

# NAAS

RESEARCH EDUCATION AND TECHNOLOGY  
POLICY FORUM



# NEWS

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Dr Kusumakar Sharma  
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## From the President's Desk

### Indian Agriculture Beyond 2020



It is with great pleasure and humility that I thank the learned fellowship of the Academy for electing me to serve as your President. NAAS has made a real difference in the advancement of Indian agriculture and the fellowship is dedicated to make it more efficient, sustainable and

inclusive. We continue to cultivate bold and innovative ideas and are willing to take actions that impact national policies and programmes. I deeply appreciate the skills, personalities, and characteristics that contribute to make the Academy an excellent professional body. I look forward to work with all of you as a team to advance issues of contemporary importance to agriculture in general and the Academy in particular. I also take this opportunity to wish the entire NAAS fraternity a happy and prosperous 2020.

Our assessment of the prevailing trends suggests that transformative changes in agriculture and food systems are required in future if we are to succeed in eradicating hunger, malnutrition and poverty, while making agriculture and food systems sustainable and lucrative worldwide. Indian agriculture, fueled by technological change and supported by investments in irrigation, infrastructure, institutions, and incentives in terms of guaranteed output price and input subsidies, treaded on an impressive growth trajectory in the past. Between 1965-66 and 2018-19, production of food grains increased from 72 to 281 million tons, and that of fruits and vegetables from 44 to 285 million tons. Growth in production of animal source foods has been even more impressive — production of milk increased from 21 to 188 million tons, of fish 1.3 to 13.3 million tons and of eggs' number from 2881 to 10331 million. This revolutionary progress in agriculture and its allied sectors not only made the country self-sufficient in food, but also contributed towards improving farm incomes and mitigating rural poverty. However the enormous task of feeding a rapidly growing global population and concurrent massive challenges posed by climate change, intensification of natural disasters and upsurges in trans-boundary pests and diseases will constantly seek answers from agricultural scientists, planners, farmers and associated stakeholders for sustainable management of natural resources.

The need to produce more food, feed and fiber will remain as urgent as ever in the wake of expected increase in India's population to nearly 1.7 billion by the year 2050,

half of which will reside in urban areas. In general, people will be more affluent, demanding more of nutrient-rich high-value foods such as fruits, vegetables, milk, meat, eggs and fish. It is worth noting that between 1993-94 and 2011-12 expenditure share of high-value commodities in food budget increased by 7.5 percentage points for rural population and 3.1 percentage points for urban population, while share of food grains declined by 12.3 and 3.7 percentage points, respectively. The factors underlying these changes have been quite robust, and are unlikely to subside in the foreseeable future. By 2050, India's overall demand for food is projected to be at least 50% more than the current demand, but with considerable variation across commodities. The demand for vegetables, fruits and dairy products will be much larger than that for staple food grains. On the other hand, agricultural production systems will come under severe stress due to biotic, abiotic, and structural constraints. The biggest threat will be the quantitative and qualitative deterioration of natural resources, particularly land and water. For the past five decades, India's net cropped area has been stagnating at around 141 million hectares; and it is apprehended that some of the agricultural land may be diverted to non-agricultural uses. Thus, prospects of bringing additional land under agriculture are not bright. Alongside, quality of land has also been deteriorating on account of soil erosion, alkalinity and salinity and excess use of agrochemicals, especially fertilizers, in the intensively cultivated regions.

India's water resources are limited, and currently more than half of its land is water-stressed. Of the total utilizable 1123 billion cubic meter (bcm) of water — surface 690 bcm and ground 433 bcm — over 80% is utilized for irrigation. At present, close to half of the net cropped area is irrigated, but its reliance on ground water has increased considerably, leading to a steep decline in water table in many parts of the country, especially in arid and semiarid regions. If this trend remains unabated, India will face acute water scarcity in the years to come.

Climate change has emerged as a big threat to sustainable development of agriculture and agriculture-based livelihoods. Predictions of the IPCC indicate climate to become warmer and accompanied by rising frequency of extreme events such as droughts, floods and heat waves. Agricultural consequences of extreme climatic events will be more severe than of a gradual change in climate.

Notwithstanding biotic stresses, farming and farmers' livelihoods in the decades to come will be significantly affected by structural changes both within and outside agricultural sector. The share of agriculture in the gross domestic product although has declined from 46% in 1970-71 to 15% in 2018-19, it has not been accompanied by a commensurate decline in its share of workforce. The sector still engages about 45% of the workforce. On the other hand, agrarian structure has

undergone a change, albeit undesirable from perspective of farmers' livelihoods. Landholdings have been fragmenting continuously — their number increased from 71 million in 1971 to 146 million in 2016 and their average size declined from 2.3 hectares to 1.1 hectares. Marginal landholdings (less than or equal to 1 hectare) now comprise over 68% of the total holdings, and these are likely to proliferate further. The average size of marginal landholdings is less than 0.4 hectare, and this poses a question: *Can such tiny pieces of land generate enough income for a decent livelihood?* In fact, over 40% of the farm households, mostly cultivating such tiny pieces of land, have a latent desire to exit agriculture, but they remain engaged in it due to lack of alternative employment opportunities.

More importantly, the gains realized from the adoption of short-duration fertilizer-responsive semi-dwarf high-yielding varieties of staple cereals, viz., paddy and wheat, in the initial phase of Green Revolution have slowed down. This is a matter of serious concern for agricultural research and development. The future growth in agriculture, therefore, has to be efficient, sustainable and environment-friendly, and driven by technological change. To make it happen we require out of box thinking and innovative means.

Scope of bringing additional land under agriculture although is limited but there is a ray of hope. At present, only 42% of the net cropped area is cultivated more than once, indicating that there are prospects of increasing agricultural production through intensification of existing land and vertical farming in urban and peri-urban area by effective management of land and water resources. India has enormous potential to improve water-use efficiency by adopting micro-irrigation (i.e., drip and sprinkler), water-scheduling devices, water-efficient agronomic practices and low-water footprint crops. At present, India has only 11.28 million hectares under micro-irrigation, and far greater efforts are required to exploit its full potential. Besides, more investment will be needed for on- and off-farm water harvesting.

Exploiting land on its intensive margin will be accompanied by removal of soil nutrients, hence management of soil fertility is crucial for sustainable agriculture. Nutrients mined need to be replaced to maintain physical, chemical and biological qualities of soils. Intensification-led pathway will result in production of more food and non-food commodities, but it will be sustainable only through adoption of balanced application of inputs including water. In this context, an appropriate combination of improved technologies and agronomic practices are required that contribute towards improving soil health and flow of ecosystem services. However, the fundamental question that requires answer is: *Can farmers adopt recommended land-use and management practices in absence of appropriate incentives?* Nonetheless, a workable system of payment for ecosystem services requires their monetization at the first instance.

Climate change will be one of the biggest threats to future growth of agriculture. The threat is more pronounced in countries like India that heavily rely on agriculture and lack financial resources and innovative technologies for mitigation and adaptation. The need is to improve resilience of agriculture to both the gradual and extreme changes in climate through the use of *ex ante* and *ex post* mitigation and adaptation measures. India has developed capacity in weather forecasts, and their dissemination requires appropriate institutions for coordination and implementation of climate services at different administrative and/or geographical levels for improving farmers' capacity to adapt to climate change. Intensification of agriculture and climate change, in all likelihood, will be accompanied by increased incidence of insects, pests and diseases, changes in pest-host relationships and emergence of new pests and trans-boundary diseases, all leading to increased loss in food production systems. For human beings, one of the greater risks is of zoonotic diseases. In the past, approaches like Integrated Pest Management (IPM) and genetically modified pest-resistant cultivars have averted crop damages to an extent, yet the research agenda needs to be broadened to develop new technologies for prophylactic management of insect pests and diseases, and to build teams to create research, education and outreach programs around the **One Health** concept. Microbes, such as bacteria, fungi and protozoa, have the potential for major breakthroughs.

Most of these challenges are complex and interrelated, and their redressal requires new generation technologies backed by appropriate investments in infrastructure and institutions. Agricultural research is capital-intensive, and requires significant increase in funds, up from the current 0.4% of the agricultural gross domestic product. The other issue relates to setting of priorities for research in terms of its relative emphasis on genetic enhancement, natural resource management, mechanization, pest management, etc. There could be trade-offs among outcomes of different research approaches addressing a specific challenge. For instance, breeding for climate resilience is claimed to provide a long-term solution compared to research on natural resource management. Nonetheless, the importance of a holistic or interdisciplinary research cannot be undermined given the complexity of emerging challenges.

Gains from investment in agricultural research will remain under-exploited in absence of its strong linkages with extension systems. At present, slightly more than 40% of the farm households have access to agricultural information, mostly from informal sources such as fellow farmers and input dealers. Outreach of the formal extension system, including mass media, research institutions and ICTs, is limited to about 15% of the farm households. In view of the emerging challenges, farmers' information needs will be diverse and huge. The 1990s brought information via the internet, and the 2000s brought social sharing. In future, the two will be fully integrated, helping farmers solve problems and learn

new skills. The evolution of inexpensive sensors, improved GPS and self-learning machinery is helping robots become mainstream. Some of these tools today are big, clunky and expensive, but in the next decade the robotic technology will get a lot smarter because of fast paced developments taking place in sensor technology, artificial intelligence and 5G connectivity. The combination of big data with cutting-edge science, artificial intelligence and cloud-connected technology has the potential to revolutionize agriculture.

Farmers' poor access to finance and markets are key constraints to commercialization of smallholder agriculture. Farmers need finance for buying inputs and for investment in on-farm infrastructure. Their financial requirements are not big, but financial institutions perceive lending to them costly and risky. Likewise, there are imperfections in agricultural markets. These are dominated by a long chain of intermediaries, reducing farmers' share in the price that consumers pay. In this context, there are a few questions that need to be addressed. *How can farmers' access to finance and markets be improved?* "Can value chain finance provide a solution? Several value chain sponsors provide inputs and credit to farmers as a part of the marketing contract, benefiting themselves as well as farmers. The value chains for most agricultural commodities, except for poultry and to some extent for milk, however, are yet to be developed.

The challenges to agricultural growth beyond 2020 will be complex, but these are not insurmountable. I strongly believe that the Academy will contribute to a common understanding of the major long-term trends and challenges that will determine the future of food security and nutrition, sustainability and resilience of rural livelihoods, agricultural systems and their natural resource base.



(T. Mohapatra)  
President

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

The 111<sup>th</sup> meeting of the Executive Council of the Academy was held under the chairmanship of Dr T. Mohapatra, President, NAAS on February 21, 2020 at the NAAS Secretariat, New Delhi. It was attended by 17 EC members, besides Prof Anupam Varma, Editor-in-Chief, Agricultural Research Journal, and Prof Rakesh Singh, Head, Department of Agricultural Economics, BHU, Varanasi & Nodal Officer for the proposed XV Agricultural Science Congress as special invitees. Dr Anil K. Singh, Secretary extended a very warm welcome to all the participants, especially the newly elected office bearers and members of the Executive Council who joined on January 1, 2020, namely, Dr Trilochan Mohapatra as President; Dr J.C. Katyal as Vice President; Dr P.K. Joshi as Secretary; Dr P.S. Birlhal as Editor; and Drs J.S. Chauhan, W.S. Lakra, Rajender Parsad and R. Visvanathan as Members of the EC.

Dr T. Mohapatra in his opening remarks lauded the commendable services of the Academy to Indian agriculture. However, he expressed the need to expand its outreach both within and outside the country. He requested the EC to critically review, and guide in doing better in the future with a tangible difference by taking its past accomplishments as the base. He called for a proactive approach in providing inputs to policy makers in areas like animal husbandry, input subsidies, water management and new science. He cited specific examples of the inputs provided by NAAS for Seed Bill, Pesticide Management Bill, and Genome Edited Organisms Guidelines. He requested the Office Bearers to meet more frequently to identify issues of topical importance.

Prof Rakesh Singh provided an update to the EC about the preparations for holding XV ASC-2021 at BHU. He provided a brief about the available facilities in and around the BHU campus. EC advised him to have an interaction with Dr Ashok K Singh, Director, IARI and Organizing Secretary of XIV ASC-2019, and expedite various activities on priority, particularly creation of a website, designing of logo & flyer of XV ASC and budgetary requirements including sources of funding. He was requested to provide desired details before the next EC meeting.

Thereafter, the items listed in the agenda were taken up for discussion. The notable decisions taken by the EC included approval of the 'Sectional Committees for Election of Fellows and Associate Fellows' for 2021, constitution of 'Judging Committees' for selection of awardees for the biennium 2019-2020, approval of the proposed programme for AGM, extension of the validity of current NAAS Score of 2019 of non-IF journals until December 31, 2020; appointment of Mr S. Bilgrami as Executive Director, besides ratification of the extension of tenure of Budget & Accounts Executive with enhanced emoluments. A proposal for an Inter-Academy Forum on Innovation (IAFI) to be jointly developed by the National Academies of Sciences, Engineering, Medical, Agriculture and others, was deliberated in the meeting and it was decided to circulate it to all the EC members for their inputs before it is finalized. The meeting ended with a vote of thanks to the Chair and all the members by Dr A.K. Singh.

## Programmes Held

### New Year Get-together

The Academy organized a get together of Delhi based Fellowship at NAAS Secretariat on January 1, 2020 under the Chairmanship of Dr T. Mohapatra, newly-elected President of the Academy. Other dignitaries included the immediate past-President Prof Panjab Singh, past-Presidents Dr R.S. Paroda and Prof R.B. Singh, Dr A.K. Srivastava, Vice-



President, Dr A.K. Singh, Secretary and Dr P.K. Joshi, newly-elected Secretary. Dr A.K. Singh extended a very warm floral welcome to all the dignitaries and introduced the newly elected members of EC, fellowship and associates present in the house. He also briefly highlighted the activities and achievements of the Academy during the year 2019.

Dr Mohapatra welcomed the NAAS family and wished a bright and professionally rewarding New Year 2020. He requested the fellowship to recall Academy's achievements, to which many have contributed by pioneering the new framework to agricultural research and development. Further, he drew attention towards the need to focus on the national issues related to agriculture and broaden horizons of NAAS to increase its visibility by attracting youngsters and inspired minds. He was of the view that NAAS needs to strengthen one of its biggest responsibility which is to inform the Society about the potential of new science for enhancing agricultural growth and improving livelihood of farmers. He wished that Regional Chapters of the Academy shall increasingly contribute in dissemination of policies and knowledge, besides creating awareness about various activities of the Academy.

He also proposed frequent interface among scientific academies in the country and abroad to establish a direct link between current global developments and scientific efforts. He appealed and requested the fellowship to reposition the activities commensurate with Academy's intellectual and other resources.

Dr R.S. Paroda wished that new year will bring new opportunities and challenges for NAAS fellowship, and stressed the need to prepare NAAS to further promote science by engaging stakeholders and working with policy makers, besides coordination, convergence and joint action with scientific societies and other academies. He reminded the fellowship about the resolve set out in Paris Inter-Governmental agreement to achieve sustainable development goals (SDGs) by 2030. He exhorted the fellowship to think globally and act locally to achieve the goal of zero hunger. He was confident that Academy will take necessary steps to bridge the disconnect with policy makers for science-led development of agriculture and farming community.

Prof R.B. Singh, past-President of the Academy also wished the fellowship a happy, healthy and prosperous New Year. He provided an insight into the book *Agricultural Transformation – The Road to New India* authored by him and released by the President, NAAS on this occasion. The book captures frontier agro-biological, scientific, technological and innovative developments; and highlights major trends, issues and challenges; main messages; policy options strategies, and actions emerging from the Policy Papers, Strategy Papers, Policy Briefs and other publications of the NAAS. Prof Singh expressed the hope that the book will underpin the urgency and importance of breaking the Indian enigma and of transforming Indian agriculture to be more rewarding, resilient, and responsive to free the nation of hunger, under-nutrition and abject poverty and to build an ever-prosperous New India. He also explained how the book internalizes voices and views not only of scientists/ academicians, but also those arising from grassroot levels, besides messages emerging from political thought processes, governmental priorities, policies and initiatives. He expressed his gratitude to the Academy for giving him the opportunity to review the usefulness of NAAS publications in suggesting policy options and research priorities for transforming India's agri-food system with a human face.

Prof Panjab Singh, immediate past-President of NAAS while conveying his warm greetings to fellowship for participation in the New Year Get-together, expressed his gratitude for all round support to him during his tenure as President. He also congratulated newly-elected President, Vice-President, Secretary, Editor, Fellows and Associates, and lauded the contribution of the outgoing office bearers and members of Executive Council. He reiterated the need to get associated with development departments through regional chapters for providing science-led solutions to various problems facing agriculture. He pointed out that NAAS has been at the forefront by expressing the views of fellowship through its

publications, media and debates on issues like GM, ZBNF, restructuring of ASRB etc. He further laid emphasis on science communication and also suggested that the recommendations of the Policy/Status/Strategy papers must be precise so that policy decisions can be made and implemented. He also highlighted the consultancy approach floated by the Academy to make use of NAAS think-tank to address the policy issues outsourced by government agencies.

Several fellows expressed their views in the open discussion and gave valuable inputs on various issues related to broadening of the horizon of NAAS in terms of mentoring by fellowship, repositioning of NAAS to increase its visibility and awareness in social arena, marrying scientific excellence with relevance, inter-academy approach and challenges of conservation agriculture and rating of the scientific journals.

On this occasion, Academy's Strategy/Policy Papers, NAAS Yearbook 2020, NAAS-NEWS October-December 2019, and NAAS Planner 2020 were also released.

The programme ended with a vote of thanks by Dr P.K. Joshi, Secretary, NAAS.

## Experts' Meet on Seed Bill (Convener: Dr D.S. Yadav)

The Ministry of Agriculture and Farmers' Welfare has drafted Seed Bill, 2019 and placed it in the public domain for inviting suggestions from various stakeholders. The Bill aims to regulate the seed industry in India in terms of certification and pricing of seeds, and accountability of seed companies. NAAS organized an Expert Meet on Seed Policy on February 03, 2020 at NASC Complex to relook into the provisions of Draft Seed Bill 2020. The meeting was co-chaired by Dr Trilochan Mohapatra, Prof R.B. Singh and Dr J.C. Katyal; and was attended by several experts both from public and private sectors.



Dr D.K. Yadava, ADG (Seed) gave a brief background of the Seed Bill and the developments that have taken place since it was conceived in 2004. Prof R.B. Singh called upon scientists to provide recommendations based on scientific discoveries, including the technologies like GMOs, gene edited products,

and seed health standards as to make Indian seed industry globally competitive. Dr Trilochan Mohapatra stressed upon the need for identifying the critical gaps in the proposed Bill and the possible ways of bridging these omissions. He appreciated public-private partnership in making India's seed sector vibrant and farmer-friendly.

The salient recommendations that emerged include: creation of a National Seed Authority to deal with all seed related issues, development of a foolproof data system through the National Agricultural Research System, harmonization of existing Acts on seed and germplasm, provisions to encourage new developments by use of cutting edge technologies, facilitate seed exports, enhance share of India in international seed market and prescribe graduation in agriculture as minimum qualifications for seed dealers.

The detailed recommendations have been forwarded by the Academy to the Ministry of Agriculture and Farmers' Welfare for consideration to add further value to the *Draft Seed Bill 2019*.

### Experts' Meet on Pesticide Management Bill-2017 (Convener: Dr B.S. Parmar)

An Expert Meet on Pesticide Management Bill, 2017 was organized by NAAS on February 4, 2020 to seek views of various stakeholders on the proposed Bill under the chairmanship of Prof R.B. Singh before it is put to the Cabinet Committee on February 12, 2020. The meeting was convened by Dr B.S. Parmar, Fellow, NAAS. Representatives from Crop Life India, Crop Care Federation of India, and Pesticides Manufacturers and Formulators Association of India, besides key officials/ experts from public and private sectors, and academic bodies like ICAR, ICMR, and NAAS participated in the meeting. Dr B S Parmar highlighted salient provisions of this Bill *vis-a-vis* the Insecticides Act, 1968, and it was followed by presentations by representatives of the industry, and individuals.

The key issues of discord were identified. These include: vague definition of the terminologies used, discrepancies in the scope, lack of provisions for indigenous research



and development for newer technologies and molecules, bottlenecks in the registration process, data protection, quality of test laboratories, manpower, testing and analysis, spurious pesticides, punishments, lack of provisions on workers' safety, bio-pesticide quality, crop groupings and their importance, resistance management, malpractices by inspectors, other officials and test laboratories etc. A small committee comprising Drs B.S. Parmar, Gita Kulshreshtha, and Anupama Singh was constituted under the chairmanship of Prof R.B. Singh to study, analyze and authenticate the issues and prepare a policy brief to address the concerns in the draft Bill.

### Roundtable Discussion on Regulatory Framework and Guidelines for Risk Assessment of Genome Edited Organisms (Convener: Prof N.K. Singh)

In the wake of the recent developments in the field of Genome Editing Technologies, the Department of Biotechnology (DBT) prepared draft guidelines related to *Genome Edited Organisms: Regulatory Framework and Guidelines for Risk Assessment* accommodating applicable laws, acts, and procedures governing genome editing, general considerations and tiered approach for risk assessment of genome edited organisms and products derived therefrom, regulatory approval road



map, data requirement for risk assessment and institutional mechanism for governance and oversight. DBT invited comments on the draft from researchers/institutions and other stakeholders. NAAS had already planned a brainstorming session on this topic and utilized this opportunity to organize a roundtable discussion involving a range of stakeholders including Fellows of the Academy, representatives from seed industry, progressive farmers and other experts on February 6, 2020 to give its feedback to DBT on the proposed draft. The discussion was co-chaired by Dr T. Mohapatra, Dr R.S. Paroda and Prof R.B. Singh. The group unanimously resolved to submit the following key points for consideration of the DBT:

- There is a need to have separate guidelines for genome edited plants by exempting them from regulation and risk assessment within the existing provision under Rule 20 of the *Rules for the manufacture, use, import, export and storage of hazardous microorganisms / genetically engineered organisms or cells, Rules 1989*.
- For commercial release of the final product, which is devoid of any foreign DNA, evaluation for trait efficacy and field performance should be carried out as per the ICAR-AICRP protocol, and release and notification as per the legislations for seed quality regulations (*Seeds Act 1966, Seeds (control) order 1983, Seeds Rules, PPVFRA Act 1986, National Seed Policy and the proposed New Seeds Bill*).
- The NAAS may play a key role in facilitating dialogues and communications with the general public, policy makers and farmers about the tremendous benefits offered by the new genome editing technology and related safety issues in a simplified manner.
- Since India has already made good investment in the area of genome editing, it will be prudent to create policy environment that enables use of such technologies by scientists and students in the country for achieving sustainable food, nutritional, and income security and ultimately meeting the SDGs.

## Direct Benefit Transfer under Nutrient-based Subsidy Regime (Convener: Dr B.S. Dwivedi)

An Experts' Meet on *Direct Benefit Transfer under Nutrient-based Subsidy Regime* was organized by the Academy on March 11, 2020 to discuss challenges and complexities associated with Direct Benefit Transfer (DBT)/Direct Cash Transfer (DCT) of fertilizer subsidy. The meet convened jointly by Dr B.S. Dwivedi, Head, Division of Soil Science and Agricultural Chemistry, ICAR-IARI, New Delhi and Dr J.P. Mishra, OSD (PPP), ICAR, New Delhi, was chaired by Dr T. Mohapatra, President, NAAS. Representatives from ICAR, Department of Fertilizers, GoI, CGIAR, fertilizer industry and farmers' organizations attended the event. The convenors



flagged the issues for discussion to seek opinions of the stakeholders, which was followed by a panel discussion chaired by Shri J.N.L. Srivastava, Ex-Secretary, GoI and co-chaired by Dr Chhabilendra Raul, Secretary, Department of Fertilizers.

It was pointed out that the Government of India initiated DBT for disbursement of fertilizer subsidy in the year 2018. However, the subsidy is still not transferred directly to farmers, but rather being disbursed to fertilizer industry on real-time sale basis. The group was of the opinion that implementation of DBT/DCT of fertilizer subsidy is complex, involving several challenges such as the identification of beneficiaries, entitlements for subsidy, limited digitization of land records, differential rate of subsidy across different types of fertilizers, etc. These apart, following key recommendations emerged out of the deliberations:

- The effective implementation of DBT requires identification of beneficiaries for fertilizer subsidy, thus the need to define the beneficiary, that is, land owner or cultivator. The definition proposed by National Commission on Farmers, 2006 may be considered for this purpose. The issue of tenancy also needs to be addressed by the states by enacting tenancy act and updating existing laws based on the Model Act on Agricultural Land Leasing, 2016.
- Digitization of land records should be completed by the States at the earliest.
- Fertilizer subsidy should be given on per hectare basis across holding size, states, agro-climatic conditions or crops grown. Yet, the DCT should be performance-based and not unconditional.
- The subsidy amount may be paid to the farmers in advance through e-wallet giving farmers a menu of different fertilizers including the organic manures, seed of green manure crops etc.
- Highly subsidized provision of urea under Nutrient-based subsidy is one of the major reasons for overuse of nitrogenous fertilizer. Reducing subsidy on urea is a pre-requisite for the success of DBT/DCT.
- Linking DCT with soil health cards (SHC) is likely to encourage balanced use of plant nutrients and restoration of soil health. For this, it is essential to correctly assess the soil health status, and customize provision of different types of fertilizers as per the recommendations.
- Provide fortified urea in regions with widespread deficiency of Zinc and Boron.
- R&D on fertilizer products need to be encouraged to bring out novel fertilizers with higher use efficiency.
- Sequential reforms to decontrol fertilizer sector and improve the health of domestic fertilizer industry by correcting its back-end problems.
- Undertake extensive field demonstrations and farmer education programmes involving state extension

machinery, KVKs and fertilizer industry to enhance farmers' awareness regarding benefits of balanced

fertilization and effective use of subsidy remitted through DCT.

## International Collaboration under South-South Cooperation

### Fostering India-Africa Collaboration in Agricultural Biotechnology

The NAAS hosted an eight-member high-level delegation from seven African countries on February 10, 2020 as a part of 10-day Agricultural Biotechnology and Biosafety Study tour organized by Michigan State University in collaboration with African Union Development Agency (AUDA-NEPAD), The Energy and Resources Institute, New Delhi and Bejo Sheetal Biosciences Foundation, Jalna.

Dr Trilochan Mohapatra, President NAAS welcomed the participants and shared India's experiences in agricultural biotechnology, particularly Bt cotton technology. Underpinning the vital role of genetic engineering in agricultural transformation, he elucidated the impact of Bt hybrid cotton in the national economy, the possibility of release of herbicide tolerant Bt cotton hybrids, and the national institutional and regulatory mechanisms to promote frontline research and technology transfer. He assured the delegation of all possible scientific support of NAAS and DARE/ICAR in fostering mutual learning and collaboration.



Led by Prof R. B. Singh, former President NAAS, Drs K.V. Prabhu, Chairperson PPVFRA, N. K. Singh, National Professor B P Pal Chair, ICAR-NRC on Plant Biotechnology, Kuldeep Singh, Director, ICAR- National Bureau of Plant Genetic Resources, C. Viswanathan, Head, Division of Plant Physiology, ICAR-Indian Agricultural Research Institute, Shelly Praveen, Head, Division of Biochemistry, ICAR-Indian Agricultural Research Institute and B. Choudhary, South Asia Biotechnology Centre gave glimpses of the cutting edge biological sciences, technologies, especially biotechnology and innovations being pursued in the area of genomics, gene editing, biosafety, bioinformatics, biofortification, bio nutrients, nutritional security, food safety and quality, climate smart

agriculture, public-private partnership, functional regulatory mechanisms, Seed Bill, harmonization of national and international laws, rules, regulations, and collaborations. The delegation showed keen interest in gene editing, regulatory mechanisms, sharing of genetic resources, regular flow of adequate quality seed from breeders' plots to farmers' fields, nutritional security, food safety (freedom from aflatoxin), and human resources development. The meeting recommended that a tripartite India-Africa-MSU (USA) collaborative project with defined outcomes, timeframe, and financing mechanism should be formulated and implemented soon to enable proven modern, safe, bio-secure, productive and remunerative technologies reach the unreached, ensuring that no one in the line is left out.

### Empowering Youth in India, Africa and Michigan-USA

The National Academy of Agricultural Sciences, under the leadership of Dr T. Mohapatra, President NAAS, and chairmanship of Prof R.B. Singh, hosted an eight-member delegation from Michigan State University at the National Agricultural Science Complex in New Delhi on February 20, 2020. Drs J. C. Katyal, Vice-President NAAS, Anil K. Singh, Secretary NAAS, J. P. Sharma, Joint Director Extension, ICAR-IARI, Rashmi Aggarwal, Dean, ICAR-IARI, and other senior officials representing the Indian Council of Agricultural Research (ICAR) and Indian Agricultural Research Institute (IARI) participated in this meeting. The members representing Michigan State University (MSU) College of Agriculture and Natural Resources (CANR) included Dr Jeffrey Dwyer, Director of MSU Extension and Senior Associate Dean, Mr Brian Wibby, MSU Extension Specialist and Coordinator of Michigan Borlaug Youth Institute, Dr Dru Montri, Director of Government and Stakeholder Relations, Dr Karim Maredia, Professor and Director of International Programs





in Agriculture and Natural Resources, Dr Ruth Mbabazi, Assistant Professor and Assistant Director of International Programs in Agriculture and Natural Resources, Mrs Nancy Dwyer, Professional Nurse, Mr Adam Montri, Farmer, Michigan, USA, besides Dr Vibha Dhawan, Director of Biotechnology and Bioresources at TERI and MSU Consul General for India.

The participants of this joint meeting fully supported the idea of a joint event involving youth from India, Africa and Michigan-USA for active dialogue and networking on global issues related to food security and sustainable development. It was decided to have further discussions with the World Food Prize Foundation to make this joint India-Africa-Michigan program a reality in establishing the youth forum.

## Activities organized by the Regional Chapters

### Coimbatore Chapter

The NAAS Regional Chapter, Coimbatore organized a one-day workshop on *Post-Harvest Technology and Value Addition* on December 04, 2019 in association with Society for Sugarcane Research and Development (SSRD) at ICAR-Sugarcane Breeding Institute, Coimbatore. Over 80 delegates from several institutions including ICAR-SBI, Coimbatore, ICAR-CIAE RS, Coimbatore, TNAU, Coimbatore, Veterinary College, TANUVAS, Namakkal, KVK, Erode and Suguna Institute of Poultry Management, Farmers' organizations and NGOs participated in the workshop. Prof S.R. Sree Rangasamy, FNAAS welcomed the delegates. In his video message, Prof M. S. Swaminathan congratulated NAAS



for instituting the Coimbatore chapter and wished good future for the chapter. Dr Bakshi Ram, FNAAS and Director, ICAR-SBI joined Prof Sree Rangasamy in welcoming the delegates. Dr C. Anandharamakrishnan FNAAS, Director, IIFPT, Thanjavur in his inaugural address emphasized on technology up-gradation, product strategy, supply chain, marketing and regulation for food processing and value addition.

Following points emerged from the discussions in this workshop

- Create awareness among farmers and entrepreneurs about the value addition technologies, traceability and new initiatives such as incubation facilities for start-ups.
- Evolve grades and standards for traditional foods for their enhanced commercialization.
- Develop technologies for conversion of non-edible by-products into value added product, for example, bagasse from sugar industry into disposable plates.

### Haryana Chapter, Karnal

The National Academy of Agricultural sciences (NAAS), Haryana Chapter, Karnal organized a one-day seminar on *Restructuring of primary and secondary education to address the issue of education curriculum weaning students from farmers and farming community away from Agriculture* at ICAR-National Dairy Research Institute, Karnal on December 20, 2019 to seek views from experts, scientists, educationists, school and college teachers, students and farmers on including agriculture as a mandatory subject in school curriculum. The seminar was convened by Dr M.L. Madan, and Dr Sunita Grover, NAAS Fellow and Dr. A.K. Mohanty, Principal scientist, Animal Biotechnology, ICAR-NDRI jointly coordinated this event. Around 100 participants including NAAS Fellows and Associates of the Academy, scientists of ICAR institutes in Karnal, principals, teachers, officers from state education department and students from local schools participated in the event.

Prof Panjab Singh, President NAAS and Chief Guest in his address appreciated this initiative. He lauded role of the Academy in providing a forum to Agricultural Scientists to deliberate on important issues of agricultural research,



education and extension and present views of the fellowship as feedback to policymakers. He emphasized that agriculture at present needs multi-dimensional talented students to bridge the gap between future demand and supply. Following points emerged from the seminar:

- Urgent need for change in school education from primary school level onwards and integration of agriculture in school and college syllabus to connect students to farming in order to attract more youth towards agriculture sector.

- A need for educating parents and youth towards agriculture as a career opportunity.
- Agriculture should be a compulsory subject in school from 5<sup>th</sup>-12<sup>th</sup> class with emphasis on students' exposure to agriculture through regular visits to farms, research institutions and industries.
- Provision of agricultural land to schools to teach organic farming. Girls should be taught kitchen garden maintenance in rural areas.
- Channelize children's vision through inclusion of learning of crops and cropping system, soil-plant-animal-man relationship in production system, rural resource management and concepts of profit and loss in agriculture.
- Creation of necessary infrastructure in schools for teaching agriculture science including facilities like protein gardens, vitamin galleries, etc. and trips to agricultural universities.
- This issue of agriculture education may be taken up with the Ministry of HRD, UGC, NCERT, Board of school education etc.

Dr M. L. Madan concluded the seminar by highlighting the best way to disseminate the knowledge of the essence of agriculture via school education and importance of integrating *knowledge with skill* at primary and secondary level of education. The function ended with a vote of thanks by Dr A.K. Mohanty.

## Hyderabad Chapter

- Dr A.K. Singh, Secretary, NAAS delivered a guest lecture on *NAAS and Science Excellence in Agriculture* on February 7, 2020 at NAARM, Hyderabad. He covered various activities of NAAS since its inception on June 5, 1990. His lecture benefited the 135 young scientists of ICAR representing 28 disciplines. Several NAAS fellows and associates from Hyderabad also attended this event.



- A panel discussion on *Challenges and Opportunities in Meat Sector* was organized by Hyderabad Chapter of NAAS in association with National Research Centre

on Meat, Hyderabad on January 20, 2020. More than 100 delegates including representatives from the meat industry and government departments, entrepreneurs and processors took active part in the discussion. Dr Ch. Srinivasa Rao, Director ICAR-NAARM and Convener, Hyderabad Chapter chaired the session. Several issues related to availability and requirement of veterinarians to carry out meat inspection, newly designed vehicles for animal transport, animal market infrastructure, meat retailing requirements, popularization of animal sourced foods to reduce malnutrition and hunger, funding opportunities for start-up entrepreneurs in meat processing business were deliberated.



## Varanasi Chapter

National Academy of Agricultural Sciences -Varanasi Chapter organized a special lecture on *Molecular Breeding for Development of Climate Smart Rice Varieties* by Dr A.K. Singh, Director, ICAR-IARI, New Delhi on January 30, 2020, at ICAR-Indian Institute of Vegetable Research, Varanasi. During his deliberation, Dr A.K. Singh shared the success story of improvement of basmati rice and informed that annual export earnings from basmati rice alone have reached US \$ 2.5 billion. He emphasized on biotic stress breeding of rice and development of Non-GM herbicide resistance rice. He also elaborated about the importance of social media on popularization of improved varieties. He advised scientists to use new molecular techniques and breeding methods, which may be helpful to sustain the food production to feed the increasing population.



### COVID-19 and Lockdown: Potential Impacts on Agricultural Sector

The abrupt and unanticipated spread of Coronavirus is severely threatening the lives and livelihoods of people throughout the world. Viruses are tiny biotic agents invisible to the naked eye and difficult to manage if they spread like the Coronavirus. Their management becomes even more difficult due to the rapidly growing international travel, commerce and trade. Unlike the earlier pandemics of Swine Flu in 2009 and Spanish Flu in 1918, the on-going Corona virus (COVID-19) pandemic is exhibiting faster human-to-human transmission, impacting millions of people across the globe. It originated from Wuhan, China in December 2019, and in a very short period it spread exponentially, infecting more than 750 thousand people and causing about 36 thousand deaths all over the world till March 31, 2020.

COVID-19 is due to a novel Coronavirus (SARS-CoV-2), which belongs to the family of Coronavirus and includes the HCoVs (common cold virus), MERS-CoV (Middle East Respiratory Syndrome coronavirus) and SARS-CoV (Severe Acute Respiratory Syndrome coronavirus). Coronaviruses are spherical particles (about 120 nm diameter) with positive sense single stranded RNA genome (27-32kb) associated with nucleocapsid protein enclosed in a glycoprotein envelope with spike.

Coronaviruses are not new to mankind, but the emergence of SARS-CoV-2 has posed a serious threat to the mankind. Interestingly, these viruses share certain features like particle shape, outer lipid envelope with spike, single stranded RNA genome and mechanism of recognition and replication with the help of RdRp with plant viruses belonging to the family Tospoviridae (Groundnut bud necrosis virus, Watermelon bud necrosis virus, etc.), affecting the field and horticultural crops as well as insects (thrips). The exact origin of SARS-CoV-2 is yet to be established.

#### Coronavirus and India

India is not untouched of the menace of COVID-19. The first infection in India was reported on 30 January 2020, and by March 31, 2020 as many as 1071 people have been infected and 29 deaths have been reported. Compared to many developed countries, these figures are extremely low. The Oxford Covid-19 Government Response Tracker (OxCGRT)1 reported that the timely response and stringent measures helped India in tackling the pandemic more effectively. The government's policy response included (1) virus management, (2) economic package, and (3) social-safety net for the poor. The World Health Organization (WHO) also applauded the Indian government's response to contain the spread of virus.

Honourable Prime Minister announced a complete lockdown in the country from March 25 to April 14 2020 in the first phase and likely to be extended further to significantly contribute in containing the spread of Coronavirus. However, the continued lockdown may severely affect the income and livelihood of the people in various sectors. It is against this complex backdrop, the key challenges that agricultural sector may face due to the lockdown, and the possible means of overcoming these challenges have been examined.

#### Challenges before agriculture sector

The Country Lockdown, the most potent weapon it had at its disposal, to escape and overcome the threat of Covid-19, has adversely affected the food security and employment opportunities across all the countries including India. The poor, who often derive their livelihood from daily wages, are the most affected. The unprecedented threat to food security is not due to the adverse impact of the lockdown on food production but because of a lack of access to food caused by the disruption in food supply chains and sudden fall in the incomes of the poor. The earlier global food crises, witnessed during 2008 and 2011, were caused by steep fall in food production and abrupt spikes in food prices. During these crises the millions of people were pushed into poverty, mostly in the developing countries.

The present crisis in all likelihood will adversely affect the economic growth mainly due to the shutdown of economic activities. There are projections that most countries will face the worst recession after the Great Depression of the 1930s. For India, the economic growth during 2020-21 is projected to fall steeply to 1.5-2%. The worst affected sectors are the manufacturing and services.

Agricultural production does not seem to be directly affected by the crisis. It may be affected indirectly through the disruptions in agricultural supply chains that may weaken its backward and forward linkages to manufacturing sectors. It may be weird but the fact is that agriculture sector will be the least affected by the lockdown, and may emerge as an important contributor to economic growth in 2020-21. There are four plausible reasons for this:

- First, most of the rabi crops have either been harvested or are ready to harvest. Almost 100% of the mustard, 98% of the chickpea, and 90% of the potato areas have already been harvested. Approximately 40% of the wheat area is likely to be harvested by 15<sup>th</sup> April, and the remaining is likely to be harvested within the following week or so. Note that wheat harvesting is mostly mechanized, and the central and state governments have already permitted movement of harvesting and associated machinery, hence, it should not be affected much by the labour shortage due to the lockdown.

- Most recent advance estimates show bumper production of most rabi crops. Production of wheat has been pegged to 106.21 million tons, which is 2.61 million tons higher than previous year. Similarly, chickpea production is expected to be 11.2 million tons, as against 10.93 million tons in the previous year.
- Mid-March to mid-May is the lean season for agricultural operations in most parts of the country. During this period, the prices of most of the vegetables and fruits are relatively higher than during rest of the months due to lower supply. Processors, with some exceptions, do not prefer to procure agricultural produce during this period due to higher prices.
- Third, most of the pre-monsoon season sowing has exceeded over the previous year. Paddy acreage has already been sown in 27% more area than in the previous year. The pre-monsoon sowing of pulses, coarse cereals and oilseeds have already surpassed their corresponding acreage in the previous year. However, in some areas, labour shortage is affecting sowing of cotton.
- Fourth, the India Meteorological Department has predicted normal monsoon for 2020.

Although agriculture sector would be least affected, the farmers, especially small and marginal farmers, would face numerous challenges. Important ones are:

- Disposal of agricultural produce, especially wheat, pulses and mustard at minimum support prices. In this context, the state governments have claimed of developing appropriate arrangements for procuring wheat for the public distribution system. Central government has also asked the NAFED and the state governments to procure pulses and oilseeds at minimum support prices.
- Adverse impact on perishable commodities, especially fruits, vegetables and flowers due to (i) labor shortage for harvesting, packaging, loading/unloading, (ii) limited availability of transport facilities; and (iii) inadequate access to market due to maintaining social distancing. There are reports that farmers producing horticultural commodities are the worst hit due to lower prevailing farm harvest prices. On the other hand, the consumers are paying higher prices due to supply bottlenecks arising due to lockdown. The government has allowed transport services (both through roads and goods trains) for agricultural commodities. It is to be seen how effectively these services will connect farmers with wholesale and retail markets and consumers.
- Negative impact on Livestock producers and supply chains of milk and milk products due to (i) week collection, (ii) limited access to transport from rural to urban areas,

and (iii) reduced processing. Similarly, demand for and supplies of meat and eggs have also been distorted. Non-availability of feed for animals and poultry birds may also hit the livestock production. This sector needs special attention as it is one of the key drivers of agricultural growth.

### **Response to minimize the risk**

It is time of take appropriate measures to cope with the crisis caused due to Covid-19. It can be taken-up as an opportunity to transform Indian agriculture for higher income and employment. The key steps required to cope with the crisis and make agriculture efficient, resilient and environment-friendly include:

1. Liberalization of agricultural markets and adoption of the Model Market Act for developing efficient and sustainable value chains. The Act proposes direct sale and purchase of agricultural commodities without taking the route through the APMC markets. Although agricultural marketing is a state subject, the central government may incentivize states to adopt the Model Market Act, at least for the perishable horticultural and livestock products. This will strengthen the supply chain and improve marketing efficiency. The bulk buyers, big retailers, processors and exporters can directly procure agricultural commodities at the farm-gate. The NITI Aayog and the Ministry of Agriculture and Farmers' Welfare have also proposed for allowing the direct marketing of agricultural commodities.
2. Assured availability of seed, fertilizer and other critical inputs for the upcoming kharif season. The central government has already provided guidelines for easing the availability of key agricultural inputs. On finance, the central government has already announced an advance payment of Rs 2000 to all the farmers covered under PM-KISAN. The amount should be increased, and the second installment should be released before onset of the monsoon to enable farmers buy seed, fertilizer and other inputs for kharif crops.
3. Increased investment in agricultural research to develop resistance against multiple pathogens for saving the crops if a Corona like virus infects crops and animals. They may devastate agriculture and adversely affect global food security. Bio-farming, food safety, food processing, storage pathology, trans-boundary pests and bio-security issues should comprise an important agenda for future agricultural research. Researchers at Centre for Research in Agricultural Genomics (CRAG), Barcelona, Spain intend to use plant system (*Nicotiana benthamiana*, Lettuce etc.) to produce SARS-CoV-2 antigens that can be used as vaccines.

(Source: Drs P.K. Joshi and R.K.Jain, NAAS Fellows)

## Forthcoming Programmes

- Strategy workshop on Potential of Non-Bovine Milk (Dr M.S. Chauhan)
- Strategy workshop on Bio-fortification (Dr U.S. Singh)
- Brain storming session on Food, Agriculture and Income Policy for the Five Trillion Economy (Dr Suresh Pal)
- Strategies for Enhancing Soil Organic Carbon for Food Security and Climate Action (Dr Ch Srinivasa Rao and Dr Anil K. Singh)
- Strategy workshop on Emergency Preparedness for Prevention of Trans-boundary Infectious Diseases in Indian livestock and Poultry (Dr Parimal Roy and Dr V.P. Singh)
- Strategy workshop on Wastewater Utilisation in Urban and Peri-Urban Agriculture (Dr J.C. Dagar)
- Strategy workshop on Innovations in Potato Seed Production and Its Adoption (Dr S.K. Chakrabarti)
- Strategy workshop on Need for Breeding Tomatoes Suitable for Processing in India (Dr A.T. Sadashiva)
- Brain storming session on Sugarcane based Ethanol Production for Sustainable Fuel Ethanol Blending Programme (Dr Bakshi Ram)
- Brain storming session on Ethano-medicine (Dr P.L. Gautam)
- Strategy workshop on Anti-microbial Resistance (Dr A.K. Srivastava)

## Fellows Views

### Agriculture machinery export potential in South Asia

South Asian and South East Asian countries viz., Bangladesh, Philippines, Thailand Cambodia, Pakistan, Sri Lanka and Vietnam have primarily agrarian economy like India. Agriculture of these countries mostly depends upon small scale power source unlike western world where organized farming is practiced. A large population of these countries still relies on agriculture as principal source of income. Therefore, the growth in rural employment in these countries primarily needs accelerated growth of agriculture and its allied sector. With increasing population pressure, most of the countries of the region can't afford to increase area under agriculture; therefore, increasing agricultural productivity is key alternative. Modern methods such as precision farming increase in area under irrigation, conservation tillage, stout management and divergence in agriculture is need of the time. These practices require increase in farm power availability. Several studies suggest a direct correlation among farm mechanization, crop productivity and rural employment. In last six decades, food grain productivity in India has increased from 0.710 t/ha in 1960-61 to 2.21 t/ha in 2013-14, while farm power availability has increased from 0.296 kW/ha to 2.02 kW/ha during the same period. Mechanization in association with improved crop inputs have shown improved yields by 15-20%. Though in 2017, manpower engaged in agriculture ranged between 31.8 to 54.6% for most of the countries. However, total number of agricultural workers engaged in Indian agriculture has been gradually increasing from 185.3 million in 1991 as

compared to 263 million in 2011. Tractors, power tillers and small engines have emerged as main mechanical farm power source in Indian Agriculture over last six decades while self-propelled equipment operated by engines of higher hp viz., combine harvester, dozers and power sprayers became popular in last two decades. There were only 8500 tractors in use in 1951, 20000 in 1955 and 37000 by 1960 with annual production was 880 units in 1961. Today the Indian tractor industry is largest in the world and accounts for one third of the global production. The sale of tractors has grown at a CAGR of 11% from 247531 in year 2004-05 to 711400 in year 2017-18. The tractor industry is exporting about 10% of its annual production to China, Australia, Latin America, the Middle East and South Asian countries. The domestic consumption of the tractor indicates that the highest share is of 31-40 hp (46.2%) followed by 27.6% of 41-50 hp, 13.8% of 21-30 hp and 11.6% of greater than 50 hp tractors and the rest are less than 20 hp tractors. However, the export consumption of tractor indicates that highest demand is of tractors above 51 hp (56.4%) followed by 41-50 hp (27.5%). The demand of agricultural machinery and mechanical power source has increased multi-fold. There are about 250 medium to large scale units, 2,500 small scale industries, 15,000 tiny industries and 1,00,000 village level artisans in India. The current annual market of farm power source and machinery in India for tractor is about 5,50,000-6,00,000, power tiller 50,000-60,000, combine harvester 3500-4000, rotavators, 1,00,000-1,50,000; threshers 70,000-75,000; power weeder 35,000-45,000; M. B. Plough 45,000-50,000; laser guided



land leveler 2500-3500; and planters 15000-25000 units. Above facts about the Indian manufacturing and supply potential of agricultural machinery indicate that India has the potential to play a lead role in these areas.

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### Drought Proofing in India

The frequency of droughts has increased in the recent past in India and about half of the Indian sub-continent is highly prone to droughts. Despite large scale investments in watershed programmes and irrigation projects, water resource management assumes significance in sustaining future agriculture and human development. Emerging situation in India is that traditionally semi-arid dry regions receive high rainfall, and the ecosystems with high rainfall experience mid-season droughts. Farmers invest on drilling new wells rather than conservation and management of existing water resources. Harvesting rain water and its efficient utilization is key for rainfed dry land regions while in irrigated areas emphasis should be on arresting depletion of ground water. A comprehensive inter-ministerial water resource planning and its implementation holds prime importance to fulfil the water needs of different sectors in the country. Water sharing mechanisms at village level or landscape level along with efficient crops and cropping systems, efficient water utilization systems, crop planning based on water resources, are priority in overall drought proofing in India. Severe droughts in 2009, 2012, 2014 and 2015 caution us towards an urgent need for action on water resource planning and management. Public policy formulation, implementation and monitoring the policy

functions are urgent needs for climatically vulnerable country like India where majority of the population either directly or indirectly rely on agriculture.

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### Women in Leadership Positions in Agriculture

Some time back a news item became a household story, especially after a popular movie was made on the subject. It was about Mission Chandrayaan-2, which all of us are proud of. It was even more special to the women of this country as the Project Director and Mission Director of Chandrayaan-2 were two women scientists - M Vanitha and Ritu Karidhal. Compare the mightiest and one of world's most advanced space programmes - NASA with our own ISRO. You will be surprised. Both have staff strengths of over 17,000, of which 20% and 30% are women scientists and their participation in the Planetary Missions are 15% and 20-30%, respectively!

What is the percentage of women scientists in strategic and leadership positions in the NARES? This is despite the fact that not only the percentage of girl students admitted to various SAUs are rising steadily over the last two decades, their academic performance is no less than the boys, if not better. Similar is the situation with the success rates of women scientists in ARS and their subsequent performance. Yet, they are surprisingly missing in leadership roles.

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## Obituaries



(1947 - 2020)

**Prof Santram Sambhaji Kadam** was born on June 02, 1947 in Wawarhire Tal-Man Satara, Maharashtra. He pursued his education initially at S.S. High School Aundh. Subsequently, he graduated from College of Agriculture, Pune to join Indian Agricultural Research Institute to obtain M.Sc. and Ph.D. in the year 1971 and 1975, respectively.

A distinguished Fellow of the Academy, Dr Kadam served as Professor, Food Science and Technology 1981-96, Head, Food Science, 1996-98, Associate Dean (PGI) 1998-2002, Director of Research 2002-2005, and Dean, Faculty of Agriculture and Director of Instructions, 2000-2005, MPKV, Rahuri and subsequently as Vice Chancellor, Marathwada Agricultural University, Parbhani, 2005-10.

He was honoured with several awards including Dr D.W. Rahudkar Prize, 1992 and Dr J.C. Anand Gold Medal, 1997 and Fellow of National Academy of Biological Sciences. His research areas included nutritional biochemistry, and food science & technology. Dr Kadam served NAAS as Member of Executive Council from January 1, 2004 to 31 December, 2006.

Prof Santram Sambhaji Kadam, a distinguished researcher, administrator, who made immense contribution to agricultural sciences for more than fifty years, breathed his last on March 08, 2020. On behalf of the Fellowship, to which Late Prof S.S. Kadam belonged, the Academy prays the Almighty to grant peace to the departed soul, and strength to the bereaved family to bear this great loss.



(1944 - 2020)

**Dr Darshan Singh Brar** was born on March 07, 1944 in Bishnandi, Punjab, India and had his early education at Govt. High School, Jaitu and Brijindra College, Faridkot. He joined Punjab Agricultural University (PAU), Ludhiana and obtained his B.Sc., M.Sc., and Ph.D. degrees in 1964, 1966 and 1973, respectively.

He served in various capacities at many national and international organizations that include Associate Plant Breeder/Plant Breeder, Senior Scientist & Head, Plant Breeding, Genetics and Biotechnology Division, International Rice Research Institute, Manila, Philippines, Adjunct Professor (Agronomy), University of Philippines at Los Baos (UPLB), Research Fellow, National Research Council, Saskatoon, Canada 1976-78; Fellow, University of Nottingham, U.K. 1979; Cytogeneticist, PAU 1979-82; Research Fellow, University of Tsukuba, Japan 1982-83; Senior Research Fellow, IRR1 1983-85; Professor Biotechnology, PAU 1986-87.

An internationally renowned plant breeder and geneticist and, Dr Brar was bestowed with many awards and honours including PAUTA Award, PAU, 1980; ICAR Team Award, 1980; Ministry of Agriculture & Rural Development, Vietnam Gold Medal award 2007; Koshihikari International Rice Prize, Japan, 2007; CGIAR Science Award-Outstanding Scientist, 2007; Friendship Award, Republic of China, 2009.

He was a distinguished fellow of our Academy as well as fellow of Indian Society of Genetics and Plant Breeding; Crop Improvement Society of India; Punjab Academy of Sciences, Crop Science Society of Philippines.

Dr Darshan Singh Brar passed away on March 11, 2020. On behalf of the Fellowship fraternity, to which late Dr D.S. Brar belonged to, the Academy prays the Almighty to grant peace to the departed soul, and strength to the bereaved family to bear this great loss.

## Announcement

### **XV Agricultural Science Congress of NAAS Banaras Hindu University, Varanasi February 20-23, 2021**

The XV-Agricultural Science Congress will be organised at BHU, Varanasi from February 20-23, 2021 on the theme "*Energy and Agriculture: Challenges in 21st Century*". The four days event will include technical sessions, plenary sessions/public lectures, poster presentations, inter-university student contest, panel discussions and number of satellite meetings. There will be ASC - AgriTech-2021. A large number of participants cutting across disciplines, consisting of researchers, faculty, policy makers, farmers, entrepreneurs, development departments, NGOs and students shall be attending this biennial congress of the Academy. The Organizing Committee through this announcement is requesting everybody to join this mega event. Your participation will be very important in discussing the challenges of 21<sup>st</sup> century including policy options in Indian Agriculture. Further details will be shortly available on congress website.

**XV AGRICULTURAL  
SCIENCE CONGRESS & ASC EXPO**  
**20-24 FEB 2021**

**ENERGY & AGRICULTURE:  
Challenges in 21<sup>st</sup> Century**



**Organiser**



NAAS

**Host**



BHU

## Important Notice

Due to the current scenario of nationwide lockdown due to COVID-19, the NAAS Annual General Body Meeting and Foundation Day Programme scheduled to be held on 4-5 June, 2020 has been postponed. The next date of AGB meeting/ Foundation Day Programme will be intimated as and when finalized

**Editors:** Dr Kusumakar Sharma and Dr P.S.Birthal

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