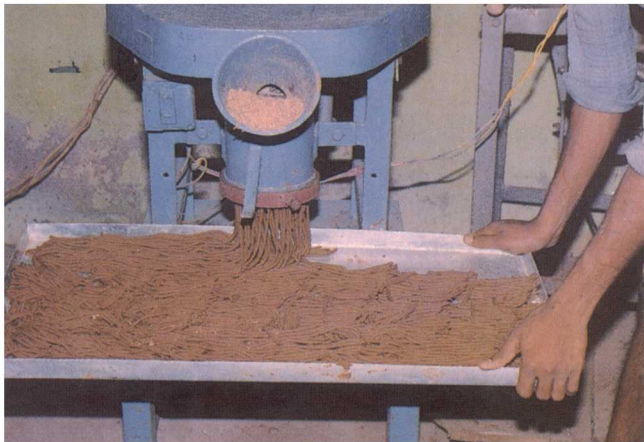




# Annual Report

## 1987



**CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE**  
INDIAN COUNCIL OF AGRICULTURAL RESEARCH  
12, LEITH CASTLE STREET, SANTHOME, MADRAS 600 028



# Annual Report

1987

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12, LEITH CASTLE STREET, SANTHOME, MADRAS 600 028

*Published by*

DR. K. ALAGARSWAMI, *Director, Central Institute of  
Brackishwater Aquaculture, Madras-600 028*

*Compiled by*

SHRI K. N. KRISHNAMURTHY, *Scientist S-2*

*Cover Photos*

*Top :*    *Left*—A view of the Narakkal Prawn hatchery  
          *Right*—A view of the cages for the rearing of finfish at Ennore

*Bottom :* *Left*—Preparation of compounded feeds  
          *Right*—Kakdwip fish farm

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## PREFACE

The year 1987 witnessed further consolidation of the establishment of the Institute with the actual transfer of the Research Centres at Kakdwip, Puri and Madras from the Central Inland Capture Fisheries Research Institute and the Narakkal Centre from the Central Marine Fisheries Research Institute. The Krishi Vigyan Kendra at Kakdwip also came under its administrative control. Independent budget and physical funds were made available to the Institute during the year for the implementation of the research projects which were drawn up under its own authority.

The first Director of the Institute, Dr. E. G. Silas, relinquished charge on 16-8-1987 on voluntary retirement to take up the post of Vice-Chancellor of Kerala Agricultural University. Dr. K. Raman, Scientist S-3, held current charge of the post of Director up to 30-10-1987 and Dr. (Mrs.) T. Rajyalakshmi, Scientist S-4, officiated as Director up to 10-4-1988. I took over as Director of the Institute on 11-4-1988. The present Annual Report for 1987 is presented by me based on reports from various sections available on record for the period.

In spite of several constraints, the scientists have made notable contributions in brackishwater aquaculture research, with

emphasis on penaeid prawns. *In vitro* fertilization of *Penaeus indicus* eggs leading to successful larval rearing has given a technique for overcoming mating failure problem as also for breeding towards stock improvement. Larval rearing technique for *P. monodon* has been developed with appropriate feed. Monitoring the ecology of prawn culture ponds on the Chilka Lake fringe, the inherent soil and water problems resulting in low productivity have been highlighted. Attempts made on breeding and larval rearing of grey mullets have yielded partial success. Breeder availability of the seabass (*Lates calcarifer*) has been ascertained. Growout systems for prawns and fish in the Institute's own ponds, and in pens and cages in the Pulicat Lake have been developed for improving production and productivity. Some highlights of results under the research projects are given in the Report.

I wish to thank Shri K. N. Krishnamurthy, Scientist S-2 for his help in compiling the report and Dr. (Mrs) T. Rajyalakshmi, Scientist S-4 and Shri A. V. P. Rao Scientist S-3, for critically going through the same.

Madras  
19th December, 1988

K. ALAGARSWAMI  
Director

## INTRODUCTION

### Objectives

The main objectives of the Institute are to conduct multidisciplinary, mission-oriented research to develop appropriate technologies for the aquaculture of finfishes and shell-fishes in the brackishwater areas for augmenting fish production ; to provide data base for sustained growth and accelerated development of the artisanal and industrial culture fisheries in the coastal sector ; and to provide development support through technology transfer, training, education and linkages.

### Organisational set-up

Since the location of the headquarters of the Institute had not been decided, the Madras establishment continued as the temporary headquarters of the Institute. The field laboratories at Ennore and Pulicat formed the main base of work at the headquarters. The Research Centres at Kakdwip, Puri and Narakkal were the subordinate establishments. The Krishi Vigyan Kendra at Kakdwip came under the administrative control of the Institute.

The proposed scientific Divisions, namely (i) Finfish Culture Division, (ii) Crustacean Culture Division, (iii) Fish Farm Survey and Engineering Research Division, (iv) Resource and Technology Improvement Division and (v) Training, Extension and Information Division could not be established during the year for want of adequate manpower in position. However, research programmes, envisaged under these Divi-

sions, except survey and engineering, were taken up. The Library section got well established to serve the reference needs of the scientists and other staff.

### Infrastructure

The present headquarters of the Institute at Madras is located in hired buildings. The Institute has its own campus including permanent laboratory-cum-administrative building, farm complex and residential quarters only at Kakdwip Research Centre. Narakkal Research Centre has a semi-permanent structure and a few experimental ponds as the establishment which was transferred was only a field laboratory of the Central Marine Fisheries Research Institute. The buildings for the Krishi Vigyan Kendra at Kakdwip were under completion. Puri Research Centre is located in a hired building.

Despite severe constraints of lack of permanent buildings as mentioned above, working facilities for the research programmes were strengthened.

### Finance

#### *Budget Expenditure*

1987-88

(Rs. in lakhs)

		<i>Budget</i>	<i>Expenditure</i>
Non-Plan	..	28.00	29.76
Plan	..	30.00	25.60
Total	..	<u>58.00</u>	<u>55.36</u>

## PROGRESS OF RESEARCH

### Prawn breeding and development of hatchery technology

Cr/PB/1.1 : PURI : Mrs. T. Rajyalakshmi,  
S. M. Pillai, P. Ravichandran

Cr/PB/1.2 : MADRAS : A. V. P. Rao,  
L. H. Rao, S. Radhakrishnan, B. P.  
Gupta, K. V. Ramakrishna, K. Gopi-  
nathan, C. P. Rangaswamy, K. N.  
Krishnamurthy, S. Srinivasagam

Cr/PB/1.3 : NARAKKAL : A. Laxmi-  
narayana, S. Kulasekharapandian,  
Syed Ahmed Ali

Work on this project was taken up in three centres viz., Narakkal, Madras and Puri. At Narakkal, concerted efforts were made to develop a viable breeding and hatchery technology for the white prawn, *Penaeus indicus*. At Madras and Puri, the major thrust was towards development of broodstock, induced breeding and hatchery technology for the tiger prawn, *Penaeus monodon*; in addition, breeding of *P. indicus* was also taken up at Madras.

#### Narakkal

At Narakkal, a breakthrough was achieved in developing a technique for production of larvae of *Penaeus indicus* by *in vitro* fertilization of eggs. In this experiment fully mature females, which were not impregnated were selected, their ovaries removed and the eggs were mixed with a thick suspension of sperms collected from the thelycum of an impregnated female, and terminal ampoules and vas deferens

of a male. The rate of fertilization of eggs mixed with sperms from the thelycum was 88.0% while that of eggs with sperms from terminal ampoule was 40.4%, with survival rate of 78.9% and 74.3% to postlarval stage (PL-5) respectively. The eggs mixed with sperms from vas deferens were not fertilized.

The nauplii were seen 10 hours after *in vitro* fertilization; the larvae were fed a diet of mixed phytoplankton dominated by *Chaetoceros*; later *Squilla* powder was used as larval food upto PL-20 stage. Subsequently clam meat was used as feed till the larvae reached sub-adult stage. The larvae had grown to 64 mm in length in a period of 68 days.

The technique of *in vitro* fertilization of *P. indicus* developed at the Institute will find wide application in inter- and intra-specific breeding of penaeid prawns and solving the problem of mating failure.

During October-December 1987, 44 eye-ablated *P. indicus* and nine wild spawners spawned successfully at the Narakkal Laboratory. All the prawns obtained from the wild spawned fully. Among eye-ablated prawns, only 14 spawned fully and the rest only partially. Majority of these prawns (64.0%) was in the 151-160 mm size group. The number of eggs spawned ranged from 28,640 to 1,26,000. The hatching rate ranged from 35.7% to 100%. Experiments on larval rearing of *Penaeus indicus*

were conducted in plastic pools and conical FRP tanks. In all, 38 larval rearing trials were conducted producing 38,00,000 nauplii. Postlarval (PL-5) production was 9,64,000.

#### *Madras-Ennore*

Studies on the development of broodstock of *P. indicus* under laboratory conditions showed that the prawns matured faster and the hatching rate of eggs better, if reared under darkness. At Ennore, a number of experiments were conducted on broodstock management and induced maturation on *P. monodon* and *P. indicus*. Adult prawns of both sexes from Pulicat lake and mature prawns from the sea were brought to the hatchery and maintained in FRP tanks and plastic pools. 25 to 50% of water exchange was done daily and the animals were fed with green mussel (*Perna viridis*) meat at 10% of the body weight during day and at 5% at night.

Induction of maturity through eyestalk ablation (unilateral) was attempted in both the species. In the case of *Penaeus monodon*, only one female showed signs of developing ovary (stage II) 26 days after eyestalk ablation; subsequently, resorption of ovary took place. All the other animals did not show any sign of maturity.

An eye-ablated *P. indicus* measuring 195 mm showed repeated maturation and spawning. The first two spawnings resulted in unfertilized eggs due to mating failure. The third spawning that took place 37 days after ablation gave fertilized eggs, yielding 60,000 nauplii. In the second trial one prawn matured four days after eye ablation but later the ovary got regressed. Two prawns matured 11 days after eye ablation.

Eleven runs of *P. indicus* larval rearing were carried out during the first half of the year. A total of 4,70,000 PL-2 was produced and survival rate ranged from 16%

to 67.6%. The larvae were fed with *Chaetoceros* and tissue suspension of green mussel.

During June-July 1987, eight larval cycles of *Penaeus monodon* were run. Mature tiger prawns obtained from trawler catches off Madras coast ranging in size from 197 mm to 265 mm in length and 70 g to 210 g in weight were used for breeding. Altogether 22,24,000 nauplii were produced. In experimental larval rearing the density of nauplii ranged between 20 and 130/litre. Three larval feeds tried were: (i) *Chaetoceros*+*Perna viridis* tissue suspension, (ii) *Chaetoceros*+boiled prawn tissue and (iii) raw prawn tissue. In all these trials the survival ranged from 0.4% to 9.8% only. Accumulation of nitrite (300 µg/l) and ammonia (0.1 ppm) despite regular water exchange and aeration resulted in heavy mortality of the larvae and only 36,400 postlarvae survived.

#### *Puri*

The Puri Research Centre continued to develop a recycling system of water management in a small hatchery facility in the laboratory premises with a biological filter and FRP tanks. *P. monodon* obtained from Chilka lake were used in repeated maturation trials using different size groups. Algal cultures and *Artemia* cyst production were also done.

#### **Prawn Culture**

Cr/PC/2: MADRAS: K. Raman, K. V. Ramakrishna, K. N. Krishnamurthy, K. Gopinathan, C. P. Rangaswamy, S. Srinivasagam, B. P. Gupta

Cr/PC/4: PURI: S. M. Pillai, Mrs. T. Rajyalakshmi, P. Ravichandran

Cr/PC/5: NARAKKAL: S. Kula-  
sekharapandian, A. Laxminarayana,



BF/A/4 : MADRAS : K. V. Ramakrishna,  
K. N. Krishnamurthy

Breeding of the grey mullet *Liza macrolepis* was attempted by stripping technique and 4,00,000 eggs were obtained. About 50% of the eggs hatched out at an ambient temperature of 20-23.5°C within 24 hours. The experiments were conducted in open field conditions at Chilka lake mouth area. The larvae were transported to Puri Research Centre and reared for 14 days in the indoor hatchery facility. Heavy mortality of larvae occurred during 15th and 16th day due to ciliate infection and inadequate aeration caused by frequent power failure. The larvae were fed with diatoms cultured in the laboratory consisting mainly of *Chaetoceros* and *Skeletonema*. At Ennore some success was achieved in the breeding of *Mugil cephalus* with a combination of carp pituitary hormone and HCG and 1,00,000 hatchlings were produced. However, the larvae did not survive beyond the 3rd day.

Near Chilka lake mouth, females of *Lates calcarifer* in stage III of maturity (7-10 kg weight) were observed. Males of 1.6-4 kg were found to be in oozing condition. Attempts were made to collect live breeders and maintain them in plastic pools of 15 t capacity and open pens with little success. The fishes collected from commercial hook-and-line catches were mostly injured and did not survive the stress of transport and handling. Attempts were made to raise a broodstock of *L. calcarifer* in specially made net enclosures in the Ennore backwaters.

In order to develop a captive broodstock of *Chanos chanos*, 5-7 year old fish were reared in a cage at Narakkal. A diet consisting of more than 40% protein was given to the fish.

## Finfish culture

FFC/PC/2 : MADRAS : R. D. Prasadam,  
L. H. Rao, K. N. Krishnamurthy,  
K. Raman, K. V. Ramakrishna,  
K. Gopinathan, S. Srinivasagam, B. P.  
Gupta

FFC/3 : KAKDWIP : B. K. Banerjee,  
R. K. Chakraborti, H. S. Majumder

Pen and cage culture of fish and shellfish was found to be a suitable technology for the Pulicat Lake fringe area. Three experiments were initiated viz., raising of juveniles in cages, growout technology for juveniles in pens and raising of immature fish to be developed as broodstock.

*Chanos chanos*, 88.1 mm length and 5.6 g weight (average), collected from Pulicat lake were stocked in five velon mesh cages of 50 m<sup>2</sup> each at 12/m<sup>2</sup>. The fish were fed with a mixed diet of groundnut oilcake and rice bran at 1 : 1 ratio at 5% of the body weight daily. At the end of the rearing period, the fish had grown to an average 162.3 mm and 31 g with a survival rate of 33.1%. The fish were later transferred to growout pens.

*Chanos* of 187.4 mm/66.9 g and *Mugil cephalus* of 218.2 mm/98.7 g were stocked together in two pens at 2400/ha. In one pen the stocked fish were fed with groundnut oil cake and rice bran at 1 : 1 ratio at 5% body weight once daily. In the second pen, no supplementary feed was given to the fish. After 8 months of rearing, the fishes were harvested. In the first pen where feed was given, the growth of *Chanos* was 319.8 mm/212.7 g and that of *M. cephalus* was 250 mm/180 g. Production of fish from this pen was 20.95 kg which worked out to 261.9 kg/ha/8 months. In the second pen, where there was no supplementary feeding, *Chanos* had grown to

300.7 mm/188.9 g and *M. cephalus* to 228.8 mm/130 g. The production worked out to be 182.6 kg/ha/8 months. Productivity was found to be of a low order in the ecosystem.

#### **Breeding and culture of horseshoe crab**

Cr/L/3 : PURI : Mrs. T. Rajyalakshmi,  
S. M. Pillai, P. Ravichandran

A special programme on horseshoe crab, *Tachypleus gigas* of Orissa coast, which has gained considerable importance in biomedical research, has been initiated. As a preliminary attempt, the horseshoe

crab ranging in size from 21 to 41 cm and 185 to 500 g were collected during the latter half of the year from Gobari river near Jambudwip and Chilka lake and transported to Puri Research Centre. They were stocked in a plastic pool provided with 30 cm sand as substratum. The animals were fed with bivalve meat. Under captivity the horse-shoe crab was found to prefer darkness and remain buried inside the sand.

In October 1987, one female (41 cm/500 g) released about 100 eggs. The eggs were 3-4 mm in diameter and grey to opaque in colour. The eggs did not hatch or show further development. The salinity and temperature of water in the rearing pools were 28-32 ppt and 27-29°C.

## ADVISORY/CONSULTANCY SERVICE PROVIDED

Dr. E. G. Silas, Director served as Member of

- Advisory Committee of Bombay Natural History Society, Bombay
- Scientific Advisory Committee of the National Institute of Oceanography, Goa
- ICAR Committee to review areas of responsibilities constituted by the Director General, ICAR
- Committee constituted by the Maharashtra Government for National Parks
- National Mangrove Committee constituted by the Department of Environment, Government of India
- Indian National Science Academy Scientific Panel, New Delhi

— Member-Secretary of the ICAR Expert Group constituted for Site Selection of the Central Institute of Brackish-water Aquaculture

Dr. (Mrs.) T. Rajyalakshmi, Scientist S-4 served as Member of

- Task Force on Fisheries of Sectoral Committee on Agriculture and Rural Development (SCOARD) of Andhra Pradesh
- Management Committee of BFDA, Puri
- Expert member to NABARD, Bhubaneswar

Dr. K. V. Ramakrishna, Scientist S-3 served as a Member of Management Committee of CICFRI, Barrackpore.

## TRAINING OF PERSONNEL

Dr. K. V. Ramakrishna, Scientist S-3—Project Planning and Coordination Course at National Academy of Agricultural Research Management, Hyderabad, September, 1987

Shri A. V. P. Rao, Scientist S-3—Human Resources Development Course at National Academy of Agricultural Research Management, Hyderabad, October, 1987

Dr. S. M. Pillai, Scientist S-2—Short-term study course on Cytogenetics and Bio-

chemical Genetics at National Bureau for Fish Genetic Resources, Allahabad, 3-11 January, 1987

— Training Course on 'Fin Fish and Shellfish Nutrition' at Central Marine Fisheries Research Institute, Cochin, May, 1987

Dr. C. P. Rangaswamy, Scientist S-2—Training Course on 'Fin Fish and Shellfish Nutrition' at Central Marine Fisheries Research Institute, Cochin, May, 1987.

## PARTICIPATION OF SCIENTISTS IN SEMINARS/SYMPOSIA

### **Dr. E. G. Silas, Director**

- The National Symposium on the Impact of Current Land Use Pattern and Water Resource Development on the Riverine Fisheries at Central Inland Capture Fisheries Research Institute, Barrackpore, 25-27 April, 1987
- Marine Fisheries Resources and Manpower Development at Central Institute of Fisheries Nautical & Engineering Training, Visakhapatnam, April, 1987
- Advisory meeting of the Bombay Natural History Society, Bombay, May, 1987
- National Seminar on Estuarine Management, Trivandrum, 4-8 June, 1987. He delivered the Keynote Address
- ICAR Review Committee meeting, New Delhi, 21st July, 1987

### **Dr. (Mrs.) T. Rajyalakshmi, Scientist S-4**

- The National Symposium on the Impact of Current Land Use Pattern and Water Resource Development on the Riverine Fisheries, Central Inland Capture Fisheries Research Institute, Barrackpore, 25-27 April, 1987
- The National Symposium on Research and Development in Marine Fisheries, Central Marine Fisheries Research Institute, Mandapam Camp, 15-18 September, 1987

— The First Indian Fisheries Forum, College of Fisheries, Mangalore, 4-8 December, 1987

— The National Seminar on Freshwater Aquaculture in India, Nagarjuna University, Guntur, December, 1987

### **Dr. K. Raman, S-3, Shri K. N. Krishnamurthy, S-2, Dr. M. L. Bhowmick, S-2**

- National Symposium on the Impact of Current Land Use Pattern and Water Resource Development on the Riverine Fisheries, CICFRI, Barrackpore, 25-27 April, 1987

### **Dr. K. Raman, S-3, Dr. K. V. Ramakrishna, S-3, Shri K. N. Krishnamurthy, S-2, Dr. R. D. Prasad, S-2, Dr. C. P. Rangaswamy, S-2, Dr. S. M. Pillai, S-2, Shri R. K. Chakraborti, S-2**

— First Indian Fisheries Forum, Mangalore, 4-8 December, 1987

### **Dr. R. D. Prasad, S-2, Dr. S. M. Pillai, S-2**

- National Seminar on Freshwater Aquaculture in India, Nagarjuna University, Guntur, December, 1987

### **Dr. K. V. Ramakrishna, S-3**

- National Seminar on Shell-fish Resources and Farming, Central Marine Fisheries Research Institute, Tuticorin.

## DISTINGUISHED VISITORS TO THE INSTITUTE

The following dignitaries visited the Institute during the year :

- |                                                               |                                                                                               |
|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Dr. M. V. Rao, Special Director General, ICAR, New Delhi      | Dr. C. T. Samuel, Professor of Fisheries, Cochin University of Science and Technology, Cochin |
| Dr. P. V. Dehadrai, Dy. Director General (F), ICAR, New Delhi | Dr. D. Sudarsan, Dy. Director General, FSI, Bombay                                            |
| Dr. R. P. S. Tyagi, Member, ASRB, New Delhi                   | Dr. M. N. Kutty, Aquaculturist, FAO, Rome                                                     |
| Dr. C. M. Singh, Retd. Director, IVRI, Izatnagar              | Dr. K. H. Ibrahim, Aquaculturist, FAO, Rome                                                   |
| Shri Dulip Mathai, Chairman, World Wild Life Fund             | Dr. Allan Rolly, ODNRI, London                                                                |
| Shri B. Rajagopala Rao, Member of Parliament, Andhra Pradesh  | Mr. Ngu Yen Du, Republic of Vietnam                                                           |
| Shri K. Chidambaram, Fisheries Consultant, Madras             | Mr. Do Mich, Republic of Vietnam                                                              |
| Dr. J. V. H. Dixitulu, Editor, Fishing Chimes, Visakhapatnam  | Mr. Ngu Yen Chanh, Republic of Vietnam                                                        |
| Dr. V. S. Bhat, Director (P & I), ICAR, New Delhi             | Mr. Lee Xan Yii, Republic of Vietnam                                                          |
| Dr. S. Dutt, Retd. Professor of Zoology, Nagarjuna University | Janab Md. Mamiyul Islam, Government of Bangladesh                                             |
|                                                               | Janab Md. Rizawal Kareem, Government of Bangladesh                                            |
|                                                               | Janab Md. Rafiqul Islam, Government of Bangladesh                                             |
|                                                               | Janab Md. Habeebur Rahman Khondker, Government of Bangladesh                                  |
|                                                               | Mr. Muncer Mullah, Research Scholar, Auburn University, Alabama, USA.                         |

## STAFF

(Not a gradation list)

### Director

Dr. E. G. Silas (Upto 16-8-1987)

Dr. (Mrs.) T. Rajyalakshmi (Officiating  
from 31-10-1987)

### Scientists

#### Scientist S-3

Dr. K. Raman

Dr. K. V. Ramakrishna

Shri A. V. P. Rao

Shri A. R. Thirunavukkarasu (on study  
leave from 16-7-87 to 15-7-89)

Shri P. Ravichandran

Dr. S. M. Pillai

Shri R. K. Chakraborti

Dr. M. K. George

Dr. B. P. Gupta

Dr. K. Gopinathan

Shri S. Srinivasagam

Dr. P. K. Mukhopadhyay (on deputation  
with IIRI, Calcutta)

Shri S. B. Saha (Retired on 31-7-1987)

#### Scientist S-2

Shri K. N. Krishnamurthy

Dr. R. D. Prasadam

Dr. S. Radhakrishnan

Dr. L. H. Rao

Dr. C. P. Rangaswamy

Dr. K. M. Das

Shri S. R. Das (on study leave from 15-7-87  
to 14-7-89)

Dr. A. Laxminarayana

Dr. L. Krishnan

Dr. S. Kulasekhara Pandian

Shri Syed Ahamed Ali

#### Scientist S-1

Smt. Munawar Sultana

Shri B. K. Banerjee

Shri H. S. Majumder

Dr. P. K. Ghosh

## Technical Personnel

### Technical Officers

Shri K. V. George, T-7  
Shri Ashis Chowdhury, T-5

### Technical Assistants

Shri P. M. Abdul Khadir, T-4  
Shri S. Krishnan, T-II-3  
Shri K. K. Surendran, T-2  
Shri C. S. Sasidharan, T-2  
Shri M. G. Sivadasan, T-2  
Shri U. N. Jally, T-1  
Shri S. C. Moitra, T-I-3 (Retired on  
30-11-1987)

### Administrative Personnel

Kum. S. Chandra, Asst. Accounts Officer  
Shri B. R. Chatterjee, Assistant (On deputation to CIRG)  
Shri M. Subramanian, Assistant  
Smt. S. Bhagirathi, Senior Clerk  
Shri P. Prasad, Jr. Stenographer  
Shri S. K. Halder, Jr. Stenographer  
Shri A. B. Mondal, Jr. Clerk  
Shri P. N. Rajasekharan Nair, Jr. Clerk  
Shri P. K. Roy, Jr. Clerk  
Shri S. K. Bindu, Jr. Clerk  
Smt. K. Nandini, Jr. Clerk  
Shri R. Kandamani, Jr. Clerk

### Auxiliary Personnel

Shri M. G. Subramani, T-I-3, Driver  
Shri K. Gopinathan Nair, T-2 Driver  
Shri B. B. Roy, T-2 Driver  
Shri P. C. Mohanty, Driver

### Supporting Staff

*S. S. Gr. IV*  
Shri B. Sasmal

*S. S. Gr. III*  
Shri M. I. Raju  
Shri A. K. Mondal

*S. S. Gr. II*  
Shri M. Ramalingam  
Shri S. S. Maity  
Shri P. Manickyam  
Shri S. C. Mondal  
Shri D. N. Sahoo  
Shri Sita Ram Das  
Shri Gunadhar Das  
Shri B. Dhanuk  
Shri L. C. Manna  
Shri Gangadhar Santra  
Shri Prakash Ch. Saha  
Shri A. E. Raju  
Shri R. K. Behera  
Shri Shyam Bhoi  
Shri Biswanath Mondal  
Shri M. N. Biswas  
Shri A. K. Biswas  
Shri K. M. Das  
Shri N. C. Jena  
Shri N. N. Mondal  
Shri S. R. Bahadur  
Shri Amulya Bijali  
Shri Shyamlal Dhanuk  
Shri B. K. Jena

Shri N. C. Samanta  
Shri K. K. Raman  
Shri Dhaneswar Das

*S. S. Gr. I*

Shri Baman Jally  
Shri N. Mani  
Shri Rash Behari Das  
Shri Gour Hari Jena  
Shri Sasadar Betal  
Shri Kalipada Mondal  
Shri Pranesh Chandra Saha  
Shri K. C. Samal  
Shri M. C. Behera  
Shri P. Arumugam  
Shri R. Subramani  
Shri N. K. Shanmugam  
Shri Phani Gharami  
Shri B. C. Paik  
Shri Sudarshan Naik  
Shri Bijay Bhoi  
Shri Patit Paban Halder

Shri Abimanyu Naskar  
Shri Netaichandra Som  
Shri Rohitosh Kr. Roy  
Shri Balaram Das  
Shri K. U. Gopi  
Shri P. S. Samanta  
Shri S. Pari  
Shri T. V. Shaji  
Shri K. Kunjuraman  
Shri K. Thankkappan  
Shri N. C. Mondal  
Shri N. K. Jena  
Shri M. D. Suresh  
Shri M. Santhosam  
Shri N. Harinathan  
Shri V. Jeevanandam  
Shri Moharaja Majhi  
Shri N. N. Jena  
Shri K. P. Naskar  
Shri Amargharami  
Smt. S. Santhi  
Shri K. Mariappan  
Shri Niranjan Bhuiya (Expired on 5-10-87)



## LIST OF PUBLICATIONS\*

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