 and the other farmers of the area were benefited by getting the quality fish seed within their village itself and that too at a cheaper rate than the usual price prevailing in the area. To extend the techniques of scientific fish culture, seven ponds have been prepared and stocked with fry of Indian and exotic carps @ 5,000/ha. The fish farmers have been provided with technical guidance for the preparation and manuring of their ponds and supplementary feedings of the fishes.

Problem	:	1.31	Use of anaesthetics in transport of carp seed
Personnel	:		S. N. Dutta, K. J. Ram and S. N. Mohanty
Duration	:		Three years

Chemical anaesthetic, alcohol and tertiary amyl alcohol have been tried at different concentrations on spawn and early fry of catla, rohu and mrigal to find out the narcotic effects of these. With amyl alcohol the intensity of sedational effects, judged by the movement of the fishes and responses to stimuli on their body effected by a glass rod, observed were : little at 0.025%, moderate at 0.05% and deep at 0.08%. But with tertiary amyl alcohol at comparatively higher concentrations ; *viz.*, 0.08% for little, 0.1% for moderate and 0·15% for deep sedational effects were required. It was further observed that at the dose of 0.2% of tertiary amyl alcohol the fishes lost equilibrium but regained balance at the end of 24 hours in the same medium. In all the experiments, the narcotic effects on fishes were almost instantaneous and recovery in freshwater too was immediate.

Problem	:	1.32	Bionomics and culture of tendipedid larvae a favoured fish food organism
Personnel	:		N. G. S. Rao
Duration	:		Three years

'Controlled spawning' method of propagation of tendipedids was experimented upon in two series, besides 'natural spawning' method was tried further. Organic manures such as cow dung, chicken droppings, besides mahua oilcake were used as media for culture. These were added in finely powdered form to the water (6 l) in glass jars at 300 mg every fifth day. Each treatment was replicated.

A set of jars was kept in the open while the other set in a meshed enclosure. Counted number of larvae and pupae were introduced in each jar and were provided with a little amount of milk powder as feed. Egg deposition and larval abundance were more in the latter series of jars than in the former. After a period of about 25-30 days, the larval production and consequently, density was observed to be more (around 780-2,800/m^2) by 'controlled spawning' method than in the 'natural spawning' method.

Problem	:	1.33	Studies on detection of digestive enzyme complex of freshwater culturable food fishes
Personnel	:		B. N. Saigal, K. K. Bhanot (Mrs), Amitava Ghosh, P. K. Chakraborti and K. S. Banerjee
Duration	:		Four years

Preliminary observations have indicated that lipase is absent in the intestine and oesophagus but present in the stomach of *Mystus gulio* (size : 89-116 mm), whereas amylase has been detected from all the three parts ; *viz.*, oesophagus, intestine and stomach. In *Channa striatus* (size: 110-390 mm), though significant amount of lipase has been detected from the stomach, the oesophageal lipase has been found to be quite insignificant. Invertase has been found to be practically nil in the buccal epithelium, oesophagus and stomach, but to be appreciable in quantity in the intestine as far as *Channa striatus* is concerned. Lipase has been detected neither in the intestine nor in the intestinal bulb of *Cirrhinus mrigala* (av. size : 125 mm) but it has been detected in the liver and gall-bladder of the fish. Investigations are being continued.

Problem : 1.34 Observations on cultural possibilities of fish in jute retted pond waters

Personnel : B. N. Saigal, K. K. Bhanot (Mrs), Amitava Ghosh, Susanta Saha, P. K. Chakrabarti and K. S. Banerjee

Duration : Two years

Three ponds at JARI, Nilganj were selected to culture *Tilapia mossambica* and air-breathing fishes in jute-retted waters. Of the three ponds, one was charged thinly and another thickly with jute plant while the third one was kept as the control. The hydrological studies were continued till the retting period. Post-retting studies and release of fry and fingerlings of the fishes had to be kept in abeyance for sudden transfer of project associates. Ecological parameters so far known about such water bodies are not at all discouraging for the culture of the above selected species of fish. The physicochemical features of the three ponds during the retting time were as follows :-

	Chunapukur (thinly charged)	Kulupukur (thickly charged)	Mohishpukur (control)
Water temp.	31—32°C (range)	31—32°C (range)	31—32°C (range)
pH	7.2 (average)	6.9 (average)	8.4 (average)
DO	0.3 ,,	nil	4.6 ,,
CO_2 (ppm)	12.5 ,,	75.0 ,,	nil
Total alkalinity (ppm)	200 ,,	350 ,,	325 ,,
NO_2—N	nil	nil	nil

PO_4 (ppm)	4.00	„	7.60	„	3.06	„
NH_3—N (ppm)	0.51	„	2.06	„	trace	„
Co (ppm)	44	„	36	„	82	„
Mo (ppm)	19.2	„	48.0	„	28.0	„
30 min. OC (ppm)	11.6	„	48.0	„	4.0	„

Actual experimental stocking of the fish will be taken up during the jute retting season.

In the laboratory, fingerlings of *Cirrhinus mrigala* (size : 96-110 mm) were exposed to a medium with 10 and 15 ppm of acetic acid. During the trial, no mortality of the test fish was observed, indicating thereby that acetic acid which is liberated during jute-retting has no apparent harmful effect on mrigal fingerlings.

Problem	:	1.35	Culture of fish alongwith paddy
Personnel	:		S. N. Dutta, S. L. Kar, R. P. Singh, P. K. Pati and R. K. Nigam
Duration	:		Three years

At the CRRI Experimental Farm, Cuttack, common carp fry (av. wt. 0.8 g) were released in two 0.16 ha plots while cultivating CR 1014 variety of paddy. An average gain in weight by 100 g per fish was observed when they were harvested after 120 days of culture in paddy fields.

Problem	:	1.36	Snail control in ponds under fish culture
Personnel	:		K. J. Ram and S. L. Kar
Duration	:		Three years

A survey of the molluscan population in Killa Fish Farm was made. About 11 species of common occurrence were recorded in the area.

Experiments to evaluate the effects of conventional toxicants ; *viz.*, endrin, mahua oilcake, *Barringtonia* sp., etc. on these molluscan species have been set up and are in progress.

probiem	:	1.37	Devising effective sampling technique for estimating production
Personnel	:		M. Rout and R. D. Chakrabarty
Duration	:		Two years

Fish samples were collected by drag netting in farm ponds and random selection of smaller groups were made through subsampling. Estimates of mean values of length and weight from successive hauls did not differ significantly. Due to heterogeneity of stock in some of the ponds, the method of stratified random sampling was applied to estimate the production. The differences calculated for standard errors by raising the samples up to 25% of total stock were found to be nonsignificant. Loss in weight of the culturable indigenous and exotic carps was studied against temperature and time. The percentage loss in two seasons (monsoon & winter) was observed to remain within the range of 2·41 to 1.08 during the first four hours with temperatures ranging from 28.0° to 33.0°C.

Problem	:	1.38	Biology of some bloom forming blue-green algae of fish ponds
Personnel	:		B. Dash
Duration	:		Two years

Total nitrogen fixed by a species of nitrogen fixing bloom forming algae, *Anabaena roxburghii*, has been studied. The alga fixed 14.48 mg of nitrogen per 1,000 cc of culture containing population of 72.8×10^4 filaments.

Problem	:	1.39	Effect of lime in pond soils
Personnel	:		D. K. Chatterjee, G. N. Saha, D. Nath and K. C. Pani
Duration	:		Four years

The efficacy of different liming materials, such as quick lime—CaO, slaked lime—$Ca(OH)_2$ and carbonate of lime—$CaCO_3$ at 250, 500 and 1,000 kg/ha was studied. In laboratory, trials were made with 3 replications using slightly acid soil having low nutrient contents.

Among the treatments, calcium carbonate at higher rate showed the maximum increase in water pH 7.6 and total alkalinity (116.7 ppm) as against control (7.0 and 42.0 ppm respectively). Liming also increased the concentration of phosphate, maximum being with slaked lime (0.09 ppm) as compared to control (0.04 ppm). Increase in nitrogen concentration was not very appreciable as the organic matter content of the soil was very low.

Problem	:	1.40	Comparative efficiency of organic manures on the fertility of pond soils

Personnel : G. N. Saha, C. Selvaraj, D. K. Chatterjee and K. C. Pani

Duration : Five years

In laboratory, a comparative study was made on the effects of cow dung and mustard oilcake on survival and growth of rohu fry and also on nutrient status. These manures were applied at 3 rates on equivalent carbon basis (300, 600 and 1,200 kg C/ha) in slightly acid soil. After 15 days of manuring, each jar was stocked with 20 rohu spawn which were reared for 20 days. Cow dung maintained higher concentration of phosphate in water while mustard oilcake maintained more of nitrogen and total alkalinity. The former gave maximum survival & growth of fry at 1,200 kg C/ha (70% & 23.8 mg) and the latter at 600 kg C/ha (70% & 19.04 mg) as against the control (18.8% & 7.3 mg).

Yard trials were conducted using the same soil type at 600 kg C/ha. In this case too, cow dung enriched the water more with phosphorus (0.19 ppm P_2O_5) as compared to oilcake (0.02 ppm) while oilcake enriched the water with inorganic nitrogen (0.12 ppm) as compared to cow dung (0.03 ppm).

Project 2 : Induced fish breeding

Problem : 2.1 (Research work completed in 1970)

Problem : 2.2 (Research work completed in 1976)

Problem : 2.3 (Research work completed in 1972)

Problem : 2.4 Hatching of eggs of major carps in newly designed hatchery jars under controlled conditions

Personnel : R. M. Bhowmick, R. K. Jana and S. D. Gupta

Duration : Nine and half years

In the hatchery complex, eleven experiments were conducted with Indian major carp eggs and two experiments with grass carp eggs. A total of 22.5 lakhs of spawn was produced. In each of the experiments, the indoor hatchery showed better hatching of eggs and survival of spawn than those of controls, fixed in ponds in cloth *hapas*. Common carp eggs were degummed and hatched successfully in hatchery under controlled conditions.

Problem	:	2.5	(Research work suspended since 1973)
Problem	:	2.6	Production of multiple broods from the same individual of major carps in the course of one year
Personnel	:		R. M. Bhowmick, G. V. Kowtal, R. K. Jana and S. D. Gupta
Duration	:		Six and half years

Due to failure of monsoons, the fish breeding work was started late in July. The spent fishes stocked after first hypophysation failed to mature again in the season and hence experiments were not continued further.

Problem	:	2.7	(Research work kept in abeyance)
Problem	:	2.8	(Research work kept in abeyance)
Problem	:	2.9	Studies on the process of maturation, ovulation and resorption in Indian major carps
Personnel	:		G. V. Kowtal, R. M. Bhowmick, R. K. Jana and S. D. Gupta
Duration	:		Six years

Gross morphological and histological studies of the ovary of *C. mrigala* revealed that the immature transparent ova (stage-I) measuring 0.176-0.224 mm undergo development from the month of February. With the increase in size, the ova are progressively yolk laden and in the mature condition (stage-V) they are spherical, semi-transparent, have a clear margin and measure 0.8 to 0.96 mm. This condition is reached by the end of May when the ovary is highly distended and it fully occupies the body cavity.

Project 3 : Reservoir fisheries

Problem	:	3.1 to 3.5	(Research work completed in 1972)
Problem	:	3.6	(Research work suspended in 1976)
Problem	:	3.7	(Research work completed in 1970)

Problem	: 3.8	Fisheries of Paninsular tanks— Introduction and propagation of less known cultivable species
Personnel	:	B. V. Govind, P. K. Sukumaran, S. L. Raghavan and M. F. Rahman
Duration	:	Three years

1,200 fry of *Chanos chanos* were collected from the vicinity of Kody Fish Farm on the west coast and stocked in Hessaraghatta Fish Farm for follow up studies. The fish attained an average size of 81.8 mm and 5.92 g in three months.

Problem	: 3.9	(Research work completed in 1976)
Problem	: 3.10 & 3.11	(Research work suspended since 1973)
Problem	: 3.12	(Research work completed in 1976)

Problem	: 3.13	Composite fish culture of Indian and exotic carps in tanks simulating long seasonal irrigational tanks
Personnel	:	B. V. Govind, P. K. Sukumaran, S. L. Raghavan and M. F. Rahman
Duration	:	Two years

With periodical harvesting of fish in the ASC Centre tank (1.5 ha area) near Bangalore in which composite culture of the three Indian major carps and the three exotic carps is in progress, a total quantity of 2,278.76 kg of fish was removed in about 10½ months. Noteworthy feature of the experiment has been the attainment of average sizes of 1,388.89 g by catla, 1,305.35 g by common carps, 1,000.00 g by silver carp and 842.30 g by grass carp. The exotic carps were stocked at low rates.

The first harvesting in the Bilavardhahalli pond (1.5 ha area) yielded 129.1 kg of fish comprising catla (av. 783.33 g), silver carp (av. 550.00 g) and grass carp (av. 523.53 g) in about a year.

Hydrobiological observations made in the above two tanks were sought to be correlated with fish production. Zooplankton dominated over phytoplankton in both the tanks. Plankton density ranged from 1,97,500 to 46,20,000 u/m^3 and by volume 0.05 to 47 ml/m^3. Littoral and benthic organisms in these tanks ranged from 0.43 to 193 u/m^3 by numbers and 0.095 to 8.48 g/m^3 by weight.

Problem	: 3.14	Ecology and fishery development of Gulariya reservoir
Personnel	:	A. G. Jhingran, K. P. Srivastava, S. N. Mehrotra, R. K. Dwivedi, B. C. Jha and K. L. Shah
Duration	:	Four years

Selection of the reservoir : A preliminary survey of eight reservoirs : Baghla & Gulariya in Allahabad and Lower Khajuri, Upper Khajuri, Sirsi, Meja, Sukhara & Ghori in the district of Mirzapur was undertaken and data on reservoir morphometry, inflow-outflow, water availability during different seasons, accessibility, fish fauna and details of commercial catches during different years were recorded. Samples for hydrobiological studies and physicochemical analysis of water and soil were collected and studied. Taking into consideration all the aforesaid factors, Gulariya reservoir was selected for detailed studies on its ecology and fisheries. Studies were initiated from September 1976.

Hydrology : The reservoir water was found to be clear as indicated by high Secchi disc readings (50.0 to 54.0 cm). Water temperature and pH values ranged between 30.0 & 32.0°C and 6.6 & 7.4 respectively. Dissolved oxygen was rich (8.0 to 8.8 ppm), while the free carbon-di-oxide was low 1.2 to 4.2 ppm). Total alkalinity and hardness ranged between 32.0 & 50.0 ppm and 15.0 & 22.0 ppm respectively. Calcium ions ranged between 8.0 & 12.4 ppm, while the inorganic nutrients ; *viz.*, phosphate (0 1 to 0.13 ppm), silicate (4.2 to 10.4 ppm) and chloride (4.0 to 5.4 ppm) were moderate. Primary productivity varied between 94.0 and 137.5 mg C/m^3/hr.

Plankton : The average plankton biomass ranged between 0.36 & 0.85 ml/m^3 and the plankters by numbers varied between 924 & 2,385 u/1, being the maximum in Zone I and the minimum in Zone III, in both the cases. A small bloom of blue-green alga, *Microcystis* sp., was observed in September, while desmids alongwith zooplankton were dominant in the months of October. The dominant forms of plankters encountered were *Microcystis* sp., *Oscillatoria* sp., *Selenastrum* sp., *Staurastrum* sp., *Xanthidium* sp., *Closteriopsis* sp., *Cosmarium* sp., *Synedra* sp., *Melosira* sp., *Cymbella* sp , *Keratella* sp., *Moina* sp., *Diaptomus* sp., *Cyclops* sp. and copepod naupiii.

Bottom fauna : The benthic fauna of the reservoir was poor (65 u/m^2).

Chironomids (30 nos./m^2) were the dominant forms followed by oligochaetes (25 nos./m^2) and coleopterans (10 nos./m^2).

Stocking: The State Department of Fisheries has stocked the reservoir with 40,000 major carp fingerlings. Further stocking of the reservoir will be taken up as a part of these investigation.

Project 4 : Riverine carp spawn prospecting and collection technique

Problem	:	4.1 & 4.2	(The work is being done under a Co-ordinated Research Project)
Problem	:	4.3	(Research work suspended since 1972)
Problem	:	4.4	(Research work completed in 1973)
Problem	:	4.5	Yearly variation in quality and quantity of spawn in the river Ganga
Personnel	:		K. P. Srivastava and G. N. Srivastava
Duration	:		Four years

Mahewapatti on the river Yamuna in the district of Allahabad and Bharauli on the river Ganga in the district of Ballia (Uttar Pradesh) were the selected sites for detailed studies. Round-the-clock observations were made to study the availability & adundance of fish spawn and the effects of various meteorological, hydrological & hydrobiological factors affecting the quantity and quality of spawn.

Mahewapatti : During July, there were scanty rains and no spawn was available. In the later period, the river experienced 3 floods and during six spurts, a total of 2,134 ml (*c.* 10,67,000 hatchlings) of spawn were collected using 5 Midnapore type 1/8" meshed shooting nets. The six spurts yielded 53, 1,136, 200, 127, 532 and 86 ml of spawn contributing 2.5, 53.3, 9.4, 5.9, 24.9 and 4·0% respectively to the total spawn catch of the season. Besides this, 395 ml of spawn were also collected by operating 2 to 3 additional nets making the centre's total for the season to be 2,529 ml (*c.* 12,64,500 hatchlings).

About 1,820 ml of spawn were reared in the seasonal nursery ponds near the collection site and 150 ml were handed over for work under the project "Cage

culture in lentic waters". Nursery rearing of spawn is being done to stock the Gulariya reservoir taken for study and also for the work in different research projects of the division. The fingerlings have been observed to be growing well in the nurseries.

Microscopically, the desirable quality of the spawn from the six spurts ranged between 5·7 and 53·2%. On nursery rearing the major carp content was found to be 64·9% ; *C. mrigala*, *C. catla* and *L. rohita* contributing 32·2, 24·6 and 8% respectively. Minor carps represented by *L. bata* and *C. reba* accounted for 35.1% only. The results so far indicate that Mahewapatti on the river Yamuna in the district of Allahabad is a productive centre for quality fish seed.

Bharault : 360 ml of spawn was collected at this centre on the river Ganga in four spurts experienced in 3 floods ; the spurts I, II, III & IV contributing 42, 239, 38 & 41 ml, and their percentage contribution to the total spawn catch of the season being 11.6, 66.4, 10.6 and 11.4 respectively. Analysis of the reared spawn showed the major carps percentage to be 77.6%; *C. mrigala*, *C. catla*, *L. rohita* and *L. calbasu* contributing 2.0, 14.3, 54.5 and 6.8% respectively.

Unfavourable pattern of the floods in the river Ganga and construction of a road bridge about 2 km up-stream of Bharauli centre appear to have adversely affected the spawn catches at the centre.

Project 5 : Brackishwater fish farming

Problem	:	5.1	(Research work completed in 1975)
Problem	:	5.2	(Research work completed in 1973)
Problem	:	5.3	(Work programme transferred to Brackish-water Experimental Fish Farm Unit, (Kakdwip)
Problem	:	5.4 to 5.6	(Research work completed in 1972)
Problem	:	5.7	(Research work completed in 1973)
Problem	:	5.8	(Research work completed in 1975)
Problem	:	5.9	(Research work completed in 1973)
Problem	:	5.10	(Research work completed in 1975)
Problem	:	5.11	(Research work completed in 1974)

Problem	:	5.12	Methods of silt control and experimental trials on sluices
Personnel	:		A. B. Mukherjee, A. Sengupta and B. Basak
Duration	:		Two years

Open type wooden sluice box 0.52 m × 1.05 m × 2.72 m with no roof cover on the top and with two compartments was designed and constructed using *sal* wood planks and beams. The sluice box has been installed in the main feeder canal at the Brackishwater Fish Farm, Kakdwip. The side and floor planks of the sluice are 25 mm thick to prevent lateral thrust of the supported earth while the framed structure of the box is built with 10 cm × 7.5 cm wooden beams. To keep the sluice box in a perfectly stable condition the floor planks have been extended 30 cms on either sides transversely and the vertical beams have been driven 20 cm deep in the foundation bed to counteract uplift.

The average velocity of tidal flow through the sluice at the beginning of tide was recorded to be 0.20 m/sec and at a later stage 0.28 m/sec when the height of free water flow was 0.65 m above the floor level of the sluice.

By dropping individual 'bulk' shutter gates, desired surface layer of tide water has been taken into the farm ponds. The average velocity of tidal flow, 15 cm above the crest of the sluice shutter, is 0.16 m/sec with corresponding discharge under free flow through an area of 0.078 sq m being 0.013 cu sec.

Silt concentration in the tide water at the sill of the sluice at a depth of 0.80 m from the free water surface has been observed to be 1,100 ppm which has been prevented from flowing through the sluice by dropping the sluice shutters whereas the surface water having a silt charge of 850 ppm has been allowed to flow at a regulated velocity over the crest of the shutter. Thus the silt drawing capacity into the farm ponds has been controlled with the present water control structures.

Silt load to a depth of 8 cm from the canal bed for a length of 20 m has been flushed out during the ebb tide by churnning the canal bed and letting out the silt laden water through a narrow submerged opening at the sluice entrance when the depth of stored water was 0.72 m on the canal side.

Problem : 5.13 to 5.16 (Research work completed in 1975)

Problem	: 5.17	Brackishwater prawn culture in Madras region
Personnel	:	K. Raman, K. Gopinathan and P. M. A. Khadir
Duration	:	Five years

With a view to studying the rate of growth, survival, etc. of penaeid prawns, an experiment was conducted in a 0.01 ha nursery pond at Adyar Fish Farm by stocking juveniles of *Penaeus indicus* (16—42 mm) and *P. monodon* (14—31mm) at a combined stocking density of 11,000 nos./ha. Though the stocking was done during the end of January, the experiment had to be wound up earlier as the water area of the pond came down to 20 m^2 with negligible depth of about 15 cm due to scarcity of water. A total of 432 g of prawn could be harvested when the experiment was terminated after just over three months period. While the rate of survival in respect of *P. indicus* was observed to be 78% the same for *P. monodon* was 60%. The growth increment recorded were 72.8 mm and 97.9 mm in respect of *P. indicus* and *P. monodon*. A few specimen of *P. japonicus* which was also introduced in the experiment, had shown encouraging rate of growth for two months but subsequently perished during the last phase of the experiment.

The experiment was restarted by stocking the same pond with juveniles of *P. indicus* and *P. monodon* of slightly larger sizes (20—100 mm) than the earlier @ 35,000/ha with the provision of supplementary feeding with a feed mixture of prawn powder + ground-nut oilcake and rice-bran in the ratio of 4 : 3 : 3 : @ 10% body weight on alternate day. The experiment is in progress.

Problem	: 5 18	Culture of the edible oyster in Pulicat lake
Personnel	:	K. V. Ramakrishna and R. Ganapthy
Duration	:	Five years

To evolve a suitable technique for the culture of edible oysters to augment its production, experiments are being carried out at Pulicat Research Centre. The edible oysters (*Crassostrea madrasensis*) collected from the natural oyster beds near Pampupadu have grown to a size range of 60.0—105.0 mm and 50.0—75.0 mm in shell heights on trays and asbestos sheets respectively. While the range of shell length of the oysters on trays was 48.0—92.9 mm the same was recorded to be 43.0—68.0

mm on asbestos sheets. A new spat fall on freshly set up cultch material has been observed during September and October having shell heights ranging from 15.0—27.0 mm and shall length from 8.0—27.0 mm. In course of the experiment, wooden boxes and trays containing oyster were found to harbour *Etroplus* sp., *Epinephelus* sp., *Glossogobius* sp., *Lutjanus* sp., *Scatophagus* sp., *Tetradon* sp., & *Mugil macrolepis* among fishes and *Scylla serrata* among crabs besides prawns, such as palaemonids, penaeids and alpheids. Observations on the various hydrological parameters of the experimental site were also continued.

Problem : 5.19 (The work programme has been tansferred to problem 5.26)

Problem : 5.20 (Research work completed in 1976)

Problem : 5.21 Fish and prawn seed resources of Pulicat lake

Personnel : K. Raman, K. V. Ramakrishna, R. D. Prasadam, G. R. M. Rao, S. Radhakrishnan, C. P. Rangaswamy, M. Kaliyamurthy, K. Gopinathan, R. Ganapathy, K. O. Joseph and S. Srinivasagam

Duration : Five years

Studies on the abundance and ingress of fish and prawn larvae into the Lake Pulicat could be continued uninterrupted since the lake-mouth remained open throughout the year. Collections made by operating the shooting nets to assess the ingress of prawn and fish seeds into the lake revealed that the larval recruitment was generally better during the first half of the year in comparison to the later half. While the peak periods of availability of fish seeds were observed to occur during February, May and November, the same for the prawns were in February, May and September. Among fishes, larvae of *Sillago sihama*(16.7/net/hr); *Mugil* spp. (15.5/net/hr); *Elops saurus* (11.5/net/hr) and *Anchoviella* spp. (10.8/net/hr) were the prime contributors while *Gerres* spp. (4.5/net/hr) and *Chanos chanos* (1.4/net/hr) were available in the catch in small numbers. *Penaeus indicus* among prawns was the most abundant (327.0/net /hr) followed by *Metapenaeus monoceros* (13.8/net/hr), *Penaeus monodon* (6.5/net/hr) and *P. semisulcatus* (5.0/net/hr).

Distribution and abundance of fish and prawn within the lake were also studied by obtaining samples from different sections of the lake with the use of velon nets. The common forms encountered among fishes were *Ambassis* sp., *Anchoviella* sp., *Aplochielus* sp., *Chanos* sp., *Gerres* sp., *Hemiramphus* sp., *Mugil* sp., *Mystus* sp., *Nematolosa nasus*, *Sillago* sp., *Strongylura* sp., *Therapon* sp., *gobiids* and larvae of *Elops* sp. whereas among crustaceans and prawns, *Penaeus indicus*, *P. semisulcatus*, *Metapenaeus monoceros*, *M. dobsonii*, *Acetes* spp., mysids, palaemonids and crabs were mainly available.

Problem	: 5.22	Rearing of fry of brackishwater fishes
Personnel	:	R. D. Prasadam, K. V. Ramakrishna, G. R. M. Rao, C P. Rangaswami, M. Kaliyamurthy, K. Gopinathan and R Ganapathy
Duration	:	Five years

In an experiment conducted in a 0.005 ha pond, mullet fry (av. length/weight : 21.5 mm/0.146 g), consisting *Liza macrolapis*, *L. vaigiensis* and *Mugil cunnesius*, stocked @ 30,000 nos /ha registered an average increment in length by 10.78 mm and in weight by 2.34 g per month. The stocked fishes were subjected to supplementary feeding with a feed mixture of ground-nut oilcake + rice-bran and prawn-meal. After a period of three months rearing the highest increment recorded by an individual species was observed in case of *L. vaigiensis* (12.2 mm/month) followed by *M. cunnesius* (11.7 mm/month) and *L. macrolepsis* (8.6 mm/month).

In another experiment, 102 fingerlings of mullet (25—75 mm) stocked in the enclosure of Pulicat lake attained an average size of 63.4 mm in 120 days. No supplementary feeding was done during the course of the experiment. Whereas in two different experiments conducted in the yard in earthern tubs with lab-lab as food, the mullet fingerlings showed an increment in the length by 4.1 mm/month with very low rate of survival (16.7%) in course of 90 days rearing.

An experiment on the mixed culture of mullet and prawn was carried out in a brackishwater pond with *Mugil cephalus* (34.6 mm/0.65 g) and *Metapenaeus monoceros* (36.3 mm/0.125 g). During a period of 2½ months rearing, the former showed an increment by 46.4 mm/9.15 g as against 31.4 mm/3.1 g by the latter.

Investigations on the rearing of *Chanos chanos* fry with and without provision of artificial feeding were continued. In yard trials conducted at Adyar Fish Farm, fry of *Chanos chanos* reared in plastic pools and fed with a mixture of ground-nut oilcake and rice-bran recorded a growth increment of 12.0 mm/1.0 g in 17 days. Subsequently due to severe summer condition the fish were transproted from Adyar and reared in a freshwater pond at Chetpet Fish Farm in April 1976. In the freshwater pond, the fingerlings of *Chanos chanos* registered an increment by 47.0 mm/15.3 g in 143 days. In another experiment, 400 juveniles of *Chanos chanos* stocked in a brackishwater ponds (0.01 ha) at Adyar attained an average size of 87.6 mm/18.0 g in 3 months.

In combined culture of milk-fish, mullet and prawn, an estimated production of 835 kg/ha of *Chanos chanos* and *Penaeus indicus* could be obtained in three months through partial harvesting. The fishes were stocked in a 0.45 ha pond at Adyar Fish Farm at a combined stocking density of 33,000 nos./ha and fed with a mixture of prawn head powder+rice-bran+ground-nut oilcake in the ratio of 4 : 3 : 3.

Studies on the rearing of fry of perches were also taken up during the year, besides assessing the cultural possibilities of catfishes of lake Pulicat. In an experiment, fingerlings of *Gerres oyena* (48.9 mm/1.54 g) stocked in a brackishwater pond at the rate of 32,000 nos./ha gave a growth increment of 13.5 mm/1.62 g per month. Culture experiments were conducted in the yard with *Mystus gulio* using two different artificial feeds *i.e.*, cooked rice and ground-nut oilcake+rice-bran+commercial feed. while the fish registered an increment in the growth by 6.5 mm/0.51 g in 63 days with cooked rice as feed, the same was observed to be 6.3 mm/0.22 g in 23 days when ground-nut oilcake + rice bran+commercial feed mixture was used.

Problem	:	5.23	Experimental culture of brackishwater fish food organisms in the laboratory and field
Personnel	:		A.C. Nandy, A.N. Ghosh, S.K. Majumdar, R.K. Chakrabarty and P.R. Das
Duration	:		Three year

Two strains of diatoms, *Skeletonema costatum* and *Fragillaria* sp. were isolated on agar plates for subsequent mass culture under laboratory and yard trials. Mass culture of *Gyrosigma* sp. has been successfully achieved in 100: 10 :

ratio of N-P-Si using urea, single superphosphate and sodium silicate in 19.5‰ salinity at the rate of 385 ppm. In 10 days turn over, a cell density of 9×10^3/ml was obtained.

Culture of Artemia salina : A continuous culture of *Artemia salina* was maintained in glass aquaria. Hatching of dried viable *Artemia* eggs was found quicker within 36-48 hours during summer months when temperature ranged above 5°C, but during winter months at temperature below 20°C, hatching took more than 2 hours. Salinity ranging between 12 and 45 ppt did not show any significant influence on the hatching process. The young *Artemia* hatched out in the laboratory attained the first maturity at the size range of 7.0-8.0 mm and started viviparous reproduction after attaining a size of 11-12 mm in about 25-26 days. The young ones obtained by viviparous reproduction were maintained in a continuous culture in saline water produced by mixing common salt into tap water at 45 ppt. The eggs produced by mature *Artemia* in the culture and subsequent rearing of each alternate generation were collected and sun dried and thus the viability were tested for future propagation. The techniques of *Artemia* sp. culture are being improved gradually.

Problem	:	5.24	(The work programme has been transferred to problem 5.23)
Problem	:	5.25	(Research work suspended since 1975)
Problem	:	5.26	Transformation of nitrogen and phosphorus in water logged saline soils relative to different grades of water salinity
Personnel	:		G. N. Chattopadhyaya and M. K. Mukhopadhyay
Duration	:		Three years

Nature of transformation of nitrogen and phosphorus in two farm ponds, one treated with nitrogen in the form of urea, phosphorus in the form of superphosphate and cow dung @ 150, 150 and 1,000 kg respectively and the other kept as control, has been studied for a year. Studies on different physicochemical properties made during this year showed water salinity and dissolved oxygen to range from 7.6 to 22.8 ppt and from 8.0 to 8.8 ppm respectively. pH of the water in these

two ponds varied from 8.0 to 8.4 during the year. No appreciable difference was observed in the amounts of water soluble nitrogen and phosphorus in the treated pond over the untreated one. Available N_2 level in the soil was slightly high in the treated pond, but no such difference could be observed in case of available soil phosphorus. Plankton population in these two ponds could not be correlated with nutrient status of the ponds but growth of soil flora increased appreciably in the treated pond over the control pond.

Problem : 5.27 (Research work kept in abeyance since 1975)

Problem : 5.28 Behaviour of lake-mouth bar and its bearing on the fishery of lake Pulicat

Personnel : K. Raman, K.V. Ramakrishna, K. Gopinathan R. Radhakrishnan, R. Ganapathy, K. O. Joseph, S. Srinivasagam and P. M. A. Khadir

Duration : Three years

The total landing from the lake was estimated at 1,084.414 t during the year under report as against 759.626 t of the preceding year. The significant increase in the catch may be attributed to the uninterrupted fishing in the lake at various points as the lake-mouth remained opened throughout the year. The contribution of the northern sector of the lake (579.73 t) to the total landing was observed to be slightly higher than that of the southern sector (504.68 t). prawn dominated the catch by contributing 48.6% to the total landing followed by clupieds (20.4%). Hydrobiological observations made from the sea, lake-mouth and other adjoining centres showed no marked variation.

Problem : 5.29 Role of silt load in the Hooghly estuary on its environmental and nutrient balance and its effect on brackishwater pond fertilisation

Personnel : S.C. Banerjee, B.B. Pakrasi and N.C. Basu

Duration : Two years

Silt load in the tide water during spring tide at two centres, one at Barrackpore (1.40 g/l) and the other at Kakdwip (1.86 g/l) exhibited little difference. How

-ever, the same was observed to increase considerably during the monsoon months at both the centres. Salinity or soluble salt content and conductivity were observed to be higher at Kakdwip centre than those of at Barrackpore centre. The range of nutrient status of the silt at both the centres is presented below :

	Barrackpore	Kakdwip
pH	7.4 — 7.3	7.1 — 7.4
Available N_2 (mg/100 g)	12.0 — 19.3	13.2 — 16.5
Available P_2O_5 (mg/100 g)	1.9 — 3.2	1.9 — 2.0
Conductivity (μ mhos)	6,513—47,317	33.3—150.3

The available nitrogen in the silt being moderate at Kakdwip, resulted in high nitrate level in the water phase (0.3—1.15 ppm) at the centre whereas the same was comparatively low (0.1—0.44 ppm) at Barrackpore centre.

Problem : 5.30 (Research work kept in abeyance)

Problem : 5.31 Studies on the macrophytic flora in Lake Pulicat with special reference to their utilization as organic manure and artificial feed for fish

Personnel : S. Radhakrishan

Duration : Three years

Cymodocea sp. was observed to reappear in the northern portion of the lake, during December-January. The plants grew in the shallow areas along the periphery of the lake at depths ranging from 35.0 to 75.0 cm. The plants started flowering in February-March. The biomass of *Cymodocea* sp., collected from the lake through regular sampling, was observed to range between 1.3—12.5 kg/m^2. The plants were found to grow well in low saline waters (4.0-20.0 ppt) at a water temperature ranging from 26.1° to 31.0°C.

The filamentous algae *Enteromorpha* sp., *Chaetomorpha* sp., *Ulva* sp., *Hypnea* sp. and *Polysiphonia* sp. were generally rich in the southern sector of the lake and their biomass ranged from 0.125 to 9.0 kg/m^2.

Studies on the periphyton community inhabiting the lake water were made. The common forms of periphytons encountered were : *Pleurosigma* sp., *Nitzschia* sp., *Navicula* sp., *Amphora* sp., *Diploneis* sp., *Surirella* sp., *Fragillaria* sp., *Licmophora*

sp., *Lyngbya* sp., *Oscillatoria* sp., *Chlorococcus* sp., *Enteromorpha* sp., *Ulva* sp. and *Chaetomorpha* sp., The density of periphyton on glass panels ranged from 266 to 70,180 u/cm^2, on plastic sheet from 1,570 to 77,840 u/cm^2, on asbestos sheet from 3,226 to 1,64,560 u/cm^2 and on wooden panels from 5,167 to 1,74,240 u/cm^2.

Preliminary experiments to elucidate the possibility of utilising the plant resources alone and in combination with artificial feed as fish food were carried out. In an experiment, mullet fry were fed separately with *Chaetomorpha* sp. and *Enteromorpha* sp. An average increase in the weight of the fry by 27.0 mg/10 days was noticed with the use of *Chaetomorpha* sp. as feed as against an increase of 2.0 mg/10 days with *Enteromorpha* sp. *Gracilaria* sp. and *Ulva* sp. were also used as fish food for mullet fry in a different set of experiment and the weight of the fish was observed to be 12.01 mg after 60 days. In another experiment, mullet fry gained 66.3 mg in 30 days when fed with *Hypnea* sp., 88.0 mg with *Cymodocea* sp., and 128.0 mg with *Polysiphonia* sp. Ground-nut oilcake, which was fed concurrently with the above feeds, gave an increment of 46.0 mg in 10 days to 333.0 mg in 60 days.

Problem	:	5.32	Culture of edible portunid crabs
Personnel	:		S. Srinivasagam and K. Raman
Duration	:		Three years

Small juveniles of edible protunid crabs, *Scylla serrata*, *Portunus pelagicus* and *P. sanguinolentus* ranging from 8 to 60 mm in carapace width were fed with the fresh meat of trash fishes and molluscs. Under salinity range of 25 to 32 ppt, the average growth per month and per moult as well as the percentage survival at the end of 60 days' experiment were : 8.8 & 6.10 mm and 6.6% for *Scyllaserrata*, 11.5 & 6.90 mm and 85.7% for *P. pelagicus*, and 11.2 & 5.93 mm and 71.4% for *P. sanguinolentus*.

Problem	:	5.33	Nursery management in the culture of *Eleutheronema tetradactylum*
Personnel	:		A. V. P. Rao, A. N. Ghosh and P. K. Ghosh
Duration	:		Two years

Gut contents of 110 specimens (length range 9—43 mm) were analysed. Gut contents up to 25 mm size indicated greater dependence on copepods and thereafter on postlarvae of prawns, especially of *Penaeus indicus*, was observed.

The food items in order of preference, as seen from the laboratory experiments were : *Penaeus indicus*, mysids, *P. mondon*, *Palaemon styliferus*, *Stigmatogobius* sp., *Eleotris* spp. and megalops larvae. Cannibalistic behaviour was exhibited when no other food was available. Mashed prawns, *Scatophagus argus*, *Syngnathus* sp., *Anisops* sp. and slaughter house waste were not accepted by the fish in experimental feeding trials conducted.

Laboratory experiments with fish in the size range of 8—12 mm length were conducted at three stocking densities ; *viz.*, 300, 600 and 1,000 fish per cu. metre of water. From an initial length of 10.5 mm a net gain of 32.5 mm, 22.78 mm and 18.96 mm in length was observed at the above stocking densities respectively during 22 days' culture period. Zooplankton comprising mostly of copepods served as food. The ranges of salinity and temperature of the water in the experimental jars were 18.08 & 31.07 ppt and 28.0° & 32.6 °C respectively. The dissolved oxygen was between 2.0 and 7.2 ppm.

Larger specimens of 64 mm total length reared for 22 days at a stocking density of 66 /m^3 of water showed a net gain of 14.0 mm in length when fed with juveniles of *P. indicus* and *P. monodon*. There was preferential feeding on *P. indicus* with an average consumption of 11.4 prawns of 25-35 mm length per day per fish.

Pond No. 24 (0.02 ha) was stocked @ 1,00,000/ha with juveniles (average length of 9.9 mm). In 46 days, an average length of 72.14 mm was attained. From time to time lived food items, like *Penaeus indicus*, mysids and *Stigmatogobius* sp. were added to the pond as there was no possibility of tidal exchange in the pond. The high survival of 50.0% observed after four weeks of stocking, was later reduced to 7.45% on the 69th day due to fouling of the pond water. Further work was suspended due to repairs to the main sluice of the fish farm.

Problem	:	5.34	Stocking manipulation in polyculture of Indian and exotic carps, mullets, chanos and prawns in low saline ponds
Personnel	:		A. V. P. Rao, B. B. Pakrasi, A. N. Ghosh R.K. Banerjee, P.K. Ghosh and A.K. Roy
Duration	:		Two years

K-pond was stocked @ 8,000/ha with major carps, silver carp, common carp, *Liza tade*, *L. parsia*, *Mugil cephalus*, *Chanos chanos* and *Penaeus monodon*

at different times during May to October 1976 under the procedure of repeated stocking and harvesting for the brackishwater fishes and prawns and single stocking and harvesting for the freshwater fishes. The average sizes attained in December by different species of fishes and prawns were as follows :

H. molitrix group I : 355.8 mm/463.8 g & group II : 305.3 mm/227.5 g, *Cyprinus carpio* var. *communis* : 245.0 mm/230.0 g., *L. tade* group I : 330.4 mm/363.0 g & group II : 267.0 mm/166.5 g., *L. parsia* : 185.0 mm/40.0 g., *C. chanos* : 304.5 mm/173.3 g., *C. catla* : 154.8 mm/47.2 g., *L. rohita* : 195.6 mm/83.6 g., *C. mrigala* : 180.5 mm/52.4 g. Under partial harvesting pattern, 34.150 kg of fishes and prawns were removed. Due to short term rearing of *P. monodon*, the percentage of recoveries was 37.4 as against the maximum of 15.0 in the past.

The concentration of phyto- and zooplankton ranged between 70 & 17,000, and 900 & 4,417 units per litre of water respectively. As fertilizers were received only in October, fertilization was practised since then only. The settled volume of the plankton ranged between 0.1 and 0.5 ml. *Anabaena* sp., *Ankistrodesmus* sp., *Navicula* sp., *Chloroboytyd* sp., *Nitzschia* sp., *Mastogloss* sp., *Gyrosigma* sp. and *Euglena* sp. among the phytoplankton and copepods, nauplii larvae, *Moina* sp. and *Brachionus* sp. among the zooplankton were the common forms observed.

In the water phase, pH, dissolved oxygen, PO_4—P, NO_3—N, alkalinity and salinity were in the ranges of 7.0—8.2, 6.1—6.8 ppm, 0.155—0.216 ppm, 0.8—1.25 ppm, 164.8—206.0 ppm and 0.04—0.55 ppt respectively. In the soil phase, the available phosphorus and nitrogen varied from 5.45 to 7.21 and 12.53 to 22.96 mg/100 g soil respectively with organic carbon varying between 1.00 to 1.29%.

Problem	:	5.35	Culture of *Chanos chanos*
Personnel	:		A. N. Ghosh, M. K. Mukhopadhaya, P. K. Ghosh and A. K. Roy
Duration	:		Three years

Only one hundred fry of *Chanos chanos* (25 to 30 mm size) were collected from the pits around Bakkhali Farm area during April to end of June and reared in a nursery pond but due to overflooding of the pond all the stocked materials were lost.

Culture of Chanos chanos with other mullets and penacid prawns : Due to

non-availability of the stocking material, the work according to programme could not be initiated. The yearlings of milk-fish were cultured alongwith *L. tade* and *P. monodon*. The rates of stocking for *C. Chanos*, *L. tade* and *P. monodon* were 1,600/ha, 650/ha and 350/ha respectively. Initial size at stocking was 263.77 mm/157.25 g for *Chanos chanos*, 196.50 mm/104.60 g for *Liza tade* and 180.10 mm/65.50 g for *P. monodon*. The prawns were harvested after 82 days when they attained an average size of 205 mm/110 g. *Chanos chanos* and *Liza tade* attained an average size of 370.77 mm/328 14 g and 315.66 mm/335.00 g respectively in 172 days.

Mixture of mustard oilcake and maize powder was used as supplementary feed for *Chanos chanos* and *Liza tade* and was fed @ 2% of the body weight of the standing fish population in the pond.

Problem	: 5.36	Collection and rearing of *Penaeus monodon* seed for stocking and supply
Personnel	:	P. U. Verghese, Hardial Singh, A. N. Ghosh and M. K. Mukherjee
Duration	:	Two years

The investigations were initiated with a view to assessing the availability and abundance of the prawn, *Penaeus monodon*, in the tidal estuary adjacent to the Kakdwip Fish Farm and to evolve methods for collection, segregation and rearing of the postlarvae for stocking and supply. Fry collection shooting nets were operated in the estuary during spring tide periods. *P. monodon* postlarvae were segregated from the mixed collections and only the live ones were estimated. Collections during the year covered 20 spring tides spending 57 hours and 40 minutes employing 128.25 man-hours. 48,450 postlarvae were segregated from the collections and reared under prevailing temperature and salinity conditions during different months. The ingress of *P. monodon* postlarvae was at its peak during April-May & the maximum collection per net per hour was observed during spring tide associated with new moon. The collections per man-hour during the four quarters of the year were : 2,317, 1,800, 438 and 127 respectively. The ingress of *P. monodon* postlarvae appears to be continuous and the peak occured during April-May when estuarine water salinity ranged from 14.4 to 18.4 ppt. During the year, salinity gradually increased from 7.6 to 21.7 ppt during January to June and then decreased to 1.4 ppt by September. From October onwards, the water salinity gradually increased and was observed to be 11.5 ppt by December.

Rearing experiments were conducted in plastic pools at stocking densities varying from 4 to 20 per litre under different salinitiy and temperature ranges. 80% survival was observed in 15 days rearing of the postlarvae in plastic pools at salinity 10-12 ppt and temperature 31°—32° C. However, the rate of survival ranged from 8 to 43% at salinities lower than 5 ppt. Water temperature lower than 26°C was also observed to be detrimental to better survival. Artificial feed as fine powder prepared from goat's intestine and mixed with wheat flour was found to be an adequate feed for larval rearing. The *P. monodon* postlarvae were observed to feed actively on the floating powder. The postlarvae (size range 12 to 14 mm) were found to grow to 17-20 mm during 15 days of rearing. The plastic pool reared postlarvae were used in different culture experiments in the farm. On a trial basis, 500 numbers of plastic pool reared *P. monodon* seed were supplied to the Bakkhali Farm. The seed were transported in an open container and reached the destination over a period of 4 hours without any mortality.

Problem	: 5.37.	Crop rotation under prawn-cum-fish culture
Personnel	:	P.U. Verghese, Hardial Singh, A.N. Ghosh and H.C. Karmakar
Duration	:	Two years

During January to June, emphasis is given for the culture of prawn, *P. monodon*, with mullet, *L. parsia* forming a subsidiary crop. During July to December, when the ecological condition of the brackishwater fish farm are most unstable, rearing of more tolerant fin-fish species ; *viz*. *Chanos chanos*, *Liza tade* and *L. parsia* under mixed culture alongwith *P. monodon* is practised. 6 ponds (0.02 ha each) were selected for the experiments. As dewatering of the ponds was not possible, the ponds could not be prepared and manured as per programme. The heavy silt load of the ponds also could not be avoided.

One of the ponds was used for rearing *L. parsia* seed to stocking size. *L. parsia* seed (20-25 mm size) stocked @ 1.75 lakhs/ha during the last week of January 1976 were harvested towards the end of May. The average size attained was 87.4 mm and 9.68 g. 10.89 kg of parsia fingerlings raised from this pond amounted to a production rate of 544.8 kg/ha/4 months. Other 5 ponds were used for culture of *P. monodon* and *L. parsia* and gave fish and prawn productions ranging from 233.5 to 489.6 kg/ha/5 months.

From July onwards, culture experiments were conducted under 3 combinations as follows :

i) *P. monodon* and *L. parsia* at stocking densities of 40,000/ha and 15,000/ha respectively.

ii) *P. monodon*, *C. chanos* and *L. tade* at stocking densities of 40,000/ha, 650/ha and 1,350/ha respectively.

iii) *P. monodon*, *C. chanos*, *L. tade* and *L. parsia* at stocking densities of 40,000/ha, 350/ha, 1,050/ha and 10,500/ha respectively.

The monthly gain in weight was found to range from 3.23 to 4.50 g for *P. monodon*, 14.29 to 50.00 g for *C. chanos*, 12.5 to 43.7 g for *L. tade* and 2·5 to 7.4 g for *L. parsia*. Comparatively better growth in respect of all the species was observed during August to October when the salinity gradually decreased from 12.0 to 4.4 ppt and the water temperature ranged from 28.8° to 35.5° C. The survival rates and productions from these experiments could not be correctly assessed as the ponds were affected by an accidental inundation of the farm on 21.9.76 causing considerable loss to the stocked materials. However, from the periodical harvest and the stock recovered after dewatering the ponds, a combined production of prawns and fish ranging from 239.50 to 101.00 kg/ha/6 months was estimated. The combination of *P. monodon*, *Chanos chanos*, *L. tade* and *L. parsia* was found to give better production in the present series of experiments.

Problem	: 5.38	Stock manipulation in selective culture of *Lates calcarifer* and *Eleutheronema tetradactylum*
Personnel	:	M. K. Mukhopadhyay, A. N. Ghosh, H. C. Karmakar and B. Basak
Duration	:	One year

Culture of L. calcarifer : For stocking purpose, *L. calcarifer* fry (average size 23.83 mm) were reared in plastic pools with regular changing of water and supply of prawn juveniles @ 50% of the body weight as food. 100% survival could be achieved with the rate of growth being 0.7 mm/day when reared for 30 days. When cultured with the facility of regular flushing of tidal water, the average size attained by *L. calcarifer* fry (15.8 mm size) at a stocking density of 1,300/ha was 250.66 mm/190.00 g in 72 days and the same stock grew to an average size of 278.0 mm/243.75 g in 124 days.

In another experiment, *L. calcarifer* fry (average size 75 mm) were

stocked at the rate of 1,100/ha in a pond without arrangements for flushing with tidal water. Live prawn juveniles were provided as food. After 51 and 77 days of rearing periods, average sizes attained were 162.25 mm/37.5 g and 199.66 mm/60.0 g respectively.

Under mixed culture of *L. calcarifer* and *E. tetradactylum* the growth pattern of the 2 species was different. In 51 days, the size range attained by the 2 species was 132.46 to 160.38 mm and 75.00 to 134.30 mm respectively.

Problem	: 5.39	Intensive culture of *Penaeus indicus* alongwith other penaeid prawns
Personnel	:	N. K. Das, A. N. Ghosh, N. M. Chakrabarty and A. K. Roy
Duration	:	Two years

Three ponds (0.02 ha each) were utilized for mixed culture of estuarine prawns. Two ponds under short term culture of *P. indicus* alongwith *Metapenaeus monoceros*, *M. brevicornis* and *P. monodon* stocked at different stocking densities of 7-46 prawns/m^3 yielded a production of 418.5 kg/ha/320 days in 4 crops in one experiment. In another experiment with same species and stocking densities, the production was 211.85 kg/ha/240 days in 3 crops. Prawns, 70 mm and above in size, were harvested leaving the small ones, excepting *P. monodon* which were harvested at the size of 150 mm and above. The total production of fish (small mullets and misc. fish) harvested from two ponds was estimated to be 713. 5 kg/ha/320 days and 591.85 kg/ha/240 days respectively. Both the ponds were regularly flushed with fresh tidal water.

A third pond under long term culture and partial harvesting & replenishment was stocked with estuarine prawns at a stocking density of of 17-23 prawn fry/m^3. The pond was not flushed with tide water. In 3 crops, under this culture, a production of 191.4 kg/ha/320 days was obtained. The total production of prawn and fish (small mullets and misc. fish) in this pond was 414.4 kg/ha/320 days.

Physicochemical and biological factors : The highest salinity, 21.24-22.60 ppt. was observed in June with sharp fall in September (3.98-4.91 ppt). Similarly highest values of DO, alkalinity and turbidity were found in the months of October—November and the lowest values were observed in the months of July and February—June respectively. A relation between the salinity and

abundance of bottom fauna, like gammerids, taneids and polychaetes has been observed. It has been found that with the fall of salinity during July-August (from 22.6 ppt in June to 5.56 ppt in August), the overall production of bottom animalcules also declined considerably resulting in poor harvest of prawns in rainy season.

Experiments on supplementary feed for *P. indicus* have indicated that a mixture of prawn meal and wheat-bran, among other ingredients, gave the maximum growth of 27.3 mm in 9 weeks over the initial size of 31 0 mm. Further experiments on feeding trials with different feeds and feeding rates have been taken up.

Problem	: 5.40	Stock manipulation in intensive farming for mullets in mono-culture and in association with penaeid prawns
Personnel	:	A. N. Ghosh, G. N. Chattopadhyay, H. C. Karmakar, M. K. Mukhopadhyay and N. M. Chakrabarty
Duration	:	Two years

Effects of fertilization of ponds with & without the provision of supplementary feed, and without any fertilization but also with the provision of supplementary feed on the growth of *L. tade* fry were studied alongwith a control. Results obtained after 153 days of rearing, indicated that fertilizer and supplementary feed treatment provided the best average increment of 104.55 mm/40.12 g as against 26.18 mm/4.03 g in case of fertilizer treatment and 49.91 mm/10.88 g with the provision of supplementary feed only.

Under a stocking density of 9,150 fry/ha an average increment of 58.13 mm/36.58 g was observed in 100 days with 89.61% survival, whereas with 2,400 fry/ha stocking density average increment was 86.78 mm/96.67 g in 155 days with 100% survival. Another short duration study with an intermediate stocking density of 4,750 nos./ha for 55 days gave an average increase of 39.99 mm/11.04 g with 100% survival, there by indicating that this stocking density could be safely used in monoculture of *L. tade*.

In another monoculture experiment of *L. tade*, 1,000 fry/ha were stocked in a 0.06 ha pond during January 1976. The stocking rate was increased up to 4,700 fry/ha by June 1976. The average size attained was 191.84 mm/83.34 g. The experiment

was closed by early September 1976 and 75.33% of the stocked population could be recovered.

Mixed culture experiment was conducted on the principle of multiple stocking and harvesting with *L. tade* and *P. monodon* under respective stocking densities of 4,687 and 5,000/ha. The final sizes attained were 215.87 mm/105.96 g by *L.tade* and 149.53 mm/30.00 g by *P. monodon* with survival rates of 94.13% and 88.0% respectively.

Mixed cuture of *L. tade* and *P. monodon* was also carried out in a 0.06 ha pond for 139 days. Final sizes attained were : *L. tade*—216.34 mm/102.59 g (initial average size 162.63 mm/55.71 g) & *P. monodon*—169.63 mm/47.28 g (initial average size 135.91 mm/24.16 g) with survival rate of 57.31 and 90.19% respectively.

Survival of penaeid prawns under different textural composition of bottom soil was studied in yard experiments. Light textured soil was found favourable for *P. indicus* survival but no such relationship could be observed in case of *P. monodon*.

Problem	: 5.41	Development of devices for large scale collection, segregation and rearing of brackishwater fish and prawn fry for stocking in intensive culture.
Personnel	:	H.C. Karmakar, A.N. Ghosh, M.K. Mukhopadhyay and P.K. Ghosh
Duration	:	One year

Collection of brackishwater fish and prawn seed was initiated with the scoop net and drag net operations in the Muriganga estuary near Brackishwater Experimental Fish Farm, Kakdwip. 44,000 fry of *L. parsia* were collected during January to May of which 32,349 (size range : 12-39 mm) were collected by scoop net and 11,656 by drag net operations by spending 27.31 and 23.08 man-hours respectively. Average collection was 1,148.5 fry/man/hr by scoop-net and 505 fry/man/hr by drag net. The average catch/man/hr by scoop net and drag net operations during different months is presented below.

Months	Nos. collected by scoop net	Nos. collected by drag net
January	1,251.2	666.7
February	1,237.7	680.0

March	636.0	268.2
April	551.7	513.2
May	521.8	Nil

Average collections of *L. parsia* fry by scoop-net were significantly different from the average collections by drag net operations at 2.5% level. Average monthly collections in Junuary and February were equally good and significantly different from those of the other months at 5% level indicating this to be the peak period for collection of *L. parsia* fry.

L. tade fry were caught in the begining of July and 9,112 fry were collected by scoop-net in 61.33 man-hours.

For assessing the peak abundance and the maximum availability period of brackishwater fish and prawn seeds, shooting nets were operated in the river Muriganga. About 3,51,012 fry of commercially important fish and prawn were collected by spending 163.92 man-hours. Species-wise catch (nos.)/man/hour during different months is presented in table 5.

Table 5—Relative abundance of commercially important brackishwater fish and prawn seeds during different months

Species	Catch (nos.)/man/hr								
	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
P. indicus	2,468.9	1,911.8	482.9	704.7	176.9	60.9	416.1	437.3	178.5
P. monodon	421.5	853.1	52.6	356.2	511.6	197.9	251.6	12.0	14.2
M. brevicornis	75.7	70.9	292.0	81.2	96.3	88.7	110.3	126.8	65.3
M. monoceros	52.8	35.7	7.9	0.7	7.8	—	12.6	5.5	2.3
L. parsia	3.2	9.5	2.9	—	—	—	—	—	—
L. tade	—	—	—	1.4	13.3	4.8	1.5	—	30.1
E. tetradactylum	26.2	1,226.7	288.1	—	278.4	68.2	74.9	2.3	0.6
Miscellaneous	159.7	156.8	172.7	253.6	63.2	329.8	466.3	197.9	319.8
Total	3,208.0	4,264.5	1,298.1	1,397.8	1,147.5	750.3	1,333.3	781.8	610.8

Various physicochemical factors at the collection sites ranged as under :

Salinity : 2.16—18.44 ppt, DO : 5.6—10.4 ppm, pH : 8.2—9.2, total alkalinity : 80—148 ppm of $CaCO_3$, water temperature : 21.8°—34.4°C and transperancy : 45—600 mm.

Three ponds (0.02 ha each) were stocked with *L. parsia* fry 5,00,000, 5,00,000 and 6,00,000/ha. After 90 days of rearing the net survival and average size attained by the fry in these ponds were : 47.05% & 42.90 mm/3.40 g, 42.0% & 36.57 mm/2.00 g and 27.0% & 43 20 mm/1.60 g respectively.

In a 0.02 ha pond *P. monodon* fry (size range 13-14 mm) were stocked @ 2,00,000/ha by end of August. The fry attained an average size of 28.8 mm by end of September.

An acclimatisation experiment was conducted in the laboratory to study the survival rate of *L. parsia* fry for sudden changes of salinity after collection from the river and their stocking in the farm ponds. Experiment was conducted in 4 treatments of different salinities ranging from 4.8 to 10.8 ppt (a difference of 2 ppt.). The salinity at the collection centre was 10.8 ppt. The survival noticed in 10 days period was 62.25% to 91.80%. The mean survival rate in the treatments was significantly different at 1% level indicating that the fry caught from a salinity of 10. ppt can survive up to a low salinity level of 6.8 ppt.

Problem	:	5.42	Specified protein levels in supplementary feeds for enhancing growth of brackish-water fishes and prawns
Personnel	:		B. B. Pakrasi and S. C. Banerjee
Duration	:		Two years

Two sets of experiments were conducted with juveniles of *P. monodon* (36-42.5 mm) with provision of different feeding schedule containing different concentration of protein. In one set of experiments the juveniles were fed with feed of dried fish origin having 25% protein and in the other with feed of mainly vegetable origin containing 16% protein. The feeding in both the cases was done daily @ 2.5% body weight of the stocked fish. The average gain was noted to be 14.0 mm/0.3 in one month in case of animal protein diet and 10.0 mm/0.16 g with mixed vegetable protein feed. In another set of experiments with *P. monodon* (45-58 mm), the gain in weight was 0.32 g/month only when the prawns were fed with a feed containing 25% of vegetable protein prepared out of soyabean powder. The studies are in progress.

Problem	:	5.43	Physicochemical characteristics of the soil around the outfall area of various industries with special reference to growth of benthic algae
Personnel	:		P. Ray and E. Mitra (Miss)
Duration	:		One year

Pollutional conditions due to Sulphite Paper Mill wastes were more predominant during summer than in rainy seasons. Bottom biota was poorly represented and gastropods showed advoidance reaction when exposed to polluted mud collected from the outfall area. The polluted soil was found to be detrimental to the growth and development of plankton.

Problem	:	5.44	Role of trace elements in the mineralisation of organic nitrogen
Personnel	:		S. C. Banerjee and R. K. Banerjee
Duration	:		Two years

Effects of trace elements on poultry manure as substrate indicated that the release of nutrients was greater when treated with cobalt than with boron (Co : NH_4-N=26.4—36.4 ppm and NO_3-N=1.0—5.6 ppm and B : NH_4-N=21.3—29.0 ppm and NO_3-N=1.63—3.6 ppm). Whereas with sewage sludge the release of nutrients was observed to increase gradually and attained its peak by 30th day as an effect of cobalt treatment followed by molybdenum (Co : NH_4^+-N =69.6 and NO_3^--N=5.2 ppm ; Mo : NH_4-N=62.0 and NO_3-N=4.1 ppm). The studies are being continued with a view to assessing the maximum effective promotor.

Problem	:	5.45	Nutrient status of brackishwater ponds in Madras region
Personnel	:		K. O. Joseph, K. Raman, S. Radhakrishnan and P. M. A. Khadir
Duration	:		Two years

The hydrological parameters of ponds at Adyar and Pulicat were studied and were recorded as follows :

Parameters	Adyar	Pulicat
Dissolved oxygen (ppm)	2.4 — 8.8	6.4 — 14.4
Salinity (ppt)	13.0 — 40.0	23.5 — 34.0

Transparency (cm)	10.0 — 14.0	9.0 — 24.0
Water temperature (°C)	29.0 — 32.5	29.0 — 33.0
Free CO_2 (ppm)	1.1 — 14.5	nil
Total alkalinity (ppm)	140.0 — 210.0	110.0 — 210.0
Phosphate (ppm)	0.006 — 0.150	0.003 — 0.03
Silicate (ppm)	17.0 — 30.0	12.0 — 26.0
pH	7.2 — 8.2	8.0 — 8.6

Total plankton volume in the ponds was noticed to be higher with molybdenum (0.5 ppm) treatment followed by manganese (0.25 ppm) treatment.

Problem	: 5.46	Floculating colloidal soil suspensions in impounded waters of low salinity
Personnel	:	R. K. Banerjee, B. B. Pakrasi, A.V.P. Rao and S. C. Banerjee
Duration	:	Three years

Two nursery ponds were treated, one with compost alone @ 15,000 kg/ha and the other with compost @ 15,000 kg/ha+100 kg cow dung+5 kg N as urea and 5 kg P as superphosphate. The pond treated with compost alone maintained a transparency range of 7.5 to 20.8 cm and the other with compost+inorganic N and P had the transparency level between 7.5 to 31.2 cm as against 1.8—13.5 cm of the control pond. The phytoplankton concentration in the treated ponds ranged between 500—700 units/l. The studies are being continued.

Project 6 : Freshwater prawn culture

Problem	: 6.1	(Research work completed in 1976)
Problem	: 6.2	Propagation and culture of *M. malcolmsonii*
Personnel	:	K. V. Rao, T. S. R. Raju, K. S. Rao, D. R. Rao and P. S. C. Bose
Duration	:	Five years

4 ponds in Badampudi Fish Farm were manured with cattle dung @ 10,000 kg/ha/annum and NPK mixture (ratio 18 : 8 : 4) alternately on monthly intervals and stocked with juveniles of *M. malcolmsonii* (size range 18 0—37.0 mm ; av. 25.3 mm) @ 50,000/ha (in ponds I & IV) and @ 75,000/ha (in ponds II & III)

in the months of November and December 1975. The minimum depth of about 0.6 m was maintained in the ponds. Excessive growth of aquatic weeds was checked by introducing grass carp for short periods. Occasional aeration of water was done manually in all the ponds. The shrubs were planted in the ponds to provide protection to moulting prawns. Liming of the ponds was done @ 75 kg/ha every month. Supplementary feeding was done with rice-bran, ground-nut oilcake and fish meal (8 : 8 : 1) in ponds II & III and with poultry feed in ponds I & IV on alternate days. The rate of feeding was increased progressively from 5 to 25% of the anticipated weight of prawn mass. Plankton density, dissolved oxygen and primary productivity of all the 4 ponds were determined weekly. The plankton was mostly poor (less than 0.5 ml/50 l). DO was comparatively low (6.8—10.2 ppm) in winter and high in monsoon season (11.3-19.6 ppm). The average primary production was the minimum during December to February (188 mg C/m^3/6 hr—625 mg C/m^3/6 hr) and the maximum during September to October (3,375 mg C/m^3/6 hr—3,625 mg C/m^3/6 hr). The harvesting was done in the third week of October 1976. At the end of 10½ months, per hectare production was 211.9 kg in pond I, 93.8 kg in pond II, 269.5 kg in pond III and 313.7 kg in pond IV. The rate of survival ranged between 6.8 and 51.4 percent. The size of prawns at the time of harvesting ranged from 59.5 mm/2.0 g to 151.25 mm/64.0 g.

Survey of Upputeru drain of Collair lake in Krishna and West Godavari districts for assessing the availability and abundance of juveniles of *M. rosenbergii* was undertaken during September and October 1976. Only big-sized prawns (above 120 mm) were available in the catch which varied from 5 to 15 kg per day.

Problem	: 6.3	Freshwater prawn fishery of the middle stretch of the Ganga
Personnel	:	K. L. Shah, R. N. Seth, Shree Prakash, R. K. Tyagi, Krishna Chandra and R. A. Gupta
Duration	:	Five years

Sampling centres ; *viz.*, Meja Road, Vindhyachal, Mirzapur, Chunar and Varanasi between Allahabad and Varanasi, were visited during June and July. During September, Varanasi, Mirzapur and Meja Road centres were again visited to record prawn catch statistics. No landing of *M. birmanicum* var. *choprai* was recorded at any of the above centres in September as against 1.74 t

(Varanasi), 0.676 t (Ballia), 0.56 t (Chunar), 0.44 t (Zamania) and 3.6 t (Buxar) landings recorded during May to August 1974.

Since no berried female of *M. birmanicum* var. *choprai* was available, rearing experiments could not be attempted at Allahabad centre.

Problem	: 6.4	To study the biology and production of prawn in the lower stretch of the Ganga
Personnel	:	S. K. Wishard, B. L. Panday, R. C. Singh and A. Sarkar
Duration	:	Three years

18.31 t of prawns were estimated to have landed in the lower stretch of the river Ganga of which *M. malcolmsonii* contributed 35.72%. The maximum concentration was observed at Sahibganj followed by Rajmahal centre.

Laboratory experiments were also undertaken to raise the juvenile prawns for further culture experiments. One gravid female prawn was procured in live condition and successfully induced to release eggs under laboratory conditions. Larvae showed progressive development up to 12th day and on the 13th day, total mortality occurred, the causes of which could not be ascertained immediately. Investigations are being continued.

Project 7 : Murrel and live fish culture

(The work is being conducted under a Co-ordinated Project)

Project 8 : Estuarine and brackishwater lake fisheries

Problem	: 8.1	Brackishwater fish seed prospecting of the Hooghly-Matlah estuarine system
Personnel	:	K. K. Bhanot, D. D. Haldar, H. Singh, S. K. Mazumdar, P. B. Das, R. N. Dey, A. R. Choudhuri, N. D. Sarkar, and A. R. Paul
Duration	:	Ten years

Observations on the abundance of brackishwater fish seed were continued. The observations revealed major abundance of *Liza parsia* from Raidighi (January—86 no./net/hr), Itindaghat (January—163 no./net/hr) and Gosaba (January—302 no./net/hr), *Liza tade* from Kakdwip (July—316 no./net/hr), *L. corsula* from Kalna (October—218 no./net/hr) and *E. tetradactylum* from Kakdwip (July—107 no./net/hr). A few numbers of *Mugil cephalus* (5-60 mm) were obtained from Gosaba during March.

The other species obtained in the collections were : *Coilia* sp., *Sciaena miles, Pama pama, Hilsa ilisha, H. toli, Polynemus paradiseus, Sillago panijus, Ilisha elongata* and *Plotosus canius* from the various centres in the Hooghly—Matlah; Ichhamati & Thakuran rivers.

Problem : 8.2 & 8.3 (Research work completed in 1973)

Problem : 8.4 Brackishwater prawn seed prospecting of the Hooghly—Matlah, Rupnarayan and Ichhamati Estuarine System

Personnel : D. D. Haldar, K. K. Bhanot, S. K. Mazumdar, P. B. Das, B. K. Saha, R. N. Dey, A. R. Chowdhuri, N. D. Sarkar, S. P. Ghosh, A. R. Paul and N. C. Mondal

Duration : Four years

Prawn seed prospecting at eleven centres of the estuarine zones was conducted and the dominant species of prawns encountered were : *P. monodon, P. indicus, M. brevicornis, M. monoceros* and *P. styliferus*. The availability of *P. monodon* was the maximum at Kakdwip during April and May. *P. indicus* was recorded only from lower Sunderbans centre with peak abundance during March and April. *P. styliferus* was encountered at all the centres with a peak at Kakdwip in May (2,130/net/hr) during high tide.

Problem : 8.5 (Research work completed in 1976)

Problem : 8.6 Standardisation of Brackishwater seed prospecting, collection and transporting techniques

Personnel : K. K. Ghosh, K. K. Bhanot and R. N. Dey.

Duration : Two years

A floating net with modified design showed about 170-180% more efficiency than the conventional gear under operation.

Problem	: 8.7	Reproductive biology of cultivable brackishwater fishes
Personnel	:	K.K. Bhanot
Duration	:	Three years

Salinity preferences of a few selected euryhaline fishes with regard to their stages of maturity have been studied. The fishes collected from bag net catches were examined for the sex ratio, the stages of maturity and the fecundity estimations of the samples were made. To substantiate the results, histological examination of the gonads have also been undertaken.

It is observed that *Sillago panijus* has matured and oozing eggs at a size of 370 mm/350 g. The egg size ranges from 8-12 micrometer divisions under binocular magnification. *Scatophagus argus* has been found to mature at a size of 385 mm/1.7 kg. The gonads being obliquely placed in the body cavity in relation to the genital opening and hence they do not ooze out on applying gentle pressure. *Glossogobius guiris* was observed to be mature at a size of 180 mm/20 g wt. with oozing eggs. The above mentioned species except for *S. panijus* have been collected from the freshwater region of the estuary. *S. panijus* specimens were collected from estuarine zone with salinity varying from 25-30 ppt.

Project 9 : Selective breeding and hybridisation

Problem	: 9.1	(Research work completed in 1973)
Problem	: 9.2	(Research work completed in 1972)
Problem	: 9.3	(Research work suspended since 1973)
Problem	: 9.4	Selective breeding and hybridisation of carps and other cultivated fishes with special reference to cytogenetical features of the hybrids
Personnel	:	R. M. Bhowmick, R. K. Jana and S. D. Gupta
Duration	:	Five years

About 5,000 hybrids of rohu ♂ × calbasu ♀ produced were reared in a nursery pond for 70 days and they reached a size of 93.7 mm/ 8 g.

Project 10 : Fish farm designing

Problem	: 10.1	Designing fish farm under the soil conditions of Orissa
Personnel	:	C. Saha, D. K. Chatterjee, M. Mantri and C. Sahoo
Duration	:	Four years

Surveys with regard to water supply, soil type, topography, inlet & outlet arrangements, etc. have been conducted in 17 fish farms ; *viz*, Dhenkanal, Angul, Bainda, Sambalpur, Burla, Sundergarh, Tudalaga, Nayagarh, Bhanjanagar, Phulbani, Tandrigaon, Bhawanipatna, Bathrajore, Baldiamal, Jeypur, Malkhangiri and Gunpur in Puri, Ganjam, Dhenkanal, Sambalpur, Sundergarh, Phulbani, Kalahand and Koraput districts of Orissa. All the fish farms are rain fed fish farms. No farm is having inlet and outlet arrangements for ponds. Most of the farms are having one or two out-lets for the whole of the farm in order to avoid over-flooding. The farms are having either flat topography or gentle sloping topography. Some of the farms are having hillocks at one or more than one sides with very little run off from the hill slopes to the farm area.

Problem	: 10.2	Studying seepage losses in ponds
Personnel	:	C Saha, K. L. Srivastava, G. N. Saha, C. D. Sahoo and M. D. Mantri
Duration	:	Five years

Field trials have been conducted in excavated mini ponds of size $2 \times 2 \times 0.45$ to 0.75 m in sandy morrum type of soil at Killa. Materials tried were soil+cement mixtures, soil+cow dung mixture, soil+cement+cow dung mixture, sodium carbonate, sodium chloride, and sodium hexameta-phosphate. Of all the materials, soil+cement mixture gave the best result. Sodium chloride did not give any positive result. Soil+cow dung mixture showed quite encouraging results during the first phase of the trial only. Results showed that

average seepage loss in control ponds were 11 cm/day, whereas seepage loss in treated ponds were 1-4 cm/day only.

Project 11 : Economics in fishery investigations

Problem	: 11.1 & 11.2	(Research work completed in 1974)
Problem	: 11.3	(Research work completed in 1973)
Problem	: 11.4	(Research work completed in 1976)
Problem	: 11.5	(Research work completed in 1976)
Problem	: 11.6	Economics of semi-intensive fish farming in freshwater ponds of West Bengal and Orissa
Personnel	:	M. Ranadhir, S. D. Tripathi and M.A. V. Lakshmanan
Duration	:	Two years

Data from 63 ponds under CIFRI/IDRC Project on Rural Aquaculture have been obtained from West Bengal and Orissa. In 25 cases, the fish production was 3,000 kg/ha/yr. The physical input cost structure was worked out. The dominating costs are on feeds, next in order are on wages for labour and watch & ward.

Project 12 : Exotic fish culture

Problem	: 12.1 & 12.2	(Research work completed in 1973)
Problem	: 12.3	(Research work completed in 1972)
Problem	: 12.4	(Research work completed in 1976)
Problem	: 12.5	Techniques for large scale production of grass carp and silver carp seed
Personnel	:	S.B. Singh, D.S. Murty, R.K Dey and P.V.G.K. Reddy
Duration	:	Four years

An adequate number of brood fish stock of grass carp (*Ctenopharyngodon idella*) and silver carp (*Hypophthalmichthys molitrix*) was maintained successfully in healthy condition by recirculation and aeration of water by using a diesel pump in the ponds. Thus the mortality of the brood fish during April and May which occured in previous years was prevented.

Experiments on hypophysation of grass carp and silver carp were conducted during July-August 1976. Due to unusually prolonged drought conditions throughout the month of July, the condition of the brood fish considerably deteriorated and hence the response to hypophysation was initially very poor. During the second week of August when the rains commenced and the weather conditions improved with the accumulation of rain water in the ponds, the results in induced breeding of the fishes were somewhat encouraging. But the percentage of fertilization and hatching was found to be poor. Probably due to prolonged drought the intraovarian mature eggs appear to have lost their proper condition essential for fertilization.

The dose of carp pituitary administered varied from 10—18 mg/kg body weight to the females and 2—4 mg/kg body weight to the males.

In all 1.38 lakhs of grass carp and 1.55 lakhs of silver carp spawn were produced of which 41,000 spawn of grass carp were obtained from the eggs kept in the glass jar hatchery.

Problem	:	12.6	Compatibility and competition between silver carp and Indian major carps
Personnel	:		S. B. Singh, R. K. Dey, D. S. Murty, S.R. Ghosh and P.V.G.K. Reddy
Duration	:		Five years

A field experiment of 6 months duration to study the compatibility and competition between silver carp and Indian major carp, *L. rohita*, at stocking densites of 5,000 and 3,000/ha was concluded in October 1976. At both the stocking densities the growth of rohu appeared to suffer in the presence of silver carp compared to catla. Further experiments are in progress to confirm the findings.

Problem	:	12.7	Optimum production of fingerlings and fish of exotic species under composite culture

Personnel : S.B. Singh, R.K. Dey, S.R. Ghosh and P.V.G.K. Reddy

Duration : Four years

In two 0.08 ha ponds, the exepriments on rearing of fingerlings of exotic carp is in progress at stocking density of 2.5 lakhs/ha and species ratio of Sc 4 : Gc 3 : Cc 3 of 3 months duration.

Project : 13 Cold water fish culture

Problem : 13.1 (Research work completed in 1970)

Problem : 13.2 Artificial feeds and trout nutrition

Personnel : K. L. Sehgal (up to May 1976), Kuldip Kumar (up to August 1976), Shyam Sunder (from September 1976) and Gulam Nabi Bhat (State Fisheries)

Duration : Three years

Experimental trials on dry, compounded and pelletized feed with different levels of crude protein were continued. Five feeding trials with brown trout *(Salmo trutta fario)* were carried out during 1976, the results of which have been summarised in table 6.

Problem : 13.3 (Research work completed in 1971)

Problem : 13.4 & 13.5(Research work completed in 1970)

Problem : 13.6 (Research work completed in 1972)

Problem : 13.7 (Research work completed in 1970)

Problem : 13.8 Standardisation of trout hatchery practices

Personnel : K.L. Sehgal (up to May 1976), H.B. Singh (from June 1976), R.K. Langer, Seraj-ud-Din (State Fisheries) and G.N. Gazi (State Fisheries)

Duration : Three years

Table 6—Results of feeding trials with brown trout *(Salmo trutta fario)* at Laribal and Harwan farms during 1976

Pond	Crude Protein level	STOCKED			REMOVED			Gain in weight (g)	Feed consumption	Conversion ratio
		Date	No.	Weight (kg)	Date	No.	Weight (kg)			
1	28%	23.4.76	120	6.000	18.5.76	105	7.050	1025	1440	1.4
2	35%	23.4.76	126	4.300	18.5.76	105	4.900	600	1320	2.2
7	28%	23.4.76	16	4.250	10.6.76	14	5.300	1050	2112	2.0
9	28%	23.4.76	36	4.250	10.6.76	33	5.500	1260	2016	1.6
11	35%	23.4.76	71	4.500	10.6.76	58	7.000	2510	3262	1.3
8	35%	23.4.76	48	3 250	10.6.76	102	4.600	1350	3120	2.3
10	39%	23.4.76	48	1.750	10.6.76	17	0.750	—	—	*
4	35%	23.4.76	136	2.400	18.5.76	116	3.250	923	1200	1.3
5	39%	23.4.76	55	0.320	18.5.76	50	0.520	200	240	1.2
6	39%	23.4.76	160	1.500	18.5.76	152	2.000	480	864	1.8
14	28%	23.4.76	—	—	10.6.76	—	—	—	—	*
16	28%	23.4.76	—	—	10.6.76	—	—	—	—	*
18	35%	23.4.76	41	0.150	10.6.76	31	0.200	50	72	1.4

* The results could not be computed due to heavy mortality and massive loss of fry.

From January to March, 1,86,700 green eggs from experimental fish and 82,000 from control fish were kept for incubation. The percentage of fertilisation ranged from 95.2 to 98.3. The dose of malachite green in the ratio of 1 : 2,00,000 for 45 minutes as fungicide, and thinning operation resulted in a cumulative survival (from green egg to swim-up fry) of 88.7% in case of experimental fish as against 53.7% in control (non—segregated) fish. Feeding of fry with yolk of hen's egg and skimmed milk in the ratio of 1 : 1 was initiated in the first week of February 1976. The eyed ova and fry produced were handed over to the State Fisheries Department.

During September—December after segregation of brown trout (650 females and 450 males), the spawners were fed @ 1.0% of the body weight on eviscerated and partially boiled carp flesh. About 500 spawners of both the sexes were kept in the same pond (non-segregated) and fed @ 1% of body weight on raw fish. In all 2,17,600 green eggs from segregated stock of trout and 1,17,000 from non-segregated fish were kept for incubation. The rate of survival ranged from 95.0—99.5% in segregated as against 90.0 to 95.0% in case of non-segregated stock. Malachite green in the ratio of of 1 : 2,00,000 was used twice a week as mycocide. The green eggs started becoming eyed in the first week of December and average percentage of survival up to eyed stage ranged between 91.5 & 95.0%. Physicochemical factors were : water temperature 7.3°-8.6° C; pH 7.0-7.2; DO 9.8-10.3 ppm; alkalinity 107.3-110.0 ppm; free carbondioxide 2.2-2.4 ppm and silicates 0.280-0.292 ppm.

Problem	:	13.9	(Research work suspended since 1972)
Problem	:	13.10	(Research work suspended in 1976)
Problem	:	13.11 & 13.12	(Research work suspended since 1971)
Problem	:	13.13	Studies on the biological indicators in an eutrophic lake (Dal Lake)
Personnel	:		K. K. Vass, Shyam Sundar, H. B. Singh (from June 1976) and R. K. Langer
Duration	:		Two year

Phytoplankton : In case of Chlorophyceae at Dalgate station, during January to March, the population declined from 40 to 13%, the trend remained the

same during July to September also, and in winter, population increased slightly. At Nishat, 12% population recorded in January-March dropped to 2.5% during April to June with a slight increase in winter. Same trend in population was recorded at other stations too. Bacillariophyceae were well represented at all the sampling stations. During January to March, there was a general increase in population from 45 to 56% at Dalgate, 73 to 79% at Nishat, 57 to 66% at Charchinari. At Hazratbal, there was a decline from 32 to 8% during April to June. Myxophyceae, strong indicators of eutrophication, were recorded at different stations. At Dalgate, during January to March, Myxophyceae ranged between 20 & 24% which dropped to 9% in April and again rose to 20% in subsequent months. A subsequent increase to 44% was recorded between October & December. At other stations, a similar seasonal trend with varying percentages was observed. Charchinari and Nowpora showed high percentages of Myxophyceae throughout the year. A peak of 80 to 90% was recorded between April and June.

Zooplankton : Rotifers, copepods, cladocerans and protozoans constituted the zooplankton. In case of rotifers a peak (73%) was recorded at Hazratbal during April to June and another peak (84%) between October and December ; while in spring and summer, the population remained low. Dalgate showed a peak (88%) during January to March and at Charchinari, during spring and winter, rotifers accounted for 60 to 98% of zooplankton whereas they were less abundant (30-40%) during rest of the seasons. Nowpora station showed a population range of 22 to 60% throughout the year. Copepods showed a general increase from 28 to 59% at all the stations. At Brein and Hazratbal copepod concentration ranged between 66 and 77% while at other stations, it ranged between 30 and 35% only. Cladocerans constituted 7 to 22% at all the stations during January to August. However, at Nowpora and Dalgate, they constituted 60 and 68% respectively during September to December. At Hazratbal, their concentration was between 3 and 22% during the same period. Protozoa (95%) were recorded during June to August at Hazratbal and Brein, and at other stations their population ranged between 2 and 25% only.

Benthos : The average number of benthic organisms at Dalgate, Charchinari. Nishat and Hazratbal was 122, 418, 156 and 133/m^2 respectively during January to May. Oligochaetes, being the maximum, ranged between 68 and 94% at all the stations, while the maximum dipteran larvae (25%) were recorded at Nishat. During July to December, the average number of organisms recorded ranged as 200, 544, 333 and 111/m^2 at Dalgate, Brein,

Nowpora and Dargah respectively. During this period 84% oligochaetes were recorded at Dargah and 25% at Nowpora. The maximum dipteran larvae (76%) were recorded at Nowpora and the minimum (13%) at Dargah. Molluscans (30%) were recorded only at Dalgate.

Physicochemical characteristics : During January to June, transparency ranged between 23 & 70 cm at Dalgate, 15 & 63 cm at Nishat, and 19 & 50 cm at Hazratbal while the same remained 100 cm at Charchinari Alkalinity ranged between 70 and 140 ppm at all the stations. However, during July to December, the polluted zones of Nowpora and Dalgate showed the maximum alkalinity ranging from 140 to 180 ppm, while at other stations, 50 to 80 ppm alkalinity was recorded. Dissolved oxygen ranged as 5.5 and 10.5 ppm at Dalgate and Charchinari respectively during January to June ; but was found to increase from 6 to 9 ppm at Nishat and 7 to 11 ppm at Hazratbal during the same period. The polluted zones of Dalgate and Nowpora showed low DO values between 2 and 4 ppm while at other stations, it ranged from 8 to 10 ppm. The dissolved organic matter ranged from 5.4 to 16 ppm at Dalgate and Charchinari while at Nishat, it declined from 10.4 to 5.8 ppm during January to June. During July to September, low values (1.8 to 4.4 ppm) of dissolved organic matter were observed at all the stations, however, the maximum concentration (16.1 ppm) was recorded during October to December at Nowpora. Gross primary productivity ranged as 15-22 mg $C/m^3/hr$ at Dalgate; 21-38 mg $C/m^3/hr$ at Nishat; 15-22 mg $C/m^3/hr$ at Charchinari; 15-36 mg $C/m^3/hr$ at Hazratbal during January to June. During July to September in polluted zones at Dalgate and Nowpora, the production showed negative results-the breakdown in a community was more than the build up. In winter, the situation improved, indicating positive production.

Problem	: 13.14	Crude culture of fish-food organisms under temperate climate
Personnel	:	K. K. Vass and H. B. Singh
Duration	:	Two years and six months

Phytoplankton culture : In winter and early spring (from January to March), laboratory culture of *Chlorococcum* sp. was tried ; but due to sub-zero temperature and low light intensity, no growth was recorded. From April to June, a mixed culture of of *Chlorococcum* sp. and *Scenedesmus* sp. was initiated in laboratory, using commecial NPK as the nutrients. The concentration ranged between 20 & 50 ppm in the ratio of 1 : 1 : 1. The culture

grew better in enriched lake water than in the stream water, the cell density obtained in the former set was 25,000 cells/ml. Effect of two light treatments : (a) open sun and (b) partial shade, was studied keeping the concentration of nutrients same but the ratio was changed to 2 : 1 : 1. Partial shade treatment gave better results (1.2 to 2.5 million cells/ml). Mass culture of these species was tried in field conditions using glass aquaria and carbuoys. Nutrient concentration was changed to 100—200 ppm in the ratio of 3 : 2 : 1. Though these species could be cultured in the field conditions, the cell density did not increase as rapidly as in laboratory conditions. In the open sun treatment, the the cell density increased to 1.1 — 1.2 million cells/ml. By periodic replenishment of nutrients and harvesting the standing crop, the cultures could be maintained for longer time.

Zooplankton culture : *Daphnia* sp. was isolated from mixed culture, and laboratory studies started. Biological studies of the population at 16° to 24°C temperature revealed that it had 6 pre-adult and 18 post-adult instars. Each female produced 10 to 25 broods at a time and an average of 75 eggs were produced in a life span of 24 days. It took 1.5 to 2.0 days for embryogenesis. Experiments were conducted to study the impact of different light wave-lengths (violet, blue, green and red) on growth, reproduction, moulting survival, etc. The results showed that violet wave-length retarded the growth. The body lengths of 2.0 and 2.5 days' old animals were smaller than the animals raised under other light exposures. The number of pre-adult instars varied from 7.0 to 8.1 with the minimum in blue and the maximum in violet light Complete darkness, stimulated moulting and the rate was 0-64 moults/animal/day. Complete abortion was recorded in green light and darkness, while mortality was the maximum in green light.

In summer and autumn, trials for mass culture of *Daphnia* sp. were made in the laboratory and the field. In laboratory using raw cow dung extract as the nutrient medium, a peak population of 6,000 organisms/l was obtained within a period of 30 days. The culture was then tried in a big cement cistern having a soil base and cow dung extract as nutrient medium. In this case, a peak of 8,500 organisms/l was obtained in 20 days when the initial stocking rate was 70 organisms/l. Impact of periodic harvesting showed that growth was 24% more in harvested cultures than in non-harvested ones. This practice also helped in maintaining population for a longer period. From November onwards, there was sudden drop in temperature from 15° to 5°C and during this period, impact of low temperature on the

biology of *Daphnia* sp. was studied. The results showed a long phase of pre-adult stage, 11 pre-adult instars and 20 post-adult instars. Each female produced on an average 84 eggs in its life span of 32 days and took 4 to 5 days for complete embryogenesis.

Culture of oligochaetes : Culture trials of *Tubifex* sp. were made in plastic bags and cardboard boxes using garden soil mixed with sludge and ground-nut oil-cake. *Tubifex* sp. were stocked @ 1 ml/bag. Harvesting after 40 days showed an increase of 5 to 10 times in population. Effect of stocking density in different sized containers revealed that smaller containers (15 × 20 cm) gave 10 times more growth compared to larger containers (0.5 m^2). At 20°-25°C, the population took 8 days' time for turnover while at 5°-10°C, the turnover period was 16 days.

Problem : 13.15 & 13.16 (Research work kept in abeyance)

Problem : 13.17 Role of *Cyprinus carpio specularis* in the decline of endemic carp fishery in Dal lake

Personnel : Shyam Sunder, Kuldip Kumar (up to August 1976), H.B. Singh (from August 1976) and Seeraj-ud-Din (State Fisheries)

Duration : Two years

203 specimens (size range 23 to 460 mm in length and 12 to 1,540 g in weight), were studied for their food contents. The results showed mostly detritus (78.01%), Bacillariophyceae (18.02%), Chlorophyceae (1.95%) and Crustacea (1.06%). The rest was constituted by protozoans, rotifers and Myxophyceae. Other forms found in the guts were fish scales, small fishes (*Crossocheilus latius*), pady and maize seeds, husk, and stems of some aquatic plants.

Spawning grounds for mirror carp were located at Nishet and Pishpow nallah of Dal lake. Fecundity of fish in size range 328 to 398 mm and 381 to 890 g was found to vary between 18,072 and 57,515. The ova diameter of the ripe eggs ranged between 1.2 & 1.3 mm.

Problem : 13.18 (Research work completed in 1976)

Problem	;	13.19	Breeding of brown trout at Uttarkashi (U.P.)
Personnel	:		C.B, Joshi
Duration	:		Two years

During January and February, 14 specimens of brown trout, *Salmo trutta fario*, in the size range of 230-350 mm in length and 150-400 g were stripped and 3,900 green eggs produced at Kaldhyani hatchery, Uttarkashi. The percentage of fertilisation was 96.8. Total number of eggs per kg body weight produced were 1,130.

Out of 3,200 green eggs kept for incubation, 2,649 eyed ova were produced during March/April. The rate of survival being 82.7% only. At a temperature range of 2.0°-9.5°C the green eggs took an average of 35 days to become eyed. In about 2 months, 2,423 alevins were produced. Survival rate of 75.7% was recorded from green eggs to alevin stage, while from eyed ova to alevin stage it was 91.5%. The minimum mortality (18.5%) was recorded during eyed ova stage, while the maximum (23.5%) during alevin stage. In all, 1,853 numbers of fry were produced in the month of April/May. On an average 90 days (range 78-105 days) were needed from green egg to fry stage. The overall percentage of survival from green eggs to fry stage was 57.9. The green eggs and eyed ova were treated with malachite green (1 : 2,00,000 for 45 minutes' dose) twice a week to avoid fungal infection. Heavy deposition of silt in the hatching trays/troughs was largely responsible for mass mortalities.

The physicochemical factors of the ova-house during January-May were : turbidity, nil ; water temperature, 3.7°-15.0°C ; pH, 7.2-7.3 ; dissolved oxygen, 9.2-10.8 ppm ; free carbondioxide, nil-4.6 ppm ; and silicates, 0.250-0.750 ppm.

Project 14 : Riverine and estuarine fish catch statistics

Problem	:	14.1	Fish catch statistics of the midnle stretch of the Ganga River System
Personnel	:		R. A. Gupta, G. N. Srivastava, R.K. Tyagi, D. N. Srivastava, B. Ghosh, S. N. Mehrotra, B. C. Jha and R. K. Saxena
Duration	:		Continuing since April 1968

The fish yield from the middle stretch of the Ganga River System at Allahabad was estimated to be 127.11 t which showed an overall increase of 8.6% from that estimated last year (117.04 t). The species-wise break-up of the fish yield (in t) at different assembly centres is given below :

Species	Sadiapur (t)	Daragunj (t)	Buxar (January-June) (t)
C. mrigala	11.60	2.60	0.11
C. catla	3.30	1.35	0.46
L. rohita	4.72	0.35	0.42
L. calbasu	15.68	0.98	0.04
Total major carps	35.30 (36.26%)	5.29 (17.76%)	1.03 (28.02%)
M. aor	10.09	0.96	1.01
M. Seenghala	9.18	3.73	0.55
W. attu	6.37	1.43	0.08
Total catfishes	25.64 (26.33%)	6.12 (20.56%)	1.64 (44.74%)
Hilsa ilisha	0.24	0.09	—
Miscellaneous	36.17 (36.17%)	18.26 (61.36%)	1.00 (27.15%)
TOTAL	97.35	29.76	3.67

Fish landings at Daragunj were dominated by miscellaneous fishes which accounted for 61.36% of the total catch whereas the Sadiapur market recorded almost equal arrivals (in weight) of major carps and miscellaneous fishes.

Problem	:	14.2	Fish catch statistics of the lower stretch of the Ganga River System
Personnel	:		S. K. Wishard, S. N. Sar, B. L. Pandey, R. C. Singh and A. Sarkar
Duration	:		Continuing

The total fish production in the lower stretch of the Ganga River System was estimated to be 534.20 t during the year under report. This was based upon the sampling done at Bhagalpur, Sahibganj, Rajmahal, Farakka, Dhulian and Lalgola. The total production registered an increase of 42.12% when compared with the total yield of 375.92 t recorded in 1975. Increase in the production was shared by all the centres except Lalgola to the extent of 2.25, 106.63, 170.05, 109.23 and 86.19% at Bhagalpur, Sahibganj, Rajmahal, Dhulian and Farakka respectively. Landings at Lalgola registered a decrease by 85.16%. Centre-wise details of fish landings are given in table 7.

Unlike previous year, the maximum yield was recorded from Dhulian (20.31% of the total catch) and this was followed by Rajmahal (19.21%), Farakka (18.37%), Bhagalpur (15.19%), Sahibganj (14.93%) and Lalgola (11.23%).

Due to considerable fall in the hilsa landings at Lalgola (*i. e.*, from the stretch below Farakka), the dominant position of this species as enjoyed earlier has been replaced by the miscellaneous varieties. The latter predominated with 56.98% followed by hilsa (24.68%), *W. attu* (5.80%), *M. seenghala* (3.70%), *M. aor* (2.76%), *L. rohita* (2.71%), *C. catla* (2.01%), *C. mrigala* (1.20%) and *L. calbasu* (0.69%).

Praimary productivity : Average net & gross primary production, and community respiration during the period under report were 63.10 & 34.10, and 34.38 mg C/m^3/hr respectively. In comparing these values with those of the previous year, it has been observed that the gross and net production decreased by 3.85 and 18.79% respectively, and the community respiration increased by 26.55%. The maximum gross production was recorded in the month of May (117.50 mg C/m^3/hr) and the minimum in July (9.37 mg C/m^3/hr). In case of net production, the maximum value was recorded in the month of May (107.50 mg C/m^3/hr) and the minimum in July (5.00 mg C/m^3/hr). The community respiration was the maximum in the month of March (87.38 mg C/m^3/hr) and the minimum in July (5.25 mg C/m^3/hr).

Table 7—Species-wise total landings (t) at various centres and their percentage composition for the period ending December 1976

Centres	Mrigal	Catla	Rohu	Calbasu	M. aor	M. seenghala	W. attu	Hilsa	Misc.	Total	%
Bhagalpur	2.06	4.96	3.07	1.33	3.57	5.68	10.31	—	54.02	85.00	15.91
[%]	[2.42]	[5.84]	[3.61]	[1.56]	[4.20]	[6.68]	[12.13]	—	[63.56]	[100.00]	
Sahibganj	1.54	1.80	4.16	0.72	2.92	3.00	9.04	—	56.81	79.99	14.97
[%]	[1.93]	[2.25]	[6.20]	[0.90]	[3.65]	[3.75]	[11.30]	—	[71.02]	[100.00]	
Rajmahal	1.59	1.48	2.07	0.35	4.72	6.81	5.53	0.02	80.05	102.62	19.21
[%]	[1.55]	[1.44]	[2.02]	[0.34]	[4.60]	[6.64]	[5.39]	[0.02]	[78.00]	[100.00]	
Farrakka	0.61	1.54	1.62	0.89	1.75	3.06	3.56	14.07	44.05	98.15	18.37
[%]	[0.62]	[1.57]	[1.65]	[0.90]	[1.78]	[3.12]	[3.63]	[41.85]	[44.88]	[100.00]	
Dhulian	0.61	0.92	0.68	0.42	1.79	1.21	2.55	45.96	54.35	108.48	20.31
[%]	[0.56]	[0.84]	[0.62]	[0.38]	[1.65]	[1.11]	[2.35]	[42.37]	[50.11]	[100.00]	
Lalgola	—	—	—	—	—	—	—	44.80	15.10	59.90	11.23
[%]	—	—	—	—	—	—	—	[74.79]	[25.21]	[100.00]	
TOTAL	6.41	10.76	11.60	3.71	14.75	19.76	30.99	113.84	304.38	534.20	
[%]	[1.20]	[2.01]	[2.18]	[0.69]	[2.76]	[3.70]	[5.80]	[24.68]	[56.98]	[100.00]	

Physicochemical factors : The maximum dissolved oxygen was recorded in January (7.89 ppm) at 15.20° & 18.50°C of air & water temperatures respectively. The minimum dissolved oxygen was recorded in September (5.22 ppm) when air and water temperatures were 28.0° and 30.0°C respectively.

The secchi disc visibility varied from 29.25 cm (March) to 2.80 cm (August) and the pH varied between 6.50 & 8.50 during the year.

Plankton : The maximum abundance of phytoplankton was observed in May (42,276/1) while the minimum of 204/1 was recorded in December.

The dominant varieties encountered were as follows :

Desmidiaceae : *Gonatozygon* sp. dominated in May, April to August and September—November.

Chlorophyceae : *Ankistrodesmus* sp., *Actinastrum* sp., *Pediastrum* sp., *Spirogyra* sp., *Oedogonium* sp. and *Ulothrix* sp.

Myxophyceae : *Microcystis* sp. (dominated in May), *Merismopedia* sp., *Oscillatoria* sp., *Anabaena* sp., *Spirulina* sp. and *Phormidium* sp.

Bacillariophyceae : *Navicula* sp., *Synedra* sp., *Nitzschia* sp., *Diatoma* sp., *Asterionella* sp. and *Fragillaria* sp. (dominated in August).

Zooplankton population varied from 40 organisms/1 in September to 4 organisms/1 in March. The following forms were encountered :

Rotifera : *Brachionus* sp., (dominated throughout the year), *Keratella* sp., *Filinia* sp., *Trichocerca* sp., *Polyarthra* sp. and *Pleosoma* sp.

Copepoda : Nauplius larvae, *Cyclops* sp. and *Diaptomus* sp.

The ratio between phyto- and zooplankton was 1: 0.03 during the period under report.

Problem : 14.3 (Research work completed in 1969)

Problem	:	14.4	(Research work completed in 1971)
Problem	:	14.5	(Research work completed in 1973)
Problem	:	14.6	Effect of major environmental changes on the fisheries of commercially important stocks of the Hooghly-Matlah estuaries
Personnel	:		G.C. Laha, A. Chowdhury, P. M. Mitra, A.R. Chowdhury, B.K. Saha, R.N. De, G.P. Bhattacherjee, N.D. Sarkar, N.C. Mandal, A.R. Paul and A.K. Roy
Duration	:		Seven years

The data for September 1975 to September 1976 were processed during the year 1976. A total of 17,529.6 t of fishes were estimated to have been landed from the Hooghly-Matlah estuarine system during this period, which is more than the total catch of the previous corresponding period by 3,528.8 t. Zone III (Lower Sunderbans) accounted for about 86.5% of the total catch. The catches at Namkhana, Kakdwip, Diamond Harbour, Hasnabad and Kalinagar were estimated on the basis of Calcutta wholesale market data with better efficiency in lesser cost. Zone I, II, IV and V contributed about 4.4, 1.2, 6.9 & 1.0% to the total catch respectively. The winter months (Nov'75 to Jan 1976) accounted for about 75% of the total catch.

The species which dominated the catch were *Harpodon nehereus* (4,748.8 t ; 27.1% of the catch), *H. ilisha* (2,435.9 t; 13.9% of the total catch), prawns (1,713.9 t; 9.8% of the total catch), and *T. savala* & *T. haumela* (1,142.1 t ; 6.5% of the total catch).

The gears which accounted for the maximum catch were bag net, large & small seines and drift net. The bag net catch was estimated to be 12,496.1 t accounting for 71.3% of the total catch.

As the programme for collecting the statistics of catch and effort for winter migratory fishery could not be carried out by opening a survey camp at Fraserganj due to paucity of funds, this was done by an alternative approach for which Uluberia dry fish market was covered to collect the total dry weight of different species for November 1975 to January 1976.

Problem	:	14.7	Survey of the fish and fisheries of the river Brahmaputra

Personnel : Ravish Chandra, H. P. Singh, M. Choudhury and V. Kolekar

Duration : Four years

Catch statistics : During the year 178.3 t of fishes were estimated to have landed at four centres; *viz.*, Tezpur, Uzanbazar & Fancybazar (Gauhati) and Dhubri, as compared to 241.4 t during the year 1975, thereby showing 35.4% decline in the catch. The centre-wise break-up being as under :—

Centre	Landings (kg)
Tezpur	35,811
Dhubri	53,835
Gauhati	88,664*
*Uzanbazar—35,480 and Fancybazar—53,184	
Grand Total	178,310

Centre-wise observations of the fish catch statistics were as under :

Tezpur : 35.8 t of fishes were estimated to have landed at Tezpur, as compared to 59.4 t during the year 1975, thereby showing 65.9% decline in the catch. The landings were dominated by miscellaneous fishes (35.24%), followed by minor carps (26.24%), catfishes (16.01%), major carps (14.05%), hilsa (4.56%) and prawn (3.89%).

Gauhati : 88.7 t of fishes were estimated to have landed at two centres. The landings were dominated by miscellaneous fishes (42.30%), followed by catfishes (18.02%), hilsa (14.34%), minor carps (13.36%), major carps (8.69%) and prawn (3.28%), in Uzanbazar; and at Fancybazar by hilsa (23.4 %), followed by major carps (23.12%), miscellaneous fishes (21.98%), catfishes (20.03%), minor carps (6.39%) and prawn (5.00%).

Dhubri : 53.8 t of fishes were estimated to have landed at Dhubri. The catches were dominated by miscellaneous fishes (23.49%), followed by catfishes (21.53%), major carps (17.71%) hilsa 17.23%), minor carps (11.26%), and prawn (8.77%).

Hydrological observations :

Tezpur : The ranges of alkalinity, free CO_2, DO, nitrate and

phosphate varied from 58.0 to 78.0 ppm, 2.5 to 4.0 ppm, 7.52 to 9.60 ppm, 0.034 to 0.048 ppm and 0.055 to 0.08 ppm respectively as compared to 50.0 to 80.0 ppm, 2.0 to 4.0 ppm, 6.88 to 10.40 ppm, 0.025 to 0.05 ppm and 0.05 to 0.14 ppm respectively during the previous year.

Gauhati : The ranges of surface water temperature, pH, turbidity, alkalinity, free CO_2, DO, nitrate and phosphate ranged as 19.0° to 30.0°C, 7.6 to 8.2, 10.0 to 68.0 ppm, 62.0 to 87.0 ppm, 2.0 to 5.0 ppm, 7.32 to 11.20 ppm, 0.03 to 0.07 ppm and 0.05 to 0.09 ppm respectively as compared to 15.0° to 29.0°C, 7.4 to 8.0, 10.0 to 100.0 ppm, 54.0 to 82.0 ppm, 2.0 to 5.0 ppm, 6.4 to 10.08 ppm, 0.03 to 0.06 ppm and 0.05 to 0.14 ppm respectively during the previous year. It is observed that there was decrease in turbidity and phosphate values but an increase in water temperature, pH, DO and nitrate content during the year.

Dhubri : The ranges of alkalinity, free CO_2, DO, nitrate and phosphate varied between 65.0 & 80.0 ppm, 6.0 & 7.5 ppm, 7.12 & 8.80 ppm, 0.04 & 0.07 ppm, and 0.06 & 0.098 ppm respectively, as compared to 56.0 & 76.0 ppm, 4.5 & 8.0 ppm, 6.72 & 9.92 ppm, 0.03 & 0.06 ppm, and 0.05 & 0.16 ppm respectively during the previous year. DO, free CO_2 and phosphate contents of water showed a decline during the year.

Soil analysis : Soil samples from the river Brahmaputra analysed in May 1976 gave the following values :

Name of centres	pH	Specific-conductivity in m mhos/cm at 25°C	Organic carbon in %	Available P_2O_5 (lbs/acre)	Available K_2O (lbs/acre)	Texture (field test)
Tezpur	7.5	0.150	0.26	42	115	Sandy loam
Gauhati	7.6	0.170	0.26	38	195	Sandy loam
Dhubri	6.95	0.170	nil	35	60	Sandy

Primary productivity : Gross primary productivity fluctuated between 24.52 and 34.35 mg $C/m^3/hr$ as compared to 24.58 and 31.25 mg $C/m^3/hr$ during the previous year. The net production varied between 16.20 & 21.50 mg $C/m^3/hr$ as compared to 14.12 & 19.36 mg $C/m^3/hr$ during the previous year.

Plankton :

Tezpur : The average monthly plankton density at Tezpur was 14 u/l which consisted of 92.86% phytoplankters and the rest zooplankters. Bacillariophyceae formed the most dominant group (57.14%) followed by Chlorophyceae (28.58%) and blue-green algae (7.14%) among the phytoplankters. The zooplankters were represented by copepods (7.14%) only. The common genera were *Spirogyra*, *Ulothrix*, *Zygnema*, *Mougeotia*, *Tabellaria* and *Gomphonema* among the phytoplankters. Mainly nauplius and *Cyclops* sp. constituted zooplankton.

Gauhati : The average monthly plankton density at Gauhati was 18 u/l, which consisted of 88.88% of phytoplankters and the rest, zooplankters. Chlorophyceae formed the most dominant group (44.44%) followed by Bacillariophyceae (38.88%) and blue-green algae (5.56%) among the phytoplankters. The zooplankters were represented by rotifers (5.56%) and protozoans (5.56%) only. The common genera were the same as at Tezpur.

Dhubri : The average monthly plankton density at Dhubri was 20 u/l which consisted of 70.00% of phytoplankters and the rest, zooplankters. Bacillariophyceae was the most dominant group (40.00%) followed by Chlorophyceae (20.00%) and blue-green algae (10.00%) among the phytoplankters. The zooplankters were represented by rotifers (10.00%), copepods (15.00%) and cladocerans (5.00%). The common genera were the same as at Tezpur.

Problem	:	14.8	(Research work suspended since 1975)
Problem	:	14.9	(Research work suspended since 1974)
Problem	:	14.10	Ecological changes in the Hooghly estuary in the context of freshwater release from Farakka Barrage in the system
Personnel	:		A. C. Nandy, K. K. Ghosh, P. M. Mitra, H. Singh, S. K. Mazumdar, B.K. Saha, R. N. Dey, R. K. Chakrabarty, H. S. Mazumdar, G. P. Bhattacharjee, N. D. Sarkar, A. R. Paul and N. C. Mandal
Duration	:		Three years

Fortnightly observations on hydrological data, plankton, benthic organisms, primary production and tow net collections were made from 8 stations, 5 along the Hooghly, one each on Rupnarayan, Matlah and Moni rivers. The studies have indicated a shifting salinity pattern by about 40 km down-stream and a general improvement in the habitat. A marked decline in salinity was observed at Kakdwip from 29 to 18‰ during the summer months. Kalna-Barrackpore-Uluberia had almost freshwater throughout the year (salinity 13.200 ppm). Kolaghat—Canning and Raidighi, the sampling stations on the other rivers of the estuary were unaffected due to freshwater release from Farakka. Other parameters, like transparency, total suspended solids, pH, total alkalinity, silicates, phosphates and nitrates showed no significant change for any of the stations under observation during the period.

The plankton samples studied indicated higher abundance of freshwater forms with phytoplankton dominating the zooplankton in the estuary up to Uluberia. The phytoplankton consisted mainly of diatoms throughout the estuarine system during the year. In the upper zone of the Hooghly from Uluberia to Kalna, the chlorophycean members were also encountered in the collections in large number. The phytoplankton belonged to two major classes with the Bacillariophyceae having the maximum representation in terms of species (18), closely followed by the Chlorophyceae (8) and the Myxophyceae with the least representation. In terms of number per litre, diatoms were the most important. The monthly averages of phytoplankters encountered ranged form 5 to 15/l in the upper zone (Uluberia to Kalna); in the middle zone (Uluberia to Geokhali) from 13 to 110/l and in the lower zone (at Kakdwip) from 85 to 310/l of water.

The zooplankton consisted mainly of freshwater and brackishwater species in the upper and middle stretch of the Hooghly and the Rupnarayan estuaries, while in the lower zone of the Hooghly and in the Matlah at Canning, it comprised essentially of brackishwater and marine forms Copepods constituted the bulk of zooplankton in all the zones and had the maximum representation. Copepods consisted of calanoid and cyclopoid forms with various copepodid and nauplius stages. The calanoid group was represented by *Heliodiaptomus* sp., *Neodiaptomus* sp. and larval stages, while the cyclopoid group was represented by *Mesocyclops streneus* & *Mesocyclops leukarati* and larval stages.

Two species of *Acartiella*, *A. tortaniformes* & *A. major* were recorded at Kakdwip and Canning. *Sagitta* sp. were commonly seen almost throughout the year at Kakdwip and Geokhali.

The average monthly value of gross primary production at Barrackpore was 68.1 mg C/m³/hr.

Problem	:	14.11	Statistical evaluation of sampling and estimation techniques of plankton
Personnel	:		K. K. Ghosh, B. N. Saigal, H. Singh, A. Ghosh and S. K. Saha
Duration	:		Two years and six months

The effects of sampling size on plankton collected by the net method indicated a high degree of variation in repeated samples, both qualitatively and quantitatively for 1, 5 and 20 litre samples. Large sized samples indicated higher representation of less abundant forms and higher zooplankton concentration. Smaller samples were dominated by phytoplankton. The investigations are being continued.

Problem	:	14.12	Robustness of estimators of population size and efficiency of mortality rate estimators by Monte-Carlo methods
Personnel	:		K. K. Ghosh
Duration	:		Two years and six months

The logistic and geometric models of population growth have been further examined under step function mortality model. The survey of literature has been continued further. Monte-Carlo run will be taken when computor time is available.

Project 15 : Fish pathology

Problem	:	15.1	(Research work completed in 1976)

Project 16 : Weed control

Problem	:	16.1	(Research work completed in 1973)
Problem	:	16.2	(Research work is being done under problem 16.7)
Problem	:	16.3	Evolution and evaluation of weedicide formulations

Personnel : V. Ramachandran, T. Ramaprabhu, S. Patnaik, K. M. Das and G. C. Saboo

Duration : Continuing since April 1968

In a field trial in a 0.165 ha pond with 1.6 m depth of water *Microcystis* bloom (21,000/l) was cleared by treatment with diuron @ 0.3 mg/l in 10 days. There was good development of copepods and rotifers after clearance of the bloom. The field trial with carbamate herbicide (Asulam) gave effective control of aquatic grass, *Panicum* sp., @ 3 kg a. i./ha and above in about 4 weeks after the treatment.

In a field trial in a pond, infestation of rooted weeds, *Ottelia* sp. and *Nymphoides* sp., was completely controlled after 3 instalments of treatment with brick pellets soaked in 2,4-D aqueous solution (@ 10 kg a. i./ha) during last year. There has been practically no regeneration of the weeds so far, whereas in the control pond, there was reinfestation within 6 weeks after complete removal of weeds by manual labour. Manual removal of weeds was repeated twice and there was only slight reduction in the bulk of the successive quantities of the weeds removed so far.

Problem : 16.4 (Research work completed in 1973)

Problem : 16.5 Eradication of weeds by chemical treatments

Personnel : E. Mitra (Miss), S. C. Thakurta and A. C. Banerjee

Duration : Three years

Experiments were carried out in the laboratory to find out the adequate methods of eradicating weed infestations caused by floating and submerged vegetations, using chemicals ; *viz.*, Coppersulphate ($CuSO_4$), Urea, Fernoxone (2,4-D sodium salt) and Superphosphate at different doses. The results are briefly summerised below.

Coppersulphate treatment : In a small aquarium containing healthy population of *Salvinia* sp. and *Vallisneria* sp. together with two specimens of *Labeo rohita* (25—38 mm), $CuSO_4$ was applied in two intermittent doses @ 35 kg/ha within a spell of four days. After the treatment, copper ion concentration of

the water was observed to be the maximum (0.65 ppm) on the 4th day but gradually came down to the normal (0.01 ppm) on the 31st day. Though the decolourisation of the plants started from the 16th day of the treatment, complete destruction of *Salvinia* sp. was achieved in 143 days. In case of *Vallisneria* sp., 90% of the plants died in 195 days and the rest, though surviving, were found to have no reproductive capacity. In course of the experiments, zooplankton was noticed to grow from the 38th day of the treatment. The fish survived during the experiments and subsisted on decaying vegetation. In another experiment conducted in a large earthen tub having dense infestation of *Salvinia* sp., coppersulphate solution when applied in the above stated dose and manner caused extermination of 99% *Salvinia* plants within a month from the day of treatment. The maximum copper ion concentration (0.72 ppm) in water was observed after 4 hours of the application of second dose which came down to normal on the 26th day from the first dose.

Further experimental trials in this line are being conducted.

Urea treatment : In laboratory in a glass jar containing *Hydrilla* sp and *Vallisneria* sp. urea in powder form was sprinkled on the water surface on the 1st, 5th and 12th day of the experiment at a dose of 150 kg/ha. Besides, 500 and 1000 ml of nitrate water was further added to the jar on the 13th and the 19th day respectively. The nitrate content of the water (initially 0.8 ppm) was observed to be the maximum (4.0 ppm) just before the application of the second dose of urea on the 5th day and the minimum (0.5 ppm) after 157 days from the day of application of the first dose. Though 60% of plants were killed, the rest gradually revived and continued to grow. However, vegetative reproduction of plants could be checked to some extent.

Another experiment was carried out in a 10 l glass jar having a good popuiation of *Hydrilla* sp. and *Vallisneria* sp. Urea, was applied in 3 intermittent doses in 7 days each @ 100, 50 and 50 kg/ha and another additional dose @ 100 kg/ha on the 9th day from the last dose. The nitrate content of the water (initially 0.02 ppm) was the maximum (3.0 ppm) after the 4th dose. About 70% *Hydrilla* sp. and 50% of *Vallisneria* sp. were destroyed and the vegetative reproduction was almost completely checked.

Treatment with superphosphate : Observat ions on the control of weeds by the treatment of superphosphate were also carried out in laboratory in three 10 l glass jars with healthy *Hydrilla* sp. and *Vallisneria* sp. All the three jars

were treated with different doses of superphosphate ; *i. e.*, @ 1,000, 1,250 and 1,500 kg/ha respectively in combination with mustard oil cake applied @ 1,500 kg/ha. The initial carbondioxide and phosphate concentration of all the three jars were nil and 0.1 ppm respectively. Carbondioxide content of the water of all the jars was noted to be 0.2 ppm till the 15th day of the treatment. While the jars treated with superphosphate @ 1,000 and 1,250 kg/ha exhibited the maximum phosphate content in the water as 16.5 and 18.5 ppm respectively after 24 hours of treatment, the remaining jar registered the highest phosphate content in water (28.9 ppm) on the 4th day from the treatment. The lowest affectation (25%) of both the plants was recorded in the first jar. *Vallisneria* sp. showed the maximum affectation (80%) in the second jar and *Hydrilla* sp. (95%) in the third jar. The experiment is in progress.

Treatment with Fernoxone : In a 10 l glass jar *Azolla* sp. were treated with Fernoxone @ 10 kg/ha and in another jar @ 5 kg/ha. In both the jars, the plants were completely killed within 30—40 days. No regrowth of the plant has so far been observed.

Problem : 16.6 Autecology of aquatic weeds

Personnel : E. Mitra (Miss), S. C. Thakurta and S. C. Banerjee

Duration : Four years

Nature of weed infestation in various ponds located in different parts of West Bengal was studied. The samples of aquatic plant infesting the water bodies, pond soils and the ambient water were collected and analysed to correlate the chemical constituents present within the environment with those present in the vegetation. Such a study is going to help in ascertaining those chemicals which are actually responsible for the healthy growth of the weeds. Moreover, manipulation of the chemical ingredients of the pond water will then be easier for the eradication of unwanted vegetations. The details of the data collected are being analysed.

Problem : 16.7 Studies on the algal population of fresh-water ponds with special reference to their utility for fish culture and control when in excess

Personnel : S. Patnaik and K. M. Das

Duration : Four years

In the fish farms of southern and western Orissa, the soil pH was found to vary between 6.0 and 8.0. The water pH and total alklinity ranged from 6.8.—8.8 and 4 —450 ppm. respectively. Phytoplankters ranged from 46-325 u/l and among benthic algae *Chara* sp. was dominant in the western Orissa and *Spirogyra* sp. in the southern Orissa.

A 0.15 ha pond having bloom of *Microcystis aeruginosa* (1.3 cc/l density) was cleared in 20 days with two applications of 0.75 ppm coppersulphate at two weeks' interval. The fish and fish food organisms of the pond were not affected by the treatment given.

Problem : 16.8 & 16.9 (Research work completed in 1976)

Project 17 : Frog farming

Problem : 17.1 to 17.4 (Research work completed in 1973)

Problem : 17.5 (Research work suspended since 1972)

Problem : 17.6 (Research work completed in 1975)

Problem : 17.7 Development of hatchery complex for Indian commercial frog species

Personnel : A. K. Mondal

Duration : Three years

Experiments on methods of degumming of eggs of *Rana tigrina* and *R. crassa* were carried out by modified Woynarovich method. In eight and six experiments conducted with the eggs of the two species, complete dissolution of superficial jelly coat on the egg surface was achieved with no stickyness left at all by treatment with urea, sodium chloride and pectinase. In some cases, this treatment even appeared to have improved the condition of such eggs that normally would not have hatched at all. Eggs used in all these experiments were obtained through induced breeding. A small hatchery complex could be built up only with two hatchery jars.

Problem	:	17.8(a)	Nursery management for Indian commercial frog species
Personnel	:		A. K. Mondal
Duration	:		Five years

About ten thousand tadpoles of *R. hexadactyla* were produced and reared in a prepared field nursery pond, and a large number of early frogs were raised. Incidental to induced breeding and hatchery development work, another twenty thousand tadpoles of *R. tigrina* and *R. crassa* and their hybrids were produced.

One field experiment on rearing of tadpoles to early frogs of *R. hexadactyla* was conducted in a *hapa* fixed in a pond, at a stocking density of 10 million/ha and the tadpoles regularly fed with *Hydrilla* sp. Final survival from tadpole to early frog stage was about 71% as against 81% obtained at a stocking rate of 7.5 million/ha. Experiment with early tadpoles of *R. hexadactyla* conducted in a plastic pool at a stocking rate of 30 million/ha and fed with *Hydrilla* sp. showed 86% survival from tadpole to early frog stage. In a similar experiment with 12—day—old tadpoles of *R. tigrina* at a stocking rate of 250 tadpoles/350 litres of water and fed with frog meat only, the final survival of early frogs was 71.6%. Laboratory experiment to study the effects of iodine at 0.6 ppm dose on the metamorphic stages of *R. hexadactyla* tadpoles showed fast growth in the early tadpoles. The period of metamorphosis of the advance and pre-metamorphic stages was reduced by a few days over the controls. A similar experiment is being conducted using Berbarine sulphate.

Problem	:	17.8(b)	Rearing of the tadpoles of *Rana tigrina* up to the juvenile stage with artificial feed
Personnel	:		S.N. Mohanty, P.L.N. Rao, V. Panigrahi and C.R. Das
Duration	:		Two years

2,500 tadpoles of *Rana tigrina* could be produced through induced breeding for conducting rearing experiments under frog culture progamme. In a set of rearing experiment, 20% of tadpoles survived up to 2—legged stage and 12% up to early frog stage. Minced meat, chopped earthworms and fish meal were used as feed.

Problem	:	17.9(a)	Mono-culture of *Rana hexadactyla*
Personnel	:		A.K. Mondal
Duration	:		Six years

No experiment on monoculture of *R. hexadactyla* could be undertaken due to non-availability of facilities & scientific staff. However, from early tadpoles small frog juveniles could be reared in a small private pond.

Problem	:	17.9(b)	(Research work completed in 1976)

Problem	:	17.9(c)	Rearing of the todpoles of *Rana hexadactyla* up to the adult stage
Personnel	:		C. R. Das, S. N. Mohanty, P. L. N. Rao and V. Panigrahi
Duration	:		Two years

Rana hexadactyla could be induced to breed twice in a year in captivity by simulating the natural environment. It could be established that they have two prolonged phases of breeding, once in spring and the other in monsoon.

From the spring eggs, 55—65% hatchlings could be procured as against 90% from the monsoon eggs.

Rearing of the tadpoles of *R. hexadactyla* indicated that the provision of suitable aquatic plants ; *viz.*, *Hydrilla* sp., *Spirogyra* sp. *Lemna* sp., etc. in required quantities resulted in about 90% survival and metamorphosis.

Froglets (25 mm/0.5 g) stocked @ 25,000/ha attained an av. l./av. wt. of 67.5 mm/40 g in 8 months' rearing with the provision of insects and worms as live food organisms.

In another experiment, the frogs (av. 67.5 mm/av. 40 g) stocked @ 6,000/ha attained an av.l./av.wt. of 84.6 mm/87.1 g in 4 months' time.

Problem	:	17.10	Culture of earthworms for feeding frogs
Personnel	:		C. R. Das, P. L. N. Rao, S. N. Mohanty and V. Panigarhi
Duration	:		Three years

Two species of earthworms, *i. e.*, *Pheretima* sp. and *Megascolex* sp., were

used for cultture. Decomposed leaves, organic manure and moist environment were found to be congenial for their growth and multiplication.

Project 18 : Sewage-fed fisheries

Problem	:	18.1	Fish culture in sewage-fed ponds
Personnel	:		Apurba Ghosh, L. H. Rao and S. K. Saha
Duration	:		Five years and six months

A sewage-fed pond (0.076 ha) at Rahara stocked with *Tilapia mossambica* (2 male : 1 female) @ 57,000/ha yielded 368.870 kg (*i. e.*, 4,850 kg/ha) of fish after nine months' rearing. The pond had been initially fertilised with 22,800 litres of domestic sewage effluent diluted with rain water in the ratio of 1 : 2.2 and later with weekly/fortnightly addition of sewage @ 26,250-2,12,800 l/month till April. Owing to the septic condition of the pond bottom, the experiment was discontinued from July 1976 onwards. Regular observations on the physico-chemical conditions of water and soil in the pond were made during the course of the experiment.

Another sewage-fed pond (0.17 ha) at Rahara stocked with the fingerlings of catla, rohu, mrigal, common carp and silver carp @ 24,000/ha in the ratio of 31.2, 17.5, 36.7, 7.9 and 6.7% respectively yielded 6,452 kg/ha (gross)/ 5,711 kg/ha (net) of fish in nine months (*i.e.*, by May 1976). The pond had been initially manured with 7,80,000 l of domestic sewage effluent diluted with freshwater in the ratio of 1 : 2 and later monthly by letting in 34,000-1,61,000 l of the effluent. No artificial feed was provided.

In another set of experiment conducted in the same pond, fingerlings of catla, rohu, mrigal, common carp and silver carp were stocked in July 1976, @ 15,000/ha in the ratio of 1.0 : 2.5 : 2.5 : 2.0 : 2.0 respectively. Initially 6,80,000 l of domestic sewage effluent diluted with freshwater in the ratio of 1 : 2 was used to fertilise the pond and later 1,40,000-3,96,000 l/month was added. The fish growth registered so far is statisfactory. The hydrobiological studies in the pond are being continued.

For mixed culture of fishes in sewage-fed waters during December 1975 to December 1976, magur (*Clarias batrachus*) and male tilapia (*Tilapia mossambica*) were stocked in a 0.11 ha pond. No supplementary feeding was provided except for fertilising the pond periodically with sewage effluent in

quantities ranging from 44,000 to 1,48,000 l/ month. The pond (0.11 ha) was stocked @ 40,000/ha with *Tilapia mosssambica* and *Clarias batrachus* in the ratio of 1:1. Partial harvesting was done and about 58 kg (*i.e.*, 527 kg/ha) and 36 kg (*i.e.*, 327 kg/ha) of tilapia and magur respectively were obtained. Final harvesting will be done after dewatering the pond.

To explore the possibility of producing fish meal utilising the mass scale harvest of *Tilapia mossambica* from sewage-fed ponds, an investigation was carried out at Rahara Research Centre of the Institute. During the study it was revealed that a kg of fresh tilapia yielded 250 g of fish meal. The chemical analysis of the fish meal produced from tilapia indicated the presence of protein at 28.4%, fat at 6.1% and moisture at 11.4% levels.

Project 19 : Hilsa fisheries

Problem	:	19.1	(Research work completed in 1973)
Problem	:	19.2	(Research work completed in 1974)
Problem	:	19.3	(Research work suspended since 1973)
Problem	:	19.4 & 19.5	(Research work completed in 1973)
Problem	:	19.6	(Research work suspended since 1973)
Problem	:	19.7	Appraisal of the present status of hilsa fishery of the lower stretch of the Ganga River System
Personnel	:		B. L. Pandey, S. K. Wishard, S. N. Sar and R. C. Singh
Duration	:		Four years

The total estimated production of hilsa from the lower stretch of the Ganga River System, based on sampling at Bhagalpur, Sahibganj, Rajmahal, Farakka and Dhulian on the river Ganga and Lalgola on the Padma was recorded to be 129.60 t against 148.59 t in the previous year thus registering a decrease by 12.78%. The contribution of Dhulian, Farakka and Lalgola centres towards total production was 43.47 t (33.54%), 60.15 t (30.98%) and 45.97 t (35.47%) respectively. The production was nil at Bhagalpur & Sahibganj and 0.01 t at Rajmahal. The magnitude of hilsa fishery could not be ascertained at Farakka and Dhulian due to limited facilities.

Among the three sub-populations, the 'Slender' variety dominated at Rajmahal, Dhulian and Farakka, while 'Broad' variety dominated at Lalgola.

The pattern of intermingling between the three sub-populations during different months at a centre indicated that the 'Slender' sub-population dominated by numbers throughout the year at Dhulian and Farakka. At Lalgola centre, the 'Broad' variety dominated by numbers throughout except in the month of September, November and December, when the 'Slender' variety predominated.

Problem	:	19.8	Culture of *Hilsa ilisha* (Ham.) in confined freshwater
Personnel	:		K. L. Shah, K. P. Srivastava and Krishna Chandra
Duration	:		Five years

With the improvement in hilsa catches near Farakka, the females made up to 20% of the catch but were still in mature and maturing stages. Only two pairs of hilsa in oozing condition could be obtained and were successfully stripped at 16.30 hrs on 27th October and 16.45 hrs on 31st October, 1976. The oozing females measured 350 and 450 mm in total length and weighed 800 and 1,000 g respectively. The stripped eggs and milt were mixed in plastic basin and the fertilised eggs were placed in sediment free river water, having 27.0°C temperature. 2.5 lakhs of eggs were produced from the two females and about 85-90% of them got fertilised. The eggs were kept for hatching in hatching *hapas* fixed in the river and about 70% of the eggs hatched out within 24 hours. Two separate batches of hatchlings were reared in *hapa* for 10 and 13 days duration. Three nursery ponds near Farakka were stocked with 50,000, 50,000 and 72,000 hilsa fry on 9th November, 1976. Follow up studies are being continued.

Problem	:	19.9	Fluctuations in the *Hilsa* fisheries of the Hooghly estuary
Personnel	:		D. D. Halder, S. K. Mazumder, P. B. Das and B. K. Saha
Duration	:		Three years and six months

The larval abundance of hilsa during the post winter breeding season was poor. The hilsa fishery during the period yielded 833 t from the entire estuary.

Problem	:	20.1	(Research work completed in 1973)
Problem	:	20.2	(Research work completed in 1975)
Problem	:	20.3	Studies on estuarine pullution with reference to pulp & paper and tannery wastes
Personnel	:		B. B. Ghosh, S. B. Saha and M. M. Bagchi
Duration	:		Four years

Primary production, biotic abundance and some physicochemical parameters around the outfall of Titagarh Paper Mill No. 1, Titagarh and Tannery Works, Bata India Ltd., Batanagar were studied since January to observe the pollutional effects caused in the Hooghly and compare the condition with the stretch near Barrackpore not directly connected with the effluent discharge points. The observations were made during low water level under different tidal phases.

The average values of gross primary production at the outfall of T.P.M. No. 1 and Tannery Works were noted to be 6.7 and 9.8 mg $C/m^3/hr$ respectively which were much lower than that (41.7 mg $C/m^3/hr$) obtained at Barrackpore. Further, the average "Gross production values" above the outfall of Titagarh Paper Mill No. 1 and Tannery Works were observed to be 8.5 and 33.3 mg $C/m^3/hr$ respectively showing higher values when compared with the outfall region. The pollutional effect was also reflected from the comparatively high average value of $\frac{1}{2}$ hr OC noted at the outfall of Titagarh Paper Mill No. 1 (26.8 mg/l) and Tannery Works (8.4 mg/l) as against that (6.8 mg/l) observed at Barrackpore. Pollutional effect was of higher magnitude with respect to chemical parameters, primary production and plankton during neap tidal phase as compared to that under spring or bore tidal condition.

Problem	:	20.4	Investigations on Hooghly estuarine ecosystem to determine biological indicators of its water quality
Personnel	:		S. B. Saha

Duration : Three years and six months

No clear indication of pollutional load except at the outfall area was observed possibly due to heavy dilution caused by tidal regimes. Benthos was poor at all the centres especially around the main discharge points. Plankton and benthos distribution around the outfall of the municipal sewer was studied. Blue-green algae represented by *Oscillatoria* sp. & *Microcystis* sp. and tubificid worms were encouutered in greater abundance indicating sewage pollution.

Problem : 20.5 Investigations on the Ganga and the Yamuna river ecosystems at Allahabad to determine the biological indicators of water quality

Personnel : S. N. Mehrotra, S. P. Singh, B. C. Jha and H. C. Joshi

Duration : Four years

The results of water analysis revealed that the area around the outfall was more alkaline, hard and rich in essential inorganic nutrients, like nitrates, phosphates and silicates. The outfall area was also rich in mineral content especially calcium and magnesium ions. Free NH_3 was present at the outfall and B.O.D. of the sewage ranged between 70 & 125 mg/l for the Yamuna and 18 & 44 mg/l for the Ganga waters. pH, transparency and dissolved oxygen indicated decline at the outfall area. Areas above and below the outfall showed low values except for pH, transparency and dissolved oxygen which were high. There was no appreciable difference in the physicochemical properties of water during the monsoon period.

The plankton around the outfall and below the outfall area was characterised by high percentage of myxophycean (*Merismopedia* sp., *Oscillatoria* sp. and *Spirulina* sp.), protozoan and sewage-fungus (*Zoogles* sp. and *Fusarium* sp. only in the Yamuna), whereas chlorophycean (*Crucigenia* sp., *Phodorina* sp. and *Stigeogonium* sp.), bacillariophycean (*Nitzschia* sp., *Gomphonema* sp., *Rhoicosphenis* sp.) and dinophycean (*Ceratium* sp.) forms indicated a sharp decline in both the rivers. The zooplankton showed low concentration in the Yamuna and high values in the Ganga at the outfall areas. The area above the outfall was dominated by bacillariophycean and chlorophycean forms and the sewage-fungus was always absent. Blue-greens and protozoans were encountered in lesser numbers.

Chironomid worms followed by oligochaetes and odonate nymphs were the characteristic benthic forms at the outfall area. Shells of gastropods and bivalves were occasionally present. Chironomid egg mass and larvae were present below the outfall and were followed by gastropods. However, the area above the outfall was characterised by the dominance of molluscs and absence of chironomids. During the monsoon months, the outfall area was restricted to a narrow stretch only.

No difference in the fish catches was observed at the three centres though the concentration was more at the outfall area. The catches comprised mainly trash fishes ; *viz.*, *Puntius* sp., *O. cotio* & *Chela* sp. The other species encountered were *C. mrigala*, *M. seenghala*, *M. aor*, *M. cavasius*, *C. garua*, *Mastacembelus* sp., *S. phasa*, *N. notopterus* and *G. guiris*.

Problem	:	20.6	Effects of biocides on the physiological activities of aquatic animals
Personnel	:		M. Peer Mohammed, R. S. Panwar, G. N. Srivastava and R. A. Gupta
Duration	:		Three years

Experiments were conducted to find out the upper temperature tolerance limit of two species of fish —*Cirrhinus mrigala* and *Colisa fasciata*, a gastropod —*Viviparus bengalensis* and a bivalve—*Parreysia favidens*. Acclimatisation and tests were done in 12 litre capacity cylindrical glass jars. After the animals were acclimatised at room temperature (30.0°C), the water temperature in the experimental jars was increased by 1°C daily. The desired constant temperature was maintained with the aid of thermostatic relays with a precision of ± 0.1°C. After 35°C, the temperature was increased by 0.2°-0.5°C per 24 hours. *C. mrigala* (av. T.L. 5 cm ; av. wt. 1.5 g) and *C. fasciata* (av. T.L. 6.3 cm ; av wt. 2.3 g) were found to tolerate temperature up to 42.0°C and 40.2°C respectively. No mortality was observed in *P. favidens* (av. length 6.3 cm and wt. 17.8 g) up to 41.0°C. However, 60.0% mortality was observed when the water temperature was raised to 41.1°C and remaining (40%) died at 41.3°C. In the case of *V. bengalensis*, the smaller specimens (9mm) tolerated temperature up to 41.5°C and the larger ones (26 mm) up to 40.4°C.

In another set of experiments, where the water temperature was increased abruptly, *C. mrigala* (av. T.L. 6.4 cm, av. wt. 2.3 g) was found to tolerate temperature up to 40.0°C only.

For biochemical studies, *C. fasciata* (av. wt. 1.6 g) were exposed to three sub-lethal concentrations of BHC (0.04, 0.08 and 0.10) for 24 and 48 hrs, and the samples of the tissues were preserved for analysis.

Problem	:	20.7	Bioassay of selected industrial wastes disposed into the Hooghly estuary
Personnel	:		P. Ray, E. Mitra (Miss), K.K. Ghosh, B.B. Ghosh and M.M. Bagchi
Duration	:		Three years

LC_{50} value of synthetic rayon waste for shrimp (*Macrobrachium* sp.) and daphnia (*Daphnia similis*) were estimated. Toxicity response of shrimp (*Macrobrachium* sp.) to different concentrations of synthetic rayon waste was assayed. The LC_{50} values determined by the least chi-square method for 24, 90 and 96 hrs respectively were 41, 43 and 49 percent by volume in 3 experiments. *Daphnia* sp., however, with the same waste indicated, in 96 hrs bioassay, a value lower than 10 percent. With zinc sulphate the toxic level indicated was below 0.5 ppm. Further confirmation with *Daphnia* sp. is required, as results were interferred by the breeding of the species. The LC_{50} determined for textile waste using shrimp as test animal was 6.5 percent by volume.

Problem	:	20.8	Pollution studies in different inland waters caused by pesticides
Personnel	:		R. S. Panwar, M. Peer Mohammed, H. C. Joshi (January to May 1976), D. Kapoor and R. A. Gupta
Duration	:		Four years

Studies on toxicity of pesticides, DDT-25EC, Malathion-50EC, Rogor-30 EC and Nuvan-100 EC, were conducted at water temperatures 10° ± 1°C, 20° ± 1°C and 27° ± 1°C, using *Daphnia carinata*, as the test organisms, cultured in the laboratory. Experiments were conducted in two different qualities of water. In one case, the water medium showed total alkalinity in the range of 480-495 ppm, hardness 100-112 ppm, DO 7.0-8.0 ppm and pH 8.0-8.2 ; whereas in the other type of water medium, total alkalinity was 280-290 ppm, hardness 70-82 ppm ; DO 6.2-6.6 ppm and pH 7.6-7.7. The toxicity of pesticides was found in the following order : Nuvan, Malathion, DDT and Rogor at 10° ± 1° and 20° ± 1°C water temperature, while at 27° ± 1°C water temperature, the effect of

DDT was found more pronounced than that of Rogor and Malathion. It was also found that the effect of pesticides was lesser in the former quality of water than in the latter one, considering their LC_{50} values. In the second case, LC_{50} values of pesticides ; *viz.*, Rogor, DDT, Malathion and Nuvan with respect to *D. carinata* were 0.71, 0.14, 0.108 and 0.047 ppm at 10° ± 1°C water temperature ; 0.784, 0.158, 0.12 and 0.061 ppm at 20° ± 1°C water temperature and 0.41, 0.0275, 0.042 and 0.0166 ppm at 27° ± 1°C water temperature, respectively, while in the earlier case, LC_{50} values were 0.78, 0.173, 0.138 and 0.058 ppm at 10° ± 1°C water temperature; 0.854, 0.207, 0.158 and 0.076 ppm at 20° ± 1°C and 0.45, 0.0404, 0.044 and 0.026 ppm at 27° ± 1°C water temperature respectively.

Experiments on the toxicity of pesticide, Rogor-30 EC, were also carried out with *Colisa fasciata* and *Viviparus bengalensis* at water temperature 27° to 28°C under continuous flow system and its LC_{50} values were found to be 15.8 ppm (24 hrs exposure) and 13.4 ppm (96 hrs) and 18.0 ppm (24 hrs) and 14.1 ppm (96 hrs) respectively.

Bioassay studies were also conducted with the effluent brought from Gammoxone Plant of Kanoria Chemicals, Renukoot, Mirzapur, using fish, *C. fasciata*, as test animal. 20% mortality was found in 10% dilution of the effluent in 48 hours exposure and 20% mortality was noticed in 1% dilution in 672 hours (28 days) exposure. Its LC_{50} values were 22.5% (24 hrs) and 14.0% (72 hrs).

Project 21 : Fisheries of river basins

Problem : 21.1 & 21·2 (Research work suspended since 1973)

Project 22 : Fish culture in running waters

Problem : 22.1 (a) Cage culture of carps in running water of the river Ganga

Personnel : G. N. Mukherjee, A. G. Jhingran, S.N. Mehrotra, G. N. Srivastava and R. K. Saxena.

Duration : Six years

Experiments were initiated with common carp (*C. carpio*) fingerlings

obtained from the Tandua and Banda Fish Farms of the State Fisheries Department, Uttar Pradesh.

For rearing 400 fingerlings, six nylon cages (1×1×1 m) with identical mesh size were floated in the running water of the river Ganga at Shankerghat near Phaphamau. Fingerlings from the first batch were stocked in two cages @ 40 in each and the fingerlings from the second batch were stocked in four cages—two with 40 fingerlings in each, and the other two with 160 fingerlings in each cage. Rice-bran and mustard oilcake in the ratio of 1:1 were used as the feed -1 and the feed -2 comprised rice-bran, ground-nut oilcake and boiled potato in the ratio of 3 : 1 : 2. While both the feeds were inoculated with 2% common salt and 0.5% TM-5, the feed -2 was fortified with vitamin B-complex as well.

After a month of rearing, the experiment got spoiled due to rains and storms. Another set of experiment was initiated with the remaining stocking material. The remaining fingerlings were reared by stocking them @ 44 fingerlings in each of the two cages, and 22 fingerlings in each of the remaining two cages. The composition of the two feeds remained the same as before. In the first phase of experiment, feeds were given @ 4% of the body weight divided into four equal instalments during the day. After rearing the fingerlings for 92 days, feed -2 gave better performance with average increment in weight and length of 0.24 g and 0.7 mm respectively per fish per day.

Subsequently, for continuing the experiments during the monsoon season, the cages were shifted to a suitable site at Mahewapatti on the bank of the river Yamuna, and the investigations were carried on with the existing 85 fingerlings at hand dividing them in two cages only. Feeding of fingerlings with the above mentioned feeds was continued @ 8% of the body weight of the fingerlings for a period of one month. The growth of fingerlings was better in the river Ganga than in the river Yamuna. Average increment in weight and length was observed to be 0.14 g and 0.23 mm respectively per fish per day.

Problem : 22.1 (b) & 22.1 (C) (Research work kept in abeyance)

Problem : 22.2 Catfish culture in running water

Personnel : S.P. Singh, K.P. Srivastava, R.N. Seth, Krishna Chandra and B. Ghosh

Duration : Three years

30 km stretch of the river Ganga and 4 km in the Yamuna near Allahabad were surveyed for locating the breeding pits (*Thalas)* of *Mystus aor* and *M. seenghala.* Of the 23 *Thalas* located during the period April-June 1976, only 7 yielded 1,575 hatchlings (size range : 10-40 mm) of *M. seenghala;* the rest of them being found abandoned. The number of hatchlings per *Thala* varied from 50 to 600. The breeding pits in the rivers Ganga and Yamuna were found to be located in shallow areas (depth range : 0.5-1.5 m) having feeble current.

The hatchlings of *M. seenghala* were reared in plastic pools in laboratory/yard in nylon cages (size $1 \times 1 \times 1$ m) kept in running waters of the Ganga and the Yamuna rivers during April to September. The hatchlings were given a bath in 1 ppm acriflavine before stocking. Chironomid egg-mass and semi-boiled weed-fish flesh was given as feed to the *M. seenghala* hatchlings in plastic pools and nylon cages and both the feeds were found to be acceptable to them. However, the latter was preferred the most. As such semi-boiled fish flesh was continued during the rearing period. Aeration in the plastic pools was regularly done for better survival. The left over feed and the faecal matter were removed daily to avoid pollution. Though no infection was encountered during the rearing experiments, the survival of hatchlings in plastic pools ranged from 15—55%; the mortality being due to injury during handling and also primarily due to change in environment. The survival of *M. seenghala* hatchlings in the nylon cages was encouraging and varied between 80 & 100%.

During the rearing period of 60 days (April—June) in one plastic pool, the hatchlings (size range : 12-25 mm ; av. 15 mm) attained the size range of 60-101 mm (av. 80 mm). In another plastic pool during 48 days' rearing period (May-July), the hatchlings measuring 20-23 mm, showed a growth increment of 0.35 mm per day, whereas the hatchlings (size range : 27-46 mm) on rearing for 41 days (July-Aug) in nylon cages kept in running water showed an average growth increment @ 0.71 mm per day. Hatchlings in the size range of 24-35 mm (av. 30 mm) attained a size range of 139-256 mm (av. 168.8 mm) during 144 days' (April-September) rearing in nylon cages in running water. To improve the techniques, further rearing experiments are being conducted.

Problem : 22.3 Cage culture in lentic waters

Personnel : A. V. Natarajan, R. K. Saxena, N. K. Srivastava and B. D. Saroj

Duration : Three years

To evaluate the feasibility of rearing carp spawn in floating nurseries (cages) in lentic waters and to evaluate the feasibility of rearing fish to marketable size in floating cages in lentic waters, Jari tank situated at a distance of 33 km from Allahabad was selected for conducting the experiment. Two nylon cages (*hapas*) of $2.20 \times 1.60 \times 1.45$ m each of $\frac{1}{4^{th}}$ mesh size, were supported by a bamboo frame work floated in the tank.

30,000 hatchlings (*c.* 85 million/ha) of carps, collected at Mahewapatti from the river Yamuna on 12-13th night, were released in one cage on 18.8.76 after acclimatizing them in the plastic pool on artificial feed. The second cage was also stocked with approximately the same number of hatchlings on 25.8.76 collected from the same source on 19.8.76.

The hatchlings of Lot 1 attained an average length of 45.6 mm by 15.9.76 after a rearing for 28 days in cage. The average size at the time of stocking was 7.8 mm. The hatchlings of Lot 2 attained an average length of 30.2 mm by 15.9.76 after a rearing of 21 days in cage from an average size of 6.5 mm at the time of stocking.

The young carp fry were transferred to four mosquito netting *hapas* @ 2,500/*hapa* (*c.* 70,00,000/ha) for further rearing. Within a period of about 3 months, the fry attained the fingerling size of about 121.8 mm in Lot 1 (89 days of rearing) and 103.6 mm in Lot 2 (82 days of rearing).

Rate of growth, of different species of carps of the two Lots was observed to be as follows :

Lot 1 : Stocked on 18.8.76.

Species	28 days of rearing (av. length in mm)	89 days of rearing (av. length in mm)	113 days of rearing (av. length in mm)
C. catla	63.0	192.0	205.0
L. rohita	44.5	116.0	140.3
C. mrigala	40.0	120.5	127.6
L. calbasu	—	101.0	110.0
L. bata	53.0	102.0	114.2

Lot 2 : Stocked on 25.8.76.

Species	21 days of rearing (av. length in mm)	82 days of rearing (av. length in mm)
C. catla	40.0	150.0
L. rohita	—	—
C. mrigala	29.9	105.5
L. bata	30.0	90.0

Average growth/fish/day was recorded to be the maximum in the month of October as is evident from the following :

Months	*Lot 1*	*Lot 2*
August	1.1 mm/fish/day	0.7 mm/fish/day
September	1.3 mm/fish/day	1.1 mm/fish/day
October	1.7 mm/fish/day	1.4 mm/fish/day
November	0.9 mm/fish/day	1.1 mm/fish/day

Feeding with soyabean, ground-nut oilcake and rice-polish in 1 : 1 : 1 ratio was continued @ 20% of the body weight of fish till October in all the four cages. The feeding was later reduced to 10% of the body weight of fish with the onset of winter. Further investigations in this project are being continued.

Project 23 : Bundh breeding

Problem : 23.1 (a) Bundh breeding of major carps in Uttar Pradesh

Personnel : S.J. Karamchandani, G.N. Mukherji, G.N. Srivastava and Krishna Chandra

Duration : Four years

Bundh breeding of major carps was successfully achieved in August 1976 in the Ganne bundh in Allahabad district. The breeding experiments were

initiated from the 2nd August 1976 due to drought condition prevailing in the preceding month. Two consignments of brooders of *L. rohita* and *C. mrigala* were stocked in the bundh on the 3rd and 12th August 1976 which were procured from Tendua Fish Farm of Uttar Pradesh Fisheries Department. This dry bundh is fed by flowing rain water from about one square mile of catchment area.

As a result of heavy rainfall during the night of the 10th/11th August 1976 and the following few days, breeding took place in the early hours of the morning of the 13th and 14th August 1976, when flood-like conditions were created in the bundh. To ensure breeding late in the season, one set of brooders (1 ♀ : 2 ♂) each of rohu and mrigal were given pituitary hormone injection in the evening of the 12th August 1976. Only 6,000 fertilised eggs could be collected from the bundh as most of the eggs were washed away by gushing waters through the sluice gate.

Observations on physicochemical conditions of the water during pre-breeding, breeding and post-breeding periods in the bundh revealed that air temperature (26.8°C), water temperature (27.4°-28.0°C), pH (7.6), DO (5.6-7.6 ppm) and total alkalinity (28.32 ppm) were relatively low whereas free carbondioxide (2.0-12.0 ppm) was high during the breeding period.

Problem	:	23.1(b)	Bundh breeding of major carps in Bihar
Personnel	:		S.K. Wishard, R.C. Singh and A. Sarkar
Duration	:		Four years

Experiments on the bundh breeding of carps were undertaken in the Tonto village in Chaibasa district by the side of Roro Canal, using the canal water for breeding.

Drought conditions prevailed during June & July. In August, only the weather conditions improved slightly. One set of mrigal responded to a dose of pituitary gland extract of 2 and 4 mg/kg body wt. of males and the female, respectively. The males weighed 1.00 and 0.75 kg, and the famale, 1.80 kg. Approximately 13 litres of eggs were collected. Of which, 88% were fertilised. 3.75 *baties* (1 *bati*=20,000 spawn) of spawn were handed over to the State Fisheries Department.

Further experiments on the bundh breeding of major carps had to be given up due to erratic weather conditions and non-availability of brooders.

Project CFCSP : All India Co-ordinated Research Project on Composite Fish Culture and Fish Seed Production

Problem : CFCSP I Composite fish culture and fish seed production

Personnel : V. R. P. Sinha, M. V. Gupta, K.K. Sukumaran, H.A. Khan, R.M. Rao, M.Y. Kamal, K.N. Krishnamurthy, K. Alagaraja, K.K. Ghosh, M. Sinha, D V. Pahwa, B. N. Singh, K.G. Rao, J. B. Rao, D. P. Chakrabarty, Balbir Singh, P.M. Mathew, Dhirendra Kumar, B.C. Tyagi, P.K. Saha, D. N. Misra, P. K. Aravindakshan, B. K. Singh, P.N. Jaitly, Jagadish Chandra and P.C. Mahanta

Duration : Four years

With a view to obtaining the maximum sustained production of fish through composite culture of conventional species of Indian and exotic carps, experiments were carried out at various subcentres of the project located under different agroclimatic conditions of various States in the country.

At Karnal, two experiments—one with six species combination and the other with five species combination (excluding silver carp) were conducted. While the six species combination resulted in gross and net productions of 6,267 and 6,199 kg/ha/8 months respectively from a 0.23 ha pond, the same with five species combination were recorded to be 3,068 and 3,023 kg/ ha/8 months.

At Jaunpur, the gross production obtained with provision of supplementary feeding and fertilisation ranged from 5,119—5,887 ; with only artificial feeding from 3,612—4,330 kg and 1,681—2,745 kg/ha/yr with the provision of fertilisation alone as against a production of 1,422 kg/ha/yr obtained from the control pond where no management technique was adopted.

At Pune, four species combination of catla, rohu, mrigal and common carp has given gross and net productions of 4,072 and 3,788 kg/ha/$9\frac{3}{4}$ months respectively, whereas the gross and net productions recorded through the culture of six species in combination were 5,155 kg/ha/8 months respectively.

At Gauhati, six species combination yielded gross and net productions ranging from 3,731—4,083 and 3,534—3,896 kg/ha/yr respectively.

5,446 and

At Bhavanisagar, the gross and net productions to the tune of 2,818—3,232 and 2,599—2,902 kg/ha/yr respectively could be obtained with six species combination together with a few *Mystus aor* and *Channa striatus*.

At Kalyani, a gross production of 3,393 kg/ha/13 months was obtained with five species combination of catla, rohu, mrigal, silver carp and common carp. At the same subcentre in another pond, five species combination gave gross and net productions of 3,751 and 3,156 kg/ha/14 months respectively.

At Badampudi, four species combination of catla, rohu, mrigal and common carp has given gross and net productions of 2,128 and 1,833 kg/ha/yr respectively whereas in another experiment five species combination (eliminating grass carp) resulted in gross and net productions of 2,076 and 1,763 kg/ha/yr respectively.

In an experiment at Ranchi, the gross and net productions of 1,504 and 1,439 kg/ha/yr respectively could be obtained whereas in a different experiment, a gross production of 2,004 kg/ ha/18 months was recorded.

Fish seed production : Indian major carps have been bred at all the subcentres. Silver carp and grass carp have been bred successfully at Pune, Gauhati, Kalyani and Karnal subcentres whereas from Badampudi subcentre, the successful breeding of grass carp has been reported. Breeding of silver carp has for the first time been achieved at Ranchi subcentre in Bihar. A total of 39.76 lakhs spawn of Indian major carps and 19.20 lakhs spawn of silver carp & grass carp were produced.

Problem	: CFCSP 2	Bundh breeding of silver carp *Hypophthalmichthys molitrix* and grass carp, *Ctenopharyngodon idella*
Personnel	:	V.R.P. Sinha, M. Sinha, B.K. Sharma and M.V. Gupta
Duration	:	Two years

Three experiments were conducted during the year. In the first experiment, 2 females of silver carp weighing 7.5 kg and 4 males weighing 11 kg were injected with pituitary extract and released in the bundh. Females were given two injections of 5 and 10 mg/kg body weight and males were administered a single dose of 8 mg/kg body weight. Due to delayed monsoon, the experiment could be initiated only on the 2nd July. One female spawned

completely and the other partially. In all, 35 litres of eggs were collected from the bundh. The hatching was done in *hapas* in a pond, in *chhabas* fitted with inner hatching *hapa* and also in conventional *chhabas*. In all, 40,000 spawn was obtained.

The second experiment was conducted on the 6th July with 2 females of grass carp weighing 16.5 kg and 5 males weighing 16 kg. Females were administered two injections of 3 and 12 mg/kg body weight and males were given a single dose of 8 mg/kg body weight and subsequently released in the bundh. Sex play followed by successful breeding was noticed but the eggs collected from the bundh were found in dead condition. Later the females were cut open and the ovaries were observed to be in advanced stage of absorption.

The third experiment was conducted on the 9th July with 8 females and 11 males of silver carp. Of these, 3 females got plugged and died. There was sex play and only one female bred partially and one litre of eggs only could be collected from the bundh from which 2,000 spawn were obtained.

Problem	: CFCSP 3	Reproductive physiology of Indian & Chinese carps
Personnel	:	V. R. P. Sinha, M. V. Gupta, M. Sinha, B. K. Sharma and B. N. Singh
Duration	:	Two years

Conductivity of water collected from river and ponds having large catchment area and from those ponds which do not receive drainage from catchment area has been studied. The conductivity of river water was observed to be the lowest followed by that of ponds which receive drainage from catchment area.

Experiments were conducted to study the effectiveness of salmon gonadotropin G-100 and prostaglandin F_2 in breeding. Common carp were injected with salmon gonadotropin G-100 in three different doses of 2.5, 5 and 10 mg/kg body weight and prostaglandin F_2 @ 1 mg/kg body weight separately. All the fishes injected with salmon gonadotropin G-100 with three different doses have bred, like those injected with the second fraction of carp pituitary whereas, the fishes injected with prostaglandin F_2 did not breed. Fishes in the control also did not breed.

Problem : CFCSP 4 (Research work kept in abeyance)

Problem : CFCSP 5 (Research work suspended since 1975)

Problem : CFCSP 6 Biology and role of grass carp, *Ctenopharyngodon idella* in composite fish culture

Personnel : M. V. Gupta

Duration : Three years

The growth of the species at different stocking densities and at different feeding levels has been studied. Food conversion has been calculated. Breeding was done successfully even without much of rains.

Problem : CFCSP 7 Effects of oxygen, carbondioxide and temperature on the metabolism and assimilation of feed in certain Indian and Chinese carps

Personnel : B. N. Singh, V. R. P. Sinha, M. V. Gupta and D. P. Chakrabarty

Duration : Two years

Studies on the assimilation and conversion of artificial feeds by rohu fingerlings have clearly indicated that both these factors are significantly affected by oxygen and temperature of ambient water. The growth rate of fish is significantly increased (from 220.5 mg/day to 458.0 mg/day) if temperature is raised from 20.0°C to 28.0°C. It has been found that at the same temperature, a mixture of plant and animal protein gives a higher rate of growth (nearly double) than the plant protein alone derived from the commonly used supplementary feeds for carps in India (*i.e.*, a mixture of oilcake and bran). The artificial feeds having higher protein (about 40.0%) gave faster rate of growth compared to those having low protein (about 30.0%).

The rate of feeding as well as respiration of carp fingerlings are affected by the oxygen content in ambient water. The effect of hypoxia is clearly observed if O_2 content of water falls below 4.0 mg/l. The rate of feeding is significantly reduced (7.5 to 2.5%) in hypoxic waters. The reduced rate of feeding and the increased energy expenditure on account of respiration resulted in negative growth of fingerlings even when they were fed with diets containing high protein levels.

The oxygen consumption of rohu, mrigal and grass carp fingerlings has been studied at a temperature range of 30.0°-32.5°C. The mean VO_2 of

rohu is lowered in hypoxic waters. Grass carp appears to have the highest rate of consumption among these three carps. These results appear to be in agreement with the habitat (level of water occupied by a particular fish in a pond), since grass carp which is an active surface feeding fish has the highest VO_2 and mrigal the bottom dweller the lowest with rohu inhabiting column has intermediate level of oxygen consumption.

Problem : CFCSP 8 Composite fish culture without fertilisation and feeding

Personnel : H. A. Khan and D. N. Misra

Duration : Three years

Experiments initiated in 1975 were concluded after one year's duration. Seven ponds were utilised for the experiments. Two ponds were treated with feed & fertilisers, two ponds with artificial feed alone, 2 ponds were treated with fertilisers alone and one pond was kept as control without feed & fertilisers. The gross production ranged in ponds treated with feed & fertilisers from 5,110-5,887, with artificial feed alone from 3,612-4,330, and with fertilisers alone from 1,621-2,745 against 1,422 kg/ha/yr in the control. The experiments significantly pin-point the role of artificial feed in enhancing the production.

Problem : CFCSP 9 Composite fish culture in running water

Personnel : K. N. Krishnamurthy and P. K. Aravindakshan

Duration : Three years

Composite fish culture in one small pond with running water facility was undertaken. The pond was not fertilised or manured ; but the fishes were given artificial feed only. The duration of the experiment was one year. The gross production from the pond was 174 kg and net production 158 kg and which worked out to gross and net productions of 5,790 kg/ha/yr and 5,276 kg/ha/yr respectively. The maximum growth was recorded by common carp followed by mrigal and grass carp. The growth of catla and silver carp was not satisfactory. *Tilapia* sp. which got into the pond contributed a little over 25% of the total production.

Problem : CFCSP 10 Operational research project on composite fish culture

Personnel : V. R. P. Sinha, B. K. Sharma, A. Mukherjee and Jagdish Chandra

Duration : Four years

Stocking for the second experiment in three large ponds measuring 2.15, 1.93 and 1.48 ha was done in the months of February/March 1975. The ponds got flooded in July 1975 and bundhs were heavily damaged. Consequently certain stocked fishes escaped into the adjoining ponds. After immediate repairs of the bundhs by the State Fisheries Department, the ponds were partially harvested and the harvested stock was replenished while the duration of the experiment was extended to 18 months. The final harvesting of the ponds is in progress and so far about 20,000 kg of fish has been harvested. Another 2,000 kg of fish is expected to be harvested from these ponds.

Problem : CFCSP 11 Biology of the silver carp, *Hypophthalmichthys molitrix* (C & V) and its performance in composite fish culture

Personnel : B. K. Sharma and V. R. P. Sinha

Duration : Two years

Growth investigations and feeding relationship with other component species was continued during the year. Fecundity studies of the ovaries preserved were made. Samples for the growth and maturation studies were made. Different stages of development starting from fertilised eggs were studied.

Problem : CFCSP 12 The pituitary-gonad feed back relationship in *Mystus vittatus* (Bloch)

Personnel : A. Mukherjee and V.R.P. Sinha

Duration : Two years

Hypophysectomy has been carried out in male and female *Mystus vittatus*. Testes and ovary of hypophysectomised fish have been fixed at regular intervals for study.

Hemicastration has been done in male and female *Mystus* sp. and the compensatory activities of the remaining gonads are under study. Pituitary and gonads of *Mystus* sp. have been fixed at regular intervals and the seasonal changes in their histophysiology are under study.

Problem	:	CFCSP 13	Composite fish culture for demonstration to the fish farmers
Personnel	:		P. Das, M. Sinha and D. Kumar
Duration	:		One year

The Nilganj pond which was stocked with 3 species of Indian major carps was finally harvested during February 1976 after 15½ months of culture. The gross and net productions obtained were 5,564 and 5,154 kg/ha/15½ months with a cost of production of Rs.2.59/kg weight of fish. Demonstration of the final harvesting was arranged for the fish farmers.

The pond was stocked in the month of May 1976 @ 7,500 fingerlings/ha in the ratio of catla 3 : rohu 3 : mrigal 2 : common carp 2. The experiment is in progress. So far 6 demonstrations on different aspects of the technology have been arranged.

Problem	:	CFCSP 14	Techno-economic and socio-economic aspects of massive fish seed production for composite fish culture
Personnel	:		V. R. P. Sinha and K. K. Ghosh
Duration	:		Two years

Widely prevalent field techniques showed a wide gap in productivity against the improved scientific techniques, especially in spawn production through hypophysation in farms, riverine spawn collection and seed rearing. Bundh breeding technology commanded the highest acceptability and its commercial production of spawn marketed in recent years in Calcutta was of about the same order as that of riverine spawn. Riverine spawn markets grew in other parts of West Bengal. In breeding through hypophysation, production of catla spawn was very low. Only about 1% of the total spawn produced through this technique in 1971 was of catla. The rate of realisation of fingerlings in conventional practice rarely exceeded 19% from spawn stage against modern technology's 50%. The costs of production at site under fairly ideal conditions of natural factors, were estimated to be Rs. 189/— for riverine spawn, Rs. 804/— for breeding through hypophysation and Rs 2,474/- for per million of bundh-bred spawn. However, the high acceptability of bundh bred spawn in Calcutta market because of its pure quality (av. market price Rs. 4,000/- per million as against riverine spawn's about 1,000/-

per million) pin-pointed the advantages and promises of pure fish seed which is obtainable also through hypophysation at a cheaper rate (*i. e.*, at 20% of the cost involved in bundh breeding). Riverine spawn remained the cheapest and bulk source of spawn, specially for the spawn of catla. The socioeconomic constraints in the wider adoption of hypophysation techniques need study, as much as impacts of targetting through different techniques. The lack of detailed data on different variables limited the analysis of such results.

Problem : CFCSP 15 Statistical evaluation of some growth parameters and their confidence intervals

Personnel : K. Alagaraja

Duration : Two years

Four parametric Von-Bertalanffy's growth model under allometric growth is reduced to three metric ones by introducing shape factor. So far in fishery research, regression analysis in the conventional form is applied though functional regression is the best suited one. Hence, functional regression is applied and work is in progress in evaluating the variance of regression in this case.

Problem : CFCSP 16 Evaluation of fish production and loss due to poaching from cultivated resources

Personnel : K. Alagaraja and V.R.P. Sinha

Duration : Three years

Fishes in one of the experimental ponds at Kalyani have been clipped. Growth of the clipped & unclipped and regeneration of clipped fins are being studied.

Problem : CFCSP 17 A test on the equal catchability of tagged and non-agged animals in mark recapture studies

Personnel : K. Alagaraja

Duration : Two years

Data collected and processed are being analysed.

Project ABF : All India Co-ordinated Research Project on Air-breathing Fish Culture

Problem	: ABF 1	Propagations and stocking of air-breathing fishes for culture in swamps
Personnel	:	P. V. Dehadrai, R. N. Pal, N. K.Thakur, S. C. Pathak, D. N. Singh, V. K. Murugesan and P. Kumaraiah
Duration	:	Eight years

In Assam, mixed culture of magur, koi and singhi stocked at the rates of 8,000, 3,000 and 1,000 nos/ha respectively in a 0.1 ha derelict pond, yielded production of 916 kg/ha/yr with over 76% survival in respect of magur, *Clarias batrachus*. The expenditure involved in the culture was Rs. 1,360/— only. A production of 1,678 kg/ha/yr could be obtained in mono-culture of *Channa punctatus* at Ulubari.

In West Bengal, fingerlings of magur (10—15 g) when stocked @ 40,000/ha and fed with dried marine trash fish gave an estimated production of over 5,000 kg/ha/5 months with average growth of 139 g.

In Karnataka, the murrels grew to 800 g in 7 months at Belandur tank when fed with dried marine trash fish. It has been possible to breed magur in Assam, Bihar and West Bengal with encouraging survival.

Problem	: ABF 2	Nutrient balance of the soil and water in a weed infested swamp
Personnel	:	P. V. Dehadrai and R. K. Das
Duration	:	Two years

The laboratory and field studies made in 1975 and 1976 both with soil and water from Dhokardah beel, Kalyani, indicated that raking of the bottom soil in the field and in jars in the laboratory promotes the mineralisation of organic matter to a great extent and thereby increasing nutrient level and primary production significantly. Gross production was observed to increase from 312.5 to 1,500 mg $C/m^3/hr$.

Problem	: ABF 3	Food conversion among air-breathing fishes
Personnel	:	R. N. Pal and P. V. Dehadrai

Duration : Three years

During the year under report, two sets of experiments were conducted, one in winter and the other in summer seasons, in cement cisterns measuring (1.8 sq m). The cisterns were stocked with fingerlings of *Clarias batrachus* @ 40,000 nos./ha. The fingerlings fed with supplementary diet (comprising fish meal, ground-nut oilcake and rice alongwith yeast as a growth promoter) showed better growth 4.67 g/fish/month in comparison to the growth attained by the stock which was not supplied with yeast in the feed mixture in winter. Net gain of 9.2 g/fish/month was observed in summer months under identical conditions.

Problem : ABF 4 Digestive physiology of air-breathing fishes with particular reference to enzymes

Personnel : P. V. Dehadrai and P. K. Mukhopadhyay

Duration : Two years

Isolation and purification of alkaline protease from the intestines of *Clarias batrachus* have been done and two enzymes; *viz.*, Trypsin and Chymotrypsin, have been identified. Studies on the variation of these enzymes under different protein diet treatments have also been carried out.

Problem : ABF 5 Culture of air-breathing fishes in derelict water

Personnel : P. V. Dehadrai, S. M. Banerjea and R. N. Pal

Duration : Three years

During the period under report, two ponds measuring 0.03 and 0.04 ha were stocked with magur fingerlings @ 20,000 and 40,000/ha respectively. Fishes of both the ponds were fed with dried marine trash fish (80%) and rice-bran (20%) @ 5% of their body weight. A gross production of 36 kg in 5 months and 80 kg in 6 months were harvested from the respective ponds when only 50% fishes could be retrieved due to loss by poaching.

Problem : ABF 6 (Research work suspended in 1976)

Problem : ABF 7 Nutritional and biochemical studies of air-breathing catfish, *C. batrachus*

Personnel : R. N. Pal, P. K. Mukhopadhyay and P. V. Dehadrai

Duration : Two years

Studies on the activities of carbohydrate, protein and lipid metabolising enzymes; *viz.*, amylase, protease and lipase were made to understand the regulatory mechanisms of digestion in *Clarias batrachus* and also to get an idea on the nutritional requirement of this fish when fed with supplementary and synthetic diets.

Project R : All India Co-ordinated Research Project on Reservior Fisheries

Problem : R 1 Ecology and fisheries of freshwater reservoir

Personnel : A. V. Natarajan, G. K. Bhatnagar, Ch. Gopalakrishnaiah, V. R. Desai. Y. Rama Rao, M. Ramakrishnaiah, A. Mathew, B. P. Gupta, V.V. Sugunan, R. K. Singh, M. P. Singh Kohli, V. Pathak, N. P. Srivastava, D. K. Kausal, S. N. Singh, J. N. Pal, G.K. Vinci (Miss), V.T. Prabhakaran and P.K. Malhotra

Duration : Eight years

To study the ecology and dynamics of fish stocks with a view to obtaining sustained optimum fish production, investigations were continued in Bhavanisagar, Nagarjunasagar, Getalsud, Rihand and Govindsagar reservoirs.

Bhavanisagar (Tamil Nadu) : Detailed observations on the ecology of the reservoir including physicochemical features of water & soil, plankton, benthos, biology of fishes and some aspects of stock structure in relation to fishing effort were pursued. The estimated fish yield for 1976 (based on nine months' observations) was of the order of 276 t (*i. e.*, 75 kg/ha) which was an all time recorded for the reservoir. It was 19 kg/ha in 1971 when the reservoir was taken under the project. This was rendered possible by enhancement of fishing effort from 15 units in 1971 to 25 units in 1976 in a phased manner after giving due consideration to stock-density characteristics. *L. calbasu* among major carps and *M. aor* among catfishes continued to be dominant in catches. Detailed studies carried out at Moolathuria on the Bhavani river on up-stream stretch of the reservoir showed that the carp spawn constituted of *C.catla*, *L.calbasu*,

C. mrigala, L. fimbriatus and L. bata.

Nagarjunasagar (A. P.) : Ecological observations were pursued in Nagarjunasagar in 1976. On the basis of these observations, the fish yield potential was estimated at 128 kg/ha while the estimated fish yield was 113 t (*i. e.*, 6.12 kg/ha). The shortfall is identified as both due to inadequate fishing effort and subnormal breeding and recruitment of Gangetic carps. Qualitative and quantitative analyses of carp spawn showed that *L. fimbriatus* formed 35% of the total. Major carps were represented meagrely in the spawn. So continuous stocking of major carps to realise the maximum fish yield is needed for the reservoir.

Getalsud Reservoir (Chhotanagpur Division, Tribal Area, Bihar) : Studies on physicochemical features of water, primary productivity, plankton & benthos were in progress. In summer, there are indications of thermocline and chemical stratification especially in respect of oxygen. In spring, plankton showed a spurt of *Ceratium*. Among benthos *Tubifex* sp., *Tendipes* sp. and *Chaoborus* sp. were dominant.

In September, major carp recruitment, if any, was not reflected by drag net collections which was largely made of *Ambassis nama, Chela bacaila, Rohtee cotio and Glossogobius giuris.*

An experimental consignment of 2,860 fingerlings of sliver carp *(Hypophthalmichthys molitrix)* weighing on an average 6.5 g stocked in the reservoir in March 1974 registered a net growth of 4.3 kg in just 2 years and 4 months. One of the recoveries showed even a higher net growth of 4.7 kg in 2 years and 3 months. These observations indicated the potential role of silver carp both in Getalsud and other reservoirs of similar ecomorphological features. The gut analysis of silver carp from the reservoir revealed not only the presence of Myxophyceae but also the fact that they formed the largest percentage of the gut contents.

Rihand (U.P.) : Ecological studies were continued during the year. Biogenic chemical stratification and thermal stratification in summer were observed. Going by ecological studies, the fish yield potential of the reservoir was estimated as 49 kg/ha. Against this, the estimated actual yield was only of the order of 3 kg/ha. The fish catch in this reservoir for the year 1976 was estimated at 80 t comprising catla mainly. The yield in 1976 dropped sharply from a yield of 329 t in 1974—75 due to poor breeding and recruitment in the years 1972 and 1973. The existence of three subspecies of catla was further confirmed. The subspecies can easily be distinguished by the variations in the

drawn fortnightly at Hanspukur, the same was done monthly at Khasimari.

The chemical characteristics of Hanspukur and Khasimari ponds are as follows :

Water	Hanspukur	Khasimari
pH	7.6 — 8.8	7.0 — 9.2
Dissolved oxygen (ppm)	2.4 — 13.2	2.0 — 12.0
Free CO_2 (ppm)	Nil — 16.0	2.0 — 14.0
Total alkalinity (ppm)	110 — 240	56.0 — 170.0
Calcium (ppm)	26 — 68	14 — 36
Magnesium (ppm)	9.6 — 63.0	2.4 — 16
Nitrate (ppm)	0.02 — 0.4	0.001 — 0.1
Phosphate (ppm)	0.04 — 0.5	0.1 — 0.8
Chloride (ppm)	31 — 150	17 — 140
Silicate (ppm)	7.0 — 18.0	5 — 15.0
Specific conductivity (μ mhos)	400 — 1,500	152 — 660
Oxygen consumption (ppm)	1.5 — 7.2	4.0 — 6.0
Soil		
Mechanical composition		
Sand (%)	50 — 63	49 — 65
Silt (%)	19 — 26	20 — 40
Clay (%)	24 — 30	9 — 24
pH	6.0 — 7.2	6.6 — 7.2
Total nitrogen (%)	0.054 — 0.154	0.056 — 0.2240
Available N (mg/100 g)	17.36 — 35.0	15.2 — 35.8
Available phosphate (mg/100 g)	4.0 — 12.0	8 — 16.0
Organic carbon (%)	0.72 — 2.52	0.54 — 1.44
Primary productivity (mg C/m^3/hr)	130 — 1,050	300 — 1,200

The plankton contents varied from 0.1—4.1 cc/50 l at Hanspukur and 0.7-6.0 cc/50 l at Khasimari. During peak abundance, zooplankton dominated over phytoplankton by volume at both the centres.

Bottom biota (mainly gastropods) attained a peak during April-May (2,309-3,419 nos./sq m), at Hanspukur.

Problem	: CIFRI/IDRC/WB 3	Effect of different diets on the digestibility and growth of grass carp, *Ctenopharyngodon idella*
Personnel	:	K. M. Das and S. D. Tripathi
Duration	:	Two years

Fingerlings of *Ctenopharyngodon idella* (85.22 mm/7.7 g), fed exclusively on the duck weed (*Lemna minor*) in a plastic pool, were found to attain an average size of 88.88 mm/8.8 g in one month. Analysis of the faecal matter revealed that 52% of the protein content of the feed was digested and utilised.

C. idella (250-300 mm), fed on chopped cabbage leaves (22.5% protein on dry weight basis), indicated utilization of 46.8% of the protein content of the feed.

Studies on the food value of important aquatic weeds (*Hydrilla* sp., *Ceratophyllum* sp. and *Lemna* sp.) and vegetable wastes, like cabbage and cauliflower leave were in progress.

Problem	: CIFRI/IDRC/WB 4	Feed-input fish-yield relationship for freshwater fish culture operations
Personnel	:	S. D. Tripathi, M. Ranadhir, J. G. Chatterjee and S. R. Das
Duration	:	Two years

With a view to planning an efficient use of the feed in composite fish culture, experiments on the relationship between fish-yield and supplementary feed were initiated. Fish in four ponds (0.47, 0.45, 0.40 and 0.34 ha) were receiving their daily requirement of supplementary feed @ 8,000, 10,000, 12,000, 14,000 kg/ha/yr respectively. With a view to studying the effect of pond size on the rate of fish yield in two more ponds (0.1 & 0.2 ha), the fish were fed @ 12,000 kg/ha/yr.

The feed under use was a mixture of ground-nut oilcake and rice-bran.

Problem	: CIFRI/IDRC/WB 5	Fish diseases in semi-intensive fish culture and their remedial measures

Personnel : R. N. Pal and S. D. Tripathi

Duration : Two years

Only a single case of tail and fin rot of silver carp was recorded from a pond at Khariberia. Treatment with potassium permanganate (2 ppm) remedied the disease.

In three private ponds in the village Amgachhia where farmers were undertaking composite fish culture, the case of myxobotid infection on catla was recorded. The feeding intensity for the stock was rather poor in those ponds. So, suggestions to control the disease by providing adequate feed for the fish were imparted.

Problem : CIFRI/IDRC/WB 6 (Research work suspended in 1976)

(c) Research contemplated :

Over and above the problems on which investigations are being continued as per the project programmes inforce, a number of problems under different projects have been suggested to be initiated during the year 1977. The details of such problems are presented below :

Project 1 : Optimum per hectare production of fry, fingerlings and fish in culture fishery operations

Problem : 1.1 Composite culture of Indian and exotic species

(Old programme will continue)

Problem : 1.21 Carp fry rearing for optimum survival and growth under higher stocking density

(Old programme will continue)

Problem : 1.22.1 Culture and life-history of Cladocera from fish ponds

(Studies on the growth, reproduction, food, life-history and cyclomorphosis of water-fleas for their proper propagation to serve as food of fishes in freshwater ponds will be initiated.)

Problem	:	1.24	Studies on the effect of chemical fertilisers in relation to pond productivity (Old programme will continue)
Problem	:	1.26	Nutritional requirements of fry and fingerlings of carps (Old programme will continue)
Problem	:	1.28	Commercial production of carps through composite culture in large sized ponds (Old programme will continue)
Problem	:	1.29	Comparative study of the efficacy and economics of available fish poisons and their residual effects on the fish pond ecosystem (Old programme will continue)
Problem	:	1.30	Operational research on fish culture (Old programme will continue)
Problem	:	1.31	Use of anaesthetics in transport of fry and fingerlings under oxygen packing (Old programme will continue)
Problem	:	1.32	Bionomics and culture of tendipedid larvae, a favoured fish food organisms (Old programme will continue)
Problem	:	1.33	Studies on detection of digestive enzyme complex of freshwater culturable food fishes (Old programme will continue)
Problem	:	1.34	Observation on culturable possibilities of fish in jute-retted pond water (Old programme will continue)

Problem : 1.35 Culture of fish alongwith deep water paddy

(Old programme will continue)

Problem : 1.37 Devising effective sampling techniques for estimating production

(Old programme will continue)

Problem : 1.39 Effect of lime in pond soil

(Old programme will continue)

Problem : 1.40 Comparative efficiency of organic manures on the fertility of pond soils

(Old programme will continue)

Problem : 1.41 Effects of size of stocking material on production in composite fish culture

(Dissimilarities in the food items utilized by different sizes of same species is known among fish. As such, experiments will be conducted by stocking fingerlings of various desirable sizes for better utilisation of the food itmes present in the pond, ultimately yielding increased fish production)

Problem : 1.42 To find out the statistical relationship between the inputs and fish production in composite fish culture

(Formulating the future schemes for investigations on composite fish culture, statistical analysis and interpretations will be taken up to have a clear idea about the relationships between the inputs and fish yields so far achieved through various experiments conducted at CIFRI)

Problem : 1.43 Seasonal changes in the fat content in flesh of Indian major carps under different ecological conditions

(For harvesting fishes at proper condition, studies will be taken up to know the pattern of fat content in carp in relation to age, size and seasons)

Problem : 1.44 Studies on ecological changes in newly constructed ponds and their management

(It is reported that normally productivity of newly dug-out ponds is poor, generally due to high turbidity and low nutrient levels in the ecosystem. So, studies will be made for understanding properly the physicochemical and biological changes in the newly dug out pond to evolve suitable management measures for enhanced fish yield.)

Problem : 1.45 Culture of *Mystus seenghala* and *Mystus aor*

(Catfishes have preference as food fishes in certain parts of the country. As such, the possibilities of culturing them in ponds according to their commercial value will be explored.)

Problem : 1.46 Culture of tubificid and tendipedid worms

(The techniques of sustained yield of tubificid and tendepidid worms to feed fish of high protein demand will be standardised, besides estimating the food value of these worms and studying the extent up to which these will be useful in pisciculture operations.)

Project 2 : Induced fish breeding

Problem : 2.4 Hatching of eggs of major carps in newly designed hatchery under controlled conditions

(Old programme will continue)

Problem : 2.6 Production of multiple broods from the same individual of major carps in the course of one year

(Old programme will continue)

Problem : 2.8 Induced breeding of important cultivated fishes (other than carps)

(Old programme will continue)

Problem : 2.9 Studies on the process of maturation, ovulation and resorption of gonads in Indian major carps

(Old programme will continue)

Problem : 2.10 Pituitary—gonad relationship in a free spawning and non-free spawning carp

(Studies will be carried out on the histology of the pituitary gland for differentiating cellular organisation with particular reference to gonadotrophs and their physiological alterations and of gonads at different stages of sexual maturity, particularly in females of *Cirrhinus mrigala* and common carp from two different habitats ; *viz.*, stagnant pond water and flowing river water).

Project 3 ; Reservoir fisheries

Problem : 3.8 Fisheries of Peninsular tanks. Introduction and propagation of less known cultivable species

(Old programme will continue)

Problem : 3.13 Composite fish culture of Indian and exotic carps in tanks simulating long seasonal irrigational tanks

(Old programme will continue)

Problem : 3.14 Ecology and fishery development of Gulariya reservoir

(Old programme will continue)

Project 4 : Riverine carp spawn prospecting and collection techniques

Problem : 4.5 Yearly variation in quality and quantity of spawn in the river Ganga

(Old programme will continue)

Project 5 : Brackishwater fish farming

Problem : 5.17 Brackishwater prawn culture in Madras region

(Old programme will continue)

Problem : 5.18 Culture of edible oysters in Pulicat lake

(Old programme will continue)

Problem : 5.21 Fish and prawn seed resources of Pulicat lake

(Old programme will continue)

Problem : 5.22 Rearing of fry of brackishwater fishes

(Old programme will continue)

Problem : 5.23 Experimental culture of brackishwater fish food organisms in the laboratory and field

(Old programme will continue)

Problem : 5.24 (a) Effect of hormones and trace elements on fish food organisms

(Investigations will be taken up to get unialgal population on a large scale in the shortest possible time, besides

assessing the behaviour of cultured phytoplankters under various treatments of hormones & trace elements and subsequently studying the growth of algal cells & zooplankters nurtured in the treated media)

Problem : 5.26 Transformation of nitrogen and phosphorus in water logged saline soils relative to different grades of water salinity

(Old programme will continue)

Problem : 5.27 Surveying of Kankramari Char and Kakdwip and designing brackish water fish farm

(Investigations will be carried out to study (a) the contour characteristics of Kankramari Char and Kakdwip islands ; (b) the hydraulic phenomena such as tidal amplitudes, current velocity, etc. ; and (c) the cross section of the main creeks)

Problem : 5.28 Behaviour of lake-mouth bar and its bearing on the fishery of lake Pulicat

(Old programme will cotinue)

Problem : 5.29 Role of silt load in the Hooghly estuary on its environmental and nutrient balance and its effect on brackish water pond fertilisation

(Old programme will continue)

Problem : 5.30 Shape and structure of ponds, feeder canal and dykes relative to stability, water management and fish culture under brackish water environment

(Old programme will continue)

Problem : 5.31 Studies on the macrophytic flora in lake Pulicat with special reference to their

utilisation as organic manure and artificial feed for fish

(Old programme will continue)

Problem	:	5.32	Culture of edible portunid crabs (Old programme will continue)
Problem	:	5.33	Nursary management for the culture of *Eleutheronema tetradactylum* (Old programme will continue)
Problem	:	5.34	Stock manipulation in polyculture of Indian and exotic carps, mullets, chanos and prawns in low saline ponds in the Sunderbans (Old programme will continue)
Problem	:	5.35	Culture of *Chanos chanos* (Old programme will continue)
Problem	:	5.36	Collection and rearing of *Penaeus monodon* seed for stocking and supply (Old programme will continue)
Problem	:	5.37	Crop rotation under prawn-cum-fish cuiture (Old programme will continue)
Problem	:	5.38	Stock manipulation in selective culture of *Lates caicarifer* and *Eleutheronema tetradactylum* (Old programme will continue)
Problem	:	5.39	Intensive culture of *Panaeus indicus* in association with other penacid prawns

(Old programme will continue)

Problem : 5.40 Stock manipulation in intensive farming for mullets in monoculture and in association with penaeid prawn

(Old programme will continue)

Problem : 5.41 Development of device for large scale collection, segregation and rearing of brackish water fish and prawn fry for stocking in intensive culture

(Old programme will continue)

Problem : 5.42 Specified protein levels in supplementary feeds for enhancing growth of brackish water fishes and prawns

(Old programme will continue)

Problem : 5.44 Role of trace elements in the mineralisation of organic nitrogen

(Old programme will continue)

Problem : 5.45 Nutrient status of brackish water ponds in Madras region

(Old programme will continue)

Problem : 5.46 Floculating colloidal soil suspension in impounded waters of low salinity

(Old programme will continue)

Problem : 5.47 Accelaration of the rate of mineralisation of organic refuse by microbe inoculation

(Investigations will be carried out to reduce the C/N ratio of organic wastes to the required level at a minimum period. Composite microbs consisting mainly of cellulolytic and lignolytic bacteria will be inoculated into the refuse to be used as manure)

Problem : 5.48 Ablation of eye-stalk of fermale penaeid prawns for induced maturation

(Due to growing need of prawn seeds for brackish water farming while berried females are not readily captured in nature, experiments will be conducted to induce gonadial maturity in prawns by ablation of eye-stalk of female penaeids.)

Problem : 5.49 Evaluation of different supplementary feed used in mullet farming.

(Economics and efficacy of various types of feed used in mullet farming will be investigated statistically to get maximum benefit)

Problem : 5.50 Location, collection and acclimatisation of fingerlings of cultivable fish species

(Investigations will be carried out to establish fish seed resources of commercially important brackish water species around Madras and to standardise the methods of collection, acclimatisation and transportation of fish seed for systematic development of brackish water fish culture)

Problem : 5.51 Studies on the ecology of commercial brackish water *bheries* of variant productivity

(Studies will be taken up to know the nature of the topographical feature and layouts of brackish water ponds responsible for bringing out changes in the hydrobiological conditions which are ultimately responsible for the low and high productivities of such fish farms.)

Project 6 : Freshwater prawn culture

Problem : 6.2 Culture of *Macrobrachium malcolmsonii*

(Old programme will continue)

Problem : 6.4 To study the biology and production of prawn in the lower stretch of the Ganga

(Old programme will continue)

Problem : 6.5 Culture of *Macrobrachium birmanicum choprai* in ponds

(Rearing of freshwater prawn, *M. birmanicum choprai* from hatchling to adult stage will be taken up)

Problem : 6.6 Seed production of the giant freshwater prawn, *Macrobrachium rosenbergii*

(Suitable tehniques of mass scale raising of prawn seeds by using various types of feeds and standardisation of these methods will be taken up for large scale culture of prawns in an economic way)

Project 8 : Estuarine and brackish water lake fisheries

Problem : 8.1 Brackish water fish and prawn seed prospecting of the Hooghly-Matlah estuarine system

(Old programme will continue)

Problem : 8.6 Sandardisation of brackish water seed prospecting, collecting and transporting techniques

(Old programme will continue)

Problem : 8.7 Reproductive biology of cultivable brackish water fishes

(Old programme will continue)

Problem : 8.8 Studies on size distribution of commercially important clupeids of the Hooghly-Matlah estuary

(Studies will be taken up to understand

the size variation in length of clupeids over different seasons, so that proper fishery management practices can be adopted to improve the status af clupeids (specially *Hilsa ilisha* and *Setipinna phasa*) in the Hooghly-Matlah estuary)

Problem : 8.9 Studies on size distribution of commercially important perch and sciaenid of Hooghly-Matlah estuary

(Investigations will be conducted to study the size variations in length and weight of *Lates calcarifer* and *Pama pama* over different seasons, so that proper fishery management policies can be adopted)

Problem : 8.10 Studies on size distribution of commercially important threadfins and mullet of the Hooghly-Matlah estuary

(The size variation in length and weight of *L. parsia* and *E. tetradactylum* will be studied over different seasons to evolve a suitable management policy)

Project 9 : Selective breeding and hybridisation

Problem : 9.4 Selective breeding and hybridisation of carps and other cultivated fishes with special reference to cytogenetical features of the hybrids

(Old programme will continue)

Problem : 9.5 Studies on maturity of catla-rohu hybrid (F_1) and production of F_2 generation

(Production of hybrids (F_1) of catla and rohu, their culture and biogical investigations for further production of F_2 generations as well as trials on back crosses with the parent species will be taken up to improve the techniques of polyculture for better yield in shorter time at a lower cost)

Problem : 9.6 To develop suitable strains of Indian major carps

(Investigations will be carried out to produce strains of major carps having higher growth potential than natural stock to boost the inland fish production)

Problem : 9.7 Breeding of selected stock of grass and silver carps

(As grass carp and silver carp seed are needed for high fish yields through composite culture and as they are not readily available in the nature, it is proposed to take up experiments to breed these exotic carps).

Project 10 : Fish farm designing

Problem : 10.1 Designing fish farm under soil conditions of Orissa

(Old programme will continue)

Problem : 10.2 Studying seepage losses in ponds

(Old programme will continue)

Project 11 : Economics in fishery investigations

Problem : 11.6 Economics of semi-intensive fish farming in freshwater ponds of West Bengal and Orissa

(Old programme will continue)

Problem : 11.7 Economics of composite fish culture technology in India

(The economic viability of composite fish

culture technology in different regions of India will be investigated and a strategy of its adoption in different regions taking into consideration the demand and the price level will be evolved besides working out relationships between cost of inputs and yield in different regions, so that aquaculture is popularised as an industry)

Project 12 : Exotic fish culture

Problem	:	12.5	Techniques for large scale production of grass carp and silver carp seed (Old programme will continue)
Problem	:	12.6	Compatibilty and competition between silver carp and Indian major carps (Old programme will continue)
Problem	:	12.7	Optimum production of fingerlings and fish of exotic species under composite culture (Old programme will continue)

Project 13 : Cold water fish culture

Problem	:	13.2	Studies on the food and feeding habit of trout (Old programme will continue)
Problem	:	13.8	Standardisation of trout hatchery practices (Old programme will continue)
Problem	:	13.13	Studies on the biological indicators in an eutrophic lake (Dal lake) (Old programme will continue)

Problem : 13.14 Crude culture of fish food organisms under temperate climate

(Old programme will continue)

Problem : 13.15 Study on carrying capacity of a trout stream

(Old programme will continue)

Problem : 13.16 Induced breeding of *Schizothorax* sp. through hypophysation

(Old programme will continue)

Problem : 13.17 Some biological aspects of *Cyprinus carpio specularis* to assess its rate in the decline of endemic carp fishery in Dal lake

(Old programme will continue)

Problem : 13.19 Breeding of brown trout at Uttarkashi, Uttar Pradesh

(Old programme will continue)

Problem : 13.20 Standardisation of rearing techniques of brown trout from fry to fingerlings stages

(Suitable management technique for reduction of mortality rate to improve the production of healthy trout fingerlings will be taken up, besides utilising locally produced feeds)

Problem : 13.21 Induced breeding and rearing of mahseer (*Tor putitora*) seed in running water ponds

(Seed of mahseer by hypophysation and stripping techniques will be produced and stock of fingerlings (100-150 mm) for culture in running water ponds will be raised)

Project 14 : Riverine and estuarine fish catch statistics

Problem	:	14.1	Fish catch statistics of the middle stretch of the Ganga river system (Old programme will continue)
Problem	:	14.6	Effect of major environmental changes on the fisheries of commercially important stocks of the Hooghly-Matlah estuary (Old programme will continue)
Problem	:	14.7	Appraisal of the fish and fisheries of the river Brahmaputra (Old programme will continue)
Problem	:	14.10	Ecological changes in the Hooghly estuary in the context of freshwater release from Farakka Barrage into the system (Old programme will continue)
Problem	:	14.11	Statistical evaluation of sampling and estimation techniques of plankton (Old programme will continue)
Problem	:	14.12	Robustness of estimators of population size and efficiency of mortality rate estimators by Monte-Carlo methods (Old programme will continue)
Problem	:	14.13	The analysis of catch and effort statistics of commercially important species of the Hooghly-Matlah estuarine system (To improve the management practice

and to forecast the fishery of the Hooghly-Matlah estuarine system in a better way, the level of exploitation and population dynamics of commercially important species will be assessed)

Problem : 14.14 Comparative fishery and ecological studies of river Ganga at Bhagalpur and Farakka

(The impact of Farakka Barrage on the ecosystem of the river Ganga at Farakka and nearby areas will be assessed for proper management of the fishery of the river stretch)

Project 16 : Weed control

Problem : 16.3 Evolution and evaluation of weedicide formulations

(Old programme will continue)

Problem : 16.5 Eradication of weeds by chemical treatment

(Old programme will continue)

Problem : 16.6 Autecology of aquatic weeds

(Old programme will continue)

Problem : 16.7 Studies on the algal population of freshwater ponds with special reference to their utility for fish culture and control when in excess

(Old programme will continue)

Problem : 16.10 Recycling of animal waste and weeds in fish culture

(The effects of a regular supply of fresh liquid and solid wastes of farm animals and ducks on the ecology of fish ponds and production of fish will be investigated, besides evolving and standardizing an efficatious and economical method of recycling of aquatic weeds as compost for increasing fish production and also for prescribing the optimum dose of compost)

Problem : 16.11 Turnover of major nutrients such as nitrogen phosphorus and potassium in fish production

(The ratio of nitrogen, phosphorus and potassium returned as fish to artificial inputs of these nutrients will be worked out and studies will be carried on the economics of optimum inorganic N, P and K fertilisation in fish culture)

Project 17 : Frog farming

Problem : 17.7 Development of hatchery complex for Indian commercial frog species
(Old programme will continue)

Problem : 17.8 (a) Nursery management for Indian commercial frog species

(Old programme will continue)

Problem : 17.8 (b) Rearing of tadpoles of *Rana tigrina* up to the juvenile stage with artificial feed

(Old programme will continue)

Problem : 17.9 (a) Mono-culture of *Rana hexadactyla*

(Old programme will continue)

Problem : 17.9 (c) Rearing of tadpoles of *Rana hexadactyla* up to the adult stage

(Old programme will continue)

Problem : 17.10 Culture of earthworms for feeding frogs
(Old programme will continue)

Project 18 : Sewage-fed fisheries

Problem : 18.1 Fish culture in sewage-fed ponds
(Old programme will continue)

Project 19 : Hilsa fisheries

Problem : 19.7 Appraisal of present status of hilsa fishery of the lower stretch of the Ganga river system
(Old programme will continue)

Problem : 19.8 Culture of *Hilsa ilisha* (Ham.) in confined freshwater
(Old programme will continue)

Problem : 19.9 Fluctuations in the hilsa fisheries of the Hooghly estuary
(Old programme will continue)

Project 20 : Water pollution investigations

Problem : 20.3 Studies on estuarine pollution with reference to pulp and paper and tannery waste
(Old programme will continue)

Problem : 20.4 Investigations on Hooghly estuarine eco-

system to determine biological indicators of its water quality

(Old programme will continue)

Problem : 20.5 Investigations on the Ganga and the Yamuna river ecosystems at Allahabad to determine the biological indicators of water quality

(Old programme will continue)

Problem : 20.6 The effects of biocides on the physiological activities of aquatic animals

(Old programme will continue)

Problem : 20.7 Bioassay of selected industrial wastes disposed into the Hooghly estuary

(Old programme will continue)

Problem : 20.8 Pollution studies in different inland waters caused by pesticides

(Old programme will continue)

Problem : 20.9 The impact of pesticides on respiratory metabolism and energy utilisation in aquatic animals

(Studies will be made to find out the impact of various pesticides (used in the country) on respiratory metabolism & behavior, carbohydrate, protein & fat content in the fishes including major carps ; upper temperature tolerance limit in fish and energy utilisation)

Problem : 20.10 Pollutional effect of industrial wastes on aquatic ecosystem

(The effect of industrial waters of Kanko-

ria Chemicals, manufacturing bleaching powder, caustic soda and gammexone upon physicochemical and biological composition of Rihand reservoir at various points will be assessed and the permissible concentration of toxic industrial wastes in order to maintain ecologically favourable conditions for proper development of fisheries in the region, will be evaluated)

Problem : 20.11 Environmental pollution in the Hooghly estuary with reference to heavy metals disposed through industrial water

(The pollutional status of the Hooghly estuary due to disposal of heavy metals through industrial waste will be investigated and the level of accumulation of heavy metals in estuarine food fish, water and sediments will be determined)

Project 21 : Fisheries of river basins

Problem : 21.1 Ecology and development of '*Mans*' in Gandak Basin

(Old programme will continue)

Project 22 : Fish culture in running water

Problem : 22.1 (a) Cage culture of carp in running water (river/canal)

(Old programme will continue)

Problem : 22.1 (b) Carp culture in running water in the river Brahmaputra/tributary

(Old programme will continue)

Problem : 22.1 (c) Carp culture in running/still water 'Kol' of the Ganga in cages

(Old programme will continue)

Problem : 22.2 Catfish culture in running water
(Old programme will continue)

Problem : 22.3 Cage culture in lentic waters
(Old programme will continue)

Project 23 : Bundh breeding

Problem : 23.1(a) Bundh breeding of major carps in U. P.
(Old programme will continue)

Problem : 23.1(b) Bundh breeding of major carps in Bihar
(Old programme will continue)

Project CFCSP : All India Co-ordinated Research Project on Composite Fish Culture and Fish Seed Production

Problem : CFCSP 1 Composite fish culture and fish seed production
(Old programme will continue)

Problem : CFCSP 2 Bundh breeding of silver carp, *Hypophthalmichthys molitrix* and grass carp, *Ctenopharyngodon idella*
(Old programme will continue)

Problem : CFCSP 3 Reproductive physiology of Indian & Chinese carps
(Old programme will continue)

Problem : CFCSP 4 Efficacy of Brahmaputra silt as a fertiliser in composite fish culture

(Old programme will continue)

Problem : CFCSP 6 Biology and role of grass carp, *Ctenopharyngodon idella* in composite fish culture

(Old programme will continue)

Problem : CFCSP 7 Effect of oxygen, carbon-di-oxide and temperature on the metabolism and assimilation of feed in certain Indian and Chinese carps

(Old programme will continue)

Problem : CFCSP 8 Composite fish culture without fertilisation and feeding

(Old programme will continue)

Problem : CFCSP 9 Composite fish culture in running water

(Old programme will continue)

Problem : CFCSP 10 Operational research project on composite fish culture

(Old programme will continue)

Problem : CFCSP 11 Biology of the silver carp, *Hypophthalmichthys molitrix* (C & V) and its performance in composite fish culture

(Old programme will continue)

Problem : CFCSP 12 The pituitary-gonad feed back relationship in *Mystus vittatus* (Bloch)

(Old programme will continue)

Problem : CFCSP 13 Composite fish culture for demonstration to the fish farmers

(Old programme will continue)

Problem : CFCSP 14 Techno-economic and socio-economic aspects of massive fish seed production for composite fish culture

(Old programme will continue)

Problem : CFCSP 15 Statistical evaluation of some growth parameters and their confidence intervals

(Old programme will continue)

Problem : CFCSP 16 Evaluation of fish production and loss due to poaching from cultivated resources

(Old programme will continue)

Problem : CFCSP 17 A test on the equal catchability of tagged and non-tagged animals in mark recapture studies

(Old programme will continue)

Problem : CFCSP 18 Fish nutrition I. protein, carbohydrate and vitamin requirements of certain Indian major carps in relation to temperature

(The quantitative and qualitative requirements of important nutrients such as protein, carbohydrates and vitamin will be determined to formulate suitable artificial feed for optimum growth of fish in culture fishery operation)

Problem : CFCSP 19 Use of some cactii as piscicide

(Different species of Cactii will be evaluated to know how far these readily available indigenous plants can be used as fish poison to reduce the cost of pond management avoiding all unwanted problems arising from the use of conventional poisons like, mahua oil cake, endrine etc.)

Project ABF : All India Co-ordinated Research Project on Air-breathing Fish Culture

Problem : ABF 1 Propagation and stocking of air-breathing fishes for culture

(Old programme will continue)

Problem : ABF 2 Nutrient balance of the soil and water in a weed infested swamp

(Old programme will continue)

Problem : ABF 3 Food conversion among air-breathing fishes

(Old programme will continue)

Problem : ABF 4 Digestive physiology of air-breathing fishes with particular reference to enzymes

(Old programme will continue)

Problem : ABF 5 Culture of air-breathing fishes in derelict waters

(Old programme will continue)

Problem : ABF 7 Nutritional and biochemical studies of air-breathing catfish, *Clarias batrachus* (Linn.)

(Old programme will continue)

Problem : ABF 8 Biochemical, nutritional and toxicological investigations on the culture prospect of air-breathing catfish, *Clarias* and *Heteropneustes* in partially saline water

(To utilise partially saline derelict swampy ponds available in the coastal region, studies will be taken up to culture magur and singhi instead of investing large amount for the reclaimation of such water bodies or utilising these swamps for carp culture. The effect of such ecosystem on the biochemical, nutritional and toxicological status of air-breathing fishes will be ascertained through preliminary trials in the laboratory)

Problem : ABF 9 Some aspects of the toxicity metabolism and detoxification of organophosphorus pesticides in fish

(Studies will be carried out on the toxic action of exogenous contaminants including pesticides and insecticides (coming alongwith drained water from agricultural fields) on swamp grown fishes and also on the mechanism resposible for detoxification of those contaminants from those fishes)

Problem : ABF 10 Studies on the effect of photoperiod and temperature on the gonadal maturity of *Clarias batrachus* (Linn.)

(To establish specific daily light period and optimum temperature for gonadial maturation, a detail investigation will be carried out on *Clarias* to facilitate breeding and production of spawn at the very on set of monsoon and draw the maximum advantage of the early season)

Problem : ABF 11 Economic potential of air-breathing fish culture and plans for its development in certain pockets of West Bengal

(A 10 ha swampy area in West Bengal

for culture of air-breathing fishes will be identified, layout plans and unit economics will be drawn and the benefit cost ratio of an air-breathing fish culture project in that area will be worked out)

Problem : ABF 12 Biochemical investigations on blood and tissues of air-breathing catfish, *Clarias* and *Heteropneustes* in fresh and partially saline water under different stress conditions on nutrition and toxicity

(The changes in the biochemical parameters of blood and body tissue will be recorded in relation to nutritional and toxic stress, so that by imporving the ecosystem in appropriate direction, the growth, reproductive capability and the health of air-breathing fishes can be maintained in swamps)

Project R : All India Co-ordinated Research Project on Reservior Fisheries

Problem : R 1 Ecology and fisheries of freshwater reservoir

(Old programme will continue)

Project CIFRI/IDRC/WB : Rural Aquaculture in India

Problem : CIFRI/IDRC/WB 1 Composite culture of carps and certain air-breathing fishes

(Old programme will continue)

Problem : CIFRI/IDRC/WB 2 Chemical and biological characteristics of ponds under semi-intensive fish culture

(Old programme will continue)

Problem : CIFRI/IDRC/WB 3 Effect of different diets on the

digestibility and growth of grass carp, *Ctenopharyngodon idella*
(Old programme will continue)

Problem : CIFRI/IDRC/WB 4 Feed-inputs fish-yield relationship for freshwater fish culture operations
(Old programme will continue)

Problem : CIFRI/IDRC/WB 5 Fish diseases in semi-intensive fish culture and their remidial measures
(Old programme will continue)

3. Publication

The following publications were broughtout by the Institute during the year 1976 :

Anon 1976
First 188 case studies of composite fish culture in India. *Bull. cent. Inland Fish. Res. Inst. Barrackpore*, No. 23 (*Mimeo.*)

Banerjee, S. C. and R. K. Banerjee 1975
Soil water behaviour in ponds in brackishwater zone. *J. Inland Fish. Soc. India.*, 7 : 239-241

Barrackpore, Central Inland Fisheries Research Institute 1975
Annual Report, 1975 : 190 p.

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Half-yearly Technical Progress Report, January-June, 1975 : 59p (*Mimeo.*)

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Chakrabarty, R. D. and S. L. Kar 1975
Preliminary observations on the utility of petroleum protein as feed for carp spawn and fry. *J. Inland Fish. Soc. India*, **7** : 116-119

Chaudhuri, H. 1975
Experiments on the effects of organochlor insecticides Aldrin, Dieldrin and Endrin on fish and other pond organisms. *Ibid*, **7** : 189-203

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Macher falan barate. (in Bengali)
Dhanadhanya, **7** (11) : 13-14 & 18

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Use of hormones in induced spawning of carps. *J. Fish. Res. Bd Canada*, **33** (4, pt. 2) : 940-947

Chaudhuri, H. and K. Janaki Ram 1975
Control of aquatic weed by moth larvae. *Nature*, **253** (5486) : 40-41

Chaudhuri, H., R. D. Chakrabarty, P. R. Sen, N. G. S. Rao and S. Jena 1975
A new high in fish production in India with record yields by composite fish culture in freshwater ponds. *Aquaculture*, **6** (4) : 343-355

Das, C. R., P. L. N. Rao, S. N. Mohanty and V. Panigrahi 1975
A note on some interesting observations on the breeding behaviour of *Rana hexadactyla* Lesson in captivity. *J. Inland Fish. Soc. India*, **7** : 120-122

Das, P., D. Kumar and M. K. Guha Roy 1975
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De, Anjali *Comp.* 1976
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A note on the analysis of size frequencies of *Setipinna taty* (Valenciennes) of the lower Sunderbans region (Hooghly-Matlah estuary). *Indian J. Fish.*, **21** (1) : 285-289

De, D. K. and M. Subrahmanyam 1975
Transport of bagda *Penaeus monodon* Fabricius seed under oxygen packing. *Sci. & Cult.* 41 (12) : 588-589

Dehadrai, P. V. and S. D. Tripathi 1975
Environment and ecology of freshwater air-breathing teleosts. (*In* Respiration of amphibious vertebrates, ed. by G. M. Hughes. London, Academic Press Inc., 1976 : 39-72

Ghosh, A. N., M. K. Mukhopadhyay and G. N. Chatterjee 1975
Supplementary feeding as a tool for enhanced production in mullet culture, *Mugil parsia* (Ham.). *J. Inland Fish. Soc. India*, 7 : 209-211

Ghosh, B. B., P. Ray, D. D. Halder and M. M. Bagchi 1976
Some observations on the pollution of the Hooghly estuary in the vicinity of a rayon industry with a note on the toxicity of the effluent. *ACMRR/IABO Expert Consultation on Bioassays with Aquatic Organisms in Relation to Pollution Problems, Dubrovnik, Yugoslavia, 16-19 November, 1976.* (FI : ACMRR/DE/7 18 October 1976).

Ghosh, S. R. 1975
Preliminary observation on the effect of cobalt on survival and growth of *Mugil parsia*. *Bamidgeh*, 27 (4) : 110-111

Gopalakrishnan, V., K. K. Bhanot, S. N. Datta and S. B. Saha 1975
Procurement of stocking material for brackishwater fish culture from the Hooghly-Matlah estuarine system. *J. Inland Fish. Soc. India*, 7 : 216-224

Govind, B. V. and K. V. Rajagopal 1975
Occurrence of a giant Mystus species in Krishna river system, S. India. *Matsya* No. 1 : 79-80

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Some aspects of brackishwater aquaculture in India,
Bull. Dep. Mar. Sci., 7 (1) : 25-29

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Tagging of the mullet *Liza troschelii* (Bleeker) in the Chilka Lake. *Dr. B. S. Chauhan Commemoration Volume* : 325-333

_____1976
Systems of polyculture of fishes in the inland waters of India. *J. Fish. Res. Bd Canada*, 33 (4, pt. 2) : 905-910

Karamchandani, S. J. and M. D. Pisolkar 1976
On the location of spawing grounds of Indian shad, *Hilsa ilisha* (Hamilton) in Tapti river. *Sci. & Cult.*, 42 (1) : 563-564

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Limnology and productivity of Govindgarh Lake, Rewa, Madhya Pradesh. *Ibid*, 7 : 16-24

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Mitra, Eva, A. C. Banerjee and M. K. Banerjee 1972
Control of weeds by copper sulphate treatment in a sewage fed fish pond and post-treatment observations. *Ibid*, 14 (2-4) : 91-102

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Fish fauna of Sarda sagar reservoir in Pilibhit (U.P.) and some recommendations for development of reservoir fisheries. *Indian J. Fish.*, 21 (1) : 107-119

Natarajan, A. V., M. Ramakrishnaiah and M. A. Khan 1975
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An effective method of controlling tail and fin rot in Indian major carps. *Ibid*, 7 : 98-100

Parameswaran, S., C. Selveraj and S. Radhakrishnan 1974
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Length weight relationship, condition factor and food study of *Labeo calbasu* (Hamilton) from Loni resevoir (M.P.). *J. Inland Fish. Soc. India*, 7 : 58-64

Philipose, M. T., A. C. Nandy, D. P. Chakraborty and K. V. Ramakrishna 1976
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Internal rhythm of sexual cycle in a carp *Cirrhina reba* (Ham.) under artificial conditions of darkness. *J. Inland Fish. Soc. India*, 7 : 182-188

4. Extension

The Extension Section of the Institute continued to provide its services to the public, specially to the fish farmers and to the State Government Agencies.

Results of immediate practical application : Publicity brochure on Central Inland Fisheries Research Institute and a broad based illustrative pamphlet on

"Glass Jar Hatchery" designed and developed at this Institute were brought out during the year and were distributed to various State Fisheries Departments, Agricultural Universities, Central Government Organisations, Ministry of Agriculture and Irrigation and the interested fish farmers and other private organisations. The pamphlets on "Intensive fish farming" and "Technique of pituitary gland removal and ampouling" were reprinted during the year to cater to the growing demand for the same in the country.

Fish breeding techniques were successfully demonstrated in a private fish culturists' farm at Marshaghai, Orissa by the Scientists of the Cuttack Research Centre, Cuttack.

Weed control techniques were also demonstrated in three private ponds and in several fish ponds in the O.M.P. Campus in Cuttack on an experimental basis. The encouraging increase in fish yield through weed control/recycling was very much appreciated by the pond owners.

The possibility of controlling thick water-hyacinth (*Eichhornia* sp.) infestation in the Kulia Bheel of the West Bengal Fisheries Department by adopting the standard field technique of using 2,4-D sodium salt was demonstrated to the State officials in demonstration plots in the area.

An effective, economical and comparatively harmless method of step down, long-term control of soil rooted submerged aquatic weeds has been successfully tested against a number of weeds ; *viz.*, Lilies, *Nelumbo* sp., *Limnanthenum* sp., *Ottelia* sp., *Vallisneria* sp., *Hydrilla* sp., *Najas* sp., *Potamogeton* sp. and *Ipomoea* sp. Dry brick pellets soaked in aqueous solution of 2,4-D sodium salt formulation when broadcast judiciously amongst clusters of weed infestations in ponds have a prolonged effect because of the slow-release of the herbicide. Clearance of chronic infestations of *Nelumbo* sp., *Nymphoides* sp., *Ottelia* sp., etc. in perennial ponds has been achieved when 2 to 4 instalments of 2,4-D @ 10 kg/ha in each instalment have been applied in the above stated manner.

Demonstration programme : The Demonstration Centre at Nilgunj in the district of 24-Parganas, West Bengal was established for demonstrating the practicability of fish culture as a sound proposition. The pond at Nilgunj was stocked with the three Indian major carps *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* @ 7,500 fingerlings/ha in October 1974 and was finally harvested during February 1976 after 15½ months of culture. The gross and net productions obtained were 5,564 and 5,154 kg/ha/15½ months respectively. The cost of production of fish was Rs. 2.59/kg.

The pond was restocked in May 1976 with 7,500 fingerlings/ha in the ratio of *C. catla* 3 : *L. rohita* 3 : *C. mrigala* 2 : *Cyprinus carpio* var. *communis* 2 for demonstrating four species culture. Sample netting conducted on November 8, 1976 indicated the average weights attained by different species as catla 569 g, rohu 555 g, mrigal 663 g and common carp 310 g against initial weights of 92.3, 26.4, 26.4, and 33.0 g respectively. Several demonstrations on various aspects of pond preparation and management of fish culture techniques were arranged for the fish farmers at this centre (Photograph-7).

Publicity activities : The Saturday edition of the "Amrita Bazar Patrika" dated January 31, 1976 highlighted the presentation of awards to farm scientists by Shri Jagjivan Ram, the then Union Minister for Agriculture and Irrigation for their outstanding contributions in the field of agriculture, animal husbandry and fisheries. Dr. V. G. Jhingran, Director, CIFRI, Dr. H. Chaudhuri, Senior Fishery Scientist and Dr. V. R. P. Sinha, Senior Fishery Scientist were the joint winners of the Rafi Ahmed Kidwai Memorial Prize for the biennium 1972-73.

News about the research achievements of the Institute was flashed in "Satyaprakash", a Bengali weekly during February 1976.

The "Amrita Bazar Patrika" dated March 10, 1976 carried the news item on the first convocation of the Bidhan Chandra Krishi Vishwavidyalaya. Dr. M.S. Swaminathan, Director-General, ICAR, delivering the convocation address announced that the country was on the threshold of a major advance in inland and coastal fish culture. While commending the achievements of the Central Inland Fisheries, in his address Dr. Swaminathan mentioned about the development of the "Glass Jar Hatchery" in which about 50,000 fish eggs can be incubated with almost cent percent survival and the great strides that have been made by this Institute during the last few decades in producing table sized fish from stock ponds using composite fish culture technology. Strenuous efforts of the Institute in producing about nine thousand tonnes of fish per hectare from sewage enriched fish ponds opening up the way for converting the waste into wealth and the techniques of controlled culture of air-breathing fishes in derelict swampy waters were also mentioned by Dr. Swaminathan in his convocation address.

The Bengali daily, "Jugantar" and English dailies "Amrita Bazar Patrika" & "The Statesman" gave the news between May 26 and June 2,

Photograph 7—Shri P. Das, Scientist Extension, seen in discourse with fish farmers at Nilgunj Demonstration Centre

976 that the documentary film "Induced Breeding" produced by Films)ivision, Government of India in collaboration with this Institute won the rst prize under the instructional category of films at the International estival of Films on Aquaculture, organised by the FAO of the United Nations ı conjunction with the FAO Technical Conference on Aquaculture held in Kyoto, apan during May 29 to June 2, 1976.

"Basumati" a Bengali weekly gave an extensive coverage of the techno-)gy of air-breathing fish culture developed at this Institute in its issue of July 0 & 27, 1976.

The "Hindusthan Standard" dated February 8, 1976 carried an article on ıe noteworthy contributions of the Cuttack Research Centre of the CIFRI)wards the improvement of the civic life of the city. In a letter to the State lovernment, the Research Centre has enumerated its contributions towards the evelopment of environment of Cuttack and also making the city an internation- ! centre for training in aquaculture. The centre has trained several batches f trainees not only from within the country but also from Africa and South- ast Asian countries besides Nepal, Bangladesh and Sri Lanka.

The centre is also operating collaborative projects with the International)evelopment Research Centre (IDRC) of Canada for the development of aquacul- ure in the rural areas of Orissa.

Stressing upon the contributions of the Centre in improving the physical onditions of Cuttack, the article mentioned about its substantial role played a the clearance of extensive areas over grown with "amari" (*Ipomoea carnea*) . common variety of weed. The municipal officials appreciated the advantages)f the method demonstrated by the Weed Control Section of the Centre as hat could clear most of the areas in the city and the suburbs.

This Research Centre is the only place in the country where the grass carp, an exotic fish which avidly feeds on submerged weeds, is produced)n a large scale and distributed all over the country and abroad. The Research Centre's technical assistance has been sought by many pond owners n Cuttack to clear their weed choked ponds, keep them clear and grow fish)n a commercial scale.

The contributions of the Central Inland Fisheries Research Institute owards the development of the fishery as an industry in the country were ighly praised by Shri S.G. Pawar, Maharashtra's Minister for Agriculture when he visited the Institute on August 22, 1976. He was accompanied by

Shri Tarun Kanti Ghosh, Home Minister, Government of West Bengal. The news about the visit of the ministers appeared in the "Amrita Bazar Patrika" dated August 23, 1976.

A consignment of silver carp, grass carp and common carp fry was sent by air on September 2, 1976 to Mauritius by the Central Inland Fisheries Research Institute.

The "Fish Farming International" in its December 1976 issue in an article entitled "India on the brink of polyculture revolution" covered the achievements of the CIFRI which have the potentials of bringing about fish revolution in the country.

"The Indian Nation" dated October 5, 1976 in an article "Pisciculture" expressed that Bihar has made a break through in the production of fishes, like magur and koi from swampy and derelict ponds. It mentioned that the State Fisheries Department in collaboration with the All India Co-ordinated Research Project on "Propagation and Stocking of Seed of Air-breathing Fishes for Culture in Swamps", of the CIFRI has been able to produce 30 quintals of air-breathing fish per hectare of water area in one year. Being encouraged by this success the department proposed to popularise these varieties by distributing inputs, like seed, feed and fertilizer free of cost to the fish farmers in the State.

Under the caption "Fish for festive occasion", the Staff Reporter of the "Amrita Bazar Patrika" dated December 14, 1976 asserted that a highly assuring picture for scientific fish cultivation in West Bengal has been given by the Central Inland Fisheries Research Institute headed by Dr. V. G. Jhingran who has announced that high yields ranging from 3,000 to 9,000 kg/ha/yr in place of an Indian average of 600 kg/ha/yr have been achieved experimentally by application of a scientific technique perfected by the Institute. To do away with the doubts expressed in some quarters as to whether such high yields could be available from water bodies measuring more than one acre and such ventures would be economically viable, the Institute in collaboration with the Department of Fisheries, Government of West Bengal had adopted composite fish culture under Operational Research Project in three large sized ponds at Anjana Fish Farm of Krishnanagar in Nadia District. In this venture from three experimental ponds, a total of 20,232 kg of fish ranging from 2,654—4,290 kg/ha/yr was produced during 1973-74 as against the previous record of 462 kg/ha/yr. A sum of Rs.

59,570.00 was invested to produce 20,232 kg of fish and the cost of production being Rs. 2.94 per kg. It was concluded that what has been shown at Krishnanagar can be easily applied to other water areas of West Bengal by the Government and if this is done it will greatly reduce scarcity of fish in the State. The news about the foundation stone laying of the Freshwater Aquaculture Research and Training Centre at Dhauli by the Prime Minister on January 3, 1977 appeared in the "Amrita Bazar Patrika" of December 14, 1976.

The Institute participated in exhibitions organised in the State of West Bengal on different occasions during the year to exhibit posters depicting important research achievements of the Institute, working model of the "glass jar hatchery", clay models of various types of fishes, aquaria with live fishes, and transparency boxes, etc. The exhibitions in which the Institute participated are listed below :

(i) Krishimela organised by Bidhan Chandra Krishi Vishwavidyalaya, Kalyani from February 26 to 29, 1976 (in collaboration with the Department of Fisheries, Government of West Bengal)

(ii) All India Small Scale Industries Exhibition at Calcutta Maidan from March 1 to 20, 1976 (in collaboration with the Depatment of Fisheries, Government of West Bengal)

(iii) Agriculture on March Exhibition at Calcutta during July 23 to 27, 1976 (in collaboration with the Directorate of Extension, Government of India)

(iv) At Jawaharnagar (Gauhati) exhibition organised at the time of All India Congress Session from November 20 to December 12, 1976 (in collaboration with the Department of Fisheries, Government of Assam)

Posters depicting the work and achievements of the Institute were displayed and explained to the visiting Indian and foreign dignitories (Photograph 8 and 9). Poster exhibitions were also arranged for the Fish Farmers' Development Agency Officials, Fishery Operatives of West Bengal and Orissa ; Summer Institute participants during their training at the Institute ; trainees from the Institute of Hygiene and Public Health, Calcutta ; Fisheries Extension Training Centre, Kalyani ; Gram Sevak Training Centre, Narendrapur, West Bengal ; Civil Service Executive Orientation & Study Centre, Government of West Bengal, Kalyani ; Central Institute of Fisheries Education, Bombay and for the students from Cotton College, Gauhati ; Fisheries College, Bangalore ; Science College, Ujjain and Motilal Vigyan Mahavidyalaya, Bhopal.

Visits by students : Post-graduate students of zoology from Cotton College, Gauhati ; Bangalore University and Science College, Ujjain ; and the B. Sc. students of Motilal Vigyan Mahavidyalaya, Bhopal visited the Institute during

Photograph 8—Dr. V. G. Jhingran, Director, CIFRI, explaining a poster to Shri Shah Nawaz Khan, the then Minister of State for Agriculture and Irrigation, Govt. of India

Photograph 9—A team of foreign scientists being apprised of the achievements of the Institute by Dr. Jhingran through posters

the year. Lectures on different aspects of inland fisheries coupled with field demonstrations were arranged for them. The visiting students were acquainted with the working and the achievements of the Institute. Field trips to Composite Fish Culture Subcentre at Kulia ; Sewage-fed Fisheries Farm, Khardah ; Brackish-water Fish Farm, Kakdwip and the Operational Research Centre, Krishnanagar were arranged for the trainees of the Extension Training Centre, Hyderabad and Central Institute of Fisheries Education, Bombay.

Miscellaneous activities : The Extension Section of the Institute has taken up last year, composite fish culture work at Sarpadihi (West Bengal) under the Integrated Rural Development Scheme under Operational Research Programme of the ICAR. Three more fish farmers' ponds in Gosaba, Sunderbans were taken under the ambit of this programme during the year. The gross and net productions obtained at Sarpadihi were 2,681 and 2,563 kg/ha/yr. It was noteworthy that the pond was manured initially only and very little of supplementary feeding was done by the farmer in view of his financial limitations. Stocking of ponds at Gosaba @ 7,500 fingerlings/ha was done in July 1976. The experiment is in progress.

Technical advice on various aspects of composite fish culture, methods of common carp breeding, induced breeding techniques for major carps, nursery pond management technique, air-breathing fish culture and control measures for fish diseases and weeds in fishery ponds, etc. were rendered to 113 fish farmers possessing 234 ponds who called at this Institute with their problems. Another 57 fish farmers were rendered technical advice through correspondence. Forty-seven institutions and Government Departments were also advised on technical matters relating to fish culture practices. The extension pamphlet on "Glass Jar Hatchery" and the set of lectures presented during Fish Farmers' Development Agency Officials Training and Brackishwater Fishery Operatives Training were sent to various State Fisheries Departments, Agricultural Universities, ICAR and other interested organisations.

The officers and the staff of the Barrackpore Extension Section visited fish ponds of Apsara Agricultural Farm, Falta ; Gramophone Company of India, Dum Dum ; Nabadarsha Co-operative Society, Birati and Police Training Centre, Barrackpore ; and rendered technical help & advice to the concerned authorities of these farms with regard to input requirements, etc.

The Scientists and the staff of the Cuttack Research Centre actively participated in the Operational Research and Rural Aquaculture Projects

(IDRC) by providing fish seed, participating in village level deliberations, demonstrations and exhibitions. The Scientists also explained the techniques of fish culture to the participants of "Krishi Mela" organised by Central Rice Research Institute, Cuttack. The Officers of the Orissa University of Agriculture were also given technical assistance in the selection of suitable ponds for fry raising in their Operational Research Project Programme.

The Barrackpore Extension, Section also distributed free of charge 1,500 silver carp fry from the Cuttack Research Centre and 3,000 silver carp fry produced as a result of bundh breeding experiment conducted at Simlapal, Bankura district, West Bengal to enterprising farmers and co-operative societies, etc, as an incentive to popularise composite fish culture in villages.

The Scientist Extension, on behalf of the Director, attended the Advisory Committee Meeting of the Operational Research Project, held on June 4, 1976 and a meeting of Operational Research Project Implementation Committee held on June 8, 1976 at Jute Agricultural Research Institute, Nilgunj, West Bengal.

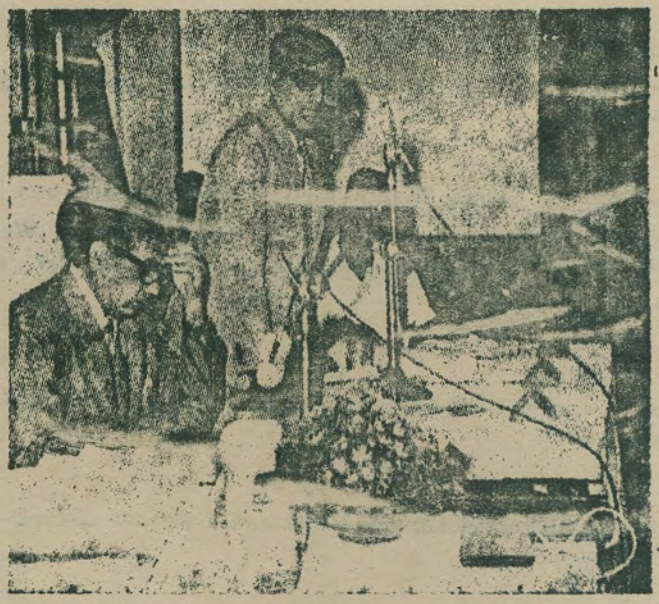
5. Conferences and Symposia

A 10-day training course in "Composite Fish Culture and Fish Seed Production" was organised for the officials of Fish Farmars' Development Agency during April 1 to 10, 1976 at the Institute.

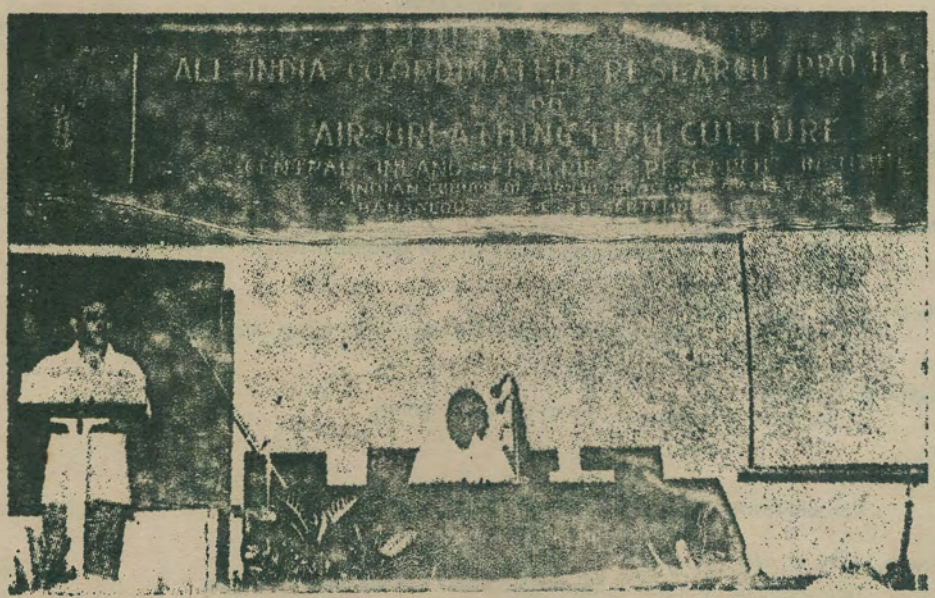
A 8-day training in "Brackish Water Prawn and Fish Culture" was organised jointly by the Institute and the Marine Products Export Development Authority for the Fishery Operatives of West Bengal and Orissa from June, 21 to 28, 1976 at the Kakdwip Farm of the Institute.

The 3rd workshop of the All India Co-ordinated Research Project on "Composite Fish Culture and Fish Seed Production" was held at the Pune Subcentre on February, 26 & 27, 1976 (Photograph 10).

A Summer Institute on "Fish Seed Production and Mobilisation for Inland Aquaculture" sponsored by the ICAR was held at CIFRI, Barrackpore during June 14 to 30, 1976 and at Cuttack during July 1 to 13, 1976 (Photograph 11).



Photograph 10—Dr. V. R. P. Sinha, Scientist S-3 (Project Co-ordinator), addressing the opening session of the 3rd Workshop of the All India Co-ordinated Research Project on "Composite Fish Culture and Fish Seed Production" held at Pune Subcentre



Photograph 11—Dr. P. V. Dehadrai, Scientist S-3 (Project Co-ordinator), presenting the report of All India Co-ordinated Research Project on "Air-breathing Fish Culture in Swamps" during the 3rd Workshop of the Project held at Bangalore Subcentre

The third workshop of All India Co-ordinated Research Project on Air-breathing Fish Culture in Swamps was held at Bangalore during September 24 and 25, 1976.

A Symposium on Animal Wealth including aquaculture was held during the 63rd Session of the Indian Science Congress Association at Waltair during Junuary 3 to 7, 1976. Following papers by the Scientists of the Institute were presented :

Basu, N. C. and B. B. Pakrasi
On the occurrence of milk-fish, *Chanos chanos* (Forskal) larvae in the Bakkhali region of lower Sunderbans

Bhowmick, R. M. *et. al.*
Large scale production of seed of catla (*Catla catla* Ham.) the quickest growing major carp by hypophysation

Chaudhuri, H. *et. al.*
Development of high fish yielding technology through aquaculture in India

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Increased production through scientific pisciculture in a farmer's ponds

Das, C. R. *et. al.*
On the rearing of tadpole of *Rana tigrina* Daud

Das, P. *et. al.*
Field demonstration for fish farmers in composite fish culture

Dehadrai, P. V. *et. al.*
Culture of Air-breathing catfishes in derelict waters

Ghosh, A. N.
Utilisation of saline swamps and mud flats for reconstruction of rural economy

Ghosh, A. N. and H. C. Karmakar
Machanism for auto-feeding as a tool for carnivore, *Lates calcarifer* (Bloch)

Ghosh, A. N. *et. al.*
Culture of *Chanos chanos* in brackishwater ponds

Ghosh, A. N. *et. al.*
Penacid prawn culture in brackishwater ponds

Ghosh, A. N. *et. al.*
Improvement of mullet culture techniques in brackishwater ponds.

Ghosh, K. K.
Choise of efficient spawn gear for riverine spawn collection

Gupta, M. Vijaya *et. al.*
Experiments on composite fish culture at Kalyani, Nadia, West Bengal

Khan, H. A. *et al.*
Composite fish culture in Gujartal Fish Farm, Jaunpur. Uttar Pradesh

Lakshmanan, M. A. V. *et. al.*
Growth potential of carp during second year of rearing in intensive carp culture

Mathew, P. M. *et. al.*
Composite fish culture in Hadapsar Farms, Poona (Maharashtra)

Murty, D. S. *et. al.*
Studies on increased fish production through nitrogenous fertilization and supplementary feeding

Murugeson, V. K. and P. V. Dehadrai
Murrel culture in derelict waters

Pakrasi, B. B.
Fish seed resources of brackishwaters along eastern coast of India

Pal, R. N. *et. al.*
Culture of air-breathing fishes in cages installed in swamps

Ramachandran, V. *et. al.*
Control of noxious algal blooms in aquaculture ponds

Sharma, B. K. *et. al.*
Experiments on composite fish culture at Krishnanagar, Nadia West Bengal

Sinha, V.R.P.
The status and strategy of development of composite fish culture in India

Sukumaran, K. K. *et. al.*
Composite fish culture in Government Fish Seed Farm, Karnal, Haryana

Tripathy, N. K.
Experiments on hypophysation of Indian major carps at Kausalyaganga Fish Farm in Orissa

Tripathi, S. D. *et. al.*
Rural development through aquaculture under the IDRC project in West Bengal

An FAO Technical Conference on Aquaculture was held in Kyoto, Japan

during May 26 to June 2, 1976. Undermentioned papers by the Scientists of the Institute were presented at the conference.

Chakraborty, R. D. *et. al.*
Intensive culture of Indian major carps

Chaudhuri, H. and S. D. Tripathi
Problems of seed production and distribution in fish culture

Ghosh, S. R.
A study of the relative efficiency of organic manure and inorganic fertilizer and the effect of salinity in plankton production

Jhingran, V. G. and A. V. Natarajan
Improvement of fishery resources in inland waters through stocking

Sen, P. R. and D. K. Chatterjee
Enhancing production of carp fry and fingerlings by use of growth promoting substances

Sinha, V.R.P.
New trends in fish farm management

At the Symposium on the Development and Utilization on Inland Fishery Resources held at the 17th Session of the IPFC in Colombo, Sri Lanka during October 27 to 29,1976, undermentioned papers by the Scientists of the Institute were presented.

Gopalakrishnan, V. and A. Ghosh
The mullet resources of the Hooghly-Matlah estuarine system in West Bengal, India — case study

Jhingran, V. G. and S. D. Tripathi
National perspective of inland fisheries of India

Natarajan, A. V.
Ecology and the state of fishery development in some of the man-made reservoirs in India.

Pakrasi, B. B. and K. K. Ghosh
The status of Hooghly-Matlah estuarine fisheries in West Bengal, India

Ranadhir, M.
Economics of culture fisheries operations in India

Sinha, V. R. P.
Economic evaluation of composite fish culture in different parts of India

A Symposium on Warm Water Zooplankton was held during October 14 to), 1976 at the National Institute of Oceanography, Dona Paula, Goa. Following apers by the Scientists of the Institute were presented.

ithew, P. M.
Studies on the zooplankton of a tropical lake

ndy, A. C. *et. al.*
Technique to obtain sustained culture of a cladoceran, *Daphnia lumholtzi* Sars

ndy, A. C. *et al.*
Experiments on the mass culture of *Brachionus mulleri* Pallas in glass aquaria

sadam, R. D.
Seasonal fluctuations in the zooplankton populations of tropical freshwater impoundments

gal, K. L.
Studies on the Indian freshwater Copepoda. III On the species of calanoids occurring in freshwater fish culture ponds of the Peninsular India along with keys for their indentification

gal, K. L.
Studies on Indian freshwater Copepoda. IV Food for *Heliodiaptomus viduus* (Gurney) and *Mesocyclops leuckartii* (Claus) in warm water fish culture ponds at Cuttack, Orissa

gal, K. L.
Studies on Indian freshwater Copepoda. V. Observation on the utilization of *Heliodiaptmus leuckartii* (Claus) as food by fry of *Catla catla* (Hamilton) and *Labeo rohita* Ham

varaj, C. and P. L. N. Rao
On the predatory behaviour of the freshwater cyclops, *Mesocyclops leuckartii* (Claus)

The Seminar entitled "ACMRR/IABO Expert Consultation on Bioassays with quatic Organisms in Relation to Pollution Problems" was held during ovember 16 to 19, in Dubrovnik, Yugoslavia. Undermentioned two papers were esented.

osh, B. B. *et. al.*
Some observations on the pollution of the Hooghly estuary in the vicinity of a rayon industry with a note on the toxicity of the effluent

y, P. *et. al.*
Some ecological considerations of the Hooghly estuary polluted by domestic and industrial wastes under tropical environment

viduus (Gurney) and *Mesocyclops*

The IXth Annual Convention of the Indian Society of Agricultural Chemists was held at the University of Agricultural Sciences, Bangalore on November 27 and 28, 1976. A paper entitled "Retention of formaldehyde by Montomorillonite : Illite and Montomorillonite : Kaolinite in aqueous system in pressence of urea" by Krishna Chandra was presented at the above convention.

6. Summary

Project 1 :

1.1 Fry of catla, rohu and mrigal stocked in equal proportion @ 3 lakh/ha attained average weight ranging from 25.71—34.55 g in 4½ months.

Fingerlings of silver carp, grass carp and common carp (4 : 3 : 3) stocked @ 2.5 lakh/ha and reared for 3 months recorded average growth and survival of 98.03 mm/9.0 g & 98.50% in silver carp, 67.56 mm/4.0 g & 42.31% in grass carp and 55.96 mm/5.0 g & 14.92% in common carp. Gross production ranging from 7,196—7,699 kg/ha/16 months could be obtained from two ponds (0.5 and 0.4 ha) with Indian and exotic carps when stocked @ 10,000 fingerlings /ha. Besides periodical fertilisation, supplementary feeding with artificial feed and aquatic weeds was done. Fingerlings of catla, rohu and mrigal (4 : 3 : 3) stocked @ 6,000/ha in two fertilised ponds and provided with artificial feed gave a gross production of 3,700 kg/ha/yr with an average survival of 75%. The harvested catla and rohu were more than 800 g while mrigal was only 650 g.

In composite fish culture with six species (C 1 : R 2.5 : M 1.5 : Sc 2.5 : Gc 1.5 : Cc 1) stocked @ 6,000/ha in a 0.15 ha pond, only fertilisation but no supplementary feeding except providing weeds for grass carp was done. Similarly in another trial, carp fingerlings (C 1.2 : R 2.9 : M 1.8 : Sc 2.9 : Cc 1.2) were stocked @ 5,100/ha in 2 identical ponds (0.15 ha each) and manuring of pond was only done. Gross production and the survival rate in the former trial were 3,400 kg/ha/4½ months and 74% respectively while in the latter the productions were 1,930 and 2,400 kg/ha/6 months with aggregate survival ranging from 60.1 to 68.5%.

1.2 (Research work suspended since 1975)

1.3 & 1.4 (Research work completed in 1972)

1.5 (Research work completed in 1970)

1.6 (Research work completed in 1972)

1.7 (Research work completed in 1973)

1.8 (Research work completed in 1971)

1.9 to 1.11 (Research work completed in 1972)

1.12 (Research work completed in 1973)

1.13 (Research work completed in 1972)

1.14 (Research work suspended since 1975)

1.15 (Research work suspended since 1973)

1.16 (Research work completed in 1971)

1.17 (Research work suspended since 1975)

1.18 (Research work completed in 1975)

1.19 (Research work completed in 1973)

1.20 (Research work completed in 1974)

1.21 Catla spawn were stocked @ 25 lakh/ha and fed with artificial feed + cobalt chloride (0.01 mg/day/fish) yielded 12.5 lakhs of fry in two weeks time (av. size/wt. attained 22.2 - -24.1 mm/157.0—168.2 g).

1.22 (Research work completed in 1975)

1.23 (Research work completed in 1976)

1.24 In laboratory experiment, single and triple superphosphate were tried in slightly acidic soil (pH 6.3). The survival of rohu fry, raised in 20 days, was the maximum at the lowest dose (25 kg P_2O_5/ha) in both the trials. In a yard trial using identical soil, the best response was at 25 kg P_2O_5/ha when the phosphate levels in water were 0.28—0.15 ppm.

In a pond fertilised with urea + muriate of potash @ 250 kg N + 50 kg K_2O and cowdung @ 5,000 kg/ha/yr, fry of silver carp, catla, rohu, mrigal and common carp showed better growth. Total alkalinity, phosphate and dissolved oxygen levels were also recorded to be higher than in the control.

1.25 *Daphnia lumholtzi* Sars could be cultured with different feeds and culture media such as Brewer's yeast, freshly cultured *Chlorella vulgaris* and poultry droppings. The best result was obtained with 0.1% uniform suspension of dried Brewer's yeast.

The density of *Moina dubia* Rich could be raised from 10 to 10,000 u/l in 8 days when fed with the suspension of freshly cultured *Scenedesmus obliquus* @ 0.25 ml/individual/day.

Mass culture of *Navicula cryptocephala* (5,024 cells/ml), *N. rynocephala* (4,62 cells/ml) and *Pinnularia acrosphaeria* (22,616 cells/ml) were carried out in polythene bags and fertilised with urea, single superphosphate and sodium silicate which yielded 70,000, 75,000 and 12,00,000 cells/ml in 10 days respectively.

Chlorella vulgaris cells showed a growth of maximum 6.9 and minimum of 2.5 cell diameter on the 7th and 25th day of culture respectively.

1.26 In formulating fish feed for carp culture, six purified test diets of protein levels (0, 30, 40, 45, 50 and 60%) were tried with common carp fry. The optimum growth of fish was recorded with diet having 45% protein and 25% carbohydrate.

1.27 (Research work completed in 1976)

1.28 For better management and exploitation of carps in large water bodies stocked with six species @ 7,500/ha for 2 years, a changed fertilisation programme was tried in the 2nd year. Fishes of 1 kg and above were harvested periodically which raised the production to 7,157 and 4,270 kg respectively.

1.29 Amongst fish poisons of plant origin, the powder of tamarind seed husk at 8—10 ppm was found effective in killing *Tilapia* sp. and common carp fingerlings within 2 hours.

1.30 29,000 fry of rohu and mrigal raised from 2 ponds each in Jagannathpur and Kandapur were sold to the fish farmers at an income ranging from Rs. 112.50 to 588.00. Technical guidance was provided to the fish farmers of the area. 7 ponds were prepared and stocked with Indian and exotic carp @ 5,000/ha.

1.31 Anaesthetics ; *viz.*, alcohol and tertiary amyl alcohol, were tried at different concentrations on spawn and fry of catla, rohu and mrigal. With amyl alcohol the intensity of sedation was little at 0.025%, moderate at 0.05% and deep at 0.08% while with tertiary amyl alcohol at higher concentrations showed sedational effect of little at 0.08%, moderate at 0.1% and deep at 0.15%. At 0.2% of tertiary amyl alcohol the fishes loose equilibrium but regain balance after 24 hours.

1.32 "Controlled spawning" and "Natural spawning" methods for propagation of tendipedids larvae were tried in glass jars with organic manures Egg deposition and larval abundance was better with "controlled spawning" method.

1.33 Lipase was absent in the intestine and oesophagus of *Mystus gulio* (89-116 mm) but was present in the stomach. In *Channa striatus* (110-390 mm) lipase was detected from the stomach but was insignificant in the oesophagus. Invertase was found in appreciable quantities in the intestine of *C. striatus* but was absent in the buccal epithelium, oesophagus and stomach. In *Cirrhinus mrigala* (av. size 125 mm) lipase was found only in the liver and gall bladder.

1.34 Three ponds were selected for culture of *Tilapia mossambica* and air-breathing fishes in jute-retted waters at different grades ; *viz.*, control, thinly and thickly charged. The hydrological studies and ecological parameters indicated the possibility of culture of the above selected fish in such waters. In laboratory trials, fingerlings of *C. mrigala* (size 96-110 mm) when exposed to a medium treated with 10 and 15 ppm of acetic acid showed on mortality thus indicating that liberation of acetic acid during jute-retting has no apparent harmful effects on fish.

1.35 Scale carp fry (av. wt 0.8 g) when stocked with CR 1014 variety of paddy @ 7,250/ha gained about 100 g in 120 days.

1.36 The effects of conventional toxicants, like endrin, mahua oilcake, *Barringtonia* sp., etc. on molluscan species were studied.

1.37 For estimating fish production in culture ponds, stratified random

sampling was taken up due to heterogeneity of stock. The effect of temperature and time on the growth of cultivable indigenous and exotic carps was studied.

1.38 *Anabaena roxburghii*, a bloom forming algae, can fix 14.48 mg of nitrogen/l of culture containing a population of 2.8×10^4 filaments.

1.39 Different liming materials were tried at the rate of 250, 500 and 1,000 kg/ha in laboratory trials, using slightly acid soil with low nutrient level. Calcium carbonate at higher rate showed the maximum increase in water pH (7.6) and total alkalinity (116.7 ppm). Phosphate concentration increased to the maximum (0.09 ppm) with slaked lime while nitrogen concentration was not appreciable with any of the treatments.

1.40 Effects of cowdung and mustard oilcake at 300, 600 and 1,200 kg carbon/ha were studied in slightly acidic soil. Higher concentration of phosphate in water phase was observed after 15 days of manuring with cow dung while mustard oilcake maintained more of nitrogen and total alkalinity. The former gave the maximum survival of rohu fry at 1,200 kg C/ha (70%, 23.8 mg) and latter at 600 kg C/ha (70%, 9.04 mg). Yard trials also confirmed the findings.

Project 2 :

2.1 (Research work completed in 1970)

2.2 (Research work completed in 1976)

2.3 (Research work completed in 1972)

2.4 22.5 lakhs of spawn were produced from eleven experiments with major Indian carps and two experiments with grass carp in the hatchery complex. The indoor hatchery showed better hatching of eggs and survival of spawn than in cloth *hapas* fixed in the ponds. Common carp eggs were also degummed and hatched successfully in the indoor hatchery.

2.5 (Research work suspended since 1973)

2.6 Due to failure of monsoon, the spent fish, stocked after the first hypophysation, failed to mature for the second time.

2.7 & 2.8 (Research work kept in abeyance).

2.9 Intra ovarian eggs in *C. mrigala* start developing from February onwards. In stage I, the eggs are transparent measuring 0.176—0.224 mm. At stage V, they become spherical, semi-transparent and have a clear margin, measuring 0.8—0.96 mm by the end of May. The highly distended ovaries fully occupy the body cavity.

Project 3 :

3.1 to 3.5 (Research work completed in 1972)

3.6 (Research work suspended in 1976)

3.7 (Research work completed in 1970)

3.8 1,200 fry of *Chanos chanos* were collected from the west coast near Kody and stocked in Hessaraghatta Fish Farm. In three months, they attained an average size of 81.8 mm/5.92 g.

3.9 (Research work completed in 1976)

3.10 & 3.11 (Research work suspended since 1973)

3.12 (Research work completed in 1976)

3.13 Composite culture with three Indian major carps and exotic carps at ASC Centre tank (1.5 ha), Bangalore yielded 2,278.76 kg of fish in 10½ months. The average weights attained by the species were : catla —1,388.89 g, common carp—1,305.35 g, silver carp—1,000.00 g and grass carp—842.30 g. Fish harvested from Bilavardhahalli (1.5 ha) yielded 129.1 kg of fish in about a year. In both the tanks, zooplankton significantly dominated over phytoplankton.

3.14 After a preliminary survey of eight reservoirs in Allahabad and Mirzapur districts, Gulariya reservoir was selected to study the ecology and fishery development work. Observations were made on the hydrological parameters, plankton and bottom biota of the reservoir.

Project 4 :

4.1 & 4.2 (Work is being done under a Co-ordinated Research Proje

4.3 (Research work suspended since 1972)

4.4 (Research work completed in 1973)

4.5 At Mahewapatti, though no spawn was available in July, a tot of 2,134 ml of spawn was subsequently collected by using 5 shooting ne Microscopical study of these showed 5.7—53.2% of desirable quality of spaw Among nursery reared, the percentage of major carps spawn was 64.9. At Bharat centre 360 ml of spawn was collected which constituted 77.6% of major ca spawn.

Unfavourable condition of floods in the river Ganga and the constructic work of a road bridge at 2 km up-stream of Bharauli centre appear to ha adversely affected the spawn availability.

Project 5 :

5.1 (Research work completed in 1975)

5.2 (Research work completed in 1973)

5.3 (Work programme transferred to Brackishwater Experimental Fi Farm Unit, Kakdwip)

5.4 to 5.6 (Research work completed in 1972)

5.7 (Research work completed in 1973)

5.8 (Research work completed in 1975)

5.9 (Research work completed in 1973)

5.10 (Research work completed in 1975)

5.11 (Research work completed in 1974)

5.12 An open type *sal* wood sluice box with two compartmen was installed at Brackishwater Fish Farm, Kakdwip to control the silt. T keep the sluice box stable, the floor planks were extended transversely & vertical with beams. Shutter gates were arranged to take the surface layer of t

tide water as per requirements. Silt concentration in the tide water was prevented from flowing through sluices by dropping the shutters. Silt load from the canal at a depth of 8 cm was flushed successfully by churnning the canal bed and letting out the same through a narrow submerged opening at the sluice.

5.13 to 5.16 (Research work completed in 1975)

5.17 In an experiment at Adyar, fry of *P. indicus* (23.8 mm) and *P. monodon* (23.0 mm) attained 72.8 and 97.9 mm size respectively in three months. The experiment had to be terminated due to scarcity of water and 432 g of prawns could be harvested.

5.18 Oysters culture conducted in trays and asbestos sheets registered a growth range of 50-105 mm in shell height. Observations were also made on hydrobiological parameters of the experimental site. A variety of fishes, crabs and prawns were found to take refuge along with oysters in wooden boxes and trays.

5.19 (Research work transferred to problem 5.23)

5.20 (Research work completed in 1976)

5.21 Shooting net collection at the lake-mouth indicated better larval recruitment in the 1st half of the year. Amongst fish, *Sillago sihama* (16.7/net/hr) and *Mugil* spp. (15.5/net/hr) and amongst prawn, *P. indicus* (327/net/hr) were the most abundant.

5.22 Fry of *Liza macrolepis*, *L. vaigiensis* and *M. cunnesius* registered an average increment of 10.78 mm/2.34 g per month when fed with a mixture of ground-nut oilcake, rice-bran and prawn meal. In an enclosure at Pulicat lake, 102 mullet fry registered an average size of 63.4 mm in 120 days without supplementary feeding. Mixed culture of mullet and prawn showed a growth increment of 46.4 mm/9.15 g and 31.4 mm/3.1 g respectively in $2\frac{1}{2}$ months. In plastic pool, *Chanos chanos* fry exhibited a growth increment of 12.0 mm/1.0 g in 17 days with supplementary feed. The fingerlings of *C. chanos* attained 47.0 mm/15.3 g in 143 days in freshwater pond and 87.6

mm/18.0 g in 3 months in brackishwater. In mixed culture of milk-fish, mullet and prawn, an estimated production of 835 kg/ha was obtained through partial harvesting.

Mystus gulio, when fed with cooked rice, registered an increment of 5.5 mm/0.51 g in 63 days as against 6.3 mm/0.72 g in 23 days when a mixture of ground-nut oilcake + rice-bran + commercial feed was provided.

5.23 Two strains of diatom, *S. costatum* and *Fragilaria* sp. were isolated on agar plates. *Gyrosigma* sp. was also successfully mass cultured and a cell density of 59×10^3/ml was obtained in 10 days. *Artemia salina* was effectively maintained in glass aquaria. Further attempts are in progress to put in improvement in the culture techniques.

5.24 (Research work transferred to problem 5.23)

5.25 (Research work suspended since 1975)

5.26 Physicochemical properties of two farm ponds in relation to the transformation of nitrogen and phosphorus were studied. No. marked difference was observed in water soluble nitrogen and phosphorus ; but N_2 level in soil was slightly high.

5.27 (Research work kept in abeyance)

5.28 Hydrobiological studies were continued in the lake-mouth and in a few centres of the Pulicat lake. An estimated total landing of 1084.444 t of fishes and prawns was recorded with prawn as the main catch (48.6%) while the northern sector contributing more than the southern sector.

5.29 A little difference in silt load in the tide water was observed between Kakdwip and Barrackpore during spring tide ; but salinity and conductivity were observed to be higher at Kakdwip. During the monsoon, the silt load was found to increase considerably at both the centres. The available nitrogen in the silt was moderate at Kakdwip and comparatively low at Barrackpore.

5.30 (Research work kept in abeyance)

5.31 *Cynodocea* sp. reappeared in the shallow areas of the northern portion of the Pulicat lake during December—January. Filamentous algae abounded in the southern sector. Mullet fry showed lesser growth when fed on plant and algal powder but gave a better increment when fed with a mixture of ground-nut oilcake and filamentous algae.

5.32 In laboratory experiments, portunid crabs (*Scylla serrata*, *Portunus pelagicus* and *P. sanguinolentus*) registered an average growth/moult ranging from 88 to 115 mm in 60 days. Trash fish meal and molluscs were provided as feed.

5.33 Gut content analyses revealed that *E. tetradactylum* thrived on copepods up to 25 mm stage and subsequently on postlarvae of prawns and gobiids.

At different stocking densities (300, 600 and 1,000 fish/m^3) fry of *E. tetradactylum* attained sizes of 32.50, 22.78 and 18.96 mm respectively in 22 days with copepods as main food. In another experiment, *E. tetradactylum* (64 mm) stocked @ 66 nos./m^3 exhibited a net gain of 14.0 mm in similar period with juveniles of *P. indicus* as the major food item.

At a high stocking density (@ 1,00,000/ha) the juveniles of *E. tetradactylum* (9.9 mm) grew to 72.14 mm in 46 days with 50% survival.

5.34 K pond stocked with Indian and exotic carps, mullets, milk-fish and prawn, during May—October 1976, yielded a production of 34.150 kg under repeated stocking and harvesting programme.

5.35 Rearing experiment with 100 *C. chanos* fry (30-35 mm) collected from Bakkhali region during April—June was vitiated due to over flooding of the pond. In mixed culture of milk-fish, mullet & prawn, *P. monodon* attained an av. size of 205.00 mm/110 g in 82 days and the growth of *C. chanos* and *L. tade* was recorded to be 370.77 mm/328 g and 315.66 mm/335 g respectively in 172 days. Milk-fish and mullet were fed with a mixture of mustard oilcake and maize powder @ 2% of the body weight.

5.36 Shooting nets were operated in the estuary adjacent to Kakdwip Fish Farm for collection, segregation and rearing of the postlarvae of *P. monodon*

during spring tide periods. 40,450 postlarvae were segregated and reared by covering 20 spring tides, spending 57 hours and 40 minutes and employing 128.25 man-hours. Peak period of abundance was April—May and collection/net/hr was the maximum in spring tide of newmoon when water salinity ranged between 14.4 and 18.4 ppt.

In plastic pools, 80% survival of the postlarvae was observed at 10—12 ppt salinity and 31°—32°C temperature in 15 days. Survival rate was poor at <5 ppt salinity and 26°C water temperature

The postlarvae (12—14 mm) were fed with powdered artificial feeds and after 15 days, they attained a length of 17—20 mm. Postlarvae of *P. monodon* were transported in 4 hrs to the Bakkhali Farm without any mortality.

5.37 Under crop rotation programme, *P. monodon* and *L. parsia* were cultivated during January—June but from July—December, mixed culture was practiced with *C. chanos*, *L. tade* & *L. parsia* and *P. monodon*.

In the first phase of the experiment, *L. parsia* (size 20—25 mm), stocked @ 1.75 lakhs/ha, attained 87.4 mm and 9.68 g in May with a production rate of 544.5 kg/ha/4 months.

In the second phase during unstable ecological condition, mixed culture at different densities registered a good growth of all the species resulting in better production.

5.38 100% survival of fry of *L. calcarifer* (size 23—83 mm) was achieved in plastic pools with regular change of water and supply of live food @ 50% of the body weight. The growth rate of fry was 0.7 mm/day when regular flushing of tidal water was maintained. *L. calcarifer* (av. size 15.8 mm) attained 278.0 mm/243.75 g in 124 days at a stocking density of 1,300/ha.

In another experiment without flushing arrangement, the fry fed with juveniles of live prawn attained 199.66 mm/60.0 g in 77 days at a stocking density of 1,100/ha.

5.39 *P. indicus* when cultured with *M. monoceros*, *M. brevicornis* and *P. monodon* at different densities registered a production of 418.5 kg/ha in 320 days in 4 crops and 211.85 kg/ha in 240 days in 3 crops. The ponds

were flushed regularly with tidal water. In addition, fish productions from these two ponds were estimated to be 713.25 kg/ha/320 days and 591.85 kg/ha/240 days respectively.

In another experiment, a total production of prawn and fish was 414.4 kg/ha/320 days under partial harvesting programme without flushing the pond with tide water.

Hydrobiological studies confirmed that with the fall of salinity during July—August, the production of bottom animalcules declined causing poor harvest of the prawns in rainy season.

A mixture of prawn meal and wheat-bran was provided as supplementary feed to *P. Indicus.*

5.40 Experiments were carried out on the effect of fertilisation and supplementary feeding in different combinations on the growth of *L. tade* fry. The best average increment of 104.55 mm/40.12 g was obtained after 153 days of rearing with fertilizer treatment+supplementary feeding.

At different stocking densities (2,400 to 9,150 fry/ha) *L. tade* can be safely used in monoculture with high survival (89.6 to 100%).

In 139 days of mixed culture with *L. tade* and *P. monodon* at the stocking rate of 4,687 and 5,000/ha, the final sizes attained were 216.34 mm/102.59 g and 169.63 mm/47.28 g respectively.

5.41 During January—May, about 44,000 fry of *L. parsia* (12—39 mm) were collected from Kakdwip area by scoop net (32,349) and drag net (11,656), the peak being in January—February. A total of 9,112 fry of *L. tade* were collected in July by scoop net in 61.33 man-hours, besides 3,51,012 fry of commercially important fish and prawn by shooting nets operated in the river Muriganga spending 163.92 man-hours.

Acclimatization experiment on *L. parsia* fry at different salinities (4.8—10.8 ppt) showed 62.25—91.8% survival in 10 days indicating that the fry can survive up to low salinity level of 6.8 ppt.

5.42 Juveniles of *P. monodon* (size 36—42.5 mm) were fed with dried fish (with 25% protein) and mixed vegetable (with 16% protein) @ 2.5% of body weight. Average gain in weight was good when fed with mixed vegetable protein

feed. *P. monodon* when fed with 25% of vegetable protein prepared from soyabean powder registered a gain of 0.32 g/month.

5.43 Wastes from sulphate paper mill were found more detrimental in summer than in rainy season when the bottom biota and gastropods were poorly represented.

5.44 The release of nutrient from poultry manure by using cobalt was greater than boron, whereas with sludge base the nutrient release was gradual and attained its peak on the 30th day as an effect of cobalt treatment followed by molybdenum.

5.45 Hydrobiological parameters of ponds at Adyar and Pulicat were studied and the total plankton volume was noticed to be higher with molybdenum (0.5 ppm) treatment followed by manganese treatment.

5.46 Pond treated with compost alone maintained a transparency range of 7.5 to 20.8 cm while compost along with urea+superphosphate showed transparency level between 7.5 & 31.2 cm. The phytoplankton concentration ranged between 500 & 700 u/l in treated ponds.

Project 6 :

6.1 (Research work completed in 1976)

6.2 Culture of *M. malcolmsonii* was attempted in 4 ponds stocked @ 50,000/ha and 75,000/ha after manuring with cattle dung and NPK mixture. Excessive growth of weeds were checked by introducing grass carp fry (25.3 mm). Per hectare production of the fish after 10½ months' rearing were 211.9, 93.8, 269.5 and 313.7 kg in 4 ponds with the survival range between 6.8 and 51.4%.

6.3 Landings of *M. birmanicum* var. *chopra* were recorded from the six sampling centres between Allahabad and Varanasi. Though the species was available in June and July yet no berried female was recorded.

6.4 In the lower stretch of the river Ganga 18.31 t of prawn were estimated to have landed, *M. malcolmsonii* contributing 35.72% of the catch.

One gravid female was successfully induced to release eggs which were reared up to 12th day.

Project 7 :

7.1 & 7.2 (Work being conducted under a Co-ordinated Project)

Project 8 :

8.1 Observations on brackishwater fish seed collection revealed the abundance of *Liza parsia* from Raidighi, Itinda & Gosaba and *L. tade*, *R. corsuia* & *E. tetradactylum* from Kakdwip.

8.2 & 8.3 (Research work completed in 1973)

8.4 Prawn seed prospecting at eleven centres showed dominance of *P. monodon*, *P. indicus*, *M. brevicornis*, *M. monoceros* and *P. styliferus* in order of merit. The peak period of collection was April—May for *P. monodon* and March—April for *P. indicus*.

8.5 (Research work completed in 1976)

8.6 The fabricated floating net was found to be 170—180% more efficient than the conventional one.

8.7 Histological examination of the gonads of euryhaline fishes from bag net catch showed that *Sillago panijus* became mature at a size of 370 mm/350 g, *S. argus* at 385 mm/1.7 kg and *G. giuris* at 180 mm/209 g. Mature specimens of *S. panijus* were available in saline waters (25-30 ppt) only while mature ones of the other species were collected from freshwater region.

Project 9 :

9.1 (Research work completed in 1973)

9.2 (Research work completed in 1972)

9.3 (Research work completed in 1973)

9.4 Hybrids of rohu ♂ × calbasu ♀ produced were being reared in a nursery pond.

Project 10 :

10.1 17 fish farms in 8 districts of Orissa were surveyed for fish farm construction work. All the fish farms were rain fed with no proper inlet and outlet arrangements. The farms were having hillocks at one or more sides with flat topography or gently slopping.

10.2 In field trials at Killa, different materials were used to study the seepage losses in mini ponds. Off all the materials, the soil+cement mixture was found to be the best while soil + cow dung mixture showed encouraging result during the first phase.

Project 11 :

11.1 & 11.2 (Research work completed in 1974)

11.3 (Research work completed in 1973)

11.4 & 11.5 (Research work completed in 1976)

11.6 63 ponds under CIFRI/IDRC Project on Rural Aquaculture were studied in West Bengal and Orissa. The average production was 3,000 kg/ha/yr in 25 cases.

Project 12 :

12.1 & 12.2 (Research work completed in 1973)

12.3 (Research work completed in 1972)

12.4 (Research work completed in 1976)

12.5 To prevent the mortality of brood fish of grass carp (*C. idella*) and silver carp (*H. molitrix*) recirculation and aeration of water was arranged.

Due to delayed monsoon and prolonged drought condition the response to hypophysation was initially poor. With the advent of rain and favourable weather conditions, the results of induced breeding became somewhat encouraging.

1.38 lakhs of grass carp and 1.55 lakhs of silver carp spawn were produced, of which 41,000 spawn of grass carp were obtained from the glass jar hatchery.

12.6 Six months, trial on compatibility and competition between silver carp and *L. rohita*, stocked at 5,000 and 3,000/ha, revealed that the growth of rohu suffered in the presence of silver carp as compared to catla. Further experiments are in progress.

12.7 Experiment of rearing the exotic carps in 0.08 ha ponds were continued.

Project 13 :

13.1 (Research work completed in 1970)

13.2 In brown trout (*S. trutta fario)* culture, five feeding trials with pelletised feed having 28—39% crude protein were conducted.

13.3 (Research work completed in 1971)

13.4 & 13.5 (Research work completed in 1970)

13.6 (Research work completed in 1972)

13.7 (Research work completed in 1970)

13.8 Green eggs of brown trout were incubated during January—March with 95.2 to 98.3% survival. Malachite green treatment and thinning operation proved effective to check mortality. The fry were fed with hen's egg and skimmed milk in 1 : 1 ratio from the 1st week of February 1976.

Green eggs of brown trout from segregated stock showed 95.0-99.5% survivul as against 90-95% from non-seg egated stock. Malachite green was used twice a week as mycocide. The green eggs started becoming eyed ova from the 1st week of December and the average survival was 91.5-95.0%.

13.9 (Research work suspended since 1972)

13.10 (Research work suspended in 1976)

13.11 & 13.12 (Research work suspended since 1975)

13.13 Hydrobiological studies continued in the Dal lake, indicated negative production in polluted zone during July to September. In winter, the situation improved, indicating positive production.

13.14 Due to sub-zero temperature no growth was recorded in *Chlorococcum* sp. culture. Mass culture of phyto- and zooplankton were carried out in laboratory and in the field using commercial NPK and cow dung extract as media.

Trials were made to culture *Tubifex* sp. in plastic bags and cardboard boxes where 5-10 times increase in the population was obtained in forty days.

13.15 & 13.16 (Research work kept in abeyance)

13.17 Gut content analyses of 203 specimens of mirror carp indicated mostly detritus (78.01%) followed by Bacillariophycae (18.02%) and others.

Spawning grounds of mirror carp were located at Nighat and Pishpov nallah of Dal lake. The fecundity was between 18,072 and 57,515 for the size range of 328—398 mm.

13.18 (Research work completed in 1976)

13.19 14 specimens of brown trout were stripped and 3,900 green eggs were obtained with 96.8% fertilisation during January and February. The green eggs and eyed ova were treated with Malachite green twice a week and the survival to fry stage was 57.9%.

Project 14 :

14.1 The fish yield from the middle stretch of the Ganga River System was 127.11 t during the year. Specieswise estimate of fish at Sadiapur, Daragunj and Buxar was made.

14.2 The fish yield from the lower stretch of the Ganga River System was 534.2 t. Species-wise fish landings and hydrobiological parameters were recorded at Bhagalpur, Sahibgunj, Rajmahal, Farakka, Dhulian and Lalgola during the year.

14.3 (Research work completed in 1969)

14.4 (Research work completed in 1971)

14.5 (Research work completed in 1973)

14.6 A total of 17,52?.6 t of fish was landed from the Hooghly—Matlah estuarine system. *Harpodon nehereus* dominated the catch (27.1%) followed by *Hilsa ilisha* (13.9%), prawn (9.8%) and others. Among the gears operated, bag-nets contributed the highest (71.3%) being followed by large and small seines. Zone III (lower Sunderbans) accounted for 86.1% of the total catch.

14.7 Fish landing from Tezpur, Ujan Bazar Fancy Bazar and Dhubri was 178.3 t showing 35.4% decline from the previous year's landing. At all the centres, miscellaneous fishes dominated. Ecological studies were also continued.

14.8 (Research work suspended since 1975)

14.9 (Research work suspended since 1974)

14.10 Hydrological studies were continued in the Hooghly estuary. Plankton studies indicated abundance of freshwater forms with phytoplankton (mainly diatoms) dominating over the zooplankton in the stretch up to Uluberia. The monthly averages of phytoplanktor density were 5—15, 13—110, and 85—310 per litre of water as was recorded from Kalna—Uluberia, Uluberia—Geokhali & Kakdwip regions respectively.

14.11 Evaluation of sampling and estimation technique of plankton were continued. Larger samples were found to be more reliable than the smaller ones.

14.12 Various existing methods of estimating population sizes and mortality have been examined.

Project 15 :

15.1 (Research work completed in 1976)

Project 16 :

16.1 (Research work completed in 1973)

16.2 (Research work is being done under problem 16.7)

16.3 Diuron @ 0.3 mg/l was found to clear *Microcystis* sp. bloom in 10 days. Also carbamate hebicide (Asulam) @ 3 kg a. i./ha was effective to control *Panicum* sp. in 4 weeks.

Rooted infestaton of *Ottelia* sp. *and Nymphoides* sp. was completely controlled when treated with brick pellets soaked in 2,4-D @ 10 kg a.i./ha in 4 weeks proving an edge over the mannual removal.

16.4 (Research work completed in 1973)

16.5 Experiments were carried out in laboratory to find out the suitable method of eradicating floating and submerged weeds using $CuSO_4$, urea, Fernoxone and superphosphate at different doses.

16.6 Autecological studies of aquatic plant in relation to water and soil samples from different ponds in West Bengal were continued.

16.7 Studies on the hydrobiology of the fish farms in Southern and Western Orissa were completed.

16.8 & 16.9 (Research work completed in 1976)

Project 17 :

17.1 to 17.4 (Research work completed in 1973)

17.5 (Research work suspended since 1972)

17.6 (Research work completed in 1975)

17.7 Complete degumming of the eggs of *R. tigrina* and *R. crassa* obtained though induced breeding could be achieved by the treatment of urea, sodium chloride and pectinase. The treatment in some cases was found to have incited the hatching condition of the eggs.

17.8 (a) Incidentally 20,000 tadpoles of *R. tigrina* and *R. crassa* along with their hybrids were produced. When fed with *Hydrilla* sp., the survival in field and yard trials, during metamorphosis of *R. hexadactyla* tadpoles to early frog stage were 71, 81 and 86% at the stocking densities of 10, 7.5 and 30 million/ha respectively. In a culture, 12 days old tadpoles of *R. tigrina* fed with frog meat only recorded 71.6% survival up to early frog stage.

Iodine at 0.6 ppm reduce the period of metamorphosis of *R. hexadactyla* tadpies.

17.8 (b) Off the 2,500 tadpoles of *R. tigrina* obtained through induced breeding, only 20 and 12% became 2-legged and 4-legged respectively. Minced meat, chopped earthworm and fish meal were used as feed.

17.9 (a) Early tadpoles of *R. hexadactyla* were reared in a pond up to juvenile stage.

17.9 (b) (Research work completed in 1976)

17.9 (c) *Rana hexadactyla* could be bred twice in a year. Hatchlings from spring eggs are less than the monsoon eggs. Provision of aquatic weeds resulted 90% survival. Froglets were stocked at different densities for rearing.

17.10 Decomposed leaves, organic manure and moist environment were found congeneal for culture of earthworms.

Project 18 :

18.1 In a sewage-fed pond (0.076 ha), the yield of *Tilapia mossambica* was 4.850 kg/ha, in nine months.

Composite culture of Indian and exotic carps @ 24,000/ha produced 5,711 kg/ha (net) of fish in 9 months. The pond was manured with domestic

sewage only. No supplementary feeding was resorted to. Mixed culture of fishes in sewage-fed ponds with magur and tilapia in the ratio of 1 : 1 was done. 58 kg of tilapia and 36 kg of magur were obtained by partial harvesting. An investigation was carried out to explore the possibilities of producing fish meal utilising tilapia from sewage-fed pond.

Project 19 :

19.1 (Research work completed in 1973)

19.2 (Research work completed in 1974)

19.3 (Research work suspended since 1973)

19.4 & 19.5 (Research work completed in 1973)

19.6 (Research work suspended since 1973)

19.7 During the year, 43.47, 60.15 and 45.97 t of hilsa were estimated to have landed at Dhulian, Farakka and Lalgola centres respectively while no landing of hilsa was recorded at Bhagalpur and Sahibganj. However, only 0.01 t of hilsa was recorded from Rajmahal. The intermingling pattern and other statistics on the three sub-populations were continued to be studied.

19.8 Two pairs of hilsa were collected in oozing condition from the Farakka region and stripped to obtain 2.5 lakh of eggs of which 85.90% were fertilised. 70% of the egg hatched in *hapa* fixed in the river. Spawn have been stocked @ 50,000, 50,000 and 72,000 in three nursery ponds for rearing.

19.9 Hilsa landing from the Hooghly esutary was 8.33 t during the year. Larval abundance was poor during post-winter breeding.

Project 20 :

20.1 (Research work completed in 1973)

20.2 (Research work completed in 1975)

20.3 Observations were made on various parameters, like primary production, biotic abundance, physicochemical factors, etc. around the outfall area of different industries on the bank of the river Hooghly. The pollutional effect and load of the discharges of the effluents of these industries were estimated in relation to tides.

20.4 Excepting the outfall area no appreciable pollution was recorded from the Hooghly estuary. Usually *Oscillatoria* sp., *Microcystis* sp. and tubificid worms were more abundant as biological indicators to point out those zones where sewage pollution was predominant.

20·5 The regions above, around and below the outfall area of the industries in the middle stretch of the Ganga river system were studied to ascertain the hydrobiological parameters and characteristics of plankters as well as benthic organisms. Though there was difference in the ecological nature of these regions, there was no significant difference in the fish population in those stretches.

20.6 The effects of temperature and BHC on mrigal, colisa gastropods & bivalves were stuided.

20.7 The LC_{50} values for synthetic rayon waste on shrimp and *Dahpnia* sp. were recorded through bio-assay.

20.8 Toxicity of DDT-25 EC, Malathion—50 EC, Rogor—30 EC and Nuvan—100 EC on *Daphnia carinata* under different temperature were studied. Effect of Rogor—30 EC on colisa and gastropod was observed. Bio-assay studies with gammexone were conducted using colisa as test fish. The LC_{50} values were 22.5% (24 hrs) and 14% (72 hrs.).

Project 21 :

21.1 & 21.2 (Research work suspended in 1973)

Project 22 :

22.1 (a) Cage culture of *C. carpio* has been initiated by stocking 400

fingerlings in six cages (1 m × 1 m × 1 m) at Shankarghat on the river Ganga. Due to natural hazards, after one month the experiment was shifted to Mahawapatti on the river Yamuna where surviving 85 fingerlings were stocked in 2 cages. Artificial feeding was resorted to and average increment in weight/length was 0.14 g/0.23 mm per fish per day.

22.1 (b) & **22.1** (c) (Research work kept in abeyance)

22.2 Out of 23 hatching pits of *Mystus seenghala* located in the river Ganga & Yamuna, only seven pits yielded 1,575 hatchlings. After initial nurturing and bathing with 1 ppm Acriflavine, they were kept in the rivers in nylon cages. Chironomid larvae and semi-boiled weed fish flesh were given as feed to them. The survival was 80-100% in cages as against 15-55% in plastic pools. In cages, the hatchlings (av. 30 mm) attainted an av.size of 168.8 in 144 days.

22.3 Spawn collected from the river Yamuna acclimatised in plastic pools with artificial feed were stocked in 2 cages @ about 30,000/floating nursery in *Jari* tank. The 1st lot attained an average length of 45.6 mm in 28 days and the 2nd, 30.2 mm in 21 days. The young fry were reared in mosquito netting *hapas* under stocking density of 2,500/ *hapa*. The growth of fingerlings when fed with artificial feed were 121.1 mm in 89 days for the 1st lot and 103.6 mm in 82 days for the 2nd.

Project 23 :

23.1 (a) In Ganne dry bundh, rohu and mrigal bred successfully, but only 6,000 fertilised eggs could be collected as most of them were washed away by gushing waters. Hydrological observations were also made.

23.1 (b) One set of mrigal was injected with pituitary gland extract @ 2 mg and 4 mg/kg body weight of the males and female at Ponto village, Chibasa district. An amount of 13 litres of eggs were collected with 80% fertilisation and finally 3.75 *baties* of spawn were handed over to the State Fisheries Department, Bihar.

Project CFCSP :

CFCSP 1 The gross production from various combinations of carp species were : 6,267 & 3,068 kg/ha/8 months at Karnal ; 4,072 kg/ha/9¾ months & 5,446 kg/ha/8 months at Pune ; 3,731—4,083 kg/ha/yr at Gauhati ; 2,128 kg/ha/yr & 2,076 kg/ha/yr at Badampudi ; 3,751 kg/ha/14 months & 3,393 kg/ha/13 months at Kalyani ; 2,818—3,232 kg/ha/yr at Bhavanisagar and 1,504 kg/ha/yr & 2,004 kg/ha/18 months at Ranchi subcentres. At Jaunpur subcentre, productions ranged from 1,681—2,745 ; 3,612—4,330 and 5,110—5,887 kg/ha/yr with fertilisation alone, with artificial feeding alone, and with both respectively.

Under induced breeding programme at various subcentres, a respective total of 39.76 and 19.20 lakhs of Indian and exotic carp spawn were produced.

CFCSP 2 Among silver carp and grass carp brooders hypophysed and released in the bundh for breeding at Simlapal, Bankura district, only the former bred. From 36 litres of eggs collected, about 42,000 spawn were obtained.

CFCSP 3 Salmon gonadotropin G—100 at 2.5, 5 and 10 mg/kg and prostaglandin F_2 at 1 mg/kg were injected to common carp. The former hormone acted like the 2nd fraction of carp pituitary while the fish did not respond to latter.

CFCSP 4 (Research work kept in abeyance)

CFCSP 5 (Research work suspended since 1975)

CFCSP 6 Studies on growth, feeding, breeding, etc. of grass carp were continued.

CFCSP 7 The growth rate of rohu fingerlings increased from 220.5 to 458.0 mg/day with the rise in temperature from 20° to 28°C showing higher conversion of feed at higher temperature. The growth was faster with feeds having higher protein (about 40%). Oxygen depletion reduces the feeding rate and increases the respiration rate, resulting in negative growth of the fingerlings. Comparative study revealed that grass carp was having the highest rate of O_2 consumption as against those of rohu and mrigal.

CFCSP 8 To bring down input cost and to test the economics in compo-

site fish culture, experiments were conducted using feed alone, fertilisation alone and both. The result significantly pin-pointed the importance of artificial feeding for enhanced production.

CFCSP 9 Composite fish culture in a small pond for one year with artificial feed only yielded a gross and net production of 5,790 and 5,276 kg/ha/yr respectively.

CFCSP 10 Composite fish culture in large ponds were extended to 18 months due to flood damages in 1975. Partial harvesting of about 20,000 kg of fish was done.

CFCSP 11 Studies on growth, maturation and embryological development of the silver carp were undertaken.

CFCSP 12 Studies on the gonads of hypophysationised *Mystus vittatus* were continued. Compensatory activity of hemicastrated gonads were also investigated. Histophysiological observations on pituitary and gonads of the fish were in progress.

CFCSP 13 A net production of 5,154 kg/ha/15½ months was obtained through culture of catla, rohu and mrigal in the national demonstration pond (Nilganj) which was stocked afresh with catla, rohu, mrigal and common carp @ 7,500 fingerlings in May 1976.

CFCSP 14 Riverine spawn, specially catla, remained the cheapest and bulk source of supply. The costs of production per million spawn were estimated to be Rs. 189/— form riverine source, Rs. 804/— through hypophysation and Rs. 2,474/— from bundh breeding.

CFCSP 15 Four allometric growth models have been replaced by three metric ones by introducing shape factor. Functional regression is being extensively used for analyses.

CFCSP 16 Fish yield statistics is being studied at Kalyani fish farm through fin clipping.

CFCSP 17 Processed data on marked recapture studies are being analysed.

Project ABF :

ABF 1 A production of 916 kg/ha/yr was achieved through mixed culture of magur, koi and singhi in Assam. At Ulubari, a production of 1,678 kg/ha/yr was obtained in monoculture of *C. punctatus.*

In West Bengal, magur stocked @ 40,000/ha and fed with dried marine trash fish yielded over 5,000 kg/ha/5 months while in Karnataka, the murrels grew to 800 g in 7 months.

ABF 2 Raking of bottom soil of Dhokardah *bell* at Kalyani promoted the mineralisation of organic matter and increased the nutrient level and primary production significantly.

ABF 3 *C. batrachus* stocked @ 40,000 nos./ha in the cement cistern showed better growth when fed with supplementary diet fortified with yeast.

ABF 4 Alkaline protease was isolated and purified from the intestine of *C. batrachus* and trypsin & chymotrypsin were identified. Variations of these enzymes with different protein diets were studied.

ABF 5 Providing artificial feeds to the fingerlings, gross productions of 36 and 80 kg of magur in 5 and 6 months respectively were obtained from two derelict ponds, when the recovery was 50% only.

ABF 6 (Research work suspended in 1976)

ABF 7 Studies on the activities of carbohydrate, protein and lipid metabolising enzymes were conducted to find out the regulatory digestive mechanism in *C. batrachus.*

Project R :

R 1 Investigations on the fish population dynamics, fishery biology, limnology and other aspects were carried out in Bhavanisagar, Nagarjunasagar, Getalsud, Rihand and Govindsagar reservoirs. The estimated fish yields during

the year were 276 t in Bhavanisagar, 113 t (6.12 kg/ha) in Nagarjunasagar, 80 t (3 kg/ha) in Rihand and 598 t in Govindsagar reservoirs. An increase in fish yield up to 75 kg/ha from 19 kg/ha in 1971, from Bhavanisagar was possible due to increase in fishing effort. At Nagarjunasagar, the yield was below the estimate due to inadequate fishing effort and sub-normal breeding of carps. At Getalsud reservoir, silver carp registered a growth of 4.3 kg in 28 months. The total yield dropped sharply due to poor breeding and recruitment in previous year. The existence of three subspecies of catla were confirmed. Natural breeding of *C. catla*, and *C. mrigala* in Rihand, *L. fimbriatus* in Nagarjunasagar and *C. catla*, *L. calbasu*, *C. mrigaala*, *L. fimbriatus* and *L. bata* in Bhavanisagar was observed.

A spart of *Ceratium* sp. in spring and dominance of *Tubifex* sp., *Tendipes* sp. & *Chaoborus* sp. were recorded at Getalsud. In Govindsagar where chemical and thermal statification were well marked, *Ceratium* sp. was found as a dominant plankter.

Project CIFRI/IDRC/WB :

CIFRI/IDRC/WB 1 *Hanspukur—Bishnupur Complex* : Demonstration on hypophysation techniques and rearing of fry were arranged in 5 ponds of different villages. A total of 0.32 million rohu spawn were obtained out of which 0.22 million were reared for 15 days to produce 0.17 million fry (20-25 mm). The resultant fry gave a fish production of 333-1,830 kg/ha/3 months rearing.

Composite fish culture in 15 ponds were continued. At Amgachhia pond, magur was also stocked and a total production of 3,108 kg/ha/9 months was obtained where magur alone contributed 1,000 kg/ha/4½ months.

Harishchandrapur/Khasimari (District Malda) Centre : About 0.31 million spawn of common carp were produced and 33,000 advanced fry were distributed to the local fish farmers.

Composite culture was in progress in 11 ponds covering a total area of 5.70 ha.

CIFRI/IDRC/WB 2 The physicochemical and biological characteristics of 6 ponds at Hanspukur and 11 ponds at Khasimari were studied fortnightly and monthly respectively.

CIFRI/IDRC/WB 3 Fingerlings of gass carp were found to digest 52% and 46.8% protein contents of duck weeds and chopped cabbage leaves respecttively.

CIFRI/IDRC/WB 4 Relationship between fish-yield and supplementary feeding were studied in six ponds by providing various diets to the fish.

CIFRI/IDRC/WB 5 At Kharibari, a silver carp affected with tail and fin rot was cured with 2 ppm $KMnO_4$ bath.

Myxobolid infection was also recorded from 3 ponds at Amgachhia.

CIFRI/IDRC/WB 6 (Research work suspended in 1976)

7. Personnel

Retirement :

Dr. H. Chaudhuri, Scientist S-3, retired during the year under report :

Promotion :

The following promotions took place during the year under report :

Shri K. V. Rajani	:	Assistant to Superintendent
Shri P. C. Kanungo	:	Assistant to Superintendent
Shri M. L. Biswas	:	Assistant to Superintendent
Shri S. C. Roy	:	Senior Clerk to Assistant
Shri F. A. Zaidi	:	Senior Clerk to Assistant
Shri G. M. Chakrabarty	:	Junior Stenographer to Stenographer
Shri H. Chakladar	:	Junior Stenographer to Stenographer
Shri A. K. Banerjee	:	Junior Stenographer to Stenographer
Shri Keshab Prasad	:	Junior Clerk to Senior Clerk
Shri H. K. Nath	:	Junior Clerk to Senior Clerk
Shri T. K. Sridharan	:	Junior Clerk to Senior Clerk

Shri B. Prakash	:	Fisherman to Laboratory Boy
Shri Musa Das	:	Fisherman to Laboratory Boy
Shri A. K. Mandal	:	Fisherman to Laboratory Boy
Shri Hari Bahadur	:	Watchman to Laboratory Boy
Shri G. B. Shetty	:	Peon to Laboratory Boy
Shri K. K. Das	:	Peon to Laboratory Boy
Shri S. K. Dutta	:	Boatman to Laboratory Boy
Shri A. M. Patra	:	Deck Tindel to Laboratory Boy
Shri B. Bhoi	:	Daftury to Laboratory Boy
Shri D. Barik	:	Mali to Laboratory Boy
Shri B. Appa Rao	:	Fisherman to Laboratory-cum-fieldman
Shri D. Sahu	:	Fisherman to Fieldman
Shri A. Behera	:	Fisherman to Fieldman
Shri K. C. Behera	:	Fisherman to Fieldman
Shri Durga Bahadur	:	Watchman to Fieldman
Shri Sita Ram	:	Sweeper to Fieldman

Transfer :

Inter-institutional :

Shri C. D. Kulkarni, Administrative Officer has been transferred to the Cotton Technological Research Institute, Matunga, Bombay during the year 1976.

Inter-departmental :

The following inter-departmental transfers were made during the year under report :

SCIENTIST S—3 / SENIOR FISHERY SCIENTIST

Dr. V. R. P. Sinha	:	Barrackpore to Bhubaneswar

SCIENTIST S—2 / FISHERY SCIENTIST

Shri A. N. Ghosh	:	Kakdwip to Barrackpore

SCIENTIST S—1 / JUNIOR FISHERY SCIENTIST

Dr. K. L. Sehgal	:	Harwan to Barrackpore
Dr. M. L. Bhowmick	:	Kalyani to Harishchandrapur and then to Malda
Shri K. K. Sukumaran	:	Barrackpore to Cuttack
Shri Ajoy Kumar Ghosh	:	Cuttack to Barrackpore
Shri N. K. Tripathi	:	Cuttack to Bhubaneswar
Shri C. D. Saha	:	Cuttack to Bhubaneswar
Shri G. K. Batanagar	:	Nagarjunasagar to Ranchi
Shri Ch. Gopalakrishnayya	:	Bhavanisagar to Nagarjunasagar

SCIENTIST S / SENIOR RESEARCH ASSISTANT

Shri K. V. Rao	:	Rajahmundry to Tedepalligudem
Shri M. Ramkrishniah	:	Hazaribagh to Nagarjunasagar
Shri D. Kumar	:	Pune to Krishnanagar
Shri P. C. Mohanta	:	Krishnanagar to Gauhati
Shri Shree Prakash	:	Allahabad to Buxar
Shri B. L. Pandey	:	Bhagalpur to Lalgola
Shri H. C. Joshi	:	Allahabad to Govindsagar
Shri J. N. Pal	:	Ranchi to Barrackpore
Shri M. P. S. Kohli	:	Bilaspur to Darbhanga
Shri S.A.K. Nasar	:	Darbhanga to Bhagalpur
Shri P. Kumariah	:	Kalyani to Bangalore
Shri D. Nath	:	Cuttack to Barrackpore
Shri B. K. Misra	:	Kalyani to Cuttack
Shri V. K. Sharma	:	Kalyani to Bilaspur
Dr. H. Singh	:	Barrackpore to Harwan
Shri Jagadish Chandra	:	Krishnanagar to Karnal
Shri Anup Kumar Datta	:	Harishchandrapur to Malda and then to Hanspukur
Dr. S. P. Rai	:	Aska to Puri
Shri Amitabha Ghosh	:	Barrackpore to Krishnanagar

ASSISTANT ENGINEER

Shri A. B. Mukherjee	:	Kakdwip to Barrackpore

RESEARCH ASSISTANT

Shri D. R. Rao	:	Kakinada to Tedepalligudem
Shri K. S. Rao	:	Kakinada to Tedepalligudem
Shri B. Roy	:	Bilaspur to Barrackpore
Shri T. S. Ramaraju	:	Rajahmundry to Tedepalligudem
Shri N. K. Srivastava	:	Cuttack to Allahabad

DRAFTSMAN

Shri Chakradhar Sahoo	:	Cuttack to Bhubaneswar

ESTIMATOR

Shri Muralidhar Mantri	:	Cuttack to Bhubaneswar

JUNIOR-SURVEY ASSISTANT

Shri P. S. C. Bose	:	Rajahmundry to Tedepalligudem
Shri D. P. Varma	:	Sankargarh to Buxar
Shri B. D. Saroj	:	Buxar to Allahabad

LABORATORY AND FIELD ASSISTANT

Shri C. Lakra	:	Getalsud to Ranchi and then to Hazaribagh
Shri M. P. Singh	:	Hazaribagh to Buxar

DRIVER

Shri R. N. Singh	:	Hazaribagh to Allahabad

STENOGRAPHER

Shri A. K. Banerjee	:	Barrackpore to Bhubaneswar

JUNIOR STENOGRAPHER

Shri R. C. P. Sinha	:	Hazaribagh to Allahabad

SENIOR CLERK

Shri Abdul Halim	:	Hazaribagh to Bhubaneswar

JUNIOR CLERK

Shri K. B. Soni	:	Badarpudi to Bhubaneswar
Shri G. B. Das	:	Barrackpore to Bhubaneswar and then to Barrackpore
Shri D. K. Dey Sarkar	:	Kalyani to Barrackpore
Shri M. Kachhap	:	Hazaribagh to Ranchi

LABORATORY BOY

Shri R. N. Saha	:	Barrackpore to Gauhati
Shri D. Barik	:	Barrackpore to Cuttack

FIELDMAN

Shri B. Dalai	:	Cuttack to Bhubaneswar
Shri Natabar Jena	:	Barrackpore to Bhubaneswar
Shri B. Behara	:	Rihand to Bhubaneswar

FISHERMAN

Shri S. Parida	:	Kalyni to Cuttack
Shri D. Bhanja	:	Harishchandrapur to Malda
Shri H. Burman	:	Harishchandrapur to Malda

PEON

Shri Ramdeo Singh	:	Calcutta to Barrackpore

MESSENGER

Shri R. L. Debroy	:	Kakdwip to Barrackpore

Staff :

The following staff rendered their services to the Institute during the year :

DIRECTOR

Dr. V. G. JHINGRAN

Scientific and Technical :

SCIENTIST S—3

Chaudhuri, H. (Left on 29. 2. 76)
Dehadrai, P. V.
Gopalakrishnan, V (on FAO assignment)
Natarajan, A. V.
Sinha, V. R. P.

SCIENTIST S--2

Chakrabarty, R. D.
Ghosh, A. N.
Jhingran, A. G.
Pakrasi, B. B.
Rajyalakshmi, T. (on study leave)
Raman, K.
Singh, S. B.
Tripathi, S. D.

FISHERY SCIENTIST

Khan, H. A.
Malhotra, J. C.
Mondal, A. K.
Ramachandran, V.

SCIENTIST EXTENSION

Das, P.

SCIENTIST S—1

Alagaraja, K. (left on 24. 12. 76)
Ayyar, S. P.
Bhanot, Kailash K.
Bhatnagar, G. K.
Bhowmick, M.
Chandra, Ravish
Chatterjee, D. K.
Das, C. R.
Das, N. K.
Desai, V. R.
Dutta, S. N.
Ghosh, Ajoy K.
Ghosh, Apurba
Ghosh, B. B.
Ghosh, K. K.
Gopalakrishnayya, Ch.
Govind, B. V.
Gupta, M. V.
Halder, D. D.
Ibrahim, K. H.
Jana, R. K.
Jena, S.
Kamal, M. Y.
Kowtal, G. V.
Krishnamurthy; K. N.
Mitra, Eva
Mohammed, M. Peer
Mukhopadhyay, S. K. (on study leeave)
Nandy, A. C.
Pal, R. N.
Panwar, R. S.
Pathak, S. C.
Patnaik, S.
Pravakaran, V. T.
Prasadam, R. D.
Ramakrishna, K. V.
Ramamohana, G.
Ramaprabhu, T.
Ranadhir M.
Rao, A. V. P.
Rao, J. B.
Rao, K. G.
Rao, N. G. S.
Rao, R. M.
Rao, Y. Rama
Rout, M. D.
Saha, C.
Saha, G. N.
Saha, S. B.
Saigal, B. N.

Sehgal, K. L.
Selvaraj, C.
Sen, P. R.
Shah, K. L.
Singh, B. N.
Singh, S. P.
Sinha, M.
Srivastava, K. P.
Subrahmanyam, M.
Thakur, N. K.
Vass, K. K.
Verghese, P. U.
Wishard, S. K.

ARS PROBATIONERS (Scientist S—I)

Arabindakshan, P. K.
Bali, Usha
Bhanot, Kuljeet K.
Bhowmick, U.
Chandra, Jagadish
Chitransi, V. R.
Das, M. K.
Das, R. C.
Das, S. R.
Kumar, Kuldip
Laal, A. K.
Lal, Babu
Mathew, P. M.
Mohanty, S. N.
Mukherjee, A.
Munnet, S. K.
Pillai, S. M.
Raj, R. Paul
Ram, K. J.
Rao, K. J.
Rao, L. H.
Ravichandran, P.
Sahu, A. K.
Sen, A.
Singh, H.
Sivakami, S.
Sultana, M.
Tyagi, B. C.
Yadav, Y. S.

JUNIOR FISHERY SCIENTIST

Bhowmick, R. M.
Karamchandani, S. J.
Lakashmanan, M. A. V.
Mukherjee, G. N.
Murthy, D. S. (on foreign deputation)
Pahwa, D. V.
Ray, P.
Sukumaran, K. K

JUNIOR SCIENTIST EXTENSION

Sharma, B. K.

LIAISON OFFICER

Tripathi, N. K.

FISHERIES FARM ENGINEER

Sengupta, A.

ASSISTANT ENGINEER

Mukherjee, A. B.

SCIENTIST S

Abraham, Mathew
Bagchi, M. M.
Banerjee, R. K.
Banerjee, S. C.
Chakrabarty, D. P.
Chakrabarty, R. K.
Chandra, Krishna
Chattopadhyay, G. N.
Choudhuri, Mahadev
Das, K. M.
Das, R. K.
Dutta, A. K.
Dey, R. K.
Ghosh, Amitabha
Ghosh, P. K.
Ghosh, S. R.
Gopinathan, K.
Gupta, B. P.
Gupta, R. A.
Gupta, S. D.
Jaitaly, P. N.
Joshi, H. C.
Joshi, C. B.
Joseph K. O.
Kaliamurthy, M.
Kanuji, D. R.
Karmakar, H. C.
Kumar, Dhirendra
Mehrotra, S. N.
Mishra, B. K.
Mishra, D. N.
Mitra, P. M.
Mohanta, P. C.
Mukhopadhyay, M. K.
Mukhopadhyay, P. K.
Murugesan, V. K.
Nath, D.
Pal, J. N.
Pandey, B. L.
Pathak, V.
Prakash, Shree
Radhakrishnan, S.
Ramakrishnaiah, M.
Rangaswami, C. P.
Rao, K. V.
Rao, P. L. N.
Saha, P. K.
Saha, S. K.
Saxena, R. K.
Seth, R. N.
Shrivastava, N. P.
Singh, Balbir
Singh, D. N.
Singh, Harbhajan
Singh, H. P.
Singh, R. K.
Singh, S. N.
Srinivasagam, S.
Srivastava, G. N.
Sugunan, V. V.
Sunder, Shyam
Thakurta, S. C.
Tyagi, R. K.

SENIOR RESEARCH ASSISTANT

Banerjee, A. C.
Basu, N. C.
Bhagat, M. J.
Chakrabarty, N. M.

Chaudhury, A.
Das, B. (left on 30.11.76)
Ganapati, R. (left on 7.4.76)
Hazra, A.
Jha, B. C.
Kapoor, D.
Kaushal, D. K.
Kohali, M. P. Singh
Kolakar, V.
Kumar, D.
Kumaratha, P.
Laha, G. C.
Malhotra, P. K. (left on 25.9.76)
Mazumder, S. K.
Nasar, S. A. K.
Rai, S. P.
Roy, A. K.
Sar, S. N. (on study leave)
Sharma, V. K.
Singh, B. K.
Sukumaran, P. K.

OVERSEER

Bhattacherjee, P. N.

SENIOR ARTIST

Ghosh, J.

SENIOR LIBRARY ASSISTANT (Grade— I)

De, Anjali

RESEARCH ASSISTANT

Banerjee, B. K.
Chakrabarty, P. K.
Chaudhury, A. R. (on study leave)
Das, P. B.
Das, P. R. (on study leave)
De, D. K.
De, R. N.
Diwedi, R. K.
Kar, S. L.
Mazumder, H. S. (on study leave)
Pandit, P. K. (on study) leave)
Pisolkar, M. D. (on study leave)
Raghaban, S. L.
Ramaraju, T. S.
Rao, D. R.
Rao, K. S.
Reddy, P. V. G. K.
Roy, B.
Saha, B. K.
Sarkar, S. K. (on study leave)
Singh, R. C.
Srivastava, N. K.
Vincci, G. K.

OVERSEER

Basak, B.

ESTIMATOR

Sahoo, Chakradhar

DRAFTSMAN

Mantri, Muralidhar

ARTIST PHOTOGRAPHER & PHOTOGRAPHIC ASSISTANT

Ghosh, P. K. — Mazumdar, A. R.

ARTIST

Das, S. K.

SENIOR LIBRARY ASSISTANT (Grade—II)

Das, Sukla

JUNIOR SURVEY ASSISTANT

Agarwal, K. K.
Abdul Khadir, P. M.
Banerjee, K. S.
Bhattacherjee, G. P.
Bose, P. S. C.
Chandra, Ram
Das, K. M.
Dutta, B. R. (on study leave)
Ekka, A. K.
Ghosh, Bhaskar
Ghosh, S. P.
Mazumder, N. N.
Mondal, N. C.
Muduli, H. K.
Panigrahi, V.
Paul, A. R.
Rahaman, M. F.
Roy, A. K.
Sarkar, Aloke
Sarkar, N. D.
Sarkar, N. N. (on study leave)
Srivastava, D. N.
Saroj, B. D.
Sen, H. K.
Verma, D. P.

ARTIST

Dasgupta, P.

ELECTRICIAN

Chatterjee, S. K,
Guin, Narsing
Sadhukkan, B. N.

MECHANIC

Sathpati, R. C.

Singh, Donald

LABORATORY AND FIELD ASSISTANT

Chatterjee, Swapan Kumar
Das, B. B.
Jain, Aloke Kumar
Krishnan, S.
Lakra, Camil
Langer, R. K.
Mohanti, A. N.
Mishra, J. P.
Pani, K. C.
Saha, Sukumar
Sahoo, G. C.
Safui, Debashis
Sarengi, N.
Singh, M. P.
Tiwari, Ranjit

SAMPLE SORTER

Banerjee, A. K.
Gupta, A. K.
Moitra, S. C.
Nath, A. K.
Saha, K. P.
Saha, N. P.
Saha, R. D.

SENIOR GESTETNER OPERATOR

Bhowmick, S. C.

SENIOR BINDER

Das, M M.

DRIVER/ENGINE DRIVER/LAUNCH DRIVER/MINI BUS DRIVER/ VEHICLE DRIVER

Bahadur, Suraj
Balmiki, R. L.
Basmodaya
Biswas, N. C.
Chatterjee, U. K.
Das, K. L.
Das S. C.
Deb, K. R.
Deo, Kishen
Dutta, K. K.
Das, Harihar
Ghosh, T. P.
Kahali, B.
Negi, R. S.
North, C. K.
Roy, B. B.
Roy R. M.
Saha, J. C.
Sethi, B. B.
Singh, Badal lal
Singh, R. N.
Subramani, M. G.
Tarai, D.

CARPENTER

Bhattacherjee, S.

PUMPMAN

Roy, N.

Technical Supporting

BOOK BINDER

Saha, N. K.

GESTETNER OPERATOR

Naik, D.

AQUARIUM ATTENDENT

Bose, M. R.

Routh, H. K.

LABORATORY BOY

Bahadur, Budhi
Bahadur, Hari
Barik, D.
Barik, N.
Bhoi, B.
Bhuyan, U.
Biswas, D. N.
Bose, J. L.
Burman, M. S.
Chakrabarty, S. K.
Das, K. K.
Das, Musa
Das, S. K.
Dutta, S. K.
Haldar, R. K.
Iruthiraj, M.
Kujur, J. M.
Mishra, P.
Mondal, A. K.
Majhi, B.
Panda, L.
Pandey, C. K.
Patra, A. M.
Prakas, B.
Ram, Bokshi
Saha, R. N.
Sahu, D.
Samal, D. R.
Sasmal, B.
Singh, Chattar
Verghese, P. V.

LABORATORY-CUM-FIELDMAN

Choudhury, M. S.
Kotarah, S.
Naik, B.
Rao, B. Appa

FIELDMAN

Bahadur, C.
Bahadur, Durga
Bahadur, Jit
Bahadur, Nar
Barik, S.
Behera, A.
Behera, A. C.
Behera, B. N.
Behera, K. B.
Behera, K. C.
Behera T.
Bhuyan, N.
Biswas, J. N.
Biswas, T. K.
Burman, G. N.
Chakrabarty, K. L.
Dalai, Balaram
Das, A. R.
Das, C.
Das, H. K.
Das, K. P.
Das, P. V. N.
Dey, S. K.
Dosad, R. B.
Gopal, K.
Gangaram
Jally, D.
Jally, H.
Jally, U. N.
Jana, N.
Jana. K. C.
Lal, Bhai
Lal, Hari
Lal, Madan
Lama, H. B.
Mandal, S. L.
Mewalal
Mohanty, N. N.
Moolchand
Munda, B. R.
Naik, J.
Nhuloka, D.
Patnaik, S. R.
Pramanick, H. K.
Prasad, K.
Rahman, A.
Raikwar, R. L.
Ramdeo
Ram, Lalu
Rao, Ch. G.
Sahmood
Sahu, D.
Samal, H. K.
Sarkar, A. K.
Setty, P. C.
Singh, Dasharath
Singh, D. N. Baldev
Sitaram
Sivaraj, M.

BOAT DRIVER

Jally, K. B.

BOATMAN

Balaram, M.
Behara, K.
Burman, H. K.
Das, P. C.
Tiwar, R. N.
Yadav, A. L.

DECK SUKHANY

Chakraborty, S.
Saha, P. C.

KHALASI

Biswas, S. G.

LASKAR

Pugalendhi

CHAINMAN

Das, J. R.

Ranjit, R. B.

FISHERMAN

Anjanappa, M.
Appana, K.
Banjara, S. S.
Barik, D.
Behara, K.
Behara, K. B.
Behara, R. K.
Bez, P. C.
Bhanja, D.
Binda, M. P.
Biswas, Ananda
Biswas, A. K.
Biswas, Jagadish
Biswas, M. N.
Biswas, R. C.
Biswas, S. C.
Borah, B.
Burman, B.
Burman, H. S.
Burman, N. K.
Burman, Shatendra
Burman, Sudhanshu
Burman, S. K.
Burman, S. N.
Burman, S.S.
Chaudhury, J.
Das, B. C.
Das, D. C
Das, Giridhari
Das, Gunadhar
Das, Janiram
Das, K. M
Das, S.
Dhibar, G.
Dukharan
Gangayya, A.
Garate, S. T.
Gowada, K. N.
Gowada, M.
Halder, R. K.
Hazarika, B.
Jally, Baman
Jally, K. C.
Jally, L.
Jana, B. K.
Jana, G. M.
Japhuram
Jena, N. C.
Kallanan, K.
Kemparasha, A.
Krishnan, M. V.
Lal, Bideshi
Lal, Jawari
Mallah, J. N.
Mallah, .
Mandal, Biswanath
Mandal, B. N.
Mandal, G. C.
Mandal, N. K.
Mandal, N. N.
Mandal, S. C.
Mani, K.
Manickyan, P.
Marappa, V.

Moolchand
Mukhia, J.
Murugesan, A.
Naik, N. B.
Namasudra, R. K.
Parasram
Parida, F.
Parida, G.
Parida, S.
Parida, Y.
Pradhan, B.
Prasad, R.
Raju, K. D.
Ram, L.
Ramalingam, M.
Rao, Subba
Ray, Karam
Runndale, G. J.
Sahani, A.
Sahoo, D.
Sahoo, G.
Sahoo, L.
Samanta, N. C.
Santra, G.
Santram
Satyanarayan, U.
Sayalu, P.
Seshanna
Singh, C. P.
Sihgh, M.
Sita
Somulu, L.
Srjnivasan, V. K.
Subramani
Subramaniyan, K.
Vava, C. K.
Yesiah, R.

Administrative

ADMINISTRATIVE OFFICER

Kulkarni, C. D. (left on 25.10.1976)

ACCOUNTS OFFICER

Sarkar, M. K.

ASSISTANT ADMINISTRATIVE OFFICER

Chakraborty, S. N.
Chatterjee, S. K.
Lahiri, G.
ithanapati, P. K. (from 25.10.1976)

P. A. to Director,

SENIOR STENOGRAPHER

SUPERINTENDENT

Biswas, M. L.
Das, A. K.

Kanungo, P. C.
Rajani, K. B.
Roy, K. C.
Sengupta, A. K.

ASSISTANT

Bhattacherjee, B. C.
Bose, S. K.
Chatterjee, B. R.
Chatterjee, N. G.
Das, T. P.
Dasgupta, S.
Dutta, B. C.
Roy, M. R.
Roy, S. C.
Saha. S. C.
Sarkar, A. C.
Sarkar, N. K.
Shastry, S. P.
Zaidi, F. A.

STENOGRAPHER

Banerjee, A. K.
Chakladar, H.
Chakrabarty, G. M.
Srivastava, R. C.

JUNIOR STENOGRAPHER

Das, P. K.
Ghosh, U. K.
Jena, P.
Prasad, P.
Sahoo, D. C.
Sinha, R. C. P.

SENIOR CLERK

Acherjee, D. K.
Baidya, D. N.
Banerjee, D. K.
Banerjee, J.
Bose, D. C.
Choudhury, Namita
Das, C. C.
Ghosh, B. K.
Halder, S. R.
Halim, Abdul
Kar, S. K.
Kodandraman, I. N.
Mazumder, Sandhya
Mishra, L. P.
Mitra, N. K.
Nath, H. K.
Neogi, M. M.
Patra, J. C.
Pramanick, S. K.
Pramanick, S. N.
Prasad, Keshab
Prasad, Mahesh
Roy, Bani
Sarkar, S. K.
Shaw, Awadh
Singh, R. C. P.
Sreedharan, T. K.
Subrahamaniam, M.
Sutar, H. B.

JUNIOR CLERK

Banerjee, Anita,
Banerjee, Narayani
Behara, A. C.
Behara, R. C.
Bhagirathi, S.
Bhattacherjee, S.
Bhowmick, S.
Biswas, A. B.
Biswas, Manjulal
Biswas, P. K.
Bose, Samir Kumar
Chatterjee, Dipankar
Chatterjee, T.
Das, D. K.
Das, G. B.
Das, M. K.
Dey Sarkar, D. K.
Dutta, P. K.
Ghosh, P. K.
Guriah, W.
Hansda, Sreedam
Kachhap, M.
Kumar, Surendra
Kundu, N. R.
Lahiri, P.
Lal, Ambika
Mandal, A. B.
Mandal, S. P.
Mazumder, B. C.
Mazumder, Sikha,
Mazumder, T. K.
Mukherjee, B. B.
Mukherjee, R. R.
Mupid, S. S.
Naik, N. C.
Nath, Baij
Panda, R. K.
Radhakrishnan, K.
Rai, Jagadish
Raina, R. L.
Roy, J.
Roy, Samir
Roy, S. B.
Saha, R. B.
Sarkar, B. K.
Sarkar, H. L.
Singh, K.
Sinha, S. S.
Soni, K. B,
Srivastava, A. K.

Administrative Supporting

FOREST GUARD

Manna, M. L.

PEON

Bahadur, Mina
Baral, S. K.
Behara, M. S.
Behara, N.
Bhanja, B.
Bose, H. L.
Burman, S. N.
Das, B. B.

Das, N. L.
Ghosh, A. C.
Halder, C. R.
Jangali
Jugalkishore
Maity, S. S.
Mandal, B. N.
Mandal, Kalosashi
Mani, N.
Manna, L C.
Narasappa, B.
Narendra, G. C.
Panda, Jagadish
Parbat, L. K.
Raghavana, K. V.
Ram, Rulia
Sahoo, K. M.
Singh, C. P.
Singh, Prahlad
Singh, Ramdeo
Singh, S. S.

MESSENGER

Bose, Shankar
Deb Roy, R. L.
Karmakar, S.
Khaiko, Joseph
Ram, Rajendra
Saha, M. L.
Salia, M. R.

WATCHMAN

Bahadur, Asta
Bahadur, Bhim
Bahadur, Indra
Bahadur, Karna
Bahadur, Lalit
Bahadur, Ram
Bahadur, Sitaram
Bahadur, Surja
Bahadur, Tek
Bhoi, R. C.
Bhoi, S.
Bhuyan, D.
Bijoli, Amulya
Dhir, K. K.
Kachari, P. C.
Kerketta, Joseph
Krishnappa, B. N.
Mahadeva, M.
Mahendran, S.
Mallah, M. L.
Muchi, R. U.
Naik, B. K.
Paik, B. C.
Painiswami, R.
Paramanick, G. C.
Prakash, Om
Prasad, Lalta
Rajaratnam, R.
Rao, G. C.
Sahoo, Gulab
Swain, R. N.
Yadav, S. P.

MALI

Biswas, A. K.
Biswas, Hiralal
Chaki, S. N.
Mandal, M. G.
Sunder, Ram

SWEEPER

Balmiki,
Chand, Khem
Chand, Salek
Chand, Sir
Das, D.
Dehuri, B.
Dhanuk, Badiu
Dhanuk, Shyamlal
Jena, Panchanna
Lal, Kishan
Parameshwar
Raju, A. E.
Ram, Iswar
Ram, Munsi

RESEARCH SCHOLAR

Asotra, Satish
Barua, S. K.
Bedre, R. V.
Belurkar, B. R.
Chakrabarty, Gouri
Mukherjee, A. P.
Panigrahi, S.
Rao, B. R. Vaijnath
Saha, S.
Sharma, Neelima

APPENDIX—I

CENTRAL INLAND FISHERIES RESEARCH INSTITUTE

(I.C.A.R.)

BARRACKPORE : WEST BENGAL

Ministry/Department/Office of Central Inland Fisheries Research Institute Barrackpore, West Bengal. Statement showing the total number of ICAR Servants and the number of Scheduled Castes/Tribes amongst them as on 1st January 1977.

Class	Permanent Temporary	Total No. of employees	Scheduled Castes	Percentage to total employees	Scheduled Tribes	Percentage to total employees	REMARKS
Class I	Permanent	47	1	2%	—	—	—
	Temporary	51	3	6%	—	—	—
Class II	Permanent	34	1	3%	—	—	—
	Temporary	81	6	7%	—	—	—
Class III	Permanent	134	27	20%	1	1%	—
	Temporary	105	17	16%	7	7%	—
Class IV (Excluding Sweepers)	Permanent	155	39	25%	2	1%	—
	Temporary	87	19	22%	2	1%	—
Class IV (Sweeper)	Permanent	11	11	100%	—	—	—
	Temporary	9	8	92%	1	8%	—

APPENDIX-II

ORGANISATION CHART OF CENTRAL INLAND FISHERIES RESEARCH INSTITUTE BARRACKPORE

DIRECTOR

JOINT DIRECTOR

FRESHWATER AQUACULTURE DIVISION

624, Saheed Nagar
Bhubaneswar-751007

- Pond Culture Section
- Fish Breeding Section
- Exotic Fish Culture Section
- Weed Control Section
- Soil Chemistry Section
- Frog Culture Section
- Fish Farm Engineering Section
- Fish Pathology Section
- Fish Hybridisation & Genetics Section

FRESHWATER AQUACULTURE RESEARCH & TRAINING CENTRE (Dhauli)

Research Centre
Research Centre
...ENDRA-...ATSYA)
...CENTRE-...HERIES)
Research Centre
Research Centre

ESTUARINE FISHERIES DIVISION

47/1, Strand Road
Calcutta-700007

- Estuarine Fisheries Section
- Hilsa Fisheries Section
- Water Pollution Section
- Statistical Section
- Plankton Culture Section

CALCUTTA RESEARCH CENTRE

Research Centre
Research Centre
Research Centre

RIVERINE & LACUSTRINE FISHERIES DIVISION

24, Pannalal Road,
Allahabad-211002

- Riverine Fisheries Section
- Hilsa Fisheries Section
- Reservoir Fisheries Section
- Statistical Section
- Water Pollution Section

ALLAHABAD RESEARCH CENTRE

...rch Centre
Research Centre
Research Centre
Research Centre

ALL INDIA COORDINATED RESEARCH

COMPOSITE FISH CULTURE AND FISH SEED PRODUCTION

624, Saheed Nagar,
Bhubaneswar-751007

Subcentres

...t Bengal)
...t Bengal)
... Pradesh)
...amilnadu)
... Pradesh)
... Haryana)
...arashtra)
...il (Bihar)
...l (Assam)
... (Gujarat)
...amilnadu)
... (Orissa)
... Pradesh)

AIR BREATHING FISH CULTURE IN SWAMPS

Barrackpore (W.B.)
Pin-743101

Subcentres

- GAUHATI (Assam)
- DARBHANGA (Bihar)
- BANGALORE (Karnataka)
- *PALAIR (Andhra Pradesh)
- *KALYANI (West Bengal)

RESERVOIR FISHERIES

24, Pannalal Road,
Allahabad-211002

Subcentres

... Pradesh)
...amilnadu)
... Pradesh)
...il (Bihar)
... Pradesh)
... (Gujarat)
...t Bengal)

BI... B...