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Ecology and Fisheries of Selected Reservoirs in Tamil Nadu : An investigation

Nineteen reservoirs from various river basins in Tamil Nadu have been subjected to investigations. They include upland and polluted reservoirs, and some situated at the border between Kerala and Tamil Nadu. The study has helped to update our database on the ecology of reservoirs facilitating to know the present status of fishery management and yield rates.

The scientists of Coimbatore Research Centre of the Institute generate valuable data on the reservoirs in Tamil Nadu.

The ecological investigations indicated the absence of thermal stratification in any of these reservoirs. However, a slight decrease in water temperature with increase in depth was observed in majority of the reservoirs. Homothermal conditions prevailed in a few. Strong oxycline conditions were absent in the shallow reservoirs due to mixing of water by wind and wave action. However, clinograde type of oxygen profile in certain reservoirs and orthograde type of oxycline conditions in others were observed. These reservoirs had abundant plankton population dominated by phytoplankton (51.6 to 99.9%) with a few exception where zooplankton formed a sizeable quantity. With favourable tropical climate, the primary production was of high order in most of the reservoirs and the fish production potential at 1% of gross primary production ranged from 108.3 to 904.6 kg/ha.

A critical study of the fishery management in these reservoirs revealed that the seed of Cauvery carps stocked in the newly formed reservoirs did not establish, because the lacustrine environmental conditions were not conducive for these fishes. Introduction of the exotic fish, *O. mossambicus* in the 1960's changed the scenario of fisheries in the reservoirs of Tamil Nadu. This alien species grew fast, multiplied through its prolific breeding capacity and formed a major fishery. Since the fish attained a weight of > 1.7 kg in the initial years, it commanded a good market and fetched a reasonable price, hiking the production per unit area and the



A tilapia dominated reservoir is now dominated by major carp ▲

revenue. However, over the years, the individual weight reduced (< 300 g) due to over population and stunted growth losing its demand in the market. Hence, the fish is considered to be a pest and efforts are being made to replace the tilapia fishery with that of major carps. In the absence of natural recruitment and auto-stock of Indian and exotic major carps in the reservoirs studied, stocking of farm produced seeds of cultivated carps is practised in most of the reservoirs. However, the actual fish yield from these reservoirs was pathetically low (3.9 to 357.8 kg/ha) due to improper fishery management. The size of the seed at stocking was smaller (20-40 mm), the stocking rate was too high or too low, the species ratio was not decided as per the biogenic conditions prevailing in the ecosystem, the health conditions of the seed at the time of stocking was not ensured and there was no regulation in fishing. This resulted in low recovery of stocked species. But in reservoirs where advanced fingerlings (> 100 mm) were stocked at appropriate density and species-mix as per the guidelines of CIFRI, high production through stocked varieties of fish was achieved.

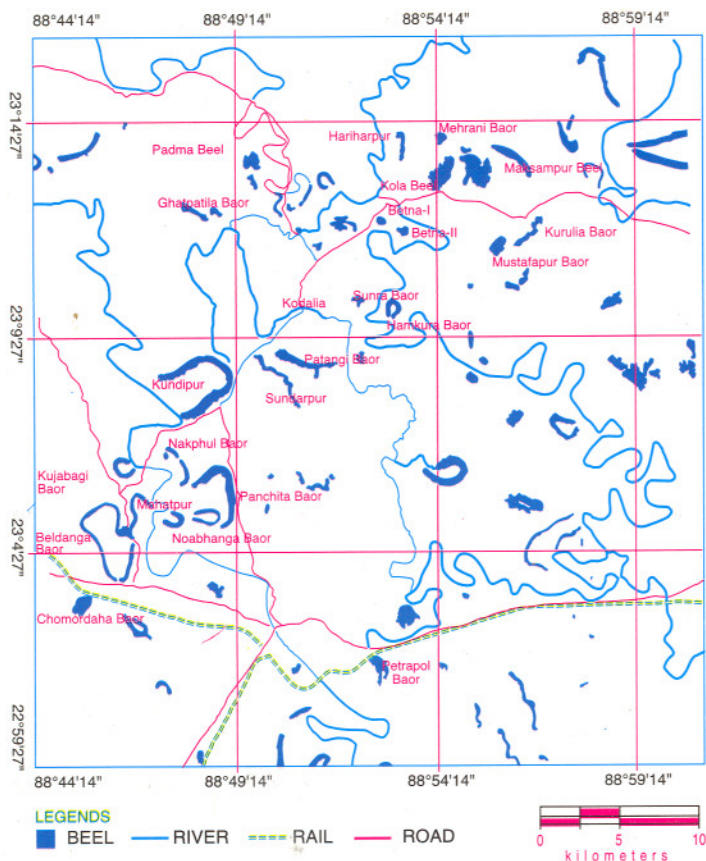
Assessing Production Potential by Satellite Imagery

Satellite image is increasingly being utilized in resource survey, especially physical and chemical properties of the soil, distribution of phytoplankton

pigments in sea and net primary productivity of forest area. Since the spectral signature of different bands corresponding to various objects on earth is predictable and repeatable in nature, the reflectance properties of these bands have been studied in assessing the productive potential of water bodies. A preliminary study conducted by CIFRI, Barrackpore has demonstrated high correlation between different water quality parameters and reflectance of red, green blue and infra red bands. However,

Investigations carried out by the scientists of CIFRI reveal that satellite image can be used effectively for assessing the productive potential of water bodies and measure their shape and size.

correlation with soil quality parameters is found to be insignificant. It has been suggested that few water quality parameters such as water temperature, NO₃, gross primary production and respiration can be assessed reliably. The study also indicated that a rough estimate of pH, salinity NO₃, total nitrogen and Ca was possible. The area and shape of the water bodies in different seasons can be determined accurately. Based on the information extracted from satellite image of West Bengal, a geographical information system (GIS) has been developed in respect of water bodies more than 50 ha in size to help the planners and decision makers in advocating the optimum management policies.



Vector map of the study area showing the distribution of water bodies ▲

National Agricultural Technology Projects of CIFRI

- The Institute has initiated research project entitled **“Fisheries management in the lentic water system : stocking of reservoir with fish seed”** under PSR mode of NATP. This project aims to achieve maximum sustainable fish production from differently located reservoirs of the country. It will establish a baseline for evolving suitable management measures towards fishery development in reservoirs and to prepare the location specific package of practices.



NATP workshop in progress at CIFRI, Barrackpore ▲

The experimental treatments are being carried out in the reservoirs of three different geo-climatic zones viz., Punjab, Uttaranchal and Madhya Pradesh under the management of the cooperating centres namely Punjab Agricultural University, Fisheries College, Govind Ballav Panth University for Agriculture and Technology and Jawaharlal Nehru Krishi Viswa Vidyalaya respectively.

- Another mission mode NATP project on **“Increasing production and productivity for life support crop species and allied enterprises of tribal, backward and hilly areas”** under Jai Vigyan National Science and Technology Mission on House-hold and Nutritional Security is in operation. Institute is the lead centre for implementation of its programme on **“Enhancing freshwater fish production and providing food security in tribal, backward and hilly regions”**. The programme has two activities : i) sustainable production of carps through freshwater culture in ponds/tanks, and ii) enhancing freshwater fish production from the beels through pen culture.

The tribal and backward districts, namely, Kalahandi in Orissa and Bastar in Chhattisgarh have been selected for the first activity. Central Institute for Freshwater Aquaculture (CIFA), Bhubaneswar is the co-operating centre for this activity. In all, 313 households from 44 ponds having an area of 33 ha have been adopted in these districts towards dissemination of aquacultural technologies of carp seed production, carp poly-culture, integrated fish farming, etc.

The North-eastern Regional Centre (NERC) of CIFRI, at Guwahati is the other co-operating centre where another activity of transfer of fish culture technology in pens is followed. Five beels, located in Golaghat, Nagaon, Morigaon and Goalpara districts of Assam have been adopted towards their fisheries enhancements under the activity.



Erection of pens in the beels of Assam ▲

Besides enhancing fish production and fisheries development in the target areas, both the activities are directed towards improving the technical skills of the fishers through on-farm demonstrations, training and participatory involvement. Training programmes have been organised at CIFA, Bhubaneswar, and NERC, CIFRI, Guwahati to train the beneficiaries and acquaint them with the concerned technologies. In addition to the technical know how, necessary inputs have also been provided to the beneficiaries on their farms to demonstrate the technologies.

The Institute is also involved as one of the co-operating centre for another programme under the project on "Impact assessment of technology interventions and crop diversification in tribal, backward and hilly areas" implemented by National Centre for Agricultural Economics and Policy Research (NCAP), New Delhi. The programme involves assessing the impact of above mentioned activities. The Institute has conducted studies on existing agricultural and allied practices followed by farmers and their food and nutritional security, in the districts of Jamnagar in Gujarat and Keonjhar and Balasore in Orissa.

EXTENSION SCENE

CIFRI's programme for conservation of biodiversity

Indiscriminate destruction of fin and shellfish seed in a vexing problem in Sundarbans. The Institute has been continuing its endeavour to create awareness on conservation through various extension activities viz., mass awareness campaign, group discussion, distribution of leaflets, coverage through mass media in the villages located near the estuaries/ coastal areas. Local civic body officials of the villages like panchayats have been involved to educate and motivate the seed collectors towards adoption of conservation measures. Impact of this endeavour indicates encouraging response from the clientele. Release of uneconomic species back to water after selecting the target species, *P. monodon* is one important conservation measure. The rate of adoption of this conservation measure *bagda* (*Penaeus monodon*) has increased from 17% last year to 23% this year.



Mass awareness campaign of CIFRI ▲

While conducting group discussions among the seed collectors in the villages, some health hazards have been identified. During collection of seeds in the estuaries, the collectors, irrespective of age and sex, remain in waste-deep water almost every day for a long time. This has affected the seed collectors specially the womenfolk with various diseases.

Exhibition

The Institute participated in the Netaji Subhash Mela, organised by Govt. of West Bengal, at Purulia during January 17-24, 2001. Charts and posters were exhibited to depict various activities and achievements of the Institute.



Fish farmers visiting CIFRI pavilion at Purulia ▲

Training Programme

- ★ A 10-day National training course on Management of small reservoirs sponsored by Directorate of Extension, Govt. of India was organised by the Institute during 12-21 February, 2001 where 17 senior officers of various State Fisheries Departments participated.
- ★ A Workshop-cum-training on fisheries management of small reservoirs was organised under the NATP during 29-31 January, 2001 at CIFRI, Barrackpore.
- ★ An On-Job Training Course on Inland Fisheries was organised for the students of Industrial Fisheries Course of Sitananda College and Ramnagar College, Midnapore during 19-28 March, 2001 where 58 trainees participated.



The training course in progress ▲

HUMAN RESOURCE DEVELOPMENT

Workshop/Seminars

- ◆ Mr. Utpal Bhaumik, Dr. M.K. Das & Dr. B.C. Jha, Principal Scientists attended National Seminar on Fish health and management at L.N. Mithila University, Darbhanga, Bihar during 25-27 March, 2001.
- ◆ Dr. V.V. Sugunan, Principal Scientist attended the NATP workshop on Germplasm inventory and gene banking, during 27/28 February, 2001 at Cochin.
- ◆ Mr. Debabrata Das, Scientist and Mrs. Sucheta Majumdar, Technical Officer were deputed to attend a Workshop on Biological Database through Oracle, held at Bio-Informatics Centre, Bose Institute, Calcutta during 28 February to 2 March, 2001.

MEETINGS

Annual Staff Research Council Meeting

The Annual Staff Research Council meeting of the Institute, was held at Barrackpore on 28 and 29 May, 2001. The meeting commenced with the welcome address by Dr. M. Sinha, Director, CIFRI. The project leaders presented the progress achieved under all the eighteen projects implemented during 2000-2001. After extensive deliberation work programmes for 2001-2002 were finalised.



Presentation of projects in SRC ▲

Research Advisory Committee Meeting

The Research Advisory Committee Meeting of the Institute was held at CIFRI, Barrackpore on 30th & 31st May, 2001 under the Chairmanship of Prof. J.S. Dutta Munshi and attended by Dr. B.N. Singh, Dr. V.S. Saharan, Dr. P. Das, Dr. S.P. Ayyar and Dr. M. Sinha. After comprehensive discussion the committee identified research priorities and gave recommendations for future research programmes.



RAC meeting in progress ▲

CIFRI hosts the 15th meeting of ICAR Regional Committee No.II at Barrackpore



The fifteenth meeting of ICAR Regional Committee No.II comprising the states of West Bengal and Assam was held on 15 and 16 June, 2001 at Central Inland Capture Fisheries Research Institute, Barrackpore, West Bengal. Shri Kiranmay Nanda, Hon'ble Minister of Fisheries, Aquaculture, Aquatic Resources and Fishing Harbour, Government of West Bengal attended the

inaugural session on 14 June 2001 as Chief Guest, where Dr (Mrs.) Hemaprava Saikia, Hon'ble Minister of Fisheries, Government of Assam was the Guest of Honour. The inaugural ceremony was presided over by Md. Anisur Rehaman, Hon'ble Minister of Animal Resource Development, Government of West Bengal. Dr. R.S. Paroda, Secretary, DARE, Government of India and Director General of ICAR, the Members of ICAR Governing Body and ICAR Society, the Vice-Chancellors, Deans and Faculty Members from SAUs, located in the Region, Senior Officers from the States of West Bengal and Assam, a number of DDGs and ADGs from ICAR Headquarters, Directors and Scientists of various ICAR Institutes, representatives from financial Institutions like NABARD, NGOs representatives and a large number of local dignitaries graced the inaugural function besides participating in technical sessions.

Joint Staff Council Meeting

The meeting of the Joint Staff Council of CIFRI was held on 22 June 2001 at Barrackpore under the Chairmanship of Dr. Ajoy Kumar Ghosh, Acting Director. The members from official and staff side attended the meeting and deliberated on the agenda.

AWARDS



Dr. V.V. Sugunan, Principal Scientist & Acting Head, Floodplain Wetlands Division, was awarded the Fisheries Technocrats Forum Annual Award for the year 2001 in recognition of his outstanding contribution to Reservoir Fisheries Management. The award, consisting of a plaque and a certificate, was given at a function held at the Library Hall of the Directorate of Fisheries, Govt. of Tamil Nadu, Chennai on 12 May, 2001.

STAFF NEWS

Appointments

Dr. M.A. Hassan, Sr. Scientist	21.07.2000
Dr. M.K. Mukhopadhyay, Pr. Scientist	30.08.2000
Sri D. Karunakaran, Scientist	01.09.2000
Sri M.S. Chimanbhai, SSG-I	06.10.2000
Sri H.V. Baria, S.S.G-I	06.10.2000
Sri T.S. Chandubhai, SSG-I	16.10.2000
Miss Mousumi Nan, L.D.C.	29.11.2000
Sri D.A. Valabhai, SSG-I	01.03.2001

Promotions

Under Career Advancement Scheme for ARS Scientists of ICAR

	<i>Promoted to</i>	<i>Effective from</i>
Dr. V.K. Unnithan G.	Pr. Scientist	27.07.1998
Dr. S.N. Singh	-do-	-do-
Dr. B.K. Singh	-do-	-do-
Dr. Ardhendu Mukherjee	-do-	-do-
Sri N.P. Srivastava	-do-	-do-
Dr. R.N. Seth	-do-	-do-
Sri J.G. Chatterjee	-do-	-do-
Smt. G.K. Vinci	-do-	-do-
Sri R.K. Dwivedi	-do-	-do-
Dr. Manas Kumar Das	-do-	-do-
Dr. Veliyil Vasu Sugunan	-do-	-do-
Dr. Dharendra Kumar	-do-	-do-
Dr. Dilip Kr. De	-do-	-do-
Dr. Pandit Piyush Kanti	-do-	-do-
Dr. D.S. Krishna Rao	-do-	-do-
Dr. D.K. Kaushal	-do-	-do-
Dr. V.K. Sharma	-do-	-do-
Sri Utpal Bhoumick	-do-	-do-
Sri V.K. Murugesan	-do-	-do-
Dr. P.K. Sukumaran	-do-	-do-
Dr. M. Ramakrishnaiah	-do-	-do-
Dr. Balbir Singh	-do-	-do-
Dr. M.K. Mukhopadhyay	-do-	-do-
Dr. D.N. Singh	-do-	-do-
Dr. Amitabh Ghosh	-do-	-do-
Dr. (Mrs.) Usha Moza	-do-	-do-
Dr. Shree Prakash	-do-	-do-
Dr. Murtaza Ali Khan	-do-	-do-
Dr. Arun Kumar Laal	-do-	-do-
Sri D.N. Mishra	-do-	-do-
Dr. Bankim Chandra Jha	-do-	-do-
Dr. H.P. Singh	-do-	-do-
Dr. Vibhakar Pathak	-do-	-do-

Dr. D. Nath	-do-	-do-
Dr. R.L. Sagar	-do-	-do-
Dr. P.K. Saha	-do-	-do-
Dr. M. Chowdhury	-do-	-do-
Sri S.K. Mondal	-do-	-do-
Sri P.M. Mitra	-do-	-do-
Sri H.C. Karmakar	-do-	-do-
Dr. R.K. Tyagi	-do-	-do-

Other Promotions

	<i>Promoted to</i>	<i>Effective from</i>
Dr. S. Bijoy Nandan	T-6	03.02.2000
Sri A.R. Paul	T-6	01.07.2000
Sri N.C. Mondal	T-6	01.07.2000
Sri N.N. Majumder	T-6	01.07.2000
Sri S.P. Ghosh	T-6	01.07.2000
Sri Alok Sarkar	T-6	01.07.2000
Sri R.C. Mandi	T-6	03.02.2000
Sri S. Bhowmick	T-6	03.02.2000
Sri S.K.S.S. Hameed	T-6	03.02.2000
Sri Sukumar Saha	T-6	03.03.2000
Sri C.N. Mukherjee	T-6	03.02.2000
Sri H.C. Banik	T-5	01.01.2000
Sri K.R. Deb	T-4	01.01.2000
Sri K. Ganesan	T-4	01.01.2000
Sri S. Bhattacharjee	T-4	01.01.2000
Sri U.K. Chatterjee	T-4	01.01.2001
Sri N.C. Biswas	T-4	01.01.2001
Shri B.B. Das	T-5	01.01.2001
Dr. P.K. Dhara	T-4	24.01.2001
Sri T.K. Roy	Private Secty.	13.03.2001
Miss Jolly Saha	P.A. (Steno.Gr.II)	13.03.2001
Smt. G. Vinoda Laxmi	P.A. (Steno. Gr.II)	13.03.2001
Sri H.K. Burman	SSG-IV	21.04.2001

Upgradations in next higher scale under Assured Career Progression (ACP) Scheme

	<i>Upgraded to</i>	<i>Effective from</i>
Sri T.K. Roy, Sr. Stenographer	Rs.6500-10500	14.02.2001
Sri S. Bhattacharyya, P.A.	Rs.6500-10500	01.03.2001
Sri S.K. Maranappan, Sr. Clerk	Rs.5500-900	30.04.2001
Smt. Bulbul Mallick, Sr. Clerk	-do-	27.05.2001
Sri Sitla Prasad, SSG-II	Rs.2650-4000	14.03.2001
Sri Bablu Bora, SSG-II	-do-	14.04.2001
Sri K. Subbaiyan, SSG-II	-do-	10.06.2001
Sri Mukti Pada Das, SSG-II	-do-	-do-
Sri Lal Bahadur, SSG-II	-do-	-do-
Sri Kharban Kumar, SSG-II	-do-	-do-
Sri Man Bahadur, SSG-II	-do-	-do-
Sri T.H. Ghume, SSG-II	-do-	29.06.2001
Sri M.S. Bhoi, SSG-II	-do-	-do-

Transfer

Dr. V.V. Sugunan, Pr. Scientist	Guwahati to Barrackpore
Sri U.K. Ghosh, Private Secretary	Allahabad to Barrackpore
Sri S.K. Das, T-6	-do-
Sri H.L. Biswas, T-2	Kolkata to Barrackpore
Sri A.C. Biswas, L.D.C.	Barrackpore to Allahabad
Sri Umashankar Ram, SSG-II	Vadodara to Barrackpore
Sri Amar Nath Prasad, SSG-II	-do-
Sri Fazal Khan, SSG-I	Farakka to Barrackpore
Sk. Abdullah, SSG-I	KVK, Kakdwip to Barrackpore
Sri Kharban Kumar, SSG-II	Barrackpore to Kolkata

Retirement

	<i>Date of retirement</i>
Sri G. Lahiri, Private Secretary	31.01.2001
Sri S. Bhowmick, Assistant	28.02.2001
Sri M.S. Burman, SSG-IV	-do-
Sri K.K. Das, T-2	31.03.2001
Sri S. Bhattacharjee, T-4	31.05.2001
Dr. M. Sinha, Director	30.06.2001
Sri P.M. Mitra, Senior Scientist	30.06.2001

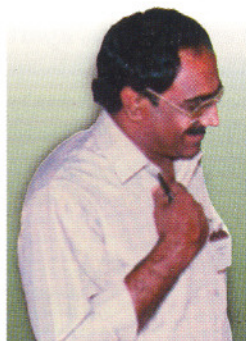
CIFRI Cultural Activities

CIFRI recreation club organized a colourful cultural evening on 15 June, 2001. Staff members presented a dance drama "Abhisar" and a short play "Choke Angul Dada". The programme was appreciated by Dr. R.S. Paroda, the Director General, DDG (Fy), ICAR and other dignitaries attending the Regional Committee No.II.



A scene from dance drama 'Abhisar' ▲

OBITUARY



Dr. V.K. Unnithan passes away

Dr. V. K. Unnithan, Vijayan for the near and dear, has left this world on 26 April 2001, plunging scores of his friends, relatives and admirers in deep sorrow. CIFRI is still reeling under the loss of its illustrious son. Unnithan spent most of his professional life at CIFRI during the 1980s and 90s, playing a vital role in shaping the destiny of this premier institute in various capacities. He worked on a number of projects on inland fisheries where he left indelible mark of quality and perfection.

Born on 25 January 1952 in Mavelikkara, Kerala, Dr. Unnithan had his graduation from Bishop Moore College, Mavelikkara and Masters Degree in Zoology from Aligarh Muslim University. He was awarded Ph. D. on the Biology and Fisheries of *Labeo gonius* by the Department of Limnology and Fisheries of Udaipur University. He did post doctoral studies on fish population dynamics in Tasmania, Australia.

Dr. Unnithan joined CIFRI, Barrackpore as ARS Probationer in 1978. During his tenure at Barrackpore, he was instrumental in project monitoring, compiling technical reports and editing publications. He was a member of the editorial board of CIFRI Annual Reports, Indian Fisheries Abstracts, and a number of CIFRI Bulletins. He also served a full term as the Editor of the Journal of Inland Fisheries Society of India. Dr. Unnithan moved on to the Reservoir Fisheries Centre at Coimbatore in the year 1992 to join the team of scientists who eventually developed the technology for the small reservoir management. Later, he took charge of the Alappuzha centre of CIFRI in the year 1993 and worked on the ecological characterization and impact assessment of environmental modifications on the fisheries resources in the freshwater zone (after the construction of Tanneermukkam barrage) of Vembanad Lake. During this part of his career, he has done some pioneering work on the backwaters of Kerala and the role of tilapia in the reservoir ecosystems of Kerala. His work on the breeding and rearing of giant snail *Achatina fulica* at CIFRI earned him the prestigious National Award – ICAR Team Award for outstanding research for the biennium 1991-93.

On promotion as Principal Scientist, Dr. Unnithan moved to the NBFGR, Lucknow in the latter part of 2000. At that Institute, he had conceived and initiated research projects on exotic fishes, apart from participating in NATP Project on Germplasm Inventory and Gene Banking. The end came suddenly on the fateful day of 26 April 2001, even as Dr. Unnithan was working in the computer laboratory of NBFGR.

Professional excellence of Dr. Unnithan was well matched with his blemishless reputation as a gentleman and philanthropist. An unassuming nature and pleasant personality were his added assets, which made him dear to anybody who came in touch with him. No one can forget the disarming smile of Unnithan in a hurry. The cause of Environment was very close to his heart. Being a committed environmental activist, he served as the Asian Regional Coordinator of the International Youth Federation for Environmental studies and Conservation, Denmark at a very early age and travelled widely abroad. He visited the United States, Australia, Denmark and Germany.

Dr. Unnithan leaves behind his wife Usha, daughter Arsha and son Aravind. In his untimely death, the fishery fraternity lost a true friend and an unending source of inspiration and confidence. The inland fishery sector has lost an eminent scientist who had a lot more to contribute in the years to come. We, the members of CIFRI family deeply mourn the death of Dr. Unnithan and pay their a tearful homage. Let the God Almighty grant peace to his noble soul.

Pabitra Lahiri no more

The members of staff of CIFRI express their deep sense of sorrow at the sudden and untimely demise of **Shri Pabitra Lahiri, Assistant**, posted at Barrackpore whose tragic end came on 26th February, 2001.

May the departed soul rest in peace.



New Additions (Books)

- *The Statesman's year book : the policies, cultures and economics of the world, 2001* by Tumer, Barry
- *Encyclopaedia of tropical fish.* Verhoef-verhallen Esther J.J.
- *Computer Networks*, 3rd ed. By Tanenbaum, Andrew S.
- *Genetics* by Sarin, C.
- *Sterilization disinfection infection control*, 3rd ed. By Gardner, Joan F. & Margaret M. Peel
- *Ecological Toxicity testing scale, complexin and relevance* By Cairns, John & B.R. Neederlehner
- *Water treatment and purification* by Ryan, William J.
- *Environmental Sampling and analysis for technicians* By Csuros, Maria
- *Water treatment process simple options* By Vigneswaran, S. & C. Visvanathan
- *Sustainable fisheries management : Pacific salmon* By Knudsen, E. Eric, Cleveland R. Steward, Donald D. MacDonald, Jack E. Williams and Dudley W. Reiser
- *Modern experimental biochemistry*, 3rd ed. By Boyer, Rodney
- *Organometallic chemistry : A unified approach*, 2nd ed. By Mehrotra, R.C. & A. Singh
- *Environmental chemistry*, 4th ed. By De, A.K.
- *Reinventing fisheries management* By Petcher, Tony J., Paul S.B. Hard & Pandey, Daniel
- *Handbook of environmental and ecological modeling* By Jorgensen, S.E., B. Halling-Sorensen & S.N. Nielsen
- *Programming pearls from C++ Report* By Lippman, Stanley B. ed.
- *Modeling Dynamic biological systems* By Hannou, Bruce & Ruth Mattheas
- *Environmental isotopes in hydrogeology* By Clerk, Ian D. & Peter Fritz
- *Fisheries bioeconomics – theory, modelling and management* (FAO Fisheries Technical paper 368) By Scijo, J.C., D. Defeo & S. Salas
- *Fish and fisheries of North Eastern India (Arunachal Pradesh)* By Pranab Nath & S.C. Dey
- *CDNA Library Protocols* by Cowell, Ian G. & Caroliue A. Austin
- *Electrophoretic and isoelectric focusing techniques in fisheries management* by Whilemore, Donald H.
- *The compleat Indian angler* by Masters, John
- *Sunlit waters : an introduction to the art of fishing with light tackle* by Conway, C.W.W.S.
- *The angler in India or the mighty mahseer* by Dhu, Skene
- *The rod in India*, 3rd ed. by Thomas, Henry Sullivan