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From the President's Desk

Aquaculture Diversification for Blue Revolution



India has witnessed remarkable growth in its fisheries sector over the past seven decades. Fish production increased from 0.75 million tons in 1950-51 to 14.2 million tons in 2019-20, contributing 1.24% to the gross domestic product and 7.28% to the agricultural gross domestic product. As elsewhere in the world, the Indian fisheries sector too has diversified. The share of capture fisheries in the total production has declined to

37% in 2019-20 from almost 100% in 1950-51. Over time, aquaculture has become prominent, raising its production to 9.0 million tons. India is now the second-largest aquaculture producer. However, aquaculture is dominated by freshwater fishes with carps as the main species. Open-sea aquaculture in the country is at the nascent stage. Land-based coastal aquaculture, with shrimp as the main produce (0.8 million tons; <10% of total aquaculture production), accounts for two-thirds of the fish exports earnings.

Freshwater aquaculture

The history of aquaculture in India is quite old, but aquaculture remained a household subsistence activity until the 1970s. The development of the technology of induced breeding of carps through hypophysation in 1957 has been the most significant event providing a scientific basis for aquaculture development in the country. Consequently, mass-scale seed production under controlled conditions ensured the supply of quality seeds of desired species. The availability of hormone formulations made seed production technology even more farmer-friendly. Carp seed production is no more confined to the monsoon season, and large-scale seed production under controlled conditions is now a reality. Carp species are adapted to breeding for an extended period. Further, the technology of multiple breeding (2-4 times during a season at an interval of about 45 days) has resulted in 2-3 times higher spawn recovery.



The development of technologies of two-tier seed systems, i.e., raising spawn to fry in the nursery, and fry to fingerlings in fingerlings-rearing systems could overcome the problem of low larval survival. Packages of practices have been standardized for pre-stocking management, stocking operations, and post-stocking management including supplementary feeding, water management and health care, resulting in higher growth and survival rates in intensive rearing systems. As of now, the country produces over 52 billion carp fries from spawn produced in about 3000 hatcheries.

The technology for grow-out carp polyculture with three Indian major carps viz., catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*), and further the composite carp culture with exotic carps viz., silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*) and common carp (*Cyprinus carpio*) into polyculture system during the 1960s provided momentum to freshwater aquaculture. Carp farming has now grown in terms of geographical spread, diversification of culture species and rearing methods. Several technologies with varying production potential offer opportunities to farmers and entrepreneurs to diversify aquaculture based on their resource endowments. The mean yield of freshwater aquaculture systems is around 3.5 tons/ha/annum, but in several regions, through carp farming, the farmers could harvest up to 12 tons/ha/annum. Farming practices have also changed, in terms of species and rearing systems. A range of non-conventional culture systems, viz., sewage-fed fish culture, integrated farming, cage and pen culture, and running water/recirculatory aquaculture have imparted dynamism to freshwater aquaculture.



Despite the availability of indigenous catfish species, the exotic striped catfish *Pangasianodon hypophthalmus* is the most widely cultivated catfish species in freshwater aquaculture systems because of its ability to be farmed at a

high density and higher yield i.e., 20-40 tons/ha/annum under monoculture system with the provision of extruded floating feed. The farming of this species, however, is largely confined to Andhra Pradesh. This species is also an ideal candidate for cage culture in reservoirs and may yield 2.5-3.5 tons in small cages of 6 m x 4 m x 4 m in 6-8 months. Red-belly Paku (*Piaractus brachypomus*) and Nile tilapia (*Oreochromis niloticus*) are other exotic species being increasingly adopted in freshwater aquaculture systems.

The farming of giant freshwater prawn *Macrobrachium rosenbergii*, the largest and fastest-growing species among freshwater prawns, is being emphasized due to its high demand in the domestic as well as international markets. The hatchery technology for the species has been standardized for controlled seed production. However, the requirement of saline water during the larval rearing stage restricts the establishment of hatcheries in the coastal regions. Nevertheless, the use of artificial seawater has led to the establishment of hatcheries in the land-locked states also. Its monoculture has produced 1.0-1.5 tons/ha in 7-8 months. Incorporation of the species at a low stocking rate of 10,000-15,000/ha in carp polyculture system has proven an economically advantageous proposition. The Indian river prawn *M. malcolmsonii* is another important species possessing a significant potential of farming in mixed farming systems with carp.



A 50% or higher growth in the genetically-improved rohu in farmers' fields after the 10th generation of selective breeding is a significant achievement in fish breeding. The technology has been extended to other species, viz., catla and giant freshwater

prawn. The technique of milt cryopreservation has also been extended to commercial hatcheries for gamete exchange to overcome the problem of inbreeding depression.

Aquaculture in upland hilly regions is in its infancy. The development of controlled seed production of trout, mahseers

and snow trout has led to the establishment of hatcheries in the upland hills. The demonstration of scientific trout farming in raceway systems in upland cold water regions has huge potential for aquaculture.

Concerted efforts for breeding and mass-scale seed production of diversified species have led to the development of technologies for a dozen of potential medium/minor carps and barbs of regional importance viz., Kalbasu (*Labeo calbasu*), Fringed-lipped carp (*L. fimbriatus*), Kuria labeo (*L. gonius*), bata (*L. bata*), Kali rohu (*L. dyocheilus*), Pangusia labeo (*L. pangusia*), Malabar Labeo (*L. dussumieri*), Cauveri carp (*Cirrhinus cirrhosus*), Reba (*C. reba*), Kalaban (*Bengana dero*), Pengba (*Osteobrama belangari*), Olive barb (*Systomus sarana sarana*), exotic Silver barb (*Barbonymus gonionotus*), etc.

Farming of air-breathing catfishes viz., magur (*Clarias magur*) and singhi (*Heteropneustes fossilis*) has attracted farmers and entrepreneurs. Although breeding and seed production technologies have been standardized, the low fecundity and necessity of sacrificing the male for removal of the testes are major issues in their large-scale seed production. With the establishment of several small-scale hatcheries in the eastern and northeastern states, the seed production of these species is gaining momentum. The potential for farming in shallow derelict water bodies and their adaption to adverse ecological conditions offer great scope for their farming.

Breeding and seed production technologies have been developed for several other non-air breathing catfishes viz., Pangas catfish (*Pangasius pangasius*), freshwater shark (*Wallago attu*), Butter catfish (*Ompok bimaculatus*), pabda (*Ompok pabda*), Yellow catfish (*Horabagrus brachysoma*), Long whiskers catfish (*Mystus gulio*), Gangetic mystus (*M. cavasius*), etc. Most of these species are high-valued species of regional importance, and the assured availability of their seed will be a key to the spread of their farming.

Brackish water aquaculture

The scientific brackish water farming in India began in the early 1990s with the shrimp being the main species. Black tiger prawn (*Penaeus monodon*) remained the single most important species for about two decades. However, the introduction of SPF Pacific white shrimp (*Litopenaeus vannamei*) introduced in 2009 has gradually replaced it. Shrimp production increased from 0.4 lakh tons in 1991-92 to 1.44 lakh tons in 2006-07. Although the disease outbreak by WSSV and imposition of CRZ by the Supreme Court caused a setback to shrimp farming, it emerged with a new vigour resulting in horizontal and vertical expansion of farming of *L. vannamei*. The fast growth, low incidence of native diseases, availability of SPF domesticated strains, culture feasibility in a wide range of salinity of 0.5-45‰ and strong demand in the international market for small white shrimps helped the expansion of its farming. As of now, about 90% of the 8.0 lakh tons of shrimp produced in the country is contributed by *L. vannamei*. In recent years, the industry has shown interest in the adoption of *P. monodon* and Indian white shrimp (*Penaeus indicus*). It is expected that with the availability of hatchery technologies for *P. indicus*, banana shrimp (*P. merguensis*), Green tiger shrimp (*P. semisulcatus*) and Kuruma shrimp (*P. japonicus*), shrimp farming will witness significant diversification.

To continue with the export growth, the industry must be able to build confidence among the importing nations. Therefore, the adoption of Good Management Practices (GMP), and implementation of the HACCP, traceability, eco-labelling and quality assurance criteria are of paramount importance. Further, the fattening of mud crab (*Scylla serrata*) is a remunerative

farming practice, and it is poised for increased adoption with the availability of hatchery-produced seeds.

The success in induced breeding and hatchery technologies of important finfish species like seabass (*Lates calcarifer*), grey mullet (*Mugil cephalus*), milkfish (*Chanos chanos*), grouper (*Ephinephelus tauvina*) and pearl-spot (*Etroplus suratensis*) has opened-up enormous scope for diversification. Some of these species also possess the potential for farming in both freshwater and under open-sea mariculture.

The states of Haryana, Punjab, Rajasthan and Uttar Pradesh have vast inland saline areas, and with the successful demonstration of shrimp farming in such areas, shrimp farming may emerge as an important enterprise in these states. Apart from shrimps, the farming of brackish water finfish species viz., mullets, milkfish, seabass and pearl-spot also have the potential for cultivation in inland saline waters.

Mariculture



Farming in marine waters has remained a low key activity in India, despite its long coastline of over 8100 kilometers. Farming technologies of mussels (Green mussel *Perna viridis* and brown mussel *P. indica*) and edible oyster (*Crassostrea*

madrasensis) were standardized about four decades back, but their farming remained confined to some states in the south. Low domestic demand, localized acceptance of the bivalve species and lack of entrepreneurship are the main reasons for their low adoption. The same is the case in the farming of pearl oysters and seaweeds.



The large-scale demonstrations of the open-sea cage farming technologies in the coastal regions have aroused interest for its adoption on a large scale. A harvest of 2.5-3.0 tons in 6-8 months of seabass (*L. calcarifer*), cobia (*Rachycentron canadum*)

and Silver pompano (*Trachinotus blochii*) in 6m diameter cages can be realized. The problem of their seed availability needs to be addressed through the development of technologies of breeding and seed production. However, to meet the seed demand, commercial hatcheries must be established. With the growing demand for high-valued fishes, the prospects of cage farming appear quite are bright.

Aquaculture of non-food species

Ornamental fish farming, pearl culture, and seaweed farming are some of the important non-food aquaculture systems that possess great potential for future aquaculture development. The ornamental fish trade in India largely involves freshwater varieties, comprising mainly the exotics for domestic consumption and the wild-caught indigenous ones for export. Peri-urban areas of Kolkata, Chennai and Mumbai have emerged as the breeding hubs for ornamental fishes. Several commercial units have also come up in the states of Kerala, Andhra Pradesh, Karnataka and Odisha. Increased focus on indigenous species has led to the successful development of technology for breeding of over 30 freshwater species, the important ones include several species of genus *Puntius*,



of genus *Puntius*, *Brachidanio*, *Badis*, *Deverio*, *Dawkinsia*, *Pethia*, *Rasbora*, *Esomus*, *Schistura* and *Trichogaster*.

The development and standardization of breeding and seed production technologies of marine ornamentals such as clownfishes (*Amphiprion percula*, *A. ocellaris*, *A. sebae*, *A. frenats*, *A. sandaracinos*, *Premnas biaculeatus*), damselfishes (*Dascyllus trimaculatus*, *D. aruanus*, *Pomacentrus caeruleus*, *P. pavo*, *Chromis viridis*, *Neopomacentrus filamentosus*, *N. nemurus*, *Chrysiptera unimaculata*), and others viz., Sapphire devil (*Chrysiptera cyanae*) and dotyback (*Pseudochromis dilectus*) offer enormous scope for fish entrepreneurship in the coastal areas and islands of Andaman & Nicobar and Lakshadweep. Although the need to promote ornamental fish farming as a cottage industry cannot be undermined, its emergence on a commercial scale provides an avenue for exports.


The research on pearl culture in India began in the early 1970s focusing on marine pearl oysters. The technology of pearl production involving the introduction of nuclear beads along with secretory mantle tissue into recipient oysters has been successfully developed. The potential species identified for production of gem-quality pearls are golden pearl oyster *Pinctada fucata* in the Gulf of Mannar, Palk Bay and Gulf of Kutch; and black lip pearl oyster *P. margaritifera* in the Andaman & Nicobar Islands. Other species distributed in the Indian waters are *P. chemnitzii*, *P. sugillata*, *P. anomoides* and *P. atropurpurea*. Freshwater mussel, *Lammelidens marginalis* is the main species identified for quality pearl production. *L. corrianus* and *Parreysia corrugata* are other potential species. The packages of practices for pearl culture of round, half-round and designed pearls have been developed for these species.

Seaweed resources are confined to the coasts of Tamil Nadu and Gujarat. The research on seaweed farming was initiated in 1964 with *Sargassum* under the net culture method in the ponds at Porbandar, Gujarat. Subsequently, several species were evaluated for their potential of farming through the rope and net methods. However, seaweed farming remained confined to *Gracilaria edulis* because of its high regenerative capacity. Of late, the cultivation of exotic *Kappaphycus alvarezii* - a carragenophyte, has received the attention of entrepreneurs because of its high growth potential. The Integrated Multi-Trophic Aquaculture (IMTA),



encompassing seaweed farming and cage culture of marine finfishes, has shown the considerable potential of seaweed farming for bioremediation and carbon sequestration. With the implementation of the Pradhan Mantri Matshya Sampada Yojana (PMMSY) India is likely to emerge as a leading seaweed producer.

By 2025, fish production in India is predicted to increase to 22 million tons, of which 16 million tons have to come from aquaculture. In other words, freshwater aquaculture must continue to attract greater attention for the expansion of land-based coastal, inland-saline and open-sea farming of brackish water and marine species. Aquaculture provides an opportunity and scope economies to farmers for enhancing their income. Hence, it is necessary to develop a roadmap for Blue Revolution through the diversification of aquaculture leveraging the available resources, breeding technologies and culture practices for an efficient, sustainable and resilient fisheries sector.


(T. Mohapatra)
President

119th Executive Council Meeting

The 119th meeting of the NAAS Executive Council was held on August 6, 2021 (in virtual mode) under the chairmanship of Dr T. Mohapatra, President of the Academy. The progress regarding preparations for the XV Agricultural Science Congress to be held at Banaras Hindu University from November 13-16, 2021 was presented by Dr Rakesh K. Singh, Organising Secretary. The Technical Program of the Congress including Plenary Lectures, was also presented.

The President appreciated the activities carried out by the Regional Chapters. Despite the limitations due to Covid

pandemic, programmes were organized particularly for students at school and graduate level. The President reiterated that Regional Chapters are providing a much needed platform for students by harnessing the expertise of the NAAS Fellows. As per the review of the Regional Chapters undertaken on June 23, 2021, a Committee was constituted to relook into the guidelines for the Regional Chapters. The Committee would deliberate to address the constraints and concerns of the Regional Chapters and come out with specific recommendations to strengthen the Regional Chapters.

28th Annual General Body Meeting

The 28th Annual General Body Meeting of the Academy was convened in a hybrid mode on August 9, 2021, at 4.00 pm under the chairmanship of Dr Trilochan Mohapatra, President of the Academy. Before taking up the agenda for the meeting, the house observed a one-minute silence to pay homage to Dr Anand Swarup, Dr M Mahadevappa, Dr Sanjay Rajaram, Dr Hukum Chandra, Dr Ram Roshan Sharma, Dr Sushil Kumar, Dr Chakrapani Misra and Dr M. Udaya Kumar, Fellows of the Academy; and Mr Umesh Rai, Programme Executive at the NAAS Secretariat, who left for their heavenly abode since the previous AGM.

Dr P.K. Joshi, Secretary, welcomed the President, past-Presidents and esteemed Fellows and Associates who joined the AGM in-person or through virtual mode. Dr T. Mohapatra extended a hearty welcome to the entire fellowship, including the newly-elected Fellows and Associates.

Dr P.K. Joshi conducted proceedings of the AGM as per the

agenda. After that, the floor was opened for seeking views of the fellowship on various issues for discussion at the Academy. Several topics were suggested for organizing policy/strategy workshops by the Fellowship. The topics will be considered by the Programme Committee while finalizing the programme for 2022.

Admission of the Fellows and Associates

It was informed that the presentations of the newly-elected NAAS Fellows of all the Sections were organized in a virtual mode from June 15-18, 2021. During the AGM, citations of the Fellows and Associates were readout, and by virtue of the authority vested in him, the President, NAAS admitted 29 Fellows, 2 Foreign Fellows, 2 Pravasi Fellows and 11 Associates.

On this occasion, a publication "Memoir – Prof Virender Lal Chopra" was released by the President in memory of Prof V.L. Chopra, past President of the Academy, and a brilliant scientist and teacher, who passed away on 18 April 2020.

Presidential Address

Dr T. Mohapatra, President of the Academy delivered the presidential address. He expressed his appreciation to the founder Fellows, all the past-Presidents and the entire fellowship for the stature that the Academy has attained nationally and internationally, congratulated the newly inducted fellows and associates, and thanked the fellowship present in the AGM. In his address on 'Startup Culture in Agriculture', Dr Mohapatra mentioned Hon'ble Prime Minister's vision of encouraging technology and innovation as effective instruments for economic transformation and emphasized the need for an effective public R&D system to develop new technologies with innovative approaches to create entrepreneurs/startups in agricultural value chain. The Government of India has undertaken reforms to uplift the start-up ecosystem. He also mentioned that

out of more than 41,000 recognized startups in India, there are over 6000 agri-startups, the majority of which deal with downstream of the supply chain.

He mentioned the opportunities to improve efficiency in agriculture by applying drones, satellite photography, sensors, IoT-based sensor networks, phase tracking, weather forecasts, and biotech solutions; and enumerated the business models that have emerged to harness the opportunities in agriculture. These include:

- Upstream marketplace models that operate nearer to the farmer providing efficient material inputs required for production
- Downstream 'farm-to-fork' supply chain models that operate closer to the consumer and provide efficient production and distribution of products

- Farming-as-a-service model that offers farm equipment rentals to ease the burden of capital investments for farmers
- IoT or Big Data-led innovation models that deploy smart technology to assist farmers to gain access to timely information and drive productivity
- Engineering-led innovation models that drive innovative solutions in the agriculture space.

With appropriate policy support, the Farmer Producer Organisations (FPOs) are emerging as a practical approach towards empowering smallholder farmers. The strength of the FPOs needs to be harnessed for filling important gaps in the supply chain focusing on the aggregation of farm produce and linking farmers to both inputs and output markets. The hand holding between farmers and agri-tech entrepreneurs will create unique win-win collaborative business models.

He also discussed many challenges in agri-startups, such as lack of mentorship, inadequate knowledge of agriculture and allied fields, as well as problem of funding.

These need professional mentoring at different stages, networking and communication, besides funding support. To overcome this, the active participation of academia, investors, industry and other stakeholders is a must. Agri-Business Incubators (ABIs)/Accelerators are emerging as a crucial component of the startup ecosystem providing support for the development and scaling-up of growth-oriented early-stage enterprises. The Indian Council of Agricultural Research (ICAR) has established a network of 50 ABI Centers in its research institutes. Besides, other public sector organizations (DBT, DACFW, DST, NSTEDB, AIM, NITI Aayog, Bio-NEST, BIRAC) have also taken the initiative of establishing agriculture specific incubators. He expressed satisfaction that a new generation of budding entrepreneurs and emerging startups are leading the way in disrupting the age-old agriculture system with innovative ideas and affordable solutions, which will be vital to fuel economic growth.

The meeting ended with a vote of thanks by Dr K.C. Bansal, Secretary, NAAS.

NAAS Programmes

During this period, three Strategy Workshops/ Brainstorming Sessions were organised in virtual mode.

Strategy Workshop on Drudgery Free Agriculture: Challenges and Way Forward (Convener: Dr K.P. Singh, Co-Convener: Dr Naresh Chhuneja)

A strategy workshop on 'Drudgery Free Agriculture: Challenges and Way Forward' was organized on September 15, 2021. The workshop was convened by Dr K.P. Singh, Principal Scientist, ICAR-CIAE, Bhopal under the chairmanship of Dr Trilochan Mohapatra, President NAAS. Dr Gajendra Singh, Ex-DDG (Engineering), ICAR was the Co-Chair. Dr A.K. Singh, Vice-President, NAAS presented the objectives of the workshop, while Dr K.P. Singh delivered the outline of the programme. Dr Mohapatra in his opening remarks highlighted the role of machines and management practices using digital platform for intensification of Indian agriculture. He also emphasised the need to develop entrepreneurship for the establishment of farm machinery custom-hiring centres for proper utilization of tractors and other agricultural machines.

A lack of access to appropriate agricultural machines and decision support system results in excessive physical stress and fatigue amounting to high levels of drudgery. The working conditions and lack of essential facilities,



are forcing farmers to adopt static machines, which drastically reduce the comfort index. The following key recommendations emerged from the discussion:

- Development of entrepreneurship models to establish farm machinery custom-hiring centres (CHC) for proper utilization of tractor power and other machines to reduce the drudgery in agriculture. Some modern mechanization strategies for proper utilization of available machines and tools using digital platform equipped with sensors, and machine and deep learning technologies should be introduced.
- Development of Uber / Ola type model using digital platform may be adopted for optimal utilization of tractor power and machines.

- Gender-neutral machines need to be designed and developed in view of increasing participation of women workers in agriculture.
- Multi-disciplinary national and international collaborations are needed in the field of digital and disruptive technologies in agriculture.
- Introduction of Mobile vans for on-farm repair and maintenance services of agricultural machines in remote areas.
- Development of linkages among researchers, entrepreneurs and farmers.
- High initial investment for the adoption of digital and disruptive technologies needs to be addressed.
- A national level apex body is required to oversee the planning and execution of overall certification programme of all the clonally-propagated plants.
- Guidelines need to be framed for certification of pre-basic and basic material, including indexing and eradication of pathogens and maintenance of passport data.
- Establishment of a strong network of universities and research institutions mandated with supply of certified basic material of specific crops and accredited nurseries producing the certified planting materials is the need of the hour.
- Facilities for virus indexing and genetic homogeneity should be established in institutions mandated with the production of certified basic material of fruit crops.
- All the imported planting material should be adequately tested for pests and diseases through PEQ
- Bar-coding/QR-coding is needed for all the certified and clean planting materials.

Strategy Workshop on Certification of Quality Planting Material of Clonally Propagated Fruit Crops for Promoting Diversification (Convener: Dr V.K. Baranwal)

A strategy workshop on 'Certification of Quality Planting Material of Clonally Propagated Fruit Crops for Promoting Diversification' was organized on September 20, 2021. The workshop was chaired by Dr T. Mohapatra, President, NAAS, and co-chaired by Prof Anupam Varma, Ex ICAR National Professor, IARI. Dr K.C. Bansal, Secretary, NAAS welcomed the participants; and Dr V.K. Baranwal, Professor, Division of Plant Pathology, IARI & Convener of the workshop presented the national and international status of the programmes related to the certification of quality planting material. Dr Mohapatra highlighted the need to establish a robust system for certification of planting material of fruit crops and development of a national data base of the centres producing the planting material. He also laid emphasis on testing of soil-borne pathogens and bacteria, besides testing of plant viruses, and development of easy-to-use diagnostics, as to ensure the total health of planting materials before these are provided to the growers.

Fruit crops like apple, apricot, almond, cherry, pear, peach, plum and walnut are high-value clonally-propagated crops and can contribute significantly to enhance income of farmers. Non-availability of genuine and quality planting material of improved/ superior fruit varieties is a major bottleneck in increasing productivity of fruit crops. Diseases of clonally-propagated fruit crops that are caused by viruses and virus-like agents, as well as bacterial pathogens, can severely affect longevity, yield, appearance and taste of fruits. Such pathogens are often difficult to detect in the rootstocks and budwoods, and hence easily spread to newer areas. Therefore, there is an urgent need to prepare detailed guidelines to ensure production and supply of certified quality planting material (QPM) of fruits crops. Following recommendations emerged from the discussion.

Brainstorming Session on Strategies and Approaches for Promotion of Sustainable Bivoltine Sericulture in India (Convener: Dr Shailaja Hittalmani, Co-conveners: Dr Dandin S.B. and Dr S. Rajendra Prasad)

A brainstorming session on 'Strategies and Approaches for Promotion of Sustainable Bivoltine Sericulture in India' was organized on 22 September 2021 to address the issues confronting the sericulture industry with special reference to production of quality bivoltine silk as a substitute of



imported silk. Dr T. Mohapatra, President, NAAS chaired the session. Dr P.K. Joshi, Secretary NAAS, extended a warm welcome to the participants. In his remarks, Dr Mohapatra stated that mulberry based bivoltine sericulture system needs improvement to meet the domestic demand for quality silk. Diverse germplasm lines of both mulberry as well as silkworms are needed to develop the improved varieties for higher productivity and quality. He suggested

the use of nano-urea and nano-micronutrients, simple and cheap tools and machines, and development of entrepreneurship through FPOs and SHGs. Likewise, participation of corporate sector in silk reeling would help farmers to get better returns. He assured that NAAS will support women and youth engaged in sericulture through certificate and diploma courses developing skilled human resources.

Dr S. B. Dandin, former Vice Chancellor, UHS, Bagalkot and former Director, Central Silk Board, Bengaluru presented the base paper highlighting the current status, issues and prospects of bivoltine silk production. Silk production, an age-old agro-based industry, is practiced by more than 12.5 lakhs farm households and recognized as a strong instrument of poverty alleviation. India not only produces all the four types of natural silks, it is also the second-largest producer, as well as the largest-consumer of raw silk. However, the locally-produced silk is suitable for handlooms and power looms. Hence, India imports a sizable quantity of raw silk from China. In spite of best efforts made to produce 4A and above grade quality silk, there are still some issues which have remained unattended till date.

The workshop was organized in two sessions (i) technology

intervention and extension, and (ii) marketing and policy which were respectively chaired by Sh Okhandiar Rajat Ranjan, IFS, Member Secretary, Central Silk Board and Dr Ashok Dalwai, IAS, Chairman, National Rainfed Area Authority. The following recommendations emerged from the deliberations:

- Conduct a study to assess the actual demand for silk in the domestic market.
- Evolve sericulture-based farming systems to exploit the fallow and uncultivated forest lands for silk production.
- Assess the grades of cocoons produced locally for their suitability for different quality grades of silk.
- Emphasise on the development of silkworm double hybrids.
- Involve private egg producers by providing them financial assistance.
- Extension should cover all aspects of sericulture, including reeling, twisting, weaving etc. in the supply chain. Sericulture extension must be participatory and involve all community-based organizations such as FPOs, SHGs and FFSS.
- To improve quality of silk, quality based pricing can be adopted for all products.

Activities of Regional Chapters

Barapani Chapter

Webinar on Nanotechnology in Agriculture: Opportunities and Challenges

The Regional Chapter-Barapani organised a lecture on 'Vision for Agricultural Education and Research in India in 21st Century with Special Reference to NEP-2020 and Agricultural Education' on September 20, 2021 in collaboration with the International Union of Organic Agriculture and College of Agriculture (CAU-I), Kyrdemkulai, Meghalaya. Dr S. Ayyappan Chancellor, CAU, Imphal delivered the inaugural lecture focussing on new aspects of agricultural education, research and innovation. The lecture was followed by the release of publications, distribution of inputs and farm development cards.

Bengaluru Chapter

Professor Paul J. Verma, Professor at SARDI, an Affiliate Professor at the University of Adelaide, and an Adjunct Professor at Monash University Australia, delivered a lecture on 'Potential of Stem Cell Technologies for AgTech Outcomes' on September 3, 2021. His presentation focused on the generation of embryonic stem cells and induced pluripotent stem cell in cattle, sheep, horse and feline. He discussed different strategies and success rate, and application of these cell types in animal and agricultural technologies. He emphasized the need for

future research on stem cell biology in large animals, as well as other animal reproductive technologies, including JIVET, SCNT and genome editing. It was mentioned that the production of sex specific animal is pivotal to minimize inputs in animal production system and for addressing the animal welfare issues.

Coimbatore Chapter

Coimbatore Chapter organized the following events:

- (a) A lecture on 'Entrepreneurship Opportunities in Nutricereals' by Dr S. Balasubramanian, Head, ICAR-Central Institute for Agricultural Engineering Regional Centre, Coimbatore. Dr Balasubramanian highlighted the development of small machineries



for the entrepreneurs to process millets and millet-based products for value addition to support tribal

farmers. Dr G. Hemaprabha, FNAAS and Director, ICAR-SBI delivered the presidential address and Dr R. Viswanathan FNAAS, Head, Division of Crop Protection delivered the welcome address.

- (b) A webinar on 'Economizing Water Signature in Agriculture' was organized on August 31, 2021 in a hybrid mode. Dr R. Viswanathan FNAAS, Head, Division of Crop Protection, ICAR-SBI welcomed the lead speaker and the delegates. In his address, Dr G. Hemaprabha, highlighted the need for judicious use of water in view of increasing population and climate change, especially in Asia which has only 36% of global freshwater available to meet out the need of 60% of global population. Nearly 78% of water is utilized by agriculture sector and judicious use of water through water conservation, micro-irrigation other technologies is the need of the hour. System of Rice Intensification (SRI) and Sustainable Sugarcane Initiative (SSI) have the potential to address the water scarcity problems in rice and sugarcane.
- (c) A webinar on 'Sugarcane-based Entrepreneurship Development' was organized in collaboration with ICAR-SBI, Coimbatore on September 9, 2021. The lecture was delivered by Sh Vipin Sarin, an entrepreneur and an incubatee of ABI, ICAR-SBI. He elaborated that 1000 products can be prepared from sugarcane and it has high potential as a raw material for new and healthy products. As a successful entrepreneur he also listed challenges and way forward for the agro-based industries.

Hyderabad Chapter

Hyderabad Chapter organized following events:

- (a) A National Summit on 'Building Organized Sheep and Goat Meat Sector in India towards Ensuring Atmanirbhar Bharat' was jointly organized by Hyderabad Chapter in association with ICAR-NRC on Meat, ICAR-National Academy of Agricultural Research Management (NAARM) and Indian Meat Science Association at ICAR-NAARM, Hyderabad on September 3, 2021. Dr Bhupendra Nath Tripathi, DDG (Animal Sciences), ICAR graced the occasion as Chief Guest and Dr Praveen Malik, Animal Husbandry Commissioner, Government of India and Dr G. Venkateshwarlu, Joint Director, ICAR-NAARM were the Guests of Honour. Dr S.B. Barbuddhe, Director, ICAR-NRC on Meat set the context for the Summit.

Dr Ch. Srinivasa Rao, Convener, NAAS Hyderabad Chapter and Director, NAARM explained the importance of sheep and goat sector in Telangana and Andhra Pradesh as these states account for nearly half of the sheep and goat population. He explained the critical challenges in sheep and goat production and value addition. He expressed hope that the summit will help addressing the core concerns.

Experts from across the country delivered lead talks on various aspects of developing road map for sheep and goat meat sector in India, breeding and reproduction policies to augment production, strategies for linking sheep and goat farmers to market and role of private sector and e-commerce in organizing the small ruminant sector. This was followed by round-table discussion on selected themes.

The Summit highlighted various technological, institutional, regulatory and policy requirements concerning breeding policies, nutritional management, live animal market infrastructure, slaughter requirements, pollution board clearances, waste disposal, retailing including e-commerce, incubation and funding opportunities and deliberated on the roadmap towards ensuring *Atmanirbhar Bharat* in this sector. The following recommendations emerged from the Summit.

- Simplify and harmonize the procedures for approval/licensing of slaughter houses and meat processing plants.
 - Governments should create an enabling environment to improve infrastructure for scientific animal marketing, transportation, hygienic meat production, organized meat retailing and responsible consumption.
 - A separate National Meat and Poultry Board may be established.
 - Develop region-wise programmes for breeding and preservation of indigenous germplasm using marker assisted selection and development of high yielding breeder males for distribution.
 - Evolve strategies for high growth, improved feed usage, increased disease resistance, enhanced reproductive performance and increased prolificacy.
 - Evolve efficient and hygienic meat production and processing technologies and simple procedures for waste utilization.
 - Develop technologies for utilization of tough meat and value addition of skin and other by-products.
 - Create E-commerce platforms to source meat and poultry.
- (b) A two-day national entrepreneurship ideation competition "Aggnite" was organised during 24-25 September, 2021 to stimulate entrepreneurship among students. The programme was jointly organized by Idea, a Technology Business Incubator (TBI) of ICAR-NAARM, and NAAS-Hyderabad Chapter. Sh Y. Krishna Rao, Chief General Manager, NABARD, Telangana Regional Officer expressed that investment in Agri-Startups has huge multiplier effect

and can bring disruptive changes in the livelihood of farmers and rural community. Dr Ch. Srinivasa Rao in his address enlisted efforts of the governments in showcasing the contribution of Agri-Startups. Shri Vasudevan Chinnathambi, Co-Founder, Ninjacart, in his address gave valuable tips for the students to succeed in their entrepreneurial endeavour. Ms Anu Meena of Agrowave presented her startup journey and explained the market intricacies to build a successful business venture. Mr Subhadeep Sanyal of Omnivore shared his views on the expectations of investors on startups. Ms Smita Mohanty, General Manager, NABARD delivered a talk on various NABARD schemes for promoting FPOs and startups. Dr Ranjit Kumar, Head, ABM reiterated the need of strong linkages among agribusiness educational institutions, start-ups and corporates.

- (c) A training programme on 'Entrepreneurial Skill Development for Agricultural Graduates' was jointly organized by NAAS Hyderabad Chapter and ICAR-NAARM during 20-22 September 2021 for the students of Agricultural College, Bapatla (ANGRAU), Andhra Pradesh. The same programmes was also organized for the students of Agricultural College, Naira (ANGRAU) from September 29 to October 1, 2021.



Kolkata Chapter

To celebrate the National Nutrition Week, the Kolkata Chapter organized a webinar on its theme 'Feeding Smart, Right from Start' on September 7, 2021 for the students of Kalyani Experimental High School, Kalayni. Prof Biswapati Mandal, Convener, Kolkata Chapter introduced the theme. Prof Rintu Banerjee, Head, Department of Agricultural & Food Engineering, IIT, Kharagpur was the Chief Guest. Prof Minati Sen, former Head, Department of Home Science, University of Calcutta, and Dr Minakshi Chakraborty, ICAR-KVK, Ramkrishna Mission Ashram, Nimpith highlighted different aspects of child nutrition and health. Dr G. Kar, Director, ICAR-CRIJAF, proposed a vote of thanks.

Ludhiana Chapter

NAAS Ludhiana Chapter organized a number of awareness programmes for school children in association with PAU,

Ludhiana

(a) Awareness programme on Judicious Use of Water

Ludhiana Chapter and Krishi Vigyan Kendra of the Punjab Agricultural University at Patiala organized a one-day awareness programme for the students of Government Senior Secondary School at Kalyan, on 'Judicious Use of Water' on August 25, 2021. Dr Pardeep Kumar Chhuneja coordinated the programme which was presided over by Dr G.S. Buttar, Additional Director of Extension Education, PAU.

(b) Awareness programmes during the National Nutrition Week

Ludhiana Chapter organized awareness programmes during National Nutrition Week at Krishi Vigyan Kendras at seven locations, in collaboration with Punjab Agricultural University. These programmes were coordinated by Dr Pardeep Kumar Chhuneja.

KVK, Ropar on September 6, 2021: Dr G.S. Makkar, Deputy Director (Trg.) of KVK Ropar while inaugurating the programme, briefed about the significance of the National Nutrition Week. Emphasizing the importance of food and eating habits for overall good physical as well as mental health, Dr Makkar informed that PAU vegetable kits are available at KVK and encouraged all to grow their own vegetables as nutrition garden.



KVK, Bathinda on September 7, 2021: Deputy Director (Trg.) of the KVK Faridkot, Dr A.P.S. Dhaliwal while inaugurating the programme for the students of Sukhmani Sahib Senior Secondary School, Harbans Nagar, Bathinda, briefed about the significance of the National Nutrition Week and the theme of the programme.



Krishi Vigyan Kendra, Faridkot on September 9 & 16, 2021: Dr A.R.S. Dhaliwal, Deputy Director (Trg.) of the KVK Faridkot while inaugurating the programme for school students on September 9 at MSS Government Girls Senior



Secondary School, Faridkot, extended a warm welcome to all and briefed about the significance of the National Nutrition Week. A poster making competition on the theme was organized for the school students. Subsequently, a debate competition was also organized on September 16, 2021.

Krishi Vigyan Kendra, Patiala on September 1, 2021: Dr Vipan Kumar Rampal, Deputy Director (Trg.) of KVK Patiala while inaugurating the programme for school students of the Government Senior Secondary School at Tripuri (Patiala), extended a warm welcome to all participant and briefed them about the programme. A lecture on 'Nutritious substitutes of junk food' was organized on this occasion.

Krishi Vigyan Kendra, Bahawal (Hoshiarpur) on September 7, 2021: The speakers highlighted the challenges being faced by young minds during current epidemic and encouraged them to follow a disciplined and healthy lifestyle highlighting the nutritional benefits of eating fruits and vegetables and. Students pledged to live and eat healthy and PAU vegetable seed kit was provided for planting in the school premises.

Krishi Vigyan Kendra, Mansa: Three one-day awareness programmes were organized on July 13, September 7 and September 15, 2021 for the school and college students and farm-women.

Krishi Vigyan Kendra Bathinda: organized a programme for school students of Government Senior Secondary School, Jandawala (Bathinda). A lecture on 'Water saving techniques in agriculture and at domestic level' was also organized on September 30, 2021.

(c) Lecture Series

An online lecture on '**Nutrition: The way to Go?**' was organized on September 24, 2021 in association with the Punjab Agricultural University (PAU), Ludhiana. The lecture was delivered by Ms Ritu Sudhakar, Chief Dietitian, Dayanand Medical College & Hospital (DMC&H), Ludhiana. Ms Sudhakar began her talk on the new buzz word 'immunity' and emphasised on gut-brain relationship.

She proceeded her presentation with four *mantras* to enhance the immunity viz. nutrition, sleep, mindfulness and exercise. She completed her talk with a recommendation of 'flexitarian way of eating' to build strong immunity. The lecture was followed by question-answer session and interaction with audience. The session was organized by the Convener of the Regional NAAS Chapter, the former Vice Chancellor of Punjab Agricultural University Padma Shri Dr B.S. Dhillon, who briefed about the general activities of the NAAS and highlighted the importance of National Nutrition Week to raise public awareness about good nutrition and health through nutritional and healthy eating habits.

Pune Chapter

Pune Chapter organized a panel discussion on 'Organic Farming in Maharashtra: Challenges and Opportunities' on September 8, 2021 in collaboration with ICAR-



NRC for Grapes, Pune. This program was convened by Dr Himanshu Pathak, Convener, Pune Chapter and Director, ICAR-NIASM, Baramati, and Dr R.G. Somkuwar, Director, ICAR-NRCG. Dr S.N. Puri, former Vice Chancellor of CAU, Manipur chaired this event. The program was coordinated by Dr Kaushik Banerjee, PS, ICAR-NRCG. Dr P.K. Joshi, Secretary, NAAS offered introductory remarks highlighting several issues with organic farming and providing valuable suggestions. The panelists deliberated on the feasibility of organic farming in Maharashtra, focusing on the concept of organic farming and its practical aspects in crop science, horticulture, livestock, fisheries and commercial agriculture. The discussions also included the policy recommendation for organic farming. The panelists included, Dr S. C. Khurana from FSSAI, New Delhi, Mr Devendra Prasad DGM, APEDA, Mr G.G. Hande, Advisor to Government of Maharashtra, Dr R. G. Somkuwar, Director NRCG, Dr Major Singh, Director, DOGR, Pune; Dr R.A. Marathe, Director, NRCP Solapur; Dr K. Bhilegaonkar, Head, IVRI-TEC, Pune; Dr Gopal Krishna, Director, CIFE, Mumbai; Dr Lakhan Singh, Director, ATARI, and Dr G.K. Mohapatra, Head, IARI Regional Station, Pune, and Dr K. Banerjee, PS, NRCG. The farmers' concerns were shared by Ms. Swati Shingade, who suggested certain improvements in the regulatory framework to promote organic cultivation. At the end, Dr S.N. Puri summarized

the deliberations and offered his concluding remarks. Dr K. Banerjee proposed the vote of thanks.

Varanasi Chapter

ICAR Research Complex for Eastern Region, Patna in association with NAAS Varanasi Chapter organized a national e-workshop & stakeholders' meet on 'Medicinal Plants in Eastern India: Prospects and Constraints' on August 6, 2021. Dr Vikramaditya Pandey, ADG (HS), ICAR in his address highlighted issues like creating a data base on indigenous medicinal plants, use of integrated medicinal system, and herbal products at household level. Dr Ujjwal Kumar, Director, ICAR RCER, Patna in his welcome address briefed about the relevance of the topic, particularly highlighting the huge demand for medicinal plants during Covid-19 pandemic, and presented present production status and domestic demand, market linkages, extraction, and processing. Dr Asis Majumdar, Professor, Jadavpur University, Dr Yamini Bhushan Tripathi, Professor, BHU, Dr P L Saran, Principal Scientist, DMAPR, Dr B.B. Basak, Scientist, DMAPR, Dr Sumit Chakraborty, Professor,

UBKV, Dr Kaushal Kumar, BAU, Ranchi) and Dr S Swain, OUAT, Bhubaneswar made insightful presentations on medicinal plants. During the stakeholders' meetings, many buyers from Bihar, Chhattisgarh, Orissa, and Jharkhand participated and gave valuable suggestions.

An awareness programme on the importance of nutrition and healthy eating for the girl students of the Government Girls Intermediate College (GGIC), Jakhini, Varanasi was organized on September 17, 2021 at ICAR-IIVR, Varanasi. On the occasion of National Nutrition week, 15 students of GGIC visited the ICAR-IIVR nutri-garden and technology park. After the field visit, Dr D R Bhardwaj, Principal Scientist, ICAR-IIVR made a presentation on 'Importance of vegetables for nutritional security'.

Dr Sudhakar Pandey, Convener, NAAS-Varanasi Chapter briefed about the National Nutrition Week, which is observed every year from September 1 to September 7 to raise public awareness about nutrition and healthy eating habits and the theme of 2021 is '**Feeding Smart Right from Start**'.

Forthcoming Programmes

- Brainstorming Session on 'WTO and Indian Agriculture' (Conveners: Drs Sachin Sharma and P.S. BIRTHAL) scheduled to be held on October 7, 2021
- Brainstorming Session on 'Secondary Agriculture: Challenges, Opportunities and Way Forward' (Convener: Dr S.N. Jha) scheduled to be held on October 21, 2021
- Brainstorming Session on 'Agri-startups in India: Opportunities, Challenges, and Way Forward' (Conveners: Dr Ch. Srinivasa Rao and Dr Ranjit Kumar, ICAR-NAARM, Hyderabad) scheduled to be held on November 1, 2021
- Strategy Workshop on 'Waste-to-Wealth: Use of Food Industry Waste as Animal Feed' (Convener: Dr N.K.S. Gowda) scheduled to be held on December 3, 2021
- Experts meet on 'Road Map to Rehabilitate 26 Million ha Degraded Lands by 2030' (Conveners: Drs Ch. Srinivasa Rao, J.C. Katyal and Anil K. Singh) scheduled to be held on December 9, 2021
- Strategy Workshop on 'Agriculture and Entrepreneurship Models for Quality Fodder Production' (Convener: Dr Ajoy Kumar Roy) scheduled to be held on December 17, 2021
- Strategy Workshop on 'Impact of COVID-19 on Animal Health and Dairy Industry' (Convener: Dr R.K. Singh).

Obituary

Dr Lal Narain Shukla



(1945-2021)

The Fellows of the National Academy of Agricultural Sciences deeply condole the sad demise of Dr Lal Narain Shukla, Fellow of the Academy and an outstanding scientist. In his illustrious career, he made immense contributions in the field of Sugarcane mechanization, conservation tillage machinery, farm machinery & power engineering.

Dr Shukla left an indelible impression among agricultural scientists in various exemplary roles as Assistant

Professor and Assistant Agriculture Engineer, Department of Agricultural Engineering, University of Puerto Rico, Mayaguez, P.R., U.S.A.; Senior Research Engineer & Head, Department of Farm Power & Machinery, and Senior Research Engineer & Research Coordinator, respectively, College of Agri. Engineering, P.A.U., Ludhiana. Dr Shukla was awarded NRDC Award; ISAE Commendation Medal; FAI Prize; and Tarsem Singh Technical Award.

In his demise, the scientific community has lost a brilliant scientist, teacher, administrator and wonderful human being. The Fellowship of the Academy prays to the Almighty to give peace to the departed soul and solace and strength to the bereaved family to bear the great loss.

Announcement

XV AGRICULTURAL SCIENCE CONGRESS 13-16 NOVEMBER, 2021 ON

Energy and Agriculture: Challenges in 21st Century

Organized by **NAAS & BHU**, Varanasi

THEME 1

- 1.1 : Food- Energy -Water-Climate Security Nexus and the Challenges
- 1.2 : Energy Audit and Innovation in important Food and Animal Production Systems
- 1.3 : Energy Smart Tillage and Nutrient Management for Soil Health and Higher Productivity
- 1.4 : Demand and Supply Sides Management of Water Resources for Minimizing Water and Energy Foot Prints

THEME 2

AGRICULTURAL ENGINEERING AND TECHNOLOGY

- 2.1: Productivity Enhancement Through Mechanisation and Automation of Agricultural and Horticultural Crop Production Systems with enhanced Energy Use Efficiency.
- 2.2: Management of Crop Residue and Other Biomass for Animal Feed and Energy
- 2.3: Bio fuels and Renewable Sources of Energy in Agricultural Production and Processing

THEME 3

POST HARVEST TECHNOLOGY

- 3.1 : Energy Auditing & Innovations in Food Processing Sector
- 3.2 : AI and Nanotechnology in Post-Harvest Sector
- 3.3 : Innovations in Food Safety and Quality

THEME 4

POLICIES AND INSTITUTIONS FOR ENERGY SMART MANAGEMENT IN AGRICULTURE

- 4.1 : The Energy and Food Systems in India
- 4.2 : Impact of Energy Policies on Efficiency, Sustainability and Environment
- 4.3 : Innovative Institutional/Business Models for Solar Powered Irrigation

THEME 5

HARNESSING ENERGY EFFICIENCY IN FISHERIES SECTOR

THEME 6

ENERGY AND LIVESTOCK & POULTRY PRODUCTION SYSTEM

- 6.1 : Energy Efficient Dairy Production
- 6.2 : Energy and Dairy Processing
- 6.3 : Small Ruminant and Non-Ruminant Farming
- 6.4 : Poultry Production System vs Efficient Energy Utilization
- 6.5 : Animal Health and Energy

THEME 7

INNOVATION IN CROP IMPROVEMENT

- 7.1 : Innovation Approaches for Crop Improvement
- 7.2 : Molecular Mechanisms of Photosynthesis and Crop Yield
- 7.3 : Disease Diagnostics and Host-Pathogen Interaction
- 7.4 : Microbiome Analysis and Synthetic Biology

THEME 8

EMERGING TECHNOLOGIES IN HORTICULTURAL SCIENCES

- 8.1 : Rootstocks in Horticulture
- 8.2 : Horticulture for Health and Leisure
- 8.3 : Input Use Efficiency in Horticulture
- 8.4 : Safe Horticulture under Controlled Conditions

THEME 9

ROLE OF INDUSTRY

- 9.1 : Innovations in Energy Efficient Agricultural Machinery for Production Agriculture: Role of Industry
- 9.2 : Innovations in Energy Efficient Post Harvest and Food Technology- Role of Industry

THEME 10

FARMERS SESSION

THEME 11

STUDENT ELOCUTION CONTEST

Editors: Dr P.S.Birthal and Dr Malavika Dadlani

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