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## Editors

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## From the President's Desk

### Small Ruminants for Big Impacts



Small ruminants, viz., goats and sheep, are adapted to a wide range of climatic conditions, but their husbandry is more prominent in the harsh environments inhabited by the poor people. They can impact the rural economies and livelihoods in several ways. Often, small ruminants are raised on pastures and degraded lands unsuitable

for the cultivation of crops to produce nutrient-rich milk and meat for human consumption, manure for crop production, and wool, hair and skin for industrial uses. During natural catastrophes like droughts and floods, small ruminants act as insurance and provide much-needed life support to human beings. Small ruminant husbandry requires a small initial investment, and the animals being a form of natural reproducible asset can be easily multiplied to generate income flows and wealth. Small ruminants possess some unique characteristics such as better thermoregulation, resistance to diseases, endurance in case of long-distance grazing, and higher feed conversion efficiency. Besides, their environmental footprints are lower than that of any other animal species, and thus, these animals are more resilient to climatic stresses, producing a sustainable stream of outputs.

#### Production

In 2019, India's small ruminant population stood at 223.2 million, comprising 148.9 million goats and 74.3 million sheep. And, their population has been increasing. Between 2012 and 2019, the goat population increased by 10.13% and of sheep by 14.13%. Small ruminants are valued for milk, meat and wool and hair. In 2019, India produced 5.4 million tons of goat milk, 226.1 thousand tons of sheep milk, 553.3 thousand tons of chevon and 276.3 thousand tons of mutton.

The small ruminant production system in India is subsistence-oriented and contributes about 12% to the gross value added from animal husbandry. Small ruminant husbandry is concentrated among the socially and economically disadvantaged groups of backward castes and marginal farm households.

## Breeds and breeding

India is rich in the biodiversity of small ruminants. The ICAR-National Bureau of Animal Genetic Resources, Karnal, in collaboration with the state government, has already characterized 34 breeds of goat and 44 breeds of sheep, and registered and notified them in the Gazette of India. The NBAGR has been continuously collaborating with states to identify new breeds through an elaborate nationwide characterization of the non-descript animals. Intensive research efforts are required for their conservation and improvement for use in future breeding strategies.

For increasing the milk yield of goats in different agro-climatic zones, systematic efforts have been made by the Indian Council of Agricultural Research under the All India Coordinated Research Project (AICRP) on Goat Improvement since 1970. The exotic breeds such as Alpine, Anglo-Nubian and Toggenberg were used in crossbreeding. However, the realized increase in milk yield of crossbred was lower than expected. Subsequently, it was also observed that the selection in pure breeds was more effective and profitable than the crossbreeding. This approach has been limited to a few breeds and the extent of gain has not been significant enough.

In the case of sheep, the East India Company started crossbreeding during the 19<sup>th</sup> century primarily for wool improvement. Cape Merino, an exotic fine wool breed, was crossed with local breeds. The All India Coordinated Research Programme (AICRP) on sheep breeding launched by the ICAR in 1971 made systematic efforts to improve sheep breeds. Although new strains of sheep such as Avivastra, Nali-synthetic and Chokla-synthetic have been evolved, the crosses containing higher exotic inheritance are also prone to higher mortality. A recent effort in crossbreeding involving three indigenous breeds at the Central Sheep and Wool Research Institute, Avikanagar, has led to the development of the Avishan breed. The Garole, a prolific sheep breed involved in this process, has contributed to multiple births, to the extent of four kids. There is a need to implement a strategy combined with genomic technologies.

A wide range of production environments also requires an equally diverse range of biological types for resilient and sustainable production. In the case of tropical countries, like India, that have diverse agroclimatic conditions, different types of feed resources, and varying probability of disease occurrence, the genetic resources to adapt to these conditions must also be diverse. Animals are crucial for system resilience and higher productivity. Hence, the conservation and improvement of small ruminant genetic resources in their native tracts have great relevance and therefore these need to be strengthened.

## Milk and market

Goat milk contains more fat, protein, fatty acids, ash, and less lactose than cow milk. It is a good source of vitamin A. It has a higher amount of calcium and phosphorous than cow milk, which help reduce blood pressure. It also enhances the bioavailability of iron and copper and thereby improve the anaemic conditions. Goat milk consumption decreases plasma cholesterol and triglyceride concentrations. The presence of selenium and zinc in goat milk boosts the immune system, and the iodine improves thyroid metabolism. Goat milk is rich in oligosaccharides, responsible for brain and nervous system development.

Sheep milk has more solids, protein, lactose and fat. The higher fat content in sheep milk makes it ideal for the production of value-added products like cheese and yoghurt. Sheep milk is a very high energy liquid (favourable for high-performance athletes) with higher contents of fat, phosphorous, magnesium and calcium as compared to bovine milk. It is a good source of protein, calcium, zinc, iron, thiamine, magnesium, riboflavin, vitamins B12, B6, C and vitamin D, the medium-chain amino acids, linoleic acids and essential amino acids. Vitamin E in milk is good for the overall health and appearance of the skin. Sheep milk is also good for improving digestion, lowering blood pressure and boosting calcium absorption. It also reduces oxidative stress, boosts the immune system, and repairs tissue damage due to free radicals. Smaller fat globule makes goat and sheep milk naturally homogenized and thus easily digestible.

These characteristics of goats and sheep milk suggest that there exist plenty of opportunities for the growth of the small ruminant sector in India. Entrepreneurship models need to be built around clusters of production. Youth needs to be incubated to take full advantage of the expanding demand for foods of small ruminant origin. Farmers should be grouped into producer organizations so that milk can be aggregated to fetch higher prices and reduce marketing costs. Quality assurance, attractive packaging and branding are pre-requisites for successful dairy business from downstream to upstream. Business can also be built around dehydrated milk for its year-round availability. There is a need for the discovery of new molecules/bioactives of pharmaceutical/nutraceutical value from the milk of indigenous breeds. Besides, the transgenic goat can be used to produce therapeutic recombinant proteins.

## Production challenges

Following are some important challenges to the development of small ruminant husbandry: (i) small ruminant rearing is not socially well-accepted, and it is mostly confined to the backward classes and smallholder farmers, (ii) there is no definite breeding policy and facility to improve the germplasm in the states, (iii) quantitative and qualitative deterioration of the grazing resources, and inadequate feeding, (iv) inadequate health management

programmes and lack of affordable disease preventive measures, (v) unorganized marketing dominated by middlemen, and (vi) limited credit and insurance schemes for small ruminant husbandry.

The development of the small ruminant sector requires a comprehensive approach. Some of the measures include (i) promotion of scientific management practices, (ii) standard package of feeding and management practices including heat synchronization to shift kidding / lambing season, (iii) community-based agroforestry for fodder, (iv) nationwide vaccination programme against important diseases, (v) ectoparasitic control and mass deworming before and after the monsoon, (vi) package of practices to reduce kid/lamb mortality, (vii) marketing and value-added products, and (viii) promoting commercial farming.

### **The pathway for development**

Small ruminants play an important role in the rural economy of India. They supplement the household income and generate employment, particularly for the landless and marginal farmers. Improvement in the village flock by providing the support services such as breeding bucks and adequate healthcare should be a priority. Small ruminant husbandry can play a significant role in empowering rural women and engaging youth.

The identified goat and sheep breeds must be conserved so that diverse gene pools are maintained for future applications. Efforts are required for the conservation of indigenous breeds and elite genetic stocks/varieties through cryopreservation of semen. The most diverse and distinctive populations are to be identified by using modern genetic/genomic approaches and tools. Evaluation of the economic value of goat and sheep genetic resources should receive adequate attention. The indigenous populations need to be systematically evaluated for disease resistance. Molecular studies including epigenetic analysis concerning stress tolerance, high endurance and productivity should be strengthened for advancing science frontiers and for designing novel technologies. Embryo technology, particularly, juvenile *in vitro* embryo transfer technology (JVET) should be explored for the rapid multiplication of elite animals. It is necessary to establish a reference semen laboratory with all types of facilities and certification for future demand. For goats, assisted reproductive technologies are necessary for the multiplication of elite animals for field application.

There is a scope for improving sheep for mutton and carpet wool production throughout the country, while fine wool production is limited to specific areas. The main thrust should be given to the popularization of dual-purpose sheep breeds. The techniques like near-infrared reflectance spectroscopic are to be used to estimate the

diet composition of free-ranging livestock by using faecal analysis, thereby assessing deficiencies and accurately tailoring supplementation to meet the needs of the animal. Characterization of factors influencing and establishing simple means for predicting the grazing activity energy cost (GAEC) should be established. The intensive goat and sheep rearing system should be standardized with locally available feed resources. Organic meat production will also be the choice for the future to fulfil consumer demand.

A major problem in small ruminant agriculture is kid mortality; managing the stock up to 6 months of age is required for getting optimum productivity and commercial viability. Appropriate health management and supplemental feeding play a key role in this respect, and thus, require focused attention. Epidemiological modelling should be established by developing a simple producer-oriented model into which weather, animal, and pasture conditions could be considered to predict the level of pasture infection and infection level in animals. As we are facing the problem of anthelmintic resistance, alternative approaches based on herbal formulations should be developed and deployed widely. Mechanisms of immune responses to internal parasites are not fully understood, and work is needed to demonstrate how the host reacts to parasite infection and whether parasites manipulate the immune outcome of the host. Testing and screening for scrapie and other genetic abnormalities are to be mainstreamed.

There is a need to integrate meat quality components into breeding and genetic selection as well as nutrition and management. Developing a method to select live animals for increased muscle mass is necessary to form selection indices for faster genetic progress on muscling attributes. It is necessary to analyze the effect of breed, diet, and geographical region on palatability, flavour, and tenderness attribute of meat and cheese quality and fatty acid composition of milk for evolving better quality goat for meat and milk. The application of genomics and proteomics in understanding the molecular basis of goat milk cheese, bioactive peptides and other nutraceuticals and therapeutic aspects should be explored. New models of entrepreneurship are needed to link small producers to the market. Digital technologies can play a key role in establishing value chains and systems of traceability.

Animal welfare measures should be defined and put in place during the transportation and confinement of animals. Most importantly, painless humane slaughter should be done in slaughterhouses and the abattoir standards should be improved to reduce unnecessary pain and suffering to the animals.



**(T. Mohapatra)**  
President

*On behalf of the Academy and my own behalf, Greetings and Best Wishes to the Fellowship for a Very Happy, Safe and Healthy 2022*

## 120<sup>th</sup> Executive Council Meeting

The 120<sup>th</sup> Executive Council Meeting was held on 23<sup>rd</sup> October 2021 under the chairmanship of Dr T. Mohapatra, President of the Academy. The listed agenda was discussed, and approval was granted where required. The Council deliberated on the (i) academic standing of

scientific societies, (ii) compendium on impacts of NARS, (iii) MoUs with international organizations, (iv) election of office bearers, and (v) election of new Fellows and Associates.

## 121<sup>st</sup> Executive Council Meeting

The 121<sup>st</sup> Executive Council Meeting was held on 13<sup>th</sup> November 2021 under the chairmanship of Dr T. Mohapatra, President NAAS at BHU, Varanasi. The EC reviewed (i) the status of preparations for the XV Agricultural Science

Congress 2021, and (ii) sought suggestions on the themes and venues for the next Agricultural Science Congress to be held in 2023.

## 122<sup>nd</sup> Executive Council Meeting

The 122<sup>nd</sup> Meeting of the Executive Council was held on 14<sup>th</sup> December 2021 under the chairmanship of Dr T. Mohapatra, President NAAS. Dr Mohapatra complimented the fellowship on the successful organisation of the

XV Agriculture Science Congress at BHU, Varanasi and appreciated the Local Organizing Committee for its tireless efforts in making the Congress a grand success.

**The EC approved the new EC members from January 1, 2022:**

Vice President	:	Dr K.M. Bujarbaruah
Treasurer	:	Dr Rajender Parsad
Foreign Secretary	:	Dr Rajeev K. Varshney
Members	:	Dr B. Mohan Kumar
		Dr C.N. Ravishankar
		Dr Ashok K. Singh
		Dr P.S. Sirohi
		Dr Ch. Srinivasa Rao

### **Section IV: Fisheries Sciences**

Prof Geevaretnam Jeyasekaran  
Dr Balasubramanian Senthilkumaran

### **Section V: Natural Resource Management Sciences**

Dr Dendi Damodar Reddy  
Dr Rajbir Singh  
Dr Janki Sharan Mishra  
Dr Santhosh Ranjan Mohanty  
Dr Om Parkash Choudhary

**The EC ratified the election of the following scientists as Fellows of the Academy from 2022:**

### **Section I: Crop Sciences**

Dr Jitendra Kumar  
Dr Naveen Chandra Bisht  
Dr Natesan Senthil  
Dr (Ms.) Parveen Chhuneja  
Dr Rajbir Yadav  
Dr Sujay Rakshit

### **Section II: Horticultural Sciences**

Dr (Ms) Charanjit Kaur  
Dr Jagdish Singh  
Dr Anil Kumar Dubey

### **Section III: Animal Sciences**

Dr Mukesh Kumar Gupta  
Dr (Ms) Pragya Dhruv Yadav  
Dr Arumugam Kumaresan  
Dr Triveni Dutt

### **Section VI: Plant Protection Sciences**

Dr Thiruvengadam Venkatesan  
Dr Bikash Mandal  
Prof Ram Singh  
Dr Sunil Chandra Dubey

### **Section VII: Agricultural Engineering & Technology**

Dr Vemuri Muthayya Chowdary  
Dr Pitam Chandra

### **Section VIII: Social Sciences**

Dr Jagdish Prasad Sharma  
Dr (Ms) Smita Sirohi  
Dr Bhupendra Veer Singh Sisodia

### **Foreign Fellows**

Dr Beat Keller  
Dr Rod A. Wing

### Pravasi Fellows

Prof Neena Mitter  
Dr Prasanta Kumar Kalita  
Dr Ashok Kumar Mishra

Dr Babasaheb B. Fand, Plant Protection Sciences  
Dr Ravi Pandiselvam, Agricultural Engineering & Technology  
Dr Prabina Kumar Meher, Social Sciences

### NAAS Associates selected for 2022

Dr Vignesh Muthusamy, Crop Sciences  
Dr Prolay Kumar Bhowmick, Crop Sciences  
Dr Sudip Kumar Dutta, Horticulture Sciences  
Dr Arun Kumar De, Animal Sciences  
Dr Kundan Kumar, Fisheries Sciences  
Dr Rahul Tripathi, Natural Resources Management Sciences  
Dr Rakesh Kumar, Natural Resources Management Sciences  
Dr Tushar Kanti Dutta, Plant Protection Sciences

### Young Scientists' Awards for 2022

Name of the Award	Name of the Awardee
Plant Improvement	Dr Vignesh Muthusamy
Plant Protection	Dr Pramod Kumar Sahu
Soil, Water and Environmental Sciences	Dr Shaon Kumar Das
Animal Sciences	Dr Jess Vergis
Agricultural Engineering and Technology	Dr Kothakota Anjineyulu
Social Sciences	Dr Reshma Gills

## XV Agricultural Science Congress

The National Academy of Agricultural Sciences (NAAS) organizes Agricultural Science Congress (ASC) every two years. This year, the Academy organized XV ASC on the theme "Energy and Agriculture: Challenges in 21<sup>st</sup> Century" jointly with the Banaras Hindu University, Varanasi from 13-16 November 2021. Due to the Covid-19 pandemic, the Congress was organized in a hybrid mode. It deliberated on the issues related to technologies, strategies and policies to make India energy-independent by 2047.

The Congress was attended by more than 1800 delegates (900 in-person including 300 farmers). The participants included fellows of the Academy, researchers, academicians, policymakers, students, farmers, leaders from the industry and representatives of the civil society organizations. It was inaugurated by Shri Narendra Singh Tomar, Hon'ble Minister of Agriculture & Farmers' Welfare, Government of India.

Sun – One World – One Grid' launched by Prime Minister Shri Narendra Modi and UK Prime Minister at the Climate Change Conference (COP-26) held in Glasgow. The initiative has the support of 80 countries. He also stated that India's commitment and ambitious plan to utilize clean and renewable energy for its developmental activities is globally applauded. He wished Congress a great success.

Dr Trilochan Mohapatra, President, NAAS & Secretary, DARE and DG, ICAR delivered the presidential address. Renowned academicians viz., Dr R.S. Paroda, former President, NAAS and Chairman, TAAS; Dr Mangala Rai, former Secretary, DARE & DG, ICAR; Dr Rattan Lal, Director, CMSC, USA; Dr Ajay Mathur, DG, International Solar Alliance; Dr Jimmy Smith, DG, ILRI; and Dr Shekhar C. Mande, DG, CSIR delivered plenary and special lectures on the challenges and opportunities for efficient energy use in agriculture.



The Hon'ble Minister emphasized promoting new technologies for smallholder farmers for increasing their incomes and reduce energy costs. He mentioned the historic international initiative 'Green Grids Initiative: One



Deliberations were held under nine scientific themes: (1) food, energy, water and climate nexus; (2) energy-smart resource use; (3) agricultural engineering and technologies; (4) post-harvest technologies; (5) policies and institutions for energy-smart management in agriculture; (6) harnessing energy efficiency in the fisheries sector; (7) energy in livestock and poultry production system; (8) innovations in crop improvement; and (9) emerging technologies in horticulture sciences.

Some important outcomes of these deliberations are listed below:

- Agriculture sector is the main user of water; its judicious and efficient utilization has direct implications in energy use. Climate change is also influenced by availability and use of water and energy in agriculture sector. Impacts of climate change are transmitted through water-related stresses (e.g., floods and droughts). Therefore, for making an effective contribution to policy formulating processes at the national and state levels, NAAS may create a **Water Advocacy Dialogue Forum** to deliberate on 'water-energy-climate change' related issues.
- Agriculture is a labour-intensive activity, and a steady decline in the agricultural workforce calls for a formal network of Science, Innovation and Technology (SIT) institutions to find solutions through IT and electronics and develop suitable automation and robotics for agriculture and post-harvest sectors.
- Adoption of conservation agriculture can save up to 80% of the energy use along with a significant reduction in the emission of CO<sub>2</sub> and other GHGs, besides improving soil health. Hence, farmer-friendly and economically-feasible technologies are needed for reducing energy use and GHGs in agriculture.
- Energy audits and incentives for ensuring the efficient use of energy in agriculture production and processing enterprises would encourage the use of renewable energy including solar, wind and biomass.
- Promote precision agricultural technologies such as sensor-based systems enabled with GPS, GNSS, RFID, VTRS and robot-controlled machines for the

application of the right amounts of inputs (seed, fertilizer, water, chemicals, etc.) at the right time and the right place. Custom-hiring of the high-cost, high-capacity, specialised machines and equipment should be promoted and popularised on large scale.

- The circular economy model is an emerging concept. It focuses on regeneration and aims at improving resource use efficiency by converting waste into valuable products with multiple uses. This requires generating more data to adopt such a model.
- Mechanised management of surplus residues of the crops and agro-processing activities is needed for converting these into animal feed and fodder, compost and manures, biogas and electricity to avoid their in-field rotting and burning.
- Noticing a positive impact of the schemes like “Pani Bachao Paise Kamao” (Government of Punjab), and PM-KUSUM the forward-looking policies are needed to replicate and promote such schemes taking into consideration the sustainability and other environmental issues.
- The promotion of the ‘grid-connected-farmer-led’ solar generation system is an effective option for enhancing farmers’ incomes through the transfer of surplus power generated on farms to the national electricity grid. It is a win-win solution for all the stakeholders.
- As urbanization is unfolding, peri-urban agriculture and 3-D sea-farming will be crucial in meeting the future food demand. Public-private partnership in R&D and policy support will be vital for their success. There is scope to capitalize on the potential of soilless culture in urban horticulture.

A national-level elocution contest was organized on the theme of the Congress for the students selected from all over the country. During the Congress, special sessions on the “Role of Industry in Facing the Energy-related Challenges for the 21<sup>st</sup> Century”, and “Farmer-Scientist Interaction” were also organized. The Agri-expo organized during the Congress provided a platform to more than 50 public and private organizations for showcasing their technologies, products and services.



## NAAS Programmes

### Brainstorming Session on 'WTO and Indian Agriculture' (Conveners: Drs P.S. Birthal, Sachin Sharma and Abhijit Das)

India has been facing several issues related to domestic support, market access, export subsidies and food security at the WTO. The developing countries, in general, are affected by the asymmetries in the Agreement on



Agriculture (AoA), which have favoured the developed countries to continue with the massive agricultural subsidies without breaching their commitments to the AoA. Their Aggregate Measurement of Support (AMS) entitlement has allowed them to provide high levels of trade-distorting support along with product-specific concentration, leading to overproduction of agricultural commodities and consequently depression in their international prices, that in a way is causing losses in farm incomes in developing countries. It also leads to related issues of the surge in cheap imports in the domestic markets of developing countries. Farmers in the developing countries are small and subsistence-oriented, and hence, they remain highly vulnerable to the volatility in international prices and import surges of agricultural commodities. India also finds itself restricted in implementing welfare-oriented agricultural policies owing to strict disciplines laid under the AoA. In recent times, even the existing flexibilities available to the developing countries are being proposed to be subjected to disciplines in agricultural negotiations. India's support programs have consistently been attacked at the WTO in terms of counter-notifications (for example, for cotton, sugar, wheat and rice) and questionings in various meetings of the Committees on Agriculture (CoA). The recent dispute on India's sugar policy is an example. The price support based procurement and public stockholding of foodgrains, the backbone of India's food security, also faces criticism at the WTO.

Given such an environment at the international level, India needs to develop a roadmap for negotiations that seek redressal of the existing asymmetries and imbalances in

the AoA. The NAAS organized a brainstorming session on October 7, 2021, to generate feedback for the policymakers to effectively manage the challenges that India faces at the WTO. The discussion led to the following recommendations that would help India and other developing countries for level playing in the liberalized global economic order.

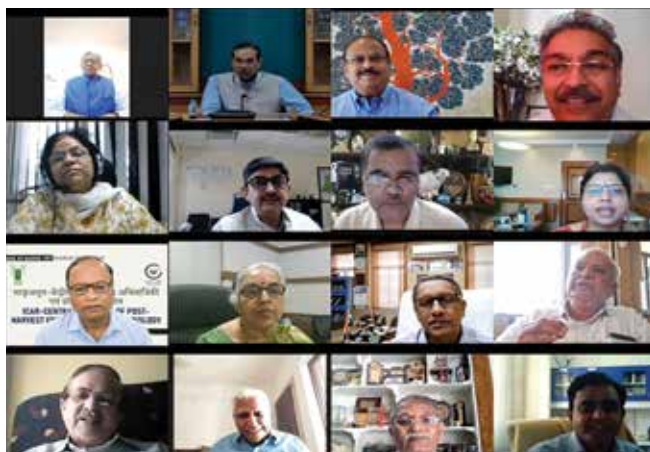
- India along with other developing countries must continue to demand removing asymmetries in the AoA, especially the AMS entitlements which allow developed countries to provide high levels of trade-distorting support under the Amber box provisions.
- Developing countries should continue to oppose any attempt to dilute the existing special and differential (S&DT) provisions, especially capping of the support under the Development box (Article 6.2) and the reduction in the *de minimis* limit.
- Since many developing countries have been implementing the price support backed procurement policy, there is a need to address the issue of external reference prices (ERP) that are based on 1986-88 prices. The ERP need to be based on the recent import or export prices of agricultural commodities. Alternatively, the developing countries should be aggressive in demanding flexibility to consider inflation in the calculation of market prices.
- Members of WTO are now engaged in finding a permanent solution to the issue of public stockholding of food grains for food security purposes. Any permanent solution should be better than the interim solution, i.e. the Bali Peace Clause, in terms of coverage of commodities, new programs and less onerous conditions.
- In view of the import surges of agricultural goods and their adverse impacts on farm income, the developing countries should seek a simple, effective, operable and accessible SSM.
- Given the fact that India can provide transport and marketing related export subsidies only (Article 9.4) till 2023, there is a need to focus on improving infrastructure for agricultural exports.
- India and many other developing members have been highlighting sustainable development goals (SDGs) related to hunger and poverty in various proposals submitted to the WTO. However, there is a need to highlight these more aggressively in the negotiations to achieve a level playing field for the poor farmers.
- There is a need for frequent inter-ministerial meetings and discussions with stakeholders including farmers, civil society organizations and state governments to sensitise them on the issues critical to agricultural

trade and seek their feedback on addressing these through domestic and trade policies.

- There should be greater cooperation among different ministries or departments related to agriculture, environment, external affairs and commerce in policy formulations to ensure that the policies are WTO compliant but not detrimental to the domestic interests. India has considerable policy space under the Green box that can be realized by aligning or reforming several of its existing agricultural and food policies.
- India should have a market intelligence unit in its embassies to track the agricultural and trade policies of the concerned countries and provide feedback to the Government of India.

### Brainstorming Session on ‘Secondary Agriculture: Challenges, Opportunities and Way Forward’ (Convener: Dr S.N. Jha)

A brainstorming session was organized on ‘Secondary Agriculture : Challenges, Opportunities and Way Forward’ on October 21, 2021. Following points emerged from the deliberations:



- The definition of secondary agriculture should focus on the development of high-value products from crop residues, industry by-products and agro-based rural industries.
- Formulate national policy on post-harvest management of agricultural commodities, including primary, secondary and tertiary processing.
- Establish linkages between research organizations and nutraceutical pharmaceutical industries to initiate demand-driven research in secondary agriculture.
- Attract FPOs, MSMEs and indigenous industries for manufacturing of high-value consumer products from agricultural residues and by-products based on market intelligence and global preference.

- Create “own and operate” type enterprises to produce high-value crop-specific products and engage the private sector with technical backstopping.
- Form dedicated networks and a group of scientists in agricultural research system in a multidisciplinary framework for ensuing research in the field of secondary agriculture for unexplored crops and by-products coming out from primary/secondary processing.
- Build a nationwide database on the availability of secondary raw material and its quality at various stages of processing and markets by engaging different stakeholders to evolve an efficient supply chain.

### Brainstorming Session on ‘Agri-startups in India: Opportunities, Challenges, and Way Forward’ (Convenors: Drs Ch. Srinivasa Rao and Ranjit Kumar)

Startups are considered to be the next growth engines to make India a US\$ 5 trillion economy and to realize the dream of Atmanirbhar Bharat. Currently, there are 2500+ active agri-startups in India. To deliberate on different facets



of the agri-startup ecosystem and create an enabling environment, the National Academy of Agricultural Sciences (NAAS) organized a one-day brainstorming session on ‘Agri-startups in India: Opportunities, Challenges, and Way Forward’ on 5th November 2021. During the deliberations following broad issues emerged:

- Facilitate testing and technology validation: Necessary provisions should be made for agri-startups for testing and validation services to encourage early-stage entrepreneurs.
- Develop startup culture in NARES: The Frequent academia-entrepreneur interaction events should be organized to nudge the students and faculty towards start ups and entrepreneurship.
- Strengthen incubation centres: Each Agriculture university to have an Incubation Centre and each centre should be adequately funded along with strong governance system and minimum layers of decision-making, based on well-laid principles and procedures.



- Create digital infrastructure in agriculture: Data related to geo-referenced land records, soil details, crop production, market transaction information, etc. should be available in the public domain so that startups need not spend time and resources on collecting the same. It will significantly reduce the product development cycle for the startups.
- A Model agri-tech policy needed: Many agri-startups face the problem when they try to replicate their business model in different policy environments. Hence, a country-wide model policy is needed for facilitating the scaling.
- Create a pool of mentors and investors: State-wise common pool of mentors with expertise in specialised fields may be created, who can support the activities of incubator centres in mentoring the startups. Similarly, a pool of investors will make the whole startup ecosystem more amenable for young minds throughout the country.

### Roundtable Discussion on Limitations of the Global Hunger Index (Convener: Dr Mahtab S. Bamji, Co-convener: Dr Rajender Parsad)

The much-debated Global Hunger Index (GHI) 2021 was published by the Welt Hunger Hilfe and Concern Worldwide, Bonn/Dublin. The index ranks selected countries based on four indicators, namely an indicator on undernourishment in population, two indicators of child undernutrition (child wasting and child stunting) and an indicator pertaining to child mortality under 5 years of age. The GHI, placed India in the category of “serious” with a score of 27.5. India is ranked at 101 out of 116 countries. The Academy organized a roundtable discussion on the GHI with leaders and academicians in nutrition, medical science, statistics and economics on 8<sup>th</sup> November 2021. The objective of the discussion was to (1) critically examine the GHI report and present views on whether it is an appropriate measure of hunger, and (2) propose the way forward on ‘Hunger Index’. The key issues on limitations of Global Hunger Index are listed below:

- The indicators used in computing the GHI do not represent ‘hunger’. The FAO uses ‘prevalence of undernourishment’ as an estimate to represent the extent of hunger. It states that “hunger” may also be referred to as undernourishment”. Of the four indicators of the Global Hunger Index, only one of the indicators, ‘undernourished population’ is included to represent hunger. The experts strongly discarded the nomenclature as Hunger Index to represent ‘hunger’.
- The GHI has used four indicators to construct the index and rank countries. The indicators used are (i) percent of undernourished population, reflecting

insufficient nutrition; (ii) the share of children <5 years, who have low weight for their height, reflecting acute undernourishment (wasting); (iii) the share of children below five years who have low height for their age (stunting), reflecting chronic undernourishment; and (iv) the mortality rate of children under five, partly reflecting the fatal mix of inadequate nutrition and unhealthy environments. The experts emphasized that while hunger leads to undernutrition, it alone is not the only reason for under five years undernutrition or mortality. The available evidence clearly shows that stunting as well as child mortality are not only due to hunger but are due to several other factors.

- The three indicators used in GHI refer only to children below five years, who constitute only one-sixth of India’s population. The experts claimed that the index is inadequately representing the entire population of the country and the hunger. The experts suggest that the four indicators used to compute GHI do not reflect hunger and lead to misleading interpretation.

The group suggested that following four indicators may be tried to begin with for constructing Hunger Index: (i) percent food insecure population; (ii) percent undernourishment population; (iii) dietary intake of major food commodities; and (iv) assessment of anxiety element.

There was a consensus that the GHI 2021 Report is misleading since it provides a highly biased estimates on hunger. The Government of India should not accept its ranking due to erroneous methodology. A new index should be developed following consensus on definition of hunger and its indicators.

### Strategy Workshop on ‘Waste to Wealth – Use of Food Industry Waste as Animal Feed and Beyond’ (Convener: Dr N.K.S. Gowda)

A strategy workshop on ‘Waste to Wealth – Use of Food Industry Waste as Animal Feed and Beyond’ was organized on 3<sup>rd</sup> December 2021 to explore opportunities to convert food industry waste into animal feed. Following recommendations emerged from the deliberations:



- Provide incentives and tax benefits to the MSME units engaged in utilizing the waste to produce valuable products.

- Develop an authentic database on waste from various sectors.
- Designate a single Ministry in the Government of India to plan and implement schemes to efficiently utilize the waste following a cluster approach.
- Efforts should be made to utilize the waste from the meat industry through the promotion of “composite feed” made from rendered meat, bone meal and agricultural waste.
- Promote silage technology to convert huge quantities of fruit residues.
- Establish hubs to ensure regular supply of lactic acid bacterial culture to small units for profitable conversion of waste to wealth.
- Enhanced support of ICAR and CSIR Institutes to the startup companies engaged in utilizing the waste.
- Design suitable financial schemes and business models to support the decentralised processing units in the MSME sector to utilize agri-waste.

### **Brainstorming Session on ‘Road Map to Rehabilitate 26 Million ha Degraded Lands by 2030’ (Conveners: Drs Ch. Srinivasa Rao, J.C. Katyal, Anil K. Singh)**

The brainstorming session was organized on 9<sup>th</sup> December 2021. Following recommendations emerged from the deliberations:

- Develop a harmonized database on land degradation focusing on the magnitude of degradation, rate of degradation and restoration.
- Encourage inter-departmental collaborations and platforms with a group of secretaries for monitoring the degradation and implementation of various government schemes by the central and state governments.
- Identify critical zones for reducing water erosion, soil loss, carbon and nutrient loss, overgrazing, zooming and soil acidity.
- Encourage participation of communities and private sector under corporate social responsibility in managing degraded lands.
- Evolve agri-food production systems and accompanying technologies suitable for degraded lands and their restoration.

### **Brainstorming Session on ‘Agriculture and Entrepreneurship Models for Quality Fodder Production’ (Convener: Dr Ajoy Kumar Roy, Co-conveners: Drs Amaresh Chandra and D.R. Malaviya)**

A brainstorming session on ‘Entrepreneurship for Quality Fodder Production’ was organized by the Academy on



17<sup>th</sup> December 2021 in hybrid mode. The main aim was to identify potential areas having scope for developing enterprises for quality fodder production and marketing. It also aims to (i) explore potential areas for developing efficient and effective value chains for fodder; (ii) needed government support in expanding production, marketing and export of fodder; and (iii) possibility of adopting best practices in fodder entrepreneurship.

The brainstorming session was attended by academicians, leaders from corporate and cooperative sectors and government representatives. It was chaired by Dr T. Mohapatra, President, NAAS. In his opening remarks, Dr Mohapatra emphasized for undertaking critical analysis on supply-demand of green fodder and identify scope for entrepreneurship development. It should be done through economic analysis and forecasting models. He also suggested that how Animal Husbandry Infrastructure Fund can be judiciously used?

Following issues emerged during discussion:

- Non-availability of improved fodder seed and planting material (especially of grasses) is a major constraint in meeting the demand for fodder.
- There is a need to effectively implement government schemes for fodder/feed production.
- A seed plan of feed and fodder may be developed for next 5-10 years for developing appropriate fodder production strategy.
- Potential of hydroponics in fodder production should be assessed.
- Potential of organic fodder for the production of organic dairy milk needs to be explored for domestic and export market.
- Decomposing packaging material need to be developed to avoid environmental degradation.

### **Special Webinar**

The Academy organized a special webinar by Dr. Takashi Yamano, Principal Economist, Asian Development Bank (ADB), Manila on "Transforming Agriculture in Asia" on December 20, 2021. The webinar was based on the report prepared by the ADB to show how agriculture sector

has significantly minimized the impact of Covid-19. He expressed that the growth trajectories of Asia's developing economies are heading in different directions. Stronger growth rates are expected in economies that are coping well with the COVID-19 pandemic, as they can take advantage of the strengthening recovery in global demand. But those are struggling with the pandemic cannot, and are falling behind. India is performing very well compared to several economies in Asia. He elaborated on the challenges faced by the Asian agriculture, which include changing (1) food demand pattern; (2) demography,

(3) climate risk; and (4) fragile environment. He also expressed that the Asian economies are becoming richer and more urbanized therefore demand pattern is shifting towards animal products that are more resource-intensive. He proposed following measures to strengthen agriculture sector (1) shift from subsidies to direct support system; (2) promote resource-conservation technologies; (3) modernize agriculture laws and regulations; (4) invest in climate resilient infrastructure, (5) support to market oriented development; and (6) invest in agricultural R&D to meet the future challenges.

## Activities of Regional Chapters

### Barapani Chapter

A lecture as a part of the nation's "Azadi Ka Amrit Mohatsav", on *Aatma Nirbhar Bharat with Integrated Natural Resources Management and Education Perspective* was delivered by Dr P.K.Ghosh, Director and Vice-Chancellor, ICAR-National Institute of Biotic Stress Management, Raipur on 28<sup>th</sup> October 2021. Dr Ghosh emphasized sustainable management of natural resources for agricultural growth and improved food security.

Barapani Chapter jointly with International Union of Organic Agriculture, Shillong and College of Agriculture (CAU-I),



Kyrdemkulai organized an International conference on "**Integrated Agriculture, Natural Farming, Biodiversity Conservation and Rural Bio-Entrepreneurship under Changing Climate Scenario**" from 7-9 December 2021 in hybrid mode at College of Agriculture (CAU-I), Kyrdemkulai, Meghalaya. The conference was organized in collaboration with ICAR Research Complex for NEH Region, Umiam, North East Centre for Technology Application and Reach (NECTAR), Shillong, National Bank for Agriculture and Rural Development (NABARD), Shillong, College of Post Graduate Studies in Agriculture Sciences, Umiam, North Eastern Space Application Centre (NESAC), Umiam, ICAR-National Research Centre on Pig, Guwahati, Assam and North Eastern Council (NEC), Shillong, Meghalaya. The conference was attended in person by 90 participants, while more than 100 joined virtually from India and abroad. Dr Trilochan Mohapatra, President NAAS, delivered

the Inaugural address emphasizing the need for climate resilient agro-techniques for the sustainable development of farming community during 21<sup>st</sup> century. Several guests of honour graced the occasion and addressed the participants.

There were ten technical sessions during the conference, which began with a plenary lecture by Dr Ermias Kebreab, Associate Dean and Director, World Food Center, University of California, Davis, USA, on '*Livestock Methane Emissions - An Opportunity to Slow Global Warming*', which was chaired by Dr M. Premjit Singh, former Vice Chancellor of CAU.



Out of a total of 155 presentations, there were 10 keynote presentations, 35 lead lectures, 88 oral presentations and 22 posters. The conference was successfully concluded with a valedictory programme on 9 December 2021, which was graced by Sh Banteidor Lyngdoh, Minister for Agriculture and Horticulture, Meghalaya as the Chief Guest and Mrs. N. Guite, General Manager, NABARD, Meghalaya as the Guest of Honor.

### Bhopal Chapter

The Bhopal Chapter in collaboration with the Indian Institute of Soil Science (IISS), Bhopal celebrated the **Soil Health Awareness Week** during December 01-07, 2021 at the Institute as well as in several villages of Bhopal district. Dr A.K. Patra, Director, IISS and Convener emphasized the role of soil for the survival of the human being and requested to create awareness amongst villagers

to protect this precious natural resource for the next generation. On this occasion, a farmer-scientist interaction meet was organised at village Khamkheda, Bhopal district. Sh Ravinder Patil, DGM, SBI, and Sanjay Kumar, AGM, SBI along with their staff participated in the programme. Soil health cards were distributed to the farmers.



An **Agricultural Education Day** was celebrated on December 03, 2021 where more than 100 college students were taught about various aspects of soils, including soil salinization. A quiz competition on soil awareness was also organized. Farmer-Scientist interaction meet and Field days were organized on December 01 and 02 where more than 200 farmers under the scheme SCSP and Farmers First were given training on conservation agriculture and soil health maintenance practices.

## Coimbatore Chapter

On the occasion of World Food Day on October 16 a lecture on '*Safe Food Now for a Healthy Tomorrow*' was delivered by Prof G Hemalatha, Head, Food Science and Nutrition, Community Science College and Research Institute, TNAU, Madurai. Dr Hemalatha stressed the immediate need to help, prevent, detect and manage food-borne risks, contributing to food security, human health, economic prosperity, agriculture, market access, tourism and sustainable development.

A webinar on '*Enzymes for 2<sup>nd</sup> Generation Ethanol: Addressing the Challenges*' was organized. Dr Rajeev K Sukumaran, Senior Principal Scientist & Head, Microbial Processes and Technology Division, CSIR-National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram delivered the lecture highlighting the work done at CSIR-NISTEM which includes Integrated Biorefinery processes of biomass conversion to ethanol and chemicals through the fermentative process using different agricultural feedstocks like rice and wheat straw and bagasse; applications of cellulases, beta glucosidases and other biomass hydrolyzing enzymes. He also deliberated on production of biomass-degrading enzymes, development of bioprocesses for enzyme production and other microbial products including process optimizations; regulation of cellulase gene expression in filamentous fungi; and challenges in the production of cellulases for biomass hydrolysis through targeted interventions.



An awareness campaign for the school children was organized on the theme, "*Agriculture and Environment: the Citizen Face*" at 'Premier Vidyaa Vikaash Higher Secondary School' at the outskirts of Coimbatore on 25 November 2021. Dr G. Hemaprabha FNAAS, Director of the Institute in her address highlighted the rising opportunities in India and abroad in agriculture education including 'start-ups' in the agricultural sector. Dr R. Viswanathan FNAAS, Head, Division of Crop Protection, ICAR-SBI spoke on the academic avenues and opportunities in the agriculture



sector for employment. On the occasion of the World Soil Day, a lecture was delivered by Kumari Rajeswari, Brahma Kumaris, Coimbatore on "*Yogic Kheti for Soil Health Improvement*". The lecture highlighted the importance of natural farming and its utility for human health.

## Hyderabad Chapter

A training programme on “Entrepreneurial Skill Development for Agricultural Graduates” for the students of Agricultural College, Naira (ANGRAU) from 29<sup>th</sup> September - 1<sup>st</sup> October 2021. Students were sensitized on the issues



of career opportunities, prospects in agricultural education and Agri-preneurship and were trained on the aspects related to the improvement of communication skills and soft skills business plan preparation, design thinking and personality development.

## Ludhiana Chapter

Ludhiana Chapter organized a series of programmes on ‘Crop Residue Management’ to create awareness among school children about the adverse effects of residue burning, and apprise them of the technological and agronomic practices for efficient management of crop residues. These programmes were jointly organized by the VKVs of the PAU.

Jointly with Krishi Vigyan Kendra, Gurdaspur, the Ludhiana Chapter of NAAS organized four one-day awareness programmes for school students on ‘Crop Residue Management’ during October-November. Besides lectures and workshops, the students were enlightened with knowledge through a ‘Painting Competition’ on the topic of crop residue management and the top three performers were honoured.

Krishi Vigyan Kendra, Moga organized a one-day awareness programme for school students on ‘Crop Residue Management’.



Krishi Vigyan Kendra, Bathinda organized four one-day awareness programmes for school students on ‘Crop Residue Management’.

Krishi Vigyan Kendra, Rauni (Patiala) organized two awareness programmes for school students in physical mode on ‘Crop Residue Management’ on October 21 and October 29, 2021.



## Varanasi Chapter

Varanasi Chapter organized an awareness campaign on ‘Career Opportunities in Higher Agriculture Education’ for the graduate students of agriculture sciences of Ram



Suresh Singh Degree College (Kashi Vidhyapeeth), Chunar, Varanasi on 21<sup>st</sup> December 2021. A total of 93 students along with 5 teachers visited the experimental farm, nutri-garden and technology park of ICAR-IIVR, Varanasi, where they were apprised about the importance of vegetables for nutritional security, organic farming, waste management and protected cultivation. Dr Sudhakar Pandey, Convener NAAS-Varanasi Chapter briefed about the opportunities of admission in post graduate courses and career opportunities in agriculture and allied sciences.

## Bengaluru Chapter

A lecture was organised on October 7, 2021 on "Can Genome Editing Contribute to Livestock Agriculture?" by Prof. Bruce Whitelaw, Interim Director, The Roslin Institute, and Professor of Animal Biotechnology, Royal (Dick) School of Veterinary Studies, University of Edinburgh.

Professor Paul J. Verma, Professor at SARDI, Affiliate Professor at the University of Adelaide, and Adjunct

Professor at Monash University, Australia, delivered a lecture on the "Potential of Stem Cell Technologies".



Dr Raghavendra Bhatta, Director, ICAR-NIANP and Convener, Bengaluru Chapter delivered a lecture on "Career Opportunities in Agriculture and Allied Sciences" at St Francis School, December 20, 2021.

## Forthcoming Programmes

- Impact of COVID 19 on animal health and dairy industry
- Sustaining pulses revolution
- Self-sufficiency in edible oil production
- Seaweed cultivation and utilization
- Beyond price support and subsidy
- Food fortification issues and the way forward
- Scaling up innovative agricultural extension models
- Service delivery mechanism in the livestock sector
- Promoting millets production, value addition and consumption
- Plant-based vs dairy milk : Myths and facts
- Public-private partnership in agriculture: Current opportunities and challenges
- Stakeholders consultation on draft regulation for GM food & feed imports and detection of unauthorized GM events

## Obituaries



### Professor Jitendra Paul Khurana

The Fellows of the National Academy of Agricultural Sciences deeply condole the sad demise of Professor Jitendra Paul Khurana, a Fellow of the Academy and an outstanding scientist and teacher. In his illustrious career, he made immense contributions in the field of plant molecular biology, specifically on photo perception and

signal transduction mechanisms; and structural and functional genomics in plants.

Prof Khurana left an indelible impression among agricultural scientists in various exemplary roles as Professor of Plant Molecular Biology, University of Delhi

South Campus (UDSC), New Delhi; Head, Department of Plant Molecular Biology, UDSC and Visiting Professor, Waksman Institute, Rutgers University, New Jersey, USA, 2001. Dr Khurana was awarded NASI Prof. Shri Ranjan Memorial Award Lecture, 2006; INSA Prof. P. Maheshwari Memorial Award Lecture, 2008; DBT Tata Innovation Fellowship, 2010-2013; ISCA Platinum Jubilee Lecture Award; Indian Botanical Society Prof. Birbal Sahni Medal; ISCA Prof. S.S. Katiyar Endowment Lecture; NASI Dr B.P. Pal Memorial Award Lecture, 2015; J.C. Sengupta Endowment Lecture; Plant Tissue Culture Association of India Prof. H.C. Arya Memorial Gold Medal, 2015. Prof Khurana was General Secretary, National Academy of Sciences, 2010-2013; Secretary, Plant Tissue Culture Association, India, 2010-2016; DST J.C. Bose Fellow, 2013-2018; Council Member, 2012-2014, Vice-President,

2014, Indian National Science Academy; West Bengal Academy of Sciences and Technology (WAST);

In his loss, the scientific community has lost a brilliant scientist, teacher, 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 this great loss.

#### Dr K.V.B.R. Tilak



(1941-2021)

The Fellows of the National Academy of Agricultural Sciences deeply condole the sad demise of Dr Kolluru Venkata Butchi Ramalinga Tilak, a Fellow of the Academy and an outstanding scientist and teacher. In his illustrious career, he made immense contributions in the field of Soil (Agricultural Microbiology), Biofertilizers, Biopesticides, Soil-plant-microbe interactions, Microbial biotechnology, Organic Farming, PGPR's.

Dr Tilak left an indelible impression among agricultural scientists in various exemplary roles as Associate Professor & Soil Microbiologist, G.B. Pant University of Agriculture & Technology, Pantnagar; Senior Microbiologist, Principal Scientist, Professor and Head, Division of Microbiology, Indian Agricultural Research Institute, New Delhi; Project Coordinator, Biological Nitrogen Fixation ICAR; Coordinator of Indo-US Science & Technology Initiative Senior Scientific Panel on Biological Nitrogen Fixation and Biofertilizers; Project Director, National Centre of Conservation & Utilization of Blue-Green Algae; Emeritus Scientist, CSIR; NASI-Senior Scientist, Platinum Jubilee Fellowship, Osmania University, Hyderabad.

Dr Tilak received several awards. These include Alexander Von Humboldt Foundation Fellow, Germany; Prof. S.R. Vyas Memorial Award, Association of Microbiologists of India; IARI Best Teacher Award; Late Prof. Uma Kant Sinha Memorial Award, Indian Botanical Society; AMI Platinum Jubilee Life Time Achievement Award in Microbiology; Life Time Achievement Award, PGPR Society; Life Time Achievement Award in Life Sciences of Global Sustainable Biotech Congress; Dr M.V. Shantaram Memorial Lecture Award, Professor Jayashankar Telangana State Agricultural University, Hyderabad, Telangana. He was General Secretary and President, Association of Microbiologists of India; and Member, Editorial Board, Journal of Indian Botanical Society. He has Steering Committee Member, TDDP, DBT; PAC, SERC, DST; Resource Expert, NBAIM, Mau. He was a Member, QRT, ICAR-Indian Institute of Soil Sciences, Bhopal and Chairman, QRT, National Bureau of Agriculturally Important Microorganisms. He has received the Dr K.C. Mehta Memorial Award of the National Academy of Agricultural Sciences.

In his loss, the scientific community has lost a brilliant scientist, teacher, 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 this great loss.

#### Dr Vishwa R.P. Sinha



(1938-2021)

The Fellows of the National Academy of Agricultural Sciences deeply condole the sad demise of Dr Vishwa R.P. Sinha, Fellow of the Academy and world-renowned fisheries and aquaculture scientist. In his illustrious career, he made immense contributions in the field of fish biology, fish endocrinology, fish reproduction, Aquaculture R&D.

Dr Sinha left an indelible impression among agricultural scientists in various exemplary roles as Lecturer in Zoology, University of Ranchi, 1961-63; Leverhume Fellow, Post Doctorate Fellow, and Environment Research Council Fellow, 1964-68, University of Liverpool, U.K; Principal Scientific Officer/ Acting Director, TFCRI, West Malaysia, 1968-71; Project Coordinator/ FAO National Project Director/ OSD, CIFA, Bhubaneswar, 1971-86; FAO Senior Aquaculturist, NACA, Bangkok, 1986-88; Director/Vice-Chancellor, CIFE, Mumbai, 1988 -92; FAO Project Manager & Senior Specialist, BFRI, Bangladesh, 1992-94; Acting Director, CIFRI, Barrackpore, 1995-96; Consultant, BFRI, Bangladesh, 1999-2001, World Bank/ Winrock International/Arcadis Euroconsult and CEO, Consulting and Professional Login LLC, Pittsburgh, USA; Vice-President, Teclincs LLC; and Vice-President, Infoyuga Inc. Pittsburgh, USA.

Dr Sinha received several awards. These include Hooker Award, 1975; Rafi Ahmed Kidwai Memorial Prize, 1976; ICAR Team Leadership Award, 1978; Lal Bahadur Shastri Award, 1989; Great Son of the Soil Award, 1991; Aashirwad Award, 1992; Congress of Zoology Gold Medal, 1995; Eminent Zoologist Award of ZSI, 2006; ISCA Millennium Plaque of Honour 2007-2008. He was Leverhume Fellow, University of Liverpool, U.K.; National Academy of Sciences, India; Indian National Science Academy; Inland Fisheries Society of India, Barrackpore; Indian Fisheries Association, Mumbai.

In his loss, the scientific community has lost a brilliant scientist 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 this great loss.

## Announcements

### **National Academy of Agricultural Sciences - Invites Nominations for Different Awards for the Biennium 2021-2022**

#### **1. Memorial Awards (6 nos)**

The nominee should be a distinguished scientist above 55 years in age. The period of assessing the contributions would be life time upto the year of nomination. Each award consists of a citation and a silver plaque.

#### **2. Endowment Awards (3 nos)**

The award would be given to outstanding scientists for their contributions towards ensuring (i) food and nutritional security and (ii) overall contribution to agriculture. The nominee can be from any branch of science relevant to agriculture. The award comprises a citation and a silver plaque.

#### **3. Recognition Awards (6 nos)**

The award would be given to distinguished scientists. In the age group of 35-55 years. The award comprises of a citation and a silver plaque.

### **Academy Fellowships**

Nominations are invited for Election of Fellows, selection of Associates and Young Scientists Award of the Academy for 2023.

For details, please visit Academy Website at <http://naas.org.in> or write to the Executive Director, National Academy of Agricultural Sciences, NASC, DPS Marg, New Delhi-110012. Tel.: 011-25846051, Email: [naas-mail@naas.org.in](mailto:naas-mail@naas.org.in)

**Last date for receipt of nominations in the Academy is March 31, 2022**

*Note : Self Nominations are not acceptable.*

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

Published by: Executive Director, on behalf of the National Academy of Agricultural Sciences, NASC, Dev Prakash Shastri Marg, New Delhi 110012; Tel. (011) 25846051-52, Fax. 25846054; Email: [naas-mail@naas.org.in](mailto:naas-mail@naas.org.in); Webside: <http://naas.org.in>