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Agricultural TECHNOLOGIES

FISHERIES

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ICAR

Indian Council of Agricultural Research
New Delhi

Agricultural Technologies

Commercialized/Ready for Commercialization

FISHERIES

Indian Council of Agricultural Research
New Delhi

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शरद पवार
SHARAD PAWAR

सत्यमेव जयते

कृषि एवं खाद्य प्रसंस्करण उद्योग मंत्री
भारत सरकार
Minister of Agriculture &
Food Processing Industries
Government of India

Message

Indian agriculture has overcome several challenges in the past and achieved phenomenal success ensuring self-sufficiency in food production. The technologies generated within the National Agricultural Research System (NARS) have significantly contributed to the transformation of Indian agriculture and ushering Rainbow Revolution representing Green, White, Golden, Brown and Blue revolutions defining outstanding technology-led performance in foodgrain, milk, oilseeds and pulses, horticulture and fisheries sectors. Agriculture along with other primary sectors is a major source of strength for the Indian economy. However, burgeoning population, increasing demand for food, feed and fodder, decreasing land availability, natural resource degradation, decreasing factor productivity, climate change, slow growth in farm income and new global trade regulations have put new challenges threatening food, nutritional and livelihood security.

Technological interventions by the NARS have led to spectacular accomplishments relating to input use efficiency, climate resilience, mechanization and secondary agriculture leading to economic transformation. These coupled with the application of information and communication technology will play a critical role in our future endeavours to accelerate agricultural growth in the country. I am glad that the Subject Matter Divisions of Indian Council of Agricultural Research (ICAR) have synthesized and compiled practical and useful technologies in this series of publications on Agricultural Technologies in a user-friendly mode. I am sure this information will be useful to farming community, extension agencies, entrepreneurs and agro-industries in their efforts to make Indian agriculture economically viable and ecologically secure.

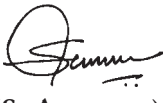
Krishi Bhawan
New Delhi 110 001

(Sharad Pawar)

Foreword

Agriculture is the corner-stone of Indian economy. About 70% of India's 1.27 billion population live in rural areas with small and marginal land holdings. India with a geographical area of over 328 million hectares is endowed with diversity of climate, soils and vegetation. This rich resource endowment is, however, threatened with ever increasing population, vagaries of nature and climate change. The National Agricultural Research System (NARS) comprising the Indian Council of Agricultural Research (ICAR), 55 State Agricultural Universities, five Deemed Universities, four Central Universities with agriculture faculty, one Central Agricultural University and 637 Krishi Vigyan Kendras have attained excellence in several frontier areas of agricultural sciences and technology contributing significantly towards the spectacular growth of Indian agriculture during past 60 years.

Initiatives by NARS in the country have led to notable accomplishments resulting in the socio-economic transformation of farmers. The agriculture sector is, however, witnessing radical changes and challenges both at national and global levels. The emerging challenges and opportunities necessitate wider and faster adoption of the improved technologies by all the stakeholders right from production to consumption in a food chain. In an effort to achieve this, the divisions of crop science, horticulture, animal science, natural resources management, fisheries and agricultural engineering in the ICAR have compiled the technologies already commercialized and the technologies ready for commercialization. This series of publications, brings out the salient features of the technologies with details on potential users and contact details of the developers for ready and ease access. It will be our endeavour to periodically update this Technology Series. I hope that this publication would be useful to the farming community, extension agencies, entrepreneurs and industry. I greatly appreciate the efforts put in by my colleagues in the Council, research institutes and State Agricultural Universities (SAUs) in bringing out this compilation.



(S. Ayyappan)
Secretary
Department of Agricultural Research and Education
and
Director General
Indian Council of Agricultural Research
New Delhi

January 2014
New Delhi 110 001

Preface

Agriculture represents a core part of the Indian economy and provides food and livelihood activities to much of its population. Fisheries, one of the promising sectors of agriculture and allied activities occupies an important place in the socio-economic development of the country. The sector, recognized as a source of income and employment generator, stimulates growth of a number of subsidiary industries besides being a foreign exchange earner.

The major thrust in fisheries development was on augmenting production and productivity, generating employment and expanding export of fishery products. Fisheries sector over the years has expanded rapidly in terms of capture and culture fisheries in both inland and marine areas. Tremendous development was made in the fields of aquaculture, breeding, nutrition, disease surveillance and control, genetic improvements, craft and gears, processing, products and by-product development, export of seafood, etc.

At present the research and education system is trying to evolve the subsistence production system into commercially viable one in the fisheries sector but the process is slow and needs focused consideration. The process of technology commercialization is fairly complex and involves a close collaboration between the researchers, research institutions and the industry. Indian Council of Agricultural Research at present is exploring new avenues to increase the number of technologies being generated by the research institute and to take these technologies to market either through business incubations or through public private partnership.

This publication is an outcome of the various technological innovations generated in the field of fisheries by ICAR research institutes. The technologies related to aquaculture, feeds, disease surveillance and control, value addition, by-products, forecasting, etc are enlisted. The publication is divided into two sections—(i) Fisheries Technologies: Commercialized; and (ii) Fisheries Technologies: Ready for commercialization. It will serve as a reference guide to the industry, entrepreneurs, farmers, stakeholders, researchers, planners and students.

The ICAR fisheries research institutes are acknowledged and appreciated for providing the information.

Dr. B. Meenakumari
Deputy Director General (Fisheries)
ICAR, New Delhi

Contents

1. Fisheries Technologies: Commercialized

Asian Seabass Seed Production

Salient technical features

Captive broodstock development, protocols for accelerating maturation and spawning under captive conditions, techniques for larval rearing, procedure for developing required livefeed – rotifers and artemia, techniques for weaning to formulated feed, grading, packing the fry and transportation achieved.

Performance results

- Year round breeding of Asian seabass under Recirculating Aquaculture System (RAS) with survival rate of 35% from hatchlings to fry and 60-70% fry to fingerlings in the nursery systems in tanks and hapa net cages arhieved.
- Under polyculture system along with tilapia, attained production up to 3.0 tonnes/ha over a period of 10 months culture.
- Using formulated feed developed by CIBA, production of 4-5 tonnes/ha in the grow out system was attained.

By stocking hatchery produced seed, adopting improved farming technology, uniform sized fish with better market price can be produced.

Social benefits

This technology can be adopted by entrepreneurs of large holdings, small farmers. women SHG as livelihood option.

Status of commercialization/IP rights

Technology was transferred under the consultancy to Rajiv Gandhi Centre for Aquaculture (RGCA, MPEDA); and to Shri N. Sankara Rao, Bhimavaram.

Likely cost/economics

Cost of hatchery production of seed is ₹ 4 per piece. Grow out culture production cost is ₹ 120-140 per kg.

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Shining Barb: A New Variety of Ornamental Fish

Shining barb, a new variety of ornamental fish, developed by selective breeding of rosy barb, *Pethia conchonius* is released for field trial on experimental basis to the entrepreneurs. The glittering gold colour females and shining pink red colour males of shining barb appear much more attractive compared to the rosy barb variety. They are amenable to varied culture conditions. The shining and vibrant colours of the fish are expected to attract fanciers and traders and can fetch better price in domestic as well as export markets. With increase in demand it may also provide additional source of livelihood to the rural poor.

Benefits

The shining and vibrant color of the fish attracts the hobbyists as well as traders which can fetch good price in the domestic and export market.

Status of commercialization/IP rights

The technology is released for field trial on experimental basis and the MoU is signed with the implementing entrepreneur Tropical Aquaculture and Farming Systems (India), Udaipur, Rajasthan.

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CIBA Bhetkiahar

CIBA Bhetkiahar is the formulated pellet feed developed for the nursery and grow-out culture of Asian seabass, *Lates calcarifer.* CIBA Bhetkiahar is a standard feed containing 45-50% protein designed and developed to meet the dietary requirements of Asian seabass for optimum growth and good feed efficiency. The feeds were extensively tested in the experimental farms and also in selected farmers' fields in different states such as Andhra Pradesh and Tamil Nadu. With this feed seabass can be grown to 1 kg in 9-10 months with an FCR of 1.6-1.8.

Status of commercialization/IP rights

The feed technology is commercialized to M/s Ratna Agro-vet Feeds India Pvt. Ltd., Hyderabad, Andhra Pradesh.

Likely cost/economics

₹ 60 lakh for establishing sinking feed production unit with a capacity of 1-2 tonnes per hour and ₹ 1.5 crores for establishing extruder floating feed unit with a capacity of 2 tonnes per hour.

Seabass cultured using CIBA Bhetkiahar

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CIBA Shrimp Feed

CIBA has developed balanced shrimp feed formulations of starter, grower and finisher grade feeds separately for tiger shrimp and white shrimp based on their dietary nutritional requirements. The feed formulations contain vitamin and mineral mixtures developed exclusively for shrimps. Beside, the formulations also contain feed attractants and other feed additives required for faster growth of shrimp and gaining better feed conversion ratio (FCR). The raw materials selected include ingredients representing sources for proteins (animal and plant), lipids, carbohydrates, feed additives and binders. Multilocation demonstration results revealed that the feed is highly palatable and gives good growth with a FCR of 1.4-1.8 and it is highly cost effective compared to the existing shrimp feed. The use of indigenous machineries and raw materials reduces the cost of production and increases the profit margin of the entrepreneur substantially.

Status of commercialization/IP rights

CIBA shrimp feed technology commercialized with Bismi Feeds(P) Ltd, Nagapattinam, Tamil Nadu

Likely cost/economics

₹ 60 lakhs for establishing shrimp feed mill with a capacity to produce 1-2 tonnes per hour.

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Portable FRP Carp Hatchery

The portable FRP carp hatchery is designed for breeding of Indian major carps, viz. rohu (*Labeo rohita*), catla (*Catla catla*), mrigal (*Cirrhinus mrigala*), kalbasu (*Labeo calbasu*); and Chinese carps, viz. silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*) and common carp (*Cyprinus carpio*). The medium carps *Puntius* sp. and *Labeo bata* were also found suitable for breeding in the system.

The complete unit of the FRP hatchery consists of:

(i) Breeding/ spawning pool,
(ii) Hatching/ incubation pool,
(iii) Egg/ spawn collection chamber, and
(iv) Overhead storage tank/ water supply system.

The hatchery has many advantages like easy to transport to different locations, installation in less space, low water consumption per cycle of operation and easy to repair. The system is suitable for breeding of 10-12 kg of carps in a single operation. It has the capacity of hatching 1.0-1.2 million eggs per operation.

Status of commercialization/IP rights

The FRP carp hatchery technology was released to the nation by CIFA, Bhubaneshwar. The technology is commercialized with M.R. Aquatech, Bhubaneshwar, Odisha.

Likely cost/economics

₹ 45,200

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Portable Magur Hatchery

The portable magur hatchery is constructed using fibreglass reinforced plastic (FRP). It includes egg incubation and hatching units. The hatchery creates suitable environment for incubation and hatching of magur eggs. The percentage of hatching is high and a time 50,000 fertilized eggs can be incubated.

Status of commercialization/IP rights

Commercialized with M.R. Aquatech, Bhubaneshwar, Odisha.

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Fish Aggregating Devices (FAD): Concrete Moulded Modules for Laying of Artificial Reefs

Fish Aggregating Devices (FAD) made from concrete moulded modules are hardy and can withstand strong currents. The floral growth on the surface with associated fauna settles easily within 4-6 months (time necessary for maturation of the reef). With aggregation of fishes and other biota in and around the artificial reefs, increase availability of fishes and add to the income of artisanal fishermen particularly those involved in coastal fishing using hooks and lines. Further, this leads to a considerable reduction in scouting time which also saves fuel. Site selection through underwater survey and fixing of reef position using GPS, in consultation with fishermen (participatory approach) is of prime importance in the successful enhancement of natural resources through artificial reefs.

Grouper module

- Welded grills are prepared to the dimension of 1 m × 1 m with 6 mm M.S. rods for reinforcement, coated with zinc chromate paint and allowed to dry
- The grills are placed in the oiled M.S. Angle mould with 1.25 cm bottom cover
- The cement concrete with 1:1:2 ratio using 10 to 20 mm stone jelly mix is filled in the mould to 6.25 cm thickness and well consolidated
- After setting and removal of the mould, the sides are dressed and finished with 1:2 mortar and allowed to cure in freshwater for a minimum period of 7 days
- Casting of 1 m long 20 cm diameter R.C.C. pipes is done in a cylindrical mould with M.S weld mesh cut in a cylindrical 1 m length shape as the inner reinforcement and cured in freshwater for 7 days
- The well cured 3 concrete plates are joined by welding the extended rods as triangle and the joints are dressed and finished with 1:2 cement mortar and chips
- Three numbers of 28 cm diameter pipes are placed in the triangle and fixed with plates by concrete mortar of 1:2 to avoid movement of the pipes
- The outer sides of the triangle is finished with stucco plastering
- The plastered finished cubes are cured in freshwater for a minimum period of 5 days

Well ring module

- The grills are prepared to the dimension of 76 cm diameter and 30 cm depth, with 3 round rings overlapping each other
- The grills are coated with zinc chromate paint

- After fixing the grills in the mould, cement concrete of 1:1:2 ratio mixed with 5 mm size stone jelly is filled in the mould with proper consolidation
- After setting and removal of the mould, the sides are dressed with 1:2 mortar and allowed to cure in freshwater for a minimum period of 7 days

Reef fish module

- Welded M.S. rod grills are prepared to the dimensions of 1.2 m × 1.2 m and are coated with zinc chromate paint
- 1.2 m × 1.2 m steel mould with 23 cm × 23 cm diameter square opening in the centre and 12 numbers of 15 cm diameter opening in the sides are prepared with coating of waste oil and the grill is placed in the mould with 1.25 cm bottom cover
- The mould is filled with 1:1:2 cement concrete mixed with 10 to 20 cm stone jelly to a thickness of 6.25 cm and consolidated
- After setting and removal of the mould, the sides are dressed with 1:2 mortar and allowed to cure in freshwater for a minimum period of 7 days
- The 3 well cured concrete plates are joined to form a triangular structure by welding the extended rods and the joints are dressed and finished with 1:2 cement mortar and chips
- The outer sides of the triangular structure are finished with stucco plastering
- The plastered finished structures are cured in freshwater for a minimum period of 5 days

Social/environmental benefits

Artificial reefs contribute to a great extent for enhancement of various biological resources and thereby increase in fish production. Installation of artificial reefs in the selected coastal districts will increase fish population in the inshore waters and fish catches after installation. This will also lead to an increase in the income of the artisanal fishermen, particularly during the lean seasons.

Status of commercialization/IP rights

Technology has been offered in consultancy mode to Tamil Nadu Fisheries Director, IFAD assisted PTSLP, (Tamil Nadu Corporation for Development of Women Ltd, Government of Tamil Nadu Undertaking), and Commissioner of Fisheries, Department of Fisheries, Government of Tamil Nadu

Likely cost/economics

Average cost of fabrication and deployment (including labour and boat hiring) calculated per module works out to approximately ₹ 6,000.

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Cadalmin™ Green Mussel Extract (Cadalmin™GMe)

Cadalmin™GMe containing 100% natural marine bioactive anti-inflammatory ingredients from green mussel *Perna viridis*, combat's chronic joint pain, arthritis/ inflammatory diseases and improves cardiovascular functioning. It is an effective green alternative to synthetic non-steroidal anti-inflammatory drugs and other products available in the market. Cadalmin™GMe is designed to find a unique way to prevent the degradation by air, moisture, heat and light and to maximize the activity. The product is free from trans fatty acids, free radicals, low molecular weight carbonyl compounds, and has been proved to be safe by a long term acute and chronic toxicity study on experimental subjects. The active principles in Cadalmin™GMe isolated from *P. viridis* competitively inhibit inflammatory $COX_{I, II}$ and LOX_V in an inflammation and oxidative stress reaction, resulting in decreased production of inflammatory prostaglandins and leukotrienes. This product is packaged as capsules.

Status of commercialization/IP rights

Commercialized with Accelerated Freeze Drying Company Pvt. Ltd., Bengaluru.

Cadalmin™ Green Mussel extract (Cadalmin™GMe for use against joint pain and arthritis)

Patent applications filed entitled: Process to concentrate anti-inflammatory principles from green mussel *Perna viridis* L. and a product incorporating these ingredients (Application No. 2065/CHE/2010); Product containing anti-inflammatory principles from green mussel *Pernaviridis* L. and a process thereof (Application No.2066/CHE/2010)

Likely cost/Economics

₹ 2.30 per capsule

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Cadalmin™ Green Algal Extract (Cadalmin™ GAe)

Cadalmin™ Green Algal extract (Cadalmin™ GAe) contains a unique blend of 100% natural marine bioactive anti-inflammatory ingredients extracted from selected seaweeds or marine macroalgae with ecofriendly "green" technology. The product is effective to combat arthritic pain and inflammatory diseases in human beings. The active principles in Cadalmin™ GAe competitively inhibit pro-inflammatory mediators, resulting in decreased production of inflammatory prostaglandins and leukotrienes, and its activity was found to be superior to some of the synthetic non-steroidal anti-inflammatory drugs available in the market. The mean lethal dose (LD_{50}) of Cadalmin™ GAe was found to be greater than 4,000 mg/kg body weight of the mammalian subjects that indicate the safety of the product. As part of the further safety assessment of the extract, feeding of Cadalmin™ GAe even at a dose up to 2,500 mg/kg body weight did not induce significant change in body weights, hematological indices, histopathological, and serum biochemical parameters between the control and treated groups indicating that it has no toxicity to the experimental animals. Cadalmin™ GAe was distributed to more than 400 patients suffering with chronic joint pain and arthritis, and questionnaire and clinical trial-based studies revealed that more than 98% of the respondents were satisfied with the product with about 70-85% relief in joint pain and arthritis. None of the respondents reported any side effects. The diagnostically useful autoantibody termed as Rheumatoid Factors (RFs), which are the most useful prognostic marker for rheumatoid arthritis, significantly reduced from more than 300 IU/mL to less than 20-35 IU/mL within a period of two months of consuming the product.

Status of commercialization/IP rights

Commercialized with Celestial Biolabs Limited, Hyderabad
Filed patent (Indian Patent Application Nos. 2064/CHE/2010, 5199/CHE/2012)

Likely cost/economics

Cost of production per capsule: ₹ 0.27 (Total number of capsules (each capsule of 0.5 g) produced from 100 tonnes of active ingredient are 20,00,00,000)

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Chitin and Chitosan from Crustacean Waste

Chitosan is a linear polysaccharide composed of randomly distributed β-(1-4)-linked D-glucosamine (deacetylated unit) and N-acetyl-D-glucosamine (acetylated unit). Chitosan is produced commercially by deacetylation of chitin. Chitin $(C_8H_{13}O_5N)_n$ is a long-chain polymer of a N-acetylglucosamine, a derivative of glucose. It is the main component of the the exoskeletons of arthropods, such as crustaceans (like the crab, lobster and shrimp). The shrimp processing industry in India turns out more than 1.25 lakh tonnes of head and shell waste per annum. Nearly 7,000 tonnes of chitin can be produced from the prawn shell which is thrown out as waste now. CIFT developed a method for the extraction of chitin from shrimp shell waste. The wet prawn shell collected from the peeling centers is initially converted into chitin which is then converted to chitosan by a chemical process of deacetylation. Then the alkali free, dried and powdered chitosan is bagged in polythene lined HDPE woven sacks.

Benefits

- Chitosan has various industrial applications like, biotechnology, food processing, pharmacy and medicine.
- Use of chitin for the production of glucosamine hydrochloride finds applications in antibiotics and baby food formulations.
- Chitosan can be used as sizing material for textiles.
- It can be used as a water/ wine clarifying agent and also in the preparation of cosmetics and pharmaceuticals, etc.
- Chitosan (in the form of microfined powder) impregnated gauze and film can be used for treatment of chronic wounds and external ulcers and to arrest/ minimize bleeding in brain surgery.

Status of commercialization/IP rights

Signed consultancy agreements with M/s. V.V. Biotech Pvt. Ltd., Ongole, Andhra Pradesh for technical assistance and guidance on extraction of chitin and chitosan from prawn shell waste.

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