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BREAKTHROUGH

CONTENTS

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Rainfed Lowlands Become Remunerative through Rice-fish System

Rice-fish system promotes gainful linkage between rice, prawn, vegetables, fruit crops, and results in better resource utilization and conservation of the ecosystems, besides increasing farm income

Rice cultivation in the geographically handicapped rainfed lowlands was chronically less productive (less than 1 to 1.5 tonnes/ha). Recent varietal improvement had made higher yields of rice possible from these lands and raised hopes of the rainfed lowland rice farmers of the country (17.3 million hectares), in general, and of eastern India (14.2 million hectares), in particular.

In order to further improve and stabilize farm productivity and income, the Central Rice Research Institute (CRRI), Cuttack, has developed an adaptable design-and-production technology of the rice-fish system. This system integrates different compatible components — improved rice, fish, prawn, different crops after rice, vegetables and fruit crops on bunds, besides

Standing crop of CR 260-77 rice by the side of the totally lodged crop of Utkalprabha after cyclone

raising birds and other systems.

Field design

The design includes 2.5-m wide dykes occupying about 20% of the field and water-harvesting-cum-storage system covering around 13% of area in the form of two 3-m wide side trenches having gentle (0.5%) gradient towards a connecting pond refuge of 10-m width and 1.75 m in depth at the lower end. The dykes are constructed by proper dressing and compaction of soil, grass pitching and maintaining around 0.5 - 1 m wide 'berm' in between refuge and dyke so as to minimize soil erosion. The dyke height is kept at least 20 - 30 cm more than the maximum flood level. Field is provided with a guarded outlet in one corner of pond refuge. Field laying-out costs Rs 24,000 per hectare.

Production technology

Rice. Improved semi-tall to tall plant types like Panidhan, Tulasi, CR 260-77 with inbuilt characters of photoperiod sensitivity, tolerance to submergence, lodging and to insect pests and diseases are cultivated in main rice season.

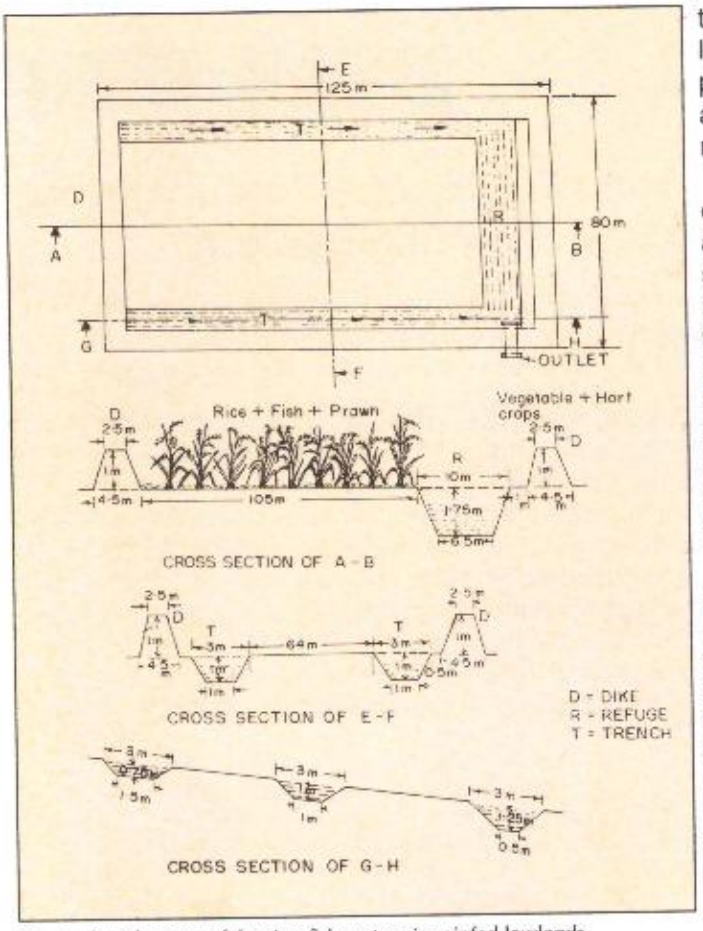
Rice is dry seeded in rows well in advance of monsoon season following a moderate fertilizer dose of 40 kg N and 20 to 30 kg each of P_2O_5 and K_2O/ha at the time of seeding, besides farmyard manure at 5 to 10 tonnes/ha.

Fish and prawn. Freshwater Indian major carps, catla, rohu, mrigal and common carp, composing 30% of surface feeder (catla), 20% of column feeder (rohu) and 50% of bottom feeder (mrigal and common carp in equal proportion) can be grown in combination with 2 freshwater giant prawn species *Macrobrachium rosenbergii* and *M. malcolmsonii*. Fish fingerlings and prawn juveniles in equal proportions at 10,000 number /ha are stocked when sufficient water accumulates in refuge system and in the field. The stock is regularly fed with oilcake and rice bran/polish (1:1) at 2-3% of the total biomass. Manuring up to 10 tonnes/ha of water-area and liming at 200-500 kg/ha are done in regular splits. Fish and prawn can be harvested periodically along with the receding water level in the refuge system.

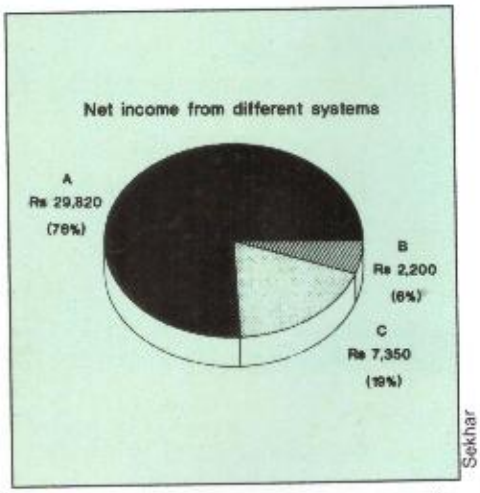
Crops after rice. Depending on the quantum of harvested water, the crops in the rice fallow are selected; usually crops requiring less water like watermelon, vegetables, cowpea, mungbean and sesamum are taken in the main field.

Crops on bunds. One hectare farm can provide a cultivable bund area of around 1,000 sqm on the top. Around 50% of this area can be utilized for vegetable farming and the rest for fruit crops like papaya, coconut and banana.

Pre-*kharif* and wet-season vegetables like okra, gourds and cowpea are



Design for 1 hectare of the rice-fish system in rainfed lowlands



Sekhar

Rice-fish system increases farm income over traditional rice farming (**A.** Rice-fish sysem, **B.** Traditional rice system, **C.** Improved rice)

CR 260-77—An ideal rice variety for coastal lowlands

Among the different lowland CRRI cultivars tested under the rice-fish system, CR 260-77 has shown a great promise for cyclone-prone coastal lowlands. It withstands cyclonic wind and rain in the reproductive phase. This culture is semi-tall and is of long duration (flowering time–last week of October to first week of November) type with excellent stiff straw, submergence tolerance and field tolerance to insect pests. It possesses superior grain and straw quality. The yield potential is around 4-5 tonnes/ha. This culture is already popular in many areas of Orissa.

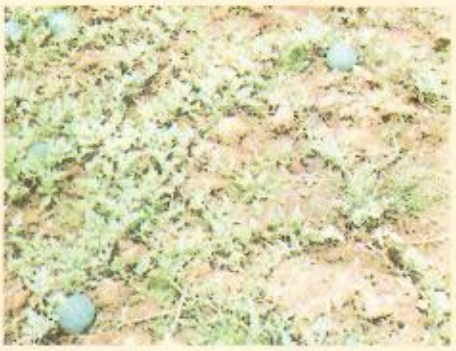
RICE-FISH SYSTEM – A PROFITABLE VENTURE

Rice-fish-prawn

A part of the fish and prawn harvest

Crops after rice

Usually crops requiring less water such as watermelon, vegetables, cowpea, mung and sesame are grown



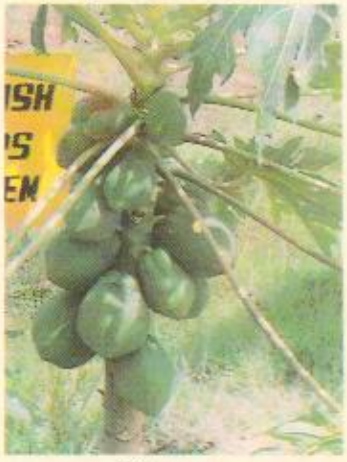
Watermelon field

Crops on bunds

About 50% of the bund area is utilized for vegetable farming

The remaining 50% bund area is utilized for growing fruit crops

Winter vegetables on bunds (inset : Carrot harvest)



C 1 papaya

sown on bunds. Erected platforms covering some area of trenches in between rice field and bund can support creepers. Spices can grow in otherwise left-over spaces like shades of fruit crops. Winter vegetables like tomatoes, radish, cabbage, cauliflower, beans, pumpkin, brinjal, beet, carrot, peas and leafy vegetables are taken after *kharif*. Stored rain-water in the refuge is used for irrigation throughout the crop growth period.

Dwarf papaya (C 1 hybrid, Honeydew, Pusa Dwarf), improved coconut (Tall x Dwarf hybrid) and banana (Cavendish) are the major fruit crops which are taken on bunds. Around 150 papaya-plants having 10% male population and 25 coconut-plants can be maintained on the remaining bund area.

Rice-fish system increases farm income by more than twelve folds over traditional rice farming and by three folds over improved practice. This system can also annually generate around 200 additional man-days/ha.

Benefits of the system

- The system becomes a micro-watershed for effective land-use.
- It encourages synergism between rice and fish leading to increase in grain yield by 5-15% and in straw yield by 5-9% due to :
  1. better crop stand at the initial stages as well as less damage of biomass at maturity due to fast drainage of excess water from the field to the refuge system.
  2. enrichment of soil organic matter and nutrients and improvement in crop-use of these materials.
  3. recycling of plant wastes and water weeds for fish growth and fish excreta for plants (which is ecologically and environmentally sound and ensures cost-effective returns).
  4. bio-control of rice pests including weeds.
- Facilitates crop diversification, thereby reduces investment-risk.
- Promotes gainful linkage between rice, fish, prawn, vegetables, fruit crops, resulting in better resource utilization as well as conservation of the ecosystem.
- Generates year-round employment on farm.
- Increases farm income.

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Technology Assessment and Refinement through Institute-Village Linkage Programme (IVLP)

The country has shown phenomenal growth in agricultural development during the preceding few decades resulting in formidable position in food sufficiency. However, the benefits of this are confined only to better endowed areas. The farmers of lesser endowed areas due to complex, diverse and risk-proneness of their agriculture have not been able to absorb new technologies, which are largely input-driven and require heavy investments.

Village-map being transferred on chart by villagers

Women participation in the programme

Earlier studies have indicated that poor adoption of technologies by resource-poor farmers is also due to attitudinal constraints–innate conservation, ignorance, resistance to changes. But, it has been proved beyond doubt that many of the new technologies are not appropriate for the farming conditions at the farms of the resource-poor farmers. Besides, the technologies dependent on purchased inputs and sensitive to environmental variations are not sustainable on small farms.

In the majority of the cases, the technologies developed are only appropriate in the area where they are generated. Even slight variations in conditions make the technology inappropriate. Keeping this in view, it is proposed that technology needs should be assessed for different farming situations, especially under low-resource conditions. Therefore, the Technology Assessment and Refinement through Institute-Village Linkage has been undertaken by the Council on the pilot basis at 42 centres in various ICAR research institutes and state agricultural universities.

Objectives

i. To introduce technological intervention with emphasis on stability and sustainability along with productivity of small production systems.

ii. To introduce and integrate the appropriate technologies to sustain technological intervention and their intergration to maintain productivity and profitability taking environmental issues into consideration in a comparatively well-defined production system.

iii. To introduce and integrate the appropriate technologies to increase the agricultural productivity with marketable surplus in commercial on-and-off farm production systems.

iv. To facilitate adoption of appropriate post-harvest technologies for conservation and on-farm value addition of agricultural products, by-products and wastes for greater economic dividend and national priorities.

v. To facilitate adoption of appropriate technologies for removal of drudgery, increased efficiency and higher income of farm-women.

vi. To monitor socio-economic impact of the technological intervention for different production systems.

vii. To identify extrapolation domains for new technology/technology modules based on environmental characterization at meso and mega levels.

In this project, the concept of agro-ecosystem analysis is being followed, instead of traditional benchmark survey approach, for characterization of resources and identification of problems prevailing in different production systems. A team of scientists is first trained in the concept and also in project formulation and action-plan preparation.

At the ICAR, the monitoring of the project is being done by the Division of the Agricultural Extension. The three-tier system for effective and close monitoring of the project—a Steering Committee at the centre, Zonal Steering Committees at the zonal level and Farmers' Clubs at the implementation centre–has also been envisaged.

Initially, only 25% of the year's budget has been released to all participating centres, to be used to meet cost of preparation of the project-document at each Centre. Subsequent releases are being made subject to approval of the project-document by the Zonal Steering Committee.

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Conservation of World-renowned Sport Fish, Golden Mahseer

Torputitora (putitor golden mahseer, Family: Cyprinidae), primarily being denizen of rocks, rapids and pools (a common feature of the Himalayan rivers having steep gradient, high current velocity, voluminous discharge and cold waters) has successfully established and flourished in the lentic waters too. Besides, being a subsistence fishery, it is considered one of the most reputed and sport delight in whole of the world, as no other game-fish affords such a thrill and excitement. From ancient times it has been a constant source of recreation for tourists from home as well as abroad. As a food fish, it is highly esteemed and fetches the best market price in certain regions. Of late, the species has been recognized as a endangered one and a general decline in its catches is reported in almost all the natural waters. The multifarious factors which have brought this fish to the brink of almost extinction in certain upland waters are indiscriminate killings of both adults and juveniles and a fast degradation of the prevailing ecological conditions of the aquatic systems. It is, therefore, necessary that this valuable resource is properly managed, conserved and propagated both for food and sport.

The National Research Centre on Coldwater Fisheries in 1990 took up a programme for establishing a mahseer hatchery and for intensive raising of stocking material of this species through artificial fecundation.

Flow-through hatchery. A standard golden mahseer hatchery unit with flow-through facilities has been established by the Centre at Bhimtal, which is the first attempt in the country for the seed production of *Torputitora* in mass-scale under controlled conditions. Each unit has a provision of airlift water system and aeration devices. The water system consists of specially designed hatching troughs/trays/rearing tanks

A flow-through hatchery unit established at Bhimtal for mass-scale seed production of golden mahseer

with flow-through facilities. The hatchery has a capacity for hatching 250,000 eggs, rearing of 200,000 fry and 100,000-150,000 advance fry at a time.

Mass-scale seed production. For intensive raising of fry and advance fry of golden mahseer, a methodology has been perfected. Its efficiency is almost three times to that of the conventional methods applied for the incubation of eggs. The species collected from wild waters during its breeding season is completely amenable to egg-taking and artificial fecundation, hatching, fry and advance fry rearing in farms. For the first time, a record survival of over 90% from fertilized eggs to fry and 85% from fry to advance fry has been achieved at Bhimtal. Nutritive pelletized diets having different protein levels fortified with vitamins and minerals have been formulated, screened and tried for better growth and high survival at different early stages of mahseer.

Stripping operation of golden mahseer

Culture in pond. Attempts have been made to culture this species in a properly managed pond with the objective to produce healthy stocking material and to raise brood stock of this endangered fish, hitherto a major constraint in its farming. Very encouraging results have so far been obtained. A size range of 80-120 mm (10.0-30.0 g weight) can be easily achieved by rearing fry of 30-35 mm length (0.150-0.250 g weight), within a rearing period of 4 months, and an average size of 210 mm in length and average weight of 150 g can also be obtained in one year's rearing period in this system. During 1992-95, more than 250,000 seeds of this species have been produced at Bhimtal.

This methodology has opened a vast scope for culture and intensive raising of stocking material in captivity in ponds to replenish depleted mahseer waters for enhancement of fish stocks.

Conservation/rehabilitation. To prevent decline of mahseer, the Centre has also taken up a programme of rehabilitation and conservation of this species. Some selected waters located in the Central Himalayas have been annually stocked with healthy seed produced at the Centre.

Thousands of advance fry and fingerlings have been supplied gratis to Uttar Pradesh, Haryana, state agricultural universities, Defence Research Laboratory (Pithoragarh), Uttar Pradesh, wherever there was commitment and opportunity to rehabilitate this species. A consignment of 15,000 golden mahseer fry/advance fry has also been given to the Food and Agriculture Organization for stocking Sepik river in Papua New Guinea.

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Central Institute of Fisheries Education

Rapid strides made in the field of fisheries necessitated the development of the qualified and trained manpower to plan, execute and manage various fisheries developmental programmes in the country. To meet this ever-increasing demand, the Government of India with the assistance of the FAO/UNDP, established the Central Institute of Fisheries Education (CIFE) on 6 June 1961. Initially, the Institute started functioning at the Institute of Science, Bombay. In 1964, the Institute was shifted to a rented building at Masjid Bunder, Bombay. In March 1967, it was shifted to the present site at Versova, Bombay. The administrative control of the Institute was taken over by the Indian Council of Agricultural Research on 1 April 1979.

The CIFE has been providing leadership in fisheries education and training in India and also in the neighbouring Afro-Asian countries for nearly three and half decades. It was in the recognition of the pivotal role played by the Institute in fisheries education that the Ministry of Human Resource Development and University Grants Commission accorded the 'Deemed University' status to the CIFE on 29 March 1989. The CIFE has thus the distinction of becoming the first Fisheries University in India.

CIFE's main building

Organizational Set-up

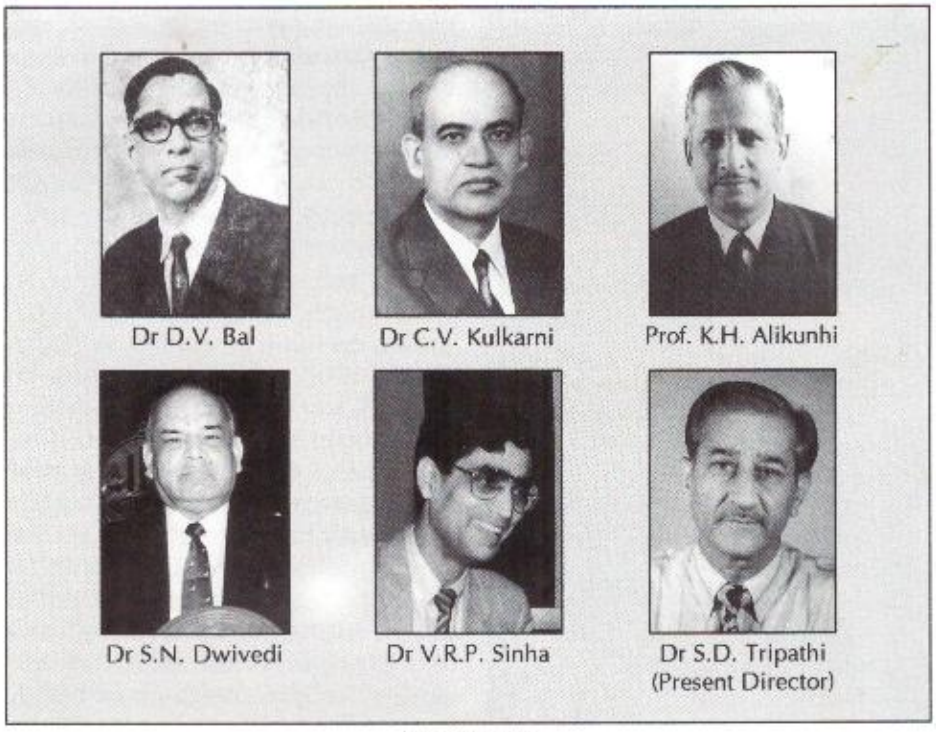
The Institute is headed by a Director who is the overall incharge of the activities related to education, research, extension and administration. The Director is assisted by a Joint Director and a band of Principal Scientists, Senior Scientists, Scientists (SG) and Scientists in academic, research, extension and administrative matters. There is also a Students' Welfare Officer (Dean) who looks after the co-curricular and extra-curricular activities of the students.

The administrative affairs are handled by the Senior Administrative Officer and Administrative Officer, and the charge of audit and accounts lies with the Finance and Accounts Officer.

The supreme authority for decision-making is with the Board of Management, headed by the Director of the Institute. Recommendations related to academic, research and extension activities are made by the Academic, Research and Extension Councils. The research activities of the Institute are guided by a Research Advisory Committee (RAC).

The academic activities of the Institute together with research and extension activities are carried out through a network of 12 divisions at the Headquarters (Fisheries Biology, Fish Genetics, Breeding and Genetic Engineering, Aquaculture, Fisheries Engineer-

Master model of the CIFE's New University Campus proposed to be developed at Yari Road, Versova, Bombay



CIFE Directors

ing, Fish Preservation and Processing (Post-harvest technology), Fisheries Economics, Fisheries Statistics, Fish Pathology, Fish Nutrition and Feed Technology, Fishing Craft and Gear (Fish-harvesting Technology), Fisheries Extension and Communication and Aquatic Environment) and at the Central Marine Fisheries Research Institute (CMFRI), Kochi. The Inlands Fisheries Training Centre located at Calcutta, West Bengal, conducts refresher courses for in-service state-fisheries personnel. The Aquaculture Research and Training Centre (ARTC), Kakinada, and Inland Fisheries Operative Training Centre (IFOTC), Lucknow, provide practical field-oriented training on various aspects of aquaculture. These programmes are primarily intended to cater to the needs of the State Governments, besides giving a fillip to entrepreneural development in fisheries. The Saline Ecosystem Aquaculture Research Centre (SEARC), Sultanpur (Haryana), is endeavouring to provide a feasible aquaculture technology for saline groundwater belts of the country. Demonstrations of feasible aquaculture technologies are carried out at the 44-hectare Freshwater Fish Farm of the Institute at Powarkheda in Hoshangabad District, Madhya Pradesh.

The Institute has 3 fishing vessels, M.V. Saraswati (36.37 OAL), M.V. Narmada (11.60 m OAL) and M.V. Sunderbans (17,00 m OAL) to support research-and-training activities in fishing, oceanography and navigation.

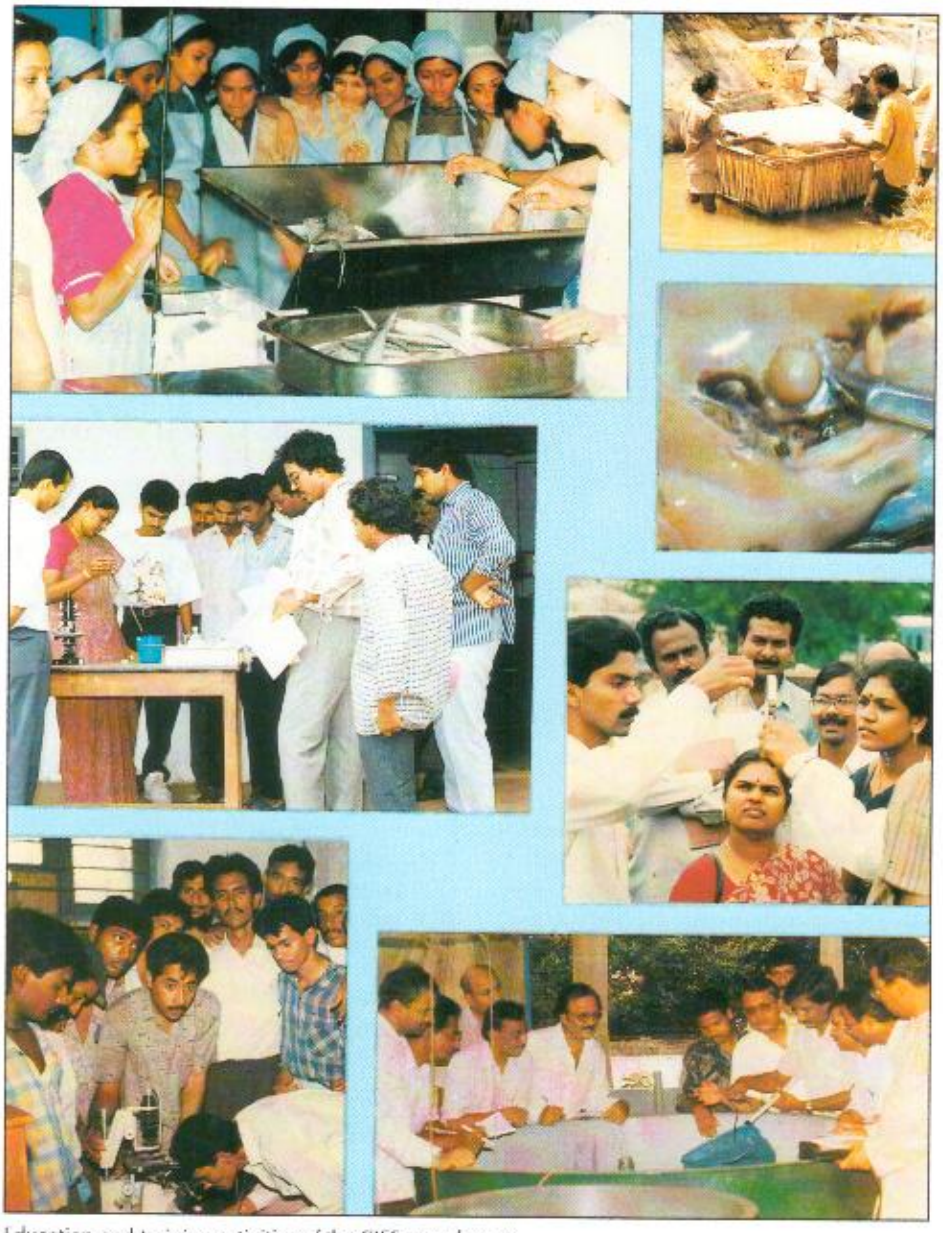
The Library, a repository of fisheries information, the Computer Section and a Museum with a fascinating collection of finfishes and shellfishes are the other facilities available with the Institute.

Educational Achievements

The CIFE has been providing yeomen service to the nation by developing qualified manpower through its various academic programmes. Till date, 3,678 students have completed their studies from this Institute which include 93 foreign students from Iran, Vietnam, Bangladesh, Aden, Tanzania and Egypt.

The post-graduate courses of the Institute have been redesigned from the academic year 1994-95 as M.F.Sc. (Fisheries Resource Management), M.F.Sc (Inland Aquaculture) and M.F.Sc (Mariculture). The total intake

M.V. Saraswati, fishing vessel of the Institute, is being used for on-board training and research



Education-and-training activities of the CIFE at a glance

capacity for the 3 courses is 40, and that for Ph.D. in Inland Aquaculture and Mariculture is 6.

Besides, the Institute offers a two-year post-graduate course of Diploma in Fisheries Sciences (D.F.Sc.) for 25 in-service state-fisheries personnel. The one-year certificate course for 40 in Inland Fisheries Development and Administration (IFDA) is conducted at the Calcutta Centre of the Institute.

Research Achievements

Since commodity-research relating to freshwater, brackishwater and marine fisheries is the domain of the Central Inland Capture Fisheries Research Institute (CICFRI), Barrackpore, Cental Institute of Brackishwater Aquaculture (CIBA), Madras, and Central Marine Fisheries Research Institute (CMFRI), Kochi, the CIFE involves itself largely in conducting research on location-specific problems and endeavours to develop users' friendly technologies through applied research. The research activities of the Institute are mainly carried out through institutional research projects and students' research programmes. The Institute also takes up sponsored research projects from time to time.

Amongst the research achievements, the Institute has the distinction of developing carp hatchery models–D-80, D-81 and D-85–with a high degree of structural flexibility for overcoming problems of high mortality and poor hatching percentage common in traditional hapa hatching techniques. The Human Chorionic Gonadotrophin (HCG) is indicated as a good substitute of the pituitary gland (PG) for induced breeding of silver carp , and a mixture of HCG and PG is found to induce breeding in Indian major carps.

The CIFE demonstrated intensive rearing of 5,000 spawn/m^3 of water with 90% survival as against 1,000 spawn/m^3 with 40% survival using the traditional method. This was achieved by maintaining optimum temperature, pH and dissolved oxygen levels of the densely stocked spawn in small water areas and by removing harmful gases from the rearing medium using air-lift water circulation system.

The users' friendly techniques are developed for culture of live-fish food organisms like *Moina, Brachionus, Daphnia, Fabrea salina, Euplotes* and *Artemia,* which are in great demand in finfish and shellfish hatcheries. The Institute has also been successful in developing artificial feeds for prawn-larvae like egg custard, *Acetes* and *Squilla* suspensions.

The CIFE has successfully used wind-mills for pumping of water as an alternate source of energy at its aquaculture farms and found them efficient in reducing operational cost of farms. Development of hatchery technology using artificial sea-water for giant freshwater prawn, *Macrobrachium*

rosenbergii, is one among the commendable research achievements of the CIFE, which has paved way for establishment of prawn hatchery even in Inland states where sea-water is not readily available.

In order to popularize aquaculture of magur *Clarias batrachus,* the CIFE has made innovative approaches of producing its seed by inducing fish to breed under simulated natural conditions. Recent research achievements of the Institute include successful culture of mud-crab (*Scylla tranquebarica*) under "fattening system", making use of bamboo-mat cages with compartments to prevent cannibalism. The considerable headway has been made in producing pearls using freshwater mussels *Lamellidens marginalis.* Other research pursuits include trials on organic aquaculture, use of nutrients in aquafeed and selective breeding.

Short-duration research endeavours of the students constitute the major research activity of the Institute. The research results of students are presented in the form of dissertations, which are kept in the library of the Institute for posterity.

Extension Achievements

The CIFE adopts a need-based and innovative approach to provide technological information to a wide specturm of clientele comprising fisheries extension personnel, fisherfolk, rural-youth and entrepreneurs through its extension programmes. The Institute at its aquafarms and regional centres has also been imparting training in various aspects of brackish- and freshwater aquaculture, and has created a cadre of about 3,000 trained manpower. These extension functionaries have a trickle-down-effect, providing technical guidance to end-users.

An impact of the successful demonstrations of the technologies can be easily seen in the coastal belt of Andhra Pradesh where over 400 private carp-farms have come up, producing about 60,000 tonnes of carp annually. Traditional fishermen of villages around Bombay have been motivated to mechanize their fishing boats with outboard motors. A number of fisherwomen have been trained in techniques of preparing value-added nutritious recipe using low-value marine fishes.

To provide an alternate vocation to fisherwomen during monsoon, efforts have been made to popularize freshwater prawn-seed production among fisherwomen of Versova. A training-cum-demonstration of backyard hatchery for giant freshwater prawn, *Macrobrachium rosenbergii,* has been conducted at the fishing village and it is expected that some backyard hatcheries will be established there shortly.

Technical guidance to fisheries entrepreneurs, fish-farmers and others is provided through the Fishery Advisory Service meetings held on first Monday of every month. Extension folders and manuals are regularly brought out for clientele.

Offering consultancy also constitutes an important extension activity of the Institute. Organizations like the ONGC and NEERI have received consultancy for integrated environmental impact assessment studies for the ONGC's offshore oil/gas field in the West coast off-shore areas.

The saline soils are creating problems in many states of the north India as these soils are not readily usable for agriculture. At the request of the Government of Haryana, the Institute had taken up an Operational Research Project (ORP) at its Sultanpur Centre to demonstrate use of such derelict waters for productive use through aquaculture. The Centre has demonstrated culture possibility of fishes (milkfish and mullets) and penaeid prawns (tiger prawn). Efforts are underway to popularize breeding and farming of giant freshwater prawn (*M. rosenbergii*) in such waters. Though the ORP is no more in operation now, the Institute is continuing its Centre at Sultanpur for taking up research and development programmes in new thrust areas for such saline soils.

The Institute has been actively participating in various international and national exhibitions with a view to creating mass awareness as well as popularizing fisheries technologies. It also participates regularly in the International Trade Fairs organized at Pragati Maidan, New Delhi, Indian Science Congress and the CGIAR Exhibitions, Kisan Melas, and Farmers' Days organized by the State Governments.

Students' Welfare Programmes

The Institute has a students' welfare cell which helps in planning, organizing and executing various cultural, sport and literary events from time to time. Major highlights of the activities include publishing students' magazine "MATSYODAY", organizing annual sports meet, holding literary competitions like debate and elocution contests, general knowledge test, organizing courses on personality development, public speaking, computer application, etc.

Placement Services

A placement cell is in operation at the CIFE since 1992. It helps in coordinating the placement possibilities of the students of this Institute with prospective employers. The cell has so far developed linkages with over 150 fisheries companies and is helping them by providing profile of students for campus-interviews and their suitable placement.

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Some latest varieties of crops recommended for release, notification and cultivation

Crop	Recommended
Groundnut	
ICGV 86325	for southern Maharashtra, Andhra Pradesh (except north coastal districts), Tamil Nadu and Karnataka; for rainfed areas
GG 3	for north-eastern states and Madhya Pradesh and northern Maharashtra; for *kharif*
Sunflower	
SUF 7	for Uttar Pradesh, Gujarat, Maharashtra, Tamil Nadu, Karnataka, Andhra Pradesh; for *kharif*
Jwalamukhi (PSCL 5015)	for Gujarat, Maharashtra, Madhya Pradesh; suitable for growing in all sunflower-growing areas of India during *rabi*/summer with assured irrigations
Castor	
Jyoti (REC 9/DCS 9)	for early-sown rainfed areas of Andhra Pradesh, Tamil Nadu and Karnataka
Sesame	
RT 125	for Jammu and Kashmir, Himachal Pradesh, Punjab, Haryana, Rajasthan, western Uttar Pradesh

Irregular protein synthesis causes yellow-berry spots in durum-wheat

Durums are gaining importance in India, especially in view of their export prospects. Though durums grown in Gujarat, Madhya Pradesh and parts of Maharashtra meet the international quality standards, but in the north-western plains zone, they develop yellow-berry spots, which adversely affect on the quality of the pasta products. Attempts to trace the cause for this disorder revealed that irregular synthesis of protein could be one of the possible reasons. Electron micrographs revealed clear differences in amyloplast and protein matrix between healthy and strippled grains.

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New coconut variety recommended for release

The XII Biennial Workshop of the All-India Co-ordinated Research Project on Palms held at the Central Plantation Crops Research Institute, Kasaragod, from 21 to 23 December 1995, has recommended for release an exotic coconut cultivar Philippines Ordinary for general cultivation in Kerala, Andhra Pradesh, Konkan Coast and West Bengal. This cultivar has consistently performed well in 4 co-ordinating centres, representing different agroclimatic conditions. It has an yield potential of 110 nuts/palm/year, 3.6 tonnes of copra per hectare and 2.7 tonnes of oil per hectare, which is superior to Local Tall and released variety, Chandrakalpa. Besides, the additional advantages are that it is relatively tolerant to root (wilt) disease, ranks sixth among the 23 cultivars evaluated for drought tolerance and suffers less from problems of pests and nematodes.

An exotic coconut Philippines Ordinary

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Clonal selections of Nagpur mandarin

To identify and select desirable clones of Nagpur mandarin, the orchards are being surveyed every year

Nagpur mandarin clone (N_3) with < 5 seeds/fruit

Early-maturing Nagpur mandarin (N_2)

in both seasons (Ambia and Mrig). Orchards at Ramtek, Kondhali, Karanja, Saoner, Katol, Warud and Narkhed were surveyed. So far, clones having less seeded fruits (< 5 seeds/fruit) have been identified from Narkhed, Kondhali and Saoner and of early maturity from Narkhed. Besides, clones with late-maturity, better coloured and tight-skinned fruits and high-yield have been identified. The selected clones are being evaluated at farmer's field for confirmation of the characteristics.

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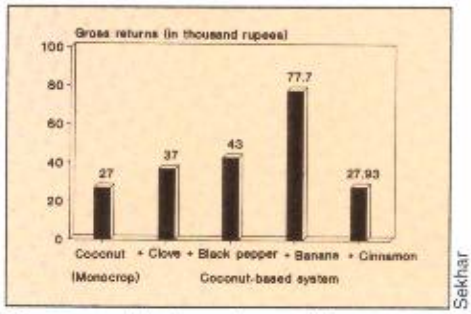
Boost income in Andaman-Nicobar Islands through plantation-based cropping systems

Adoptation of a multistoreyed cropping system is a need to improve productive potential of 24,000 hectares of the Andaman and Nicobar Islands. An hectare of land with 178 coconut-palms at 7.5-m spacing can accommodate 169 clove-plants, 169 cinnamon-plants and 178 black-pepper vines. In arecanut-based cropping system, 1,100 arecanut-palms along with 1,050 cinnamon and 1,100 black-pepper vines can be accommodated. Clove, if taken among the arecanut-palms, about 550 clove-plants can also be accommodated, replacing cinnamon.

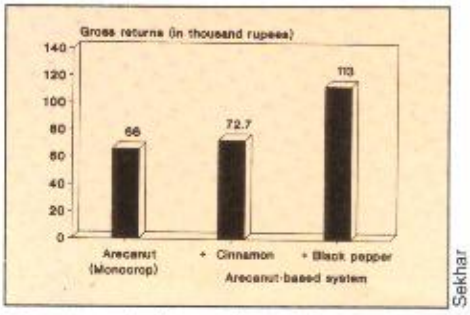
Banana, papaya, pineapple and fodder crops are grown at the initial and later stages of the growth of the plantation. They will give the initial income for sustaining cost of development of the mother plantation.

The economic returns from the plantation-based cropping systems are expected from the 7th year onwards.



Sekhar

Gross returns (in thousand rupees) from coconut-based system



Sekhar

Gross returns (in thousand rupees) from arecanut-based system

The economic returns from the plantation-based cropping systems can be expected from the 7th year and will stabilize by the 10th year. The expected total returns from coconut-based cropping system will be Rs 60,000 per hectare per year and Rs 20,000 from arecanut-based cropping system.

Developing such systems with high-yielding coconut- and arecanut-palms and high-yielding black-pepper vines will further improve yields and economic returns. By combining with poultry, fishery and livestock, biomass produced in this system will be best utilized, and economic returns will be much higher.

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Benefits from watershed management in Hoshiarpur Shiwaliks (Punjab)–Chandigarh

A watershed management project, covering an area of 627 hectares was taken up in the Relmajra village situated in Hoshiarpur Shiwaliks. The following are the highlights of this project.

With the availability of the irrigation water, 12.2 hectares out of the 20.24 hectares of command area have been levelled in the last 2 years.

The area under fodder crops in *kharif* has increased from 11 hectares to 20.3 hectares. The area under *rabi* crops in 1994-95 increased to 27.7 hectares

Water-harvesting in Shiwaliks-Relmajra project, Chandigarh

Apis mellifera Becoming Choice Species in India

A view of apiary

There were many attempts to introduce and establish *Apis mellifera* bees (exotic species) into India since 1920s but success was achieved only in 1960s. About one hundred queens and/or nuclei were imported from California and Florida (USA), Italy and UK from August 1962 to April 1966 and were established at the Bee Research Station, Nagrota (Himachal Pradesh). The *ligustica* race of the species gave 3-4 times more honey yield as compared to Indian honeybee (*A. cerana indica*)

In warmer plains of Punjab beekeeping was little known till establishment of *A. mellifera*. In 1976-78, bee colonies were given for the first time to beekeepers in Punjab and since then growth of the beekeeping industry has been phenomenal, and there is virtually honey revolution in the state, posing market problems. A beekeeper gets 25-30 kg honey per colony per year, and the yield can be as high as 80 kg. The colonies of the exotic species were also acquired by the beekeepers of Haryana during 1980s.

However, the expansion of the species did not go beyond Himachal Pradesh, Punjab and Haryana till late 1980s because of (i) good honey sources and beekeeping areas were not fully identified and thoroughly studied; (ii) resistance from many organizations for reasons other than comparative utility of the two hive species; (iii) uncalled for and lurking fear of spread of diseases and enemies through *A. mellifera*; (iv) inadequate infrastructure for testing performance of *A. mellifera* in most states; and (v) difficulty in transporting bee colonies to long distances.

There had been almost complete wipe out of *A. cerana* in the north India from Meghalaya to Jammu and Kashmir during 1978–86.

In 1986, the exotic species was introduced in Uttar Pradesh through the co-ordinating centre of the All-India Co-ordinating Research Project on Honeybees.

A co-ordinating centre of the AICRP for Pusa-Bihar has been sanctioned with the mandate to test and monitor performance of *A. mellifera*. The beekeepers of north Bihar are getting 50-70 kg honey per *A. mellifera* colony as compared to 10-15 kg from *A. cerana*. The exotic species is also performing very well in south Bihar and beekeeeping with this species is becoming very popular with tribals of south Bihar. Success of the species in Bihar helped adoption of the species in West Bengal. Commercial beekeeping with *A. mellifera* has nicely been established in Jammu and Kashmir after *A. cerana* perished due to Thai Sac Brood Virus disease. *A. mellifera* was also introduced in Andhra Pradesh and Orissa in 1990-92. During 1994 Bhubaneswar centre obtained 28.5 kg honey/colony of *A. mellifera* and 5.1 kg honey/*A. cerana*. In Andhra Pradesh, 5-6 times more honey is produced by the exotic species. Thai Sac Brood Virus epidemic killed 95-98% colonies in southern states of India in 1991-92. *A. mellifera* was first introduced in Kerala in 1992 to come to the rescue of displaced beekeepers.

Tribals have adopted *Apis mellifera*

A beehive with queen

Some of the states which have not been paid much attention for *A. mellifera* programme have limited potentials, however of these Rajasthan, Gujarat and Maharashtra, the species has already been introduced with the assistance of the co-ordinated project. Some colonies were introduced at Jorhat (Assam) also but not much headway has been made in the region. However, an ad-hoc project has now been sanctioned and is being implemented by the ICAR Research Complex for the North-eastern Region. The region seems to have huge beekeeping potentials but none of the organizations have expanded efforts in the areas.

The exotic honeybee species should be a species of choice for honey production in potential areas, however *A. cerana* will continue to serve the marginal areas since the Indian honeybee is a frugal species.

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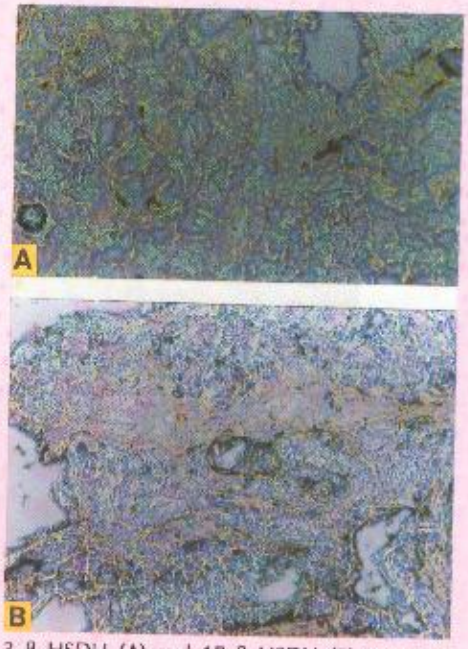
Poll Glands of Camel and their Role

Poll glands, the unique glands of the male-camels, are paired, tubulo-alveolar cutaneous glands. They secrete profuse, dark brownish, odorous secretion, akin to pheromones, during the breeding season, especially when the males are in 'rut'. Some investigations on the behavioural, morphological, structural and functional aspects through histological, histochemical, biochemical and hormonal studies have been made.

Poll glands have two well-defined regions (i) skin and (ii) alveolar. The alveolar region has the secretory epithelium. Histochemical studies have revealed the presence of protein, glycogen, lipids, DNA, RNA, ATPase, LDH and G-6-PDH (the active metabolites) in both the regions. But, the alveolar region in addition has exhibited active enzymes of steroidogenesis, viz. 3 β hydroxysteroid dehydrogenase (3 β HSDH) and 17 β hydroxysteroid dehydrogenase (17 β HSDH). The secretion of the glands has also shown lower protein, albumin, glucose, calcium and urea and relatively higher sodium and potassium levels than serum. It also contains testosterone (132.90 ng/ml), progesterone (2.67 ng/ml) and estradiol (247.08 pg/ml). The testosterone level during breeding season was approximately 4 times higher than its concentration in serum (6-30 ng/ml). It was rather difficult to observe secretion from poll glands during non-breeding season.



3 β HSDH **(A)** and 17 β HSDH **(B)** activities (expressed by blue formazon deposits) in the alveoli of the poll glands

The secretory epithelium exhibited higher cellular activity during breeding season, and was relatively quiescent in non-breeding season. But the general metabolism of the gland was not affected by the seasonal changes in the alveolar region. The secretion is attributed to sexual behaviour and pheromone-like activity during breeding season. Although it may be observed under work stress also.

It is concluded that secretory activity of the poll glands shows seasonality and poll glands undergo active steroidogenesis during breeding season.

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Secretion from poll glands

against only 8.2 hectares prior to the construction of the dam.

Traditional agroforestry systems have been replaced by the alternative agroforestry systems–horti-pastoral and pastoral systems–which are more paying and beneficial to farmers.

As a symbol of the community participation, a duly registered Water Users' Society has been constituted. The Society now manages common property resources like lease of reservoir for fish culture, sale of irrigation water from dam and sale of fodder and commercial grasses from common lands. The revenue of the Society in 1993-94 and 1994-95 from various sources was Rs 4,810 and Rs 17,135.

Taking into account all the benefits, costs and presuming the life of the project to be 20 years, the benefit: cost ratio (BCR) has been worked out to 1.2 at 12% discount rate.

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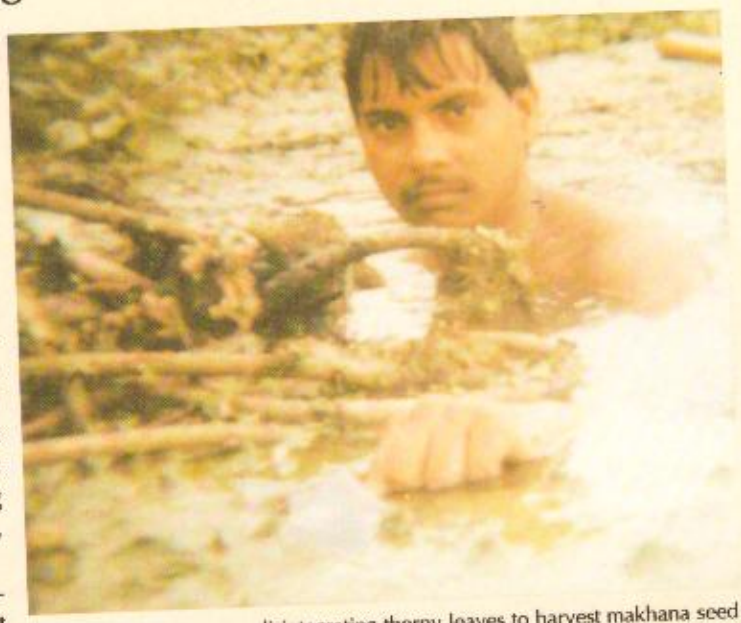
Rice-cotton cropping for Sunderban region

Ramakrishna Ashram Krishi Vigyan Kendra (KVK), Nimpith, evaluated the suitability of cotton cultivation after rice-crop, and their efforts in popularization of cotton as a second crop after rice in rice fallow through first-line extension system have resulted a change in the scenario.

The farmers of the Sunderban region, after seeing the performance, have

In Darbhanga makhana-cum-fish culture may prove a boon

Euryale ferox popularly called makhana is an aquatic plant. It grows in shallow water-bodies and is characterized by huge thorny, elliptical orbicular leaves floating on the surface of the water. The fruits are spongy and remain covered with stout prickles. They are oval or globular, slightly larger than an orange and are full with round black seeds locally called as 'gurri; these seeds after processing turn into popped makhana, being sold in the markets.



Farmer trying to remove disintegrating thorny leaves to harvest makhana seed from the bottom of the pond

Makhana is very nutritious and makes excellent delicacies when fried in ghee. It is also used for preparing dishes like 'payasam', 'kheer' and 'halwa' and is also cooked as vegetable. Seeds constitute an important component of health tonics and serve as a source of starch for textile industries.

North Bihar is the chief producer of makhana, contributing as much as 90% of the total production of the country– mainly by Darbhanga (32%), Madhubani (30%) and Saharsa (15%). In makhana-producing states Uttar Pradesh and Assam follow in order. Besides, it is also cultivated in certain parts of Nepal.

In Darbhanga makhana is regarded as an aquatic cash crop intimately linked up with the livelihood of the fisherfolk of the region. It is usually grown in age-old perennial water-bodies having a thick layer of muck at the bottom. The average yield of makhana ranges from 1,250 to 1,500 kg/ha. The cultivation is very modest because the left-over seeds at the bottom after harvesting act as seed for the next season, and the expenditure is only in the form of labour utilization in thinning, transplanting and harvesting operations.

Aquafarmers used to stock their makhana-ponds with carp (rohu, catla, mrigal) seed for having some fish besides makhana but it proved to be a failure. As these carps being water-breathing fishes are not able to thrive under ecological adversities owing to the covered water surface with makhana leaves for a good part of the cultivation period. For fish culture in such waters, use of air-breathing fishes such as magur (*Clarias batrachus*), singhi (*Heteropneustes fossilis*) and kawai (*Anabas testudineus*), which have the capacity to withstand such adverse ecological conditions, have been recommended.

Trials taken on the culture of air-breathing fishes in makhana-ponds have shown quite encouraging results. However, an essential pre-requisite for taking up fish culture in such waters is to take up adequate measures of physical improvement forestalling escape of fishstock from the pond. By taking such measures, it is possible to effect a good deal of improvement in economics of water-bodies under makhana cultivation.

Makhana popcorns

dry edible popped makhana is one-third of this product. The cost involved in its

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started taking up cotton on their own as a second crop after rice. During the last 5 years, the area under cotton has increased from 15 hectares to 90 hectares in the 4 administrative blocks. The average productivity of seed-cotton grown by the farmers is 14.2 quintals per hectare compared to the yield of 20.8 quintals per hectare at the re-

search farms of the KVK. The different technology components adopted by the farmers include improved variety (100%), seed rate (100%), seed treatment (65%), sowing time (60%), method of sowing/transplanting (50%), spacing/population (40%), fertilizer use and interculture (45%), plant protection (35%) and quality and management (30%). The KVK has also made an arrangement by which the farmers can dispose of their produce at a remunerative price to a textile mill at Calcutta.

The total cost of production works out to be Rs 9,146 per hectare with benefit: cost ratio as 2.00.

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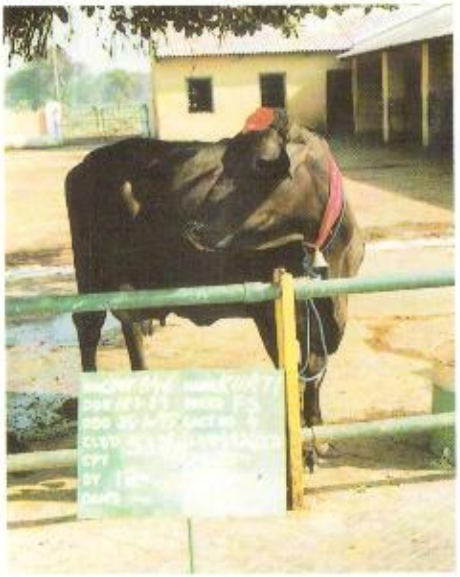
Frieswal–a potential crossbred cow

The Project Directorate on Cattle (ICAR) in collaboration with the Military Farms Directorate is operating a research project on crossbreeding to evolve a new breed Frieswal.

The research results so far accrued in this project are very encouraging. The average age and weight at the first calving of Frieswal cows was 911.74±7.4 days and 383.9±3.3 kg in the first generation, and 915.3±12.3 days and 368.2±9.2 kg in the second generation. These cows produced in the first generation 2,965.2±39.1, 3,585.2±84.8 and 3,827.8±106.0 kg of milk in the first, second and third lactation in 336.5±2.8, 346.2±5.2 and 353.0±7.0 days. The corresponding figures for 300 days milk yield were 2,807.5±32.8, 3,382.8±72.5 and 3,521.8±92.2 kg. In the second generation, they produced 2,976.2±84.4, 3,478.1±166.0 and 3,664.6±386.0 kg of milk in the first, second and third lactation in 335.2±6.1, 339.0±11.2 and 358.0±32.4 days. The corresponding figures for 300 days milk yield were 2,843.2±74.6, 3,229.1±146.1 and 3,483.5±174.7 kg.

Based on the results, it may be stated that Frieswal cows will produce around 4,000 kg of milk in 300 days in a mature lactation when inheritance level is stabilized through interbreeding and selection.

Frieswal cow



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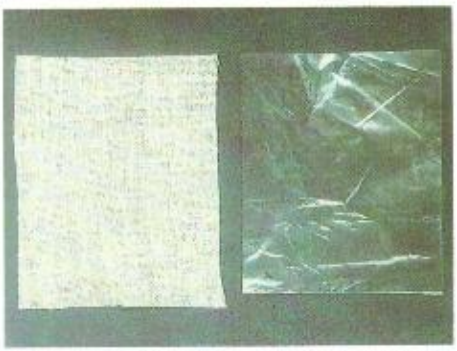
Chitosan–an industrial chemical from crustacean shell

Chitosan, a derivative of chitin (which is the chief component of crustacean shell), is reported to have wide and varied applications in diverse fields; each application needing a product with well-defined characteristics. The CIFT has been successful in designing and erecting a pilot plant for its production and in formulating processing requirements to meet such individual needs on pilot plant side.



Chitosan impregnated gauze and chitosan films

Chitosan acts as a water clarifying agent in preparation of cosmetics and as a sizing material for textiles.

Recent studies have also shown its effectiveness as chitosan-impregnated gauze and chitosan film for treatment of chronic wounds and external ulcers, to arrest/minimize bleeding during surgery including neurosurgery, as a artificial skin and kidney membrane, in plastic surgery and as a contact lens in medicine.

Collaborative studies are being carried out with the Medicine College, Thiruvananthapuram, Kerala, and Dental College, Madras, and several other institutions for evolving new areas for application of the products in the field conditions.

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EVER since independence, the foremost social priority before our nation had been to meet domestic food requirements. The major thrust to food production programme was given in the mid-sixties. The clear policy framework and sound planning backed by generous research and development investments, ensured sustained production of foodgrains and other agricultural commodities. Eventually, our country could make significant strides in agriculture. Today, we have achieved foodgrains production of 191 million tonnes and have a buffer stock of 35 million tonnes. Besides, the export of foodgrains is likely to reach the record level.

Dr R.S. Paroda, Director-General, ICAR

Food and nutritional security, equity, and sustainability would be the new paradigms in future to improve quality of life of our people. Thus, with the likely available resources, concerted efforts, both by the public and private sectors, would be desirable. In the public sector, consolidation, prioritization, avoidance of duplication of efforts and need-and-demand orientation would be important. Provision of working facilities and expenses for optimum utilization of manpower would be quite crucial for enhancing our effectiveness and efficiency. Relevance of agricultural technologies would henceforth be focussed on clients and their needs, as well as their capabilities for absorbing the more advanced technologies. In the process, reforms in the agricultural research, education and extension system would be important to bring about knowledge-oriented diversified production system. This would call for:

- a detailed characterization and a better understanding of the primary components of the natural resource base – soil, climate and water – in each agro-ecological region and addressing of conservation issues and generating 'conservation in farming technology' in-built into production system;
- improving efficiency of valuable as well as scarce inputs viz., water, nutrients and other agrochemicals and developing cost-effective technologies befitting varying requirements of highly diverse bio-physical and socio-economic conditions that are sustainable, economically viable, eco-friendly as well as socially acceptable to farming community;
- exploring alternative or non-conventional resources for diversification of agriculture and enhancing food, fodder, fuel, milk, meat, fish, and fibre production to provide much desired food and nutritional security;
- researches for strengthening production base by harnessing modern scientific knowledge through development and use of high-yielding, disease-, pest- and abiotic stress-resistant, and input-use efficient varieties, hybrids of different crops coupled with a realistic assessment of technology and its use;
- development of energy-efficient systems and relevant technologies for processing, value addition, and product development and storage and transportation technologies for perishable commodities;
- intensified efforts on policy research, market intelligence and trade; and
- programme, mission and centres of excellence modes of operation for generating new technologies.

The translation of these paradigms into possible realities would enable us to retain our green areas as green and help us in converting grey areas also green during the IX Plan. Obviously, this task would require new approaches and commitment on the part of the agricultural scientific community and the congenial environment for technology generation, assessment, refinement and transfer. The renewal process of the NARS is aiming to achieve these very objectives.

(R.S. PARODA)