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From the President's Desk

Deficit to Surplus Management

When India attained independence, the population was one-fourth of the present number, but it was suffering continuously from chronic deficiency between the basic requirement of food and that produced in the country. It is important to note that during the mid-1960's, the country imported 6-8 million tonnes (Mt) of wheat and produced 10-11 Mt annually. At that time, India was said to have a "ship to mouth", existence so heavily dependent were we on the import of wheat through PL480. Many dire predictions were made about the country's survival through this persistent food shortage. However, the Green Revolution (GR) transformed the country to a state of self-sufficiency in early 1970s through adoption of modern methods and technologies, which included the use of seeds of high yielding varieties, chemical fertilizers, irrigation facilities, pesticides and farm machinery, backed by increased public investment and facilitating institutions. Thereafter, the country never looked back and continued not only to produce enough to feed its ever growing population but also became a net exporter of several agricultural commodities, valued at Rs 235,000 (two hundred and thirty five thousand) crores during 2017-18. This spectacular success was a consequence of the hard work of Indian farmers supported by favourable policies of the Government, Pro-active line departments and continuous R&D backing by scientists. It would be relevant to mention here that during the last 70 years starting from 1950, our food production has increased by more than 5.5 times (from 50.8 Mt in 1950-51 to 284.8 Mt during the year 2017-18) whereas the population grew only 3.5 times. This incredible achievement was made possible mainly by increasing the productivity of food crops (viz. wheat, rice, and pulses) and partly by expanding the area (under these crops). It is worthwhile to mention here that the food production records have been broken year after year with the net cultivated area remaining 140 ± 2 million hectare (Mha) since 1970. In short, India has witnessed a paradigm shift in food security, moving from a food deficit to a food surplus nation.

The situation of surplus of food grains and string of good harvests has left the procurement machinery creaking under the weight of procurement of wheat and rice beyond the stipulated stock required to ensure the food security. The 'green revolution' appears to have now turned out to be 'grain revolution'. On January 1, 2020 India will be holding in stock about 57 Mt of rice and wheat against a requirement of 21 Mt. The policy of procurement of food grains was intended to lower farmer's risk but farmers exploit this policy and continue growing paddy-wheat cycle and make little efforts to diversify into other crops such as oilseeds and pulses, which India still imports. The continuation of this policy of procurement meant to make India self-sufficient in food grains has caused a glut. It is high time for the Government to review this policy of procurement and let the open market decide the requirement, availability, distribution and price of food grains.

Another issue of procurement is fulfilling the objectives of the National Food Security Act. Government is left with huge stocks of food grains without adequate infrastructure facilities. Instances of rotting food grains in FCI warehouses have even prompted the Supreme Court to instruct the Government to distribute it free-of-cost if they cannot maintain its quality. It is estimated that about 190 million people go hungry every day in India, comprising about 23% of the world's undernourished population. According to World Bank data on least developed countries, India still trails more than a dozen countries on a number of key measures, while the Global Hunger Index ranks India behind several neighbouring countries. The contrasting scenarios of record agricultural production and grinding poverty illustrate what is described as the "paradox of plenty" in the

agriculture sector. India wastes around food worth approximately $14 billion each year, according to Government figures.

According to official data released by the Ministry of Consumer Affairs, almost 62,000 tonnes of food grain was damaged in FCI warehouses between 2011 and 2017. In 2016 - 2017 alone, more than 8,600 tonnes of food grain were lost. Damage by pests and rats is another consequence of poor quality storage facilities. This waste of grains, mainly rice and wheat, is cruel in a nation with millions of poor. FCI often procures in excess of its current storage capacity. It is estimated that around 30 million tonnes of food grains are stored across India using the cover and plinth (CAP) open method. Such open storage is vulnerable to fungus and moisture, which not only deteriorates the quality but also harbours deadly diseases, according to the World Health Organisation. About 1.8 million tonnes of grain is spoiled during open storage. Another reason of wastage is lack of timely transportation. Authorities reported that 1.5 million tonnes of spoiled grain had to be disposed of, because of transportation issues to the warehouse. But the rot is only part of the problem. Corruption via what is called “leakages” - where subsidised grain intended for the poor is actually diverted for sale on the open market - has in past years caused the loss of an estimated 25.9 Mt of rice and wheat alone, according to a study by the Indian Council for Research on International Economic Relations.

This Government supply chain that wastes significant portions of its stockpiles and allows unscrupulous dealers and ineligible beneficiaries to take undue advantage of its loopholes is desperately due for an overhaul. This is further aggravated by a weak Public Distribution System (PDS). These need to be revamped urgently for the betterment of the poor and downtrodden in India. While we have been focusing on strengthening the procurement side of the agri-food value chain, there is little progress towards efficient release of produce at affordable prices.

The larger focus would be to reduce the demand-supply gap through increased productivity and reduced post-harvest wastage. A well-developed pre-harvest and post-harvest infrastructure would be a key driver to plug this gap. The onus of providing food to the citizens is vested with the Government, which through its policies, influences, and controls the food supply scenario in the country. Given that agriculture is recognised as central to India's inclusive growth strategy, it is critical to review measures planned to boost agricultural development, and look for game changers that would allow us to set ourselves a target of 4-6 per cent agricultural growth in the future. Clearly, well co-coordinated action on multiple fronts by the Government as well as the private sector on development of the pre and post-harvest infrastructure is the key solution to increase production and reduce post-harvest wastage.

Further to maintain a balance of ecological and production characteristics, crop planning plays a very important role. It depends on many factors such as the type of land, water availability, productivity, weather conditions, availability of the agricultural inputs, food demand, capital availability, and cost of production. Some of these factors are measurable and can be quantified. On the other hand factors like rainfall, weather conditions, floods, cyclones, and other natural calamities are difficult to predict. However, if the available information is utilized properly, one can provide valuable suggestions about the cultivation of different crops in different ecological conditions. The productivity of different crops also depends on functions of soil characteristics (fertility, etc.), region, crop grown, cropping pattern, and agronomic practices. For single-cropped land there are a number of alternative crops from which the crop to be cultivated in a year may be chosen. Similarly there are many different combinations of crops for double- and triple-cropped lands. Different alternatives or combinations give different outputs. The utilization of land for necessary/appropriate crops is the key problem for crop planning. Therefore a suitable modelling approach may provide an annual crop production plan that determines the area to be used for different crops for the maximum possible contribution and self-sufficiency in food having satisfied the constraints arising out of food demand, capital, and land. Through the NARES system, there is enough scientific information available for the most optimum cropping/farming systems based on agro-ecological situation.

There are various challenges which India faces in attaining food security. Natural calamities like excessive rain fall, accessibility of water for irrigation, drought, soil erosion, undulating topography and various soil types such as degraded soil, infertile soil, acidic & alkaline soil, non-improvement in agriculture facilities, growth in population, lack of education and job opportunities have further added to the problems. Thus, the concept of the availability of food involves issues of production and distribution. The availability of food means that there is sufficient food- physical availability at the household, community, state and/or international levels to provide food for everyone. In short for achieving food security, the challenges of climate change, crop diversification, land fragmentation, quality seeds, agricultural marking, globalisation and land degradation issues are to be dealt very rigorously.

The Government of India has undertaken multiple initiatives to help improve access to food and nutrition for a massive target group. These initiatives include Public Distribution System (PDS) mentioned earlier, Mid-Day Meal (MDM) scheme, National Food for Work Program (NFWP), Antyodaya Anna Yojana (AAY), Integrated Child Development Scheme (ICDS), Essential Commodities Act (ECA), National Food Security Mission (NFSM), Targeted PDS and Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). A systematic plan to harmonize the production with the requirement of these schemes along with the PDS can reduce the wastage due to storage and also take care of malnutrition and wasted children.

The time has now come to have a relook at the whole agricultural production system as an integrated approach combing the suitability of a specific agro-ecosystem for a specific crop / commodity, limiting the national production to the domestic requirement and export commitment, be it rice, wheat and pulses and the announced MSP linked to that. Storage and processing facilities and networks should be created so that farmers do not have to go for distress sales and consumers get a fair price. The integrated plan should include distribution of inputs, seed banks, fodder banks and business models for crop residue management. For example, BPL family could be given double their monthly quota or more in one go at the prescribed rate under the National Food Security Act.

Agricultural surpluses impose an environmental burden from two aspects - there is a need for resources to produce them (land, water, fertilizers, labor, etc.) and to dispose of them. Food loss occurs at the post-harvest, processing and production stages in the food supply chain, and results in decrease in edible food that was meant for human consumption. There is a need to manage food surpluses. There should be public/ private organisations which should take care of this situation. The surplus removal plan which will allow them to achieve a balance in the local market for products that are supported by regulated prices. Such agencies must intervene to prevent situations, in which the surplus produced would not enter the market to disturb the minimum price and reduce profitability. To carry out this activity, the organisation may charge a percentage fee paid by the farmers, for taking proactive measures to clear surpluses-redirecting to exports, selling to industry at a concession, or value addition/processing/ storing them. The basic objective of surplus removal plan is to prevent prices from falling below certain levels.

Future agricultural production programmes have to be based on a strategy that defends the gains already made, extends the gains with the use of yield enhancement technologies in rain fed, semi-arid and hill areas, makes new gains through farming system intensification, diversification and value addition and institutional support by way of infrastructure and market linkages. Land and water care, water harvesting, restoration of degraded and wasted lands, all need focussed attention. Our agricultural extension services need to be reorganised to bring a viable mix of traditional and frontier technologies to the farmers and can be a source of employment generation and entrepreneurship development.

Punjab Singh
President

110th Executive Council Meeting

The 110th Meeting of the Executive Council was held on November 27, 2019 and was chaired by Prof Panjab Singh, President NAAS. After brief welcome by the President all the listed agenda were discussed in detail and approval accorded wherever necessary. Some of the important decisions were; approval of the recommendation of the Programme Committee; and suggestions given by Sectional Committees may be examined further by a large group before finalising the guidelines for selection of Fellows, till then the existing guidelines will be applicable. It was also decided that the recommendations of Journal Score Committee may be submitted to EC for approval. The EC had constituted a committee Chaired by Dr A.K. Srivastava, Vice-President, NAAS to suggest suitable activities to utilize the income accrued from the savings. The members were satisfied with the progress and gave many useful suggestions including approval of activities of the Academy for the year 2020. Some changes in the guidelines of Academy awards were also approved. It was decided that in the next, 111th EC meeting, the Organising Secretary of XV ASC be invited and requested to discuss the planning of the ASC.

Approval was accorded to Election of the following Office Bearers and members of Executive Council w.e.f 1.1.2020.

President: Dr Trilochan Mohapatra

Secretary: Dr Pramod Kumar Joshi

Editor: Dr Pratap Singh Birthal

Members: Dr J.S. Chauhan

Dr Wazir Singh Lakra

Dr Rajender Parsad

Dr Rangaraju Visvanathan

The EC also ratified the election of following scientists to the Academy Fellowship for 2020 under different sections:

Section I: Crop Sciences

Dr Pawan Kumar Agrawal

Dr Murugasamy Sivasamy

Dr Lakshmi Kant

Dr (Mrs) Gurinderjit Randhawa

Dr Govindakurup Hemaprabha

Dr Dharam Pal

Section II: Horticulture Sciences

Dr Dangar Ram Bhardwaj

Dr D. Prasath

Dr Anilabha Das Munshi

Section III: Animal Sciences

Dr Anil Kumar Puniya

Dr Raghavendra Bhatta

Dr Naresh Kumar

Dr Pinaki Prasad Sengupta

Section IV :Fisheries Sciences

Dr Bimal Prasanna Mohanty

Dr Kalkuli M. Shankar

Section V: Natural Resource Management

Dr Dinesh Mohan

Dr Saroj Kanta Barik

Dr Yash Pal Singh

Dr Rajeev Pratap Singh

Dr Desouza Blaise

Section IV: Plant Protection Sciences

Dr Mahendrakar Sreenivasa Rao

Dr Arunava Goswami

Dr Muthappa Senthil-Kumar

Dr Pratyoosh Shukla

Section VII: Agricultural Engineering & Technology

Dr Madan Kumar Jha

Section VIII: Social Sciences

Dr Anil Rai

Dr Ashok Kumar Singh

Dr Shalander Kumar

Foreign Fellow

Dr Henry T. Nguyen, Crop Sciences

Dr Peter Carberry, NRM

Pravasi Fellow

Prof Krishna V. Subbarao, Plant Protection

Dr Rakesh K. Singh, Agri. Engg. & Technology

Dr Prabhu Lakshminarayana Pingali, Social Sciences

NAAS Associates Selected for 2020 under different sections

1. Dr S.L. Krishnamurthy, Crop Sciences
2. Dr B. Kumar, Crop Sciences
3. Dr S.S. Dey, Horticultural Sciences
4. Dr N.L. Selokar, Animal Sciences
5. Dr S.P. Singh, Animal Sciences
6. Dr M. Shahid, NRM
7. Dr V.S. Meena, NRM
8. Dr J. Stanley, Plant Protection
9. Dr Bhanu Prakash, Plant Protection
10. Dr Ch. J. Dash, Agri. Engg. & Technology
11. Dr M.A. Iquebal, Social Sciences.

Programmes Held

Payment for Ecosystem Services in Agriculture (Convener: Dr P.S. Birthal)

A Brainstorming Session was organized on 'Payment for Ecosystem Services in Agriculture' on October 31, 2019 by NAAS to explore its potential to add to the existing system of incentives to agriculture. The session was convened by Dr P.S. Birthal, ICAR National Professor, National Institute of Agricultural Economics and Policy Research, New Delhi, jointly with Dr Saudamini Das, NABARD Chair Professor, Institute of Economic Growth, New Delhi. The session was chaired by Dr A.K. Srivastava, Vice President of the Academy and was attended by eminent agricultural economists and scientists. Dr Birthal highlighted the likely benefits from a change in existing system of Government incentives in agriculture to a regime of incentives based on the values of the ecosystem services provided by agriculture. Besides a presentation on the concept of payment for ecosystem services and a framework of their valuation by Dr Saudamini Das, and a few more papers on specific ecosystem services were presented by the experts. Agri-ecosystems offer valuable non-market services to the society, such as climate regulation, water purification, managing surface water flow, maintaining groundwater level, assimilation and breakdown of wastes, conservation of bio-diversity, nutrient recycling, etc. The expert discussion led to the following conclusions.

(i) The Government incentives (output support prices and input subsidies) that helped boost agricultural productivity and food supplies have led to damage to natural capitals, sustainability of production systems, and social equality, and need to be repackaged as 'payment to ecosystem services'.

(ii) Agricultural systems are undervalued because of a lack of reliable data on their invisible services, especially on scientific parameters against which ecosystem services are to be valued. It is suggested that a few inter-disciplinary research platforms including biological scientists and economists may be formed to identify key ecosystem services from agri-space and generate reliable scientific parameters for putting monetary values on the ecosystem services.

(iii) From policy perspective, valuation of ecosystem services will provide an empirical basis for devising regionally differentiated income support systems for farmers. The present income supports or incentives to farmers are arbitrarily decided for a political economy perspective, ignoring largely the ecological concerns.

(iv) The system of payment for ecosystem services is likely to create a competitive market. In the existing WTO regime there are frequent allegations and counter-allegations by member countries on market support provided to agriculture through output price support and input subsidies. The policy regime based on ecosystem services complies with 'green box' provision of WTO.

(v) Finally, the payment for ecosystem services will create incentives for the adoption of technologies and practices that contribute towards conservation of natural capital, i.e., land, water, forests, etc. And, it is likely that such compensation may cause reduction in cost of production, and improvements in farm profits. This will also lead towards improving quality of food and other agricultural commodities contributing to better human health, nutrition and labour productivity.

Food Borne Zoonotic Diseases (Convener: Dr A.K. Srivastava)

A Strategy Workshop on "Food Borne Zoonotic Diseases" was organized by NAAS on 21st November, 2019. The workshop was convened by Dr A.K. Srivastava, Vice President of Academy, chaired by Prof R.B. Singh, Past President, NAAS and attended by many eminent experts. The brief of the workshop is as under.

Infections that are naturally transmissible from vertebrate animals to human and vice versa are classified as zoonotic diseases. Presently 75% of emerging diseases, that affected human population over last two decades, are due to pathogens of animal origin and not of human origin. Out of 1407 human pathogens, 816 (58%) are capable of transmission between animals and human and these include bacteria, virus, prions, protozoa, fungi, helminth, rickettsia and microsporidia. Food borne zoonotic diseases (FBDs) pose a constant threat to public health, cause huge morbidity and mortality, pose obstacles to socio economic development and international trade worldwide. More than 200 known diseases are transmitted through food by pathogenic micro organisms such as bacteria and their toxins, viruses, and parasites. The World Health Organization took initiative and reported that the FBD burden was highest in African (43%), followed by South-East Asian (24%) and Eastern Mediterranean (16%) sub regions. The risk of food borne illness has been rising during the last two decades due to several factors. Besides changes in pathogen behavior, factors such as rapid growth of population with demographic shift towards an aged group of population and globalization of food supplies have contributed to rising incidences of FBDs. The improved transport logistics and conditions facilitate some microorganisms to survive in food products for longer periods and reach the consumer in a viable form. The change in eating habits of consumer, such as the consumption of lightly cooked food and a shift from low-to-high protein-based diets (e.g. meat and fish products) has also increased the probability of occurrence of FBDs. Increased international travel and movement of human population also facilitates emergence and re-emergence of pathogens worldwide. Hence preventing illness and death through FBDs remains a major public health challenge across the globe. Lack of accurate epidemiological data on incidence and cost of FBDs, particularly in the developing countries has delayed the setting up of suitable policies and allocation of resources to mitigate the illness of FBDs.

Way Forward and Strategic Interventions to Prevent FBDs

Implementation of an integrated approach to food safety throughout the food chain "Farm to fork" is required to prevent FBDs. Although implementation of "One health" concept and regulations under "Tripartite agreements" advocated by WHO, FAO and WAHO (OIE) is very critical for prevention of food borne zoonoses in developed countries, it is very nascent in our country. A close networking is needed which would involve a series of steps to be taken by multi-disciplinary team involving veterinarians, microbiologists, medicos, environmentalists, food industry and most importantly consumers under "One Health" approach. Since the food borne diseases and their causative agents differ between the regions, preventive approach should be tailor-made to each region at national or global levels. The existing difference in the burden of food borne disease between low and high income regions clearly suggests that a major fraction of the current burden is still avoidable through implementation of general principles of food safety system. Strategic key interventions such as Good Manufacturing Practices (GMP), Good Hygiene Practices (GHP), Good Agricultural Practices (GAP) and most importantly "HACCP" regulations need to be uniformly and strictly enforced in the food industry at all stages of food production (initial stages of production to the finished product). For control and prevention of food borne zoonotic diseases, it is essential to identify priority zoonoses for appraisal of their risk assessment as well as strengthening of effective disease surveillance systems. Strategies need to be developed for trans-boundary disease surveillance and participation in global disease intelligence systems such as, Global Outbreak Alert and Response Network (GORAN) of WHO, Emergency Preventive System for Trans-boundary Animal Diseases (EMPRES) of FAO and GLEW (Global Early Warning Systems) of OIE for effective containment of food borne zoonotic diseases. Further, emergence and spread of drug resistance among microorganisms and parasites of medical and veterinary importance, is a cause of greatest concern worldwide and the problem is being hailed as a threat of dimensions equal to those of the atomic weapons. It is time that a national plan is made and law-enforcement done more effectively to address the issue of Food Borne Zoonotic Diseases. An enforcement of food safety standards based on risk assessment in particular region along with effective surveillance networks will aid in prevention of food borne diseases to a greater extent.

Livestock Improvement through Artificial Insemination (Convener: Dr A.K. Srivastava)

A Brainstorming Session (BSS) on "Livestock Improvement through Artificial Insemination" was organized by the NAAS on 6th December, 2019. The workshop was convened by Dr A.K. Srivastava, Vice President of Academy, chaired by Prof R.B. Singh, Past President, NAAS. Almost all internationally and nationally known scientists participated. A concise report of the BSS is given below.

Indian livestock industry has made several strides in the recent past; the visibility of which is very much evident from dairy production. During the last few years, the milk production

in the country has been growing at the rate of more than 6% AGR against 1% AGR during 1950-70 and at around 4% AGR during 1970-90. Analysis of milk production based on "animal population-based increase" and "animal productivity-based increase" indicated that a significant portion of enhancement in milk production was contributed by the productivity-based increase. The individual cow milk productivity was 423.53 kg/year in 1961, which increased continuously to reach 1191.54 kg/year in 2011. Similarly, the average milk productivity of individual buffaloes also showed a significant increase during the period (from 889.59 kg/year in 1961 to 1700.78 kg/year in 2011). The scientific advancements in breeding, feeding and management favored technology mediated increase in milk production in the country. Livestock breeding techniques coupled with artificial insemination (AI) technology has been largely responsible for the increases in yield of livestock products.

Animal Husbandry Network in India and AI Coverage

India has one of the largest networks for livestock breeding with 12099 Veterinary Hospitals/Poly clinics, 25263 Veterinary Dispensaries, 27628 Veterinary Aid Centres, 346 Intensive Cattle Development Projects, 185 Cattle Breeding Farms, 35 Buffalo Breeding Farms, 161 Goat Breeding Farms, 88 Sheep Breeding Farms, 69 Intensive Sheep Development Projects, 366 Pig Breeding Farms, 56 Semen Production Centres, 226 Frozen Semen Banks, 92 Liquid Nitrogen Plants and 99239 AI Centres (Basic Animal Husbandry & Fisheries Statistics, 2018). There were 130.5 million breedable cattle and buffaloes in the country during 2017-18 and the total AI done was 75.6 million with an overall AI coverage of 29.7 %. The overall conception rate was 35%. All these data indicate that, in spite of possessing huge AI network, the coverage of AI is still far less than the desired. While the national average of AI coverage of breedable bovine population is around 30%, there are several states with less than 20% AI coverage.

Major factors limiting AI coverage are proximity of AI service to farmers; distance to veterinary institution significantly influences the probability of adoption of AI by farmers; farmers look for timely and quality AI service at their doorstep. The fertility rates using AI in developed dairying countries are in the range of 60-72% with an average non-return rate of 60 days, the average conception rate in India still hovers around 35%. Poor conception rate is one of the major reasons for poor adoption of AI by farmers. Technological backstopping and AI policy is not available for use of AI in other species including small ruminants and pigs. In the given situation, genetic improvement of Indian livestock through AI could be achieved by (i) use of semen from high genetic merit and high fertile bulls (ii) expanding the AI to entire breedable bovine population and to non-bovine species and (iii) improving the conception rates with AI.

Regarding increasing the coverage of AI in other food producing animals, priorities should be given to expand the AI coverage to small ruminants and pigs. With the developments in technologies and establishment of several commercial units, now it is high time for concerted efforts to expand the realized benefits of AI in bovines to these species. However, it would require technological backstopping and establishment of an effective AI delivery mechanism. With the developments in science, now it is possible to assess every fine characteristic of spermatozoa and it is high time to shift to "Technology based semen quality control tests" from "Traditional semen analysis".

A major shift is required in the AI delivery system. In our country, a major proportion of AI is being carried out by AI technicians. Inseminator skill is very important to achieve high conception rates. Increasing the number of skilled AI technicians is the need of the hour. A mechanism should be in place for rigorous training of AI technicians. Next generation AI delivery systems should ensure timely services at farmers' doorsteps, maximize efficiency (penetration rates, conception rate, data retrieval, etc.), abide to breeding policies and goals of respective state, and be cost effective. Moreover, in line with Government policies, it should also have online or e-payment options to ensure transparency in charging. Imparting a thorough knowledge about estrus detection and insemination at proper time could improve the conception rates. In the recent past, several protocols have been developed and/or modified to allow timed inseminations so as to circumvent the practical difficulties associated with estrus detection. Some of the protocols have advantage of synchronizing ovulation as well and they can be applied on large scale to improve the fertility in dairy animals.

Big Data Analytics in Agriculture (Convener: Dr Rajender Parsad)

A brainstorming session on **Big data Analytics in Agriculture** was organized by National Academy of Agricultural Sciences on December 18, 2019 under the chairmanship of Prof Panjab Singh, President, NAAS. Dr R.B. Singh, Past President,

NAAS also provided his valuable inputs and insights in the brainstorming session. Initially Dr Anil K. Singh, Secretary, NAAS, gave a brief introduction of the topic and introduced the participants. He also elaborated on the expectations from the session. The session was convened by Dr Rajender Parsad and was well attended by the researchers from several Institutes of ICAR, CSIR, NIC, DST, CGIAR and representative from industry.

Dr Rajender Parsad presented the historical perspective of the term big data, definition of big data in current context, sources of data in agriculture, policy frameworks of data management, ICAR Research Data Repository for Knowledge Management, data availability in KRISHI portal, AICRP information systems, potential applications of big data analytics in agriculture such as in phenomics, bioinformatics, high throughput field phenotyping, faster technology development and adoption, precision agriculture, mega environment mapping of crops, crop planning, location specific advisories, personalized advisories to the farmers, quality assessment of produce, block chain for traceability, certification, international trade for food products, expected growth in data size, advances in data analytics and statistical issues. Subsequently eight other presentations were also made on Big data in Government; Integrated hybrid analytic platform for sustainable farm management; Big data analytics in agriculture: Industry perspective; Big data analysis in bioinformatics; Big data analytics: CGIAR perspective; Big data: value chain analytics towards doubling farmer income; Smart data powered farming, etc. The brainstorming session also had a panel discussion and open house discussion. The following key points emerged from the discussions during the session:

1. Establish an Innovation Centre or Center of Excellence for Big Data Analytics in Agriculture with adequate funding and trained manpower for facilitating the collaborations and working of multidisciplinary teams.
2. A National Level Seminar should be organized to brainstorm and identify use cases, prioritize potential areas to work upon and draw future roadmap. Everyone from private, public, Government, international organizations should be brought on board. Some applications such as providing location specific on-time and data driven information/advisories, crop mega environment mapping, crop planning, predicting phenology, generation of sowing schedules and contingency plans, etc. using AI /ML may be developed.
3. ICAR Research Data Management initiative should be strengthened on a continuum basis incorporating ontologies wherever feasible. Standard Operating Procedures/Community of Practices (SOPs/COPs) should be developed on defining data standards, interoperability protocols, security and privacy concerns; data capture, data storage, data transformation and data analytics along with suitable data governance mechanism and technical and business metadata management framework. There is also a need to develop standards and frameworks to harvest data from various data assets and identified sources within country.
4. National Open Data Framework should be established with metadata catalogue of all the major potential shared entities along with matrix for cross linking metadata that is available across the NARES community. The framework for “Labeling” for any image or video streaming data collection should also be initiated with a central server that can serve as a repository.
5. Efforts should be made to establish AgTech innovation center in Public-Private-Partnership mode on the lines of AgTech Unit being established by North Carolina State University in collaboration with SAS Institute Inc along with other stakeholders. Ready use cases such as devices for monitoring the tail movement of cows for timing the artificial insemination for female calf birth as in Netherlands to be explored and rolled out for pilot in India under the AgTech Innovation Center.
6. Big data analytics, Artificial intelligence, etc. would require prescriptions from experimental data and, therefore, experimental data would always remain an integral component of agricultural research and to understand biological system. Therefore, judicious blend/ amalgamation of experimental data, traditional survey data, historical data along with data from IoTs, drones, remote sensing, smart phones, crowd sourcing, administrative data, Government data, etc. needs to be thought of.
7. Identification of relevant sources and quality data from historical data sets from research, socio-economic, markets, live streaming data sets from sensors, robotics, satellite imageries, etc. needs attention. Bringing data from silos to useable and shareable, machine readable formats is the key concern. Understanding the problem under context and selection of appropriate analytical techniques are going to be key factors for successful applications in agriculture
8. Establish/strengthen Big Data Analytics platform for data management including data fabric, persistent memory

servers, forgetting insights, etc. Cloud based computing wherein services can be used based on requirement should be the way forward. Available infrastructure and resources in Government such as Meghraj, ICAR Data Centre, ASHOKA, Open Government Data Platform should be exploited, used and strengthened for the purpose.

9. System dynamic approach to be used to understand the system as a whole (soil, water, crop, weather, socio-economic, associated environment etc.) and derive useful information for crop management. Integrated hybrid analytic platform should be established to understand the dynamics of ecosystems in agriculture.

10. Capacity building of the human resources on big data analytics is essential and needs to be further strengthened.

Finally it was concluded that rigorous efforts should be made for data smart agriculture.

Eighth International Conference on Agricultural Statistics (ICAS-VIII)

The Eighth International Conference on Agricultural Statistics 2019 (ICAS-VIII) was jointly organized by National Academy of Agricultural Sciences during 18-21 November 2019 at New Delhi.

The theme of ICAS-VIII was **Statistics for Transformation of Agriculture to Achieve the Sustainable Development Goals (SDGs).** This Conference was a platform to share the rich scientific traditions of India in the field of statistics and agriculture by sharing Indian expertise with other countries. Other thematic sets for concurrent sessions were Data Analysis / Data Integration; Data Sources / Data Collection/ Data Quality; Data Dissemination & Communication; Use of Statistics for Policy Making and Research; Food Security, Poverty, Rural Development and Social Dimensions of Agriculture; Sustainable Agricultural Production and Consumption; Natural Resource Use in Agriculture; Climate Change and Environmental Issues; Capacity building in Agricultural Statistics and Monitoring the SDGs.

ICAS-VIII was organized by the Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers' Welfare (MoA & FW), Government of India with active participation from Department of Agriculture Cooperation & Farmers Welfare (DAC & FW) under MoA & FW and in close collaboration with the Food and Agriculture Organization (FAO) of the United Nations, the US Department of Agriculture (USDA), ISI-CAS, EUROSTAT, Ministry of Statistics and Programme Implementation (MoSPI) and many other international and national organizations. It is emphasized here that, the DARE, under its valuable guidance, entrusted the task of organizing this mammoth event to ICAR-Indian Agricultural Statistics Research Institute (IASRI), New Delhi which is a constituent institute of ICAR that jointly worked with Indian Society of Agricultural Statistics (ISAS), New Delhi and National Academy of Agricultural Sciences (NAAS), New Delhi for smooth conduct of the event.

The Conference was inaugurated by Shri Bill Gates, Co-Chair, Bill & Melinda Gates Foundation in the presence of Shri Narendra Singh Tomar, Union Minister of Agriculture & Farmers' Welfare, Rural Development and Panchayati Raj who presided over the inaugural function of the conference and Guest of Honour Shri Kailash Choudhary, Union Minister of State for Agriculture & Farmers' Welfare. Shri Tomar stated that it was a proud moment for India to host the ICAS event. He stressed on the importance of agricultural statistics in realizing the Government of India's various agricultural-centric schemes. While applauding the various statisticians and scientists working in the field of the Agricultural Statistics, Shri Kailash Choudhary, Union Minister of State for Agriculture & Farmers' Welfare highlighted about the Government's various schemes that are aimed at doubling the farmers' income. He emphasized that the four-day conference will be a fruitful opportunity in realizing the desired goals.

Shri Bill Gates, Co-Chair, Bill & Melinda Gates Foundation, addressed the audience on the theme of improving agricultural productivity using data and innovative technologies. In his speech on the occasion, he said, "In the hands of a single smallholder, the right information can lead to a 20% revenue increase for one farm." He further added, "We can help the world's two billion smallholders to adapt to climate change much quicker if everybody in the agriculture sector has access to quality information."

While delivering welcome address during the inauguration of the ICAS event, Dr Trilochan Mohapatra, Secretary, DARE and Director General, ICAR accentuated that prompt management of agricultural statistics is vital for agriculture-centric country like India. Dr Mohapatra stressed that in order to deal with the challenges posed due to climate change, enhancing the farmers' income, eradicating poverty and malnutrition and meeting the vision of sustainable development goals, joint efforts are required for strengthening the statistical system which in turn will pave way for achieving these targets. He opined that integration and triangulation of data coupled with modern techniques of remote sensing and GIS has become the order of the day. He quoted the words of the legendary and

world renowned agriculturist Prof M.S. Swaminathan that "It is the effective use of tools of statistical design of experiments that paved the way for green revolution". He suggested that we need to rededicate towards strengthening the statistical system so that the statistical quality of data in real time is ensured and work towards designing cloud computing, use of Artificial Intelligence and Big Data analytics which has become highly necessary in this digital era. Highlighting the importance of Sustainable Development Goals, he mentioned that it will help in eradicating the problems and challenges of malnutrition in an effective manner and that we are committed towards achieving these goals.

Shri Pietro Gennari, Chief Statistician, FAO, Rome, Italy; Ms Mariana Kotzeva, Director General, EUROSTAT and Prof Ramesh Chand, Member, NITI Aayog, India were some of the Keynote Speakers during the Conference. Dr Michael Steiner, ISI CAS and World Bank, who was also the Chair for the Scientific Programme Committee of ICAS, stated that it is pertinent to organize such types of conferences in the agriculture-centric countries like India. He emphasized on the importance of managing the agricultural statistics for the overall development of the country. Shri Ugo Astuto, Ambassador-Designate, European Union to India stated that the statistical data helps to realize the sustainable development goals. It plays a crucial role to monitor the progress of the country. The presentations in the plenary sessions along with the thematic sessions have laid the foundation stone for building the beautiful monument of achieving SDGs with mutual partnerships, collaboration and understanding.

In his Valedictory address, Dr Trilochan Mohapatra accentuated on the enhancing the capacity building through the global partnership. He stressed on the need to have more capacity building in data interpretation and data analysis than in data collection. The Director General urged the countries for identifying their special strengths and sharing them with others where ever the deficiencies are present. He opined to create a Global Knowledge Hub for Agricultural Statistics (GKHAS).

Shri Jose Rosero Moncayo, Director, Statistics Division, FAO, Rome urged the agricultural statisticians to come together and identify the gaps between the data collection and maintenance.

The 2030 Agenda encompasses a far broader ambition requiring better, more timely and reliable data on a wider variety of indicators for evaluating and monitoring of SDGs. Thus its adoption by countries around the world necessitates an even more significant increase in the data that is available to, and used by, governments, civil society, the private sector, academia and international organizations to begin tracking progress towards the achievement of the SDGs.

Activities of Regional Chapters

Bhopal Chapter

Workshop on Improving Soybean Yield in Central India

On the occasion of the launching of the NAAS Bhopal Chapter and keeping in view the concerns of climate change and risks associated with soybean production in central India, a one-day workshop on "Improving Soybean Yield in Central India" was organized under the aegis of the National Academy of Agricultural Sciences (NAAS) - Bhopal chapter on 1st October, 2019 at the Indian Institute of Soil Science. Dr Anil K. Singh, Secretary, NAAS and former Vice Chancellor, Rajmata Vijayaraje Scindia Krishi Viswa Vidyalaya, Gwalior graced the occasion as Chief Guest. In his address, he highlighted the policy implications of stagnation in soybean yield on the farm economy, soil health and overall economy of the country. In presence of progressive farmers of the region, officials from Government of Madhya Pradesh, researchers and policy makers from ICAR Institutes and SAUs, have called for adopting a holistic strategy involving crop improvement, soil nutrient management and pest control methods to improve soybean production in central India. On this occasion, the NAAS-Bhopal Chapter was formally launched.

Dr S. K. Rao, Vice Chancellor, Rajmata Vijayaraje Scindia Krishi Viswa Vidyalaya, Gwalior and an acclaimed plant breeder, stressed on the fact that soybean in India has a narrow genetic base. For improving yield under climate change conditions, one of the major options would be to enhance genetic pool of the crop. India has about 110 varieties of soybean having only 8-10 parents. In an elaborate technical presentation, he said new varieties resistant to erratic climate should be developed.

The workshop also witnessed technical presentations by Dr Sanjay Gupta and Dr A.N. Sharma from Indian Institute of Soybean Research, Indore; Dr A.K. Tiwari from Directorate of Pulse Mission, Govt. of India and Dr Pradip Dey from Indian Institute of Soil Science, Bhopal. A brainstorming session was also held where the progressive farmers and

the State Government officials put forth their views on current constraints and strategies for improved soybean production.

At the outset, Dr Ashok K. Patra, Director, ICAR-IISS and Convener of the NAAS-Bhopal Chapter welcomed the guests and dignitaries and briefed about the objectives of the technical workshop. The meeting was also attended by the Fellows and Associates of the NAAS of Bhopal Chapter. The program was coordinated by Dr Narendra K. Lenka, Principal Scientist, IISS, Bhopal.

Hyderabad Chapter

Krishi Kala Utsav

A five-day "Krishi Kala Utsav (KKU)" was conducted jointly by Hyderabad Chapter of NAAS and ICAR-NAARM, Hyderabad during 4-8 November 2019. Twenty-four students of the famous Sir J.J. School of Arts, Mumbai were invited to create paintings and works of art on agriculture and allied sector. Forty-eight paintings including a stone craft mural work were completed during the said days. Dr T. Mohapatra, Secretary DARE and Director General, ICAR and Vice-President of NAAS visited the KKU workshop hall when the artists were at work on 8th November, 2019 and appreciated the initiative taken by NAAS Chapter along with NAARM and the talent of the artistes. He interacted with artists on their innovative presentation on various important aspects of agriculture and farmer's welfare.

Artists displayed their work highlighting the different components of agriculture viz. modern technologies, virtues of traditional agriculture practices, environmental aspects, youth in agriculture, rural markets, critical role of women in agriculture, soil and water conservation, importance of trees, integrated farming systems, human health from healthy foods, mechanized agriculture systems etc. They also depicted critical role of Agri-education in sustainable development in India. Dr Ch. Srinivasa Rao, Director, ICAR-NAARM and Convener of Hyderabad Chapter of NAAS underlined the potential of this form of communicating agricultural science and technology to the students, youth and seniors who regularly visit the academy and become a part of science communication strategy through paintings. The programme was inaugurated by Dr Ch. Srinivasa Rao, Director, NAARM and the valedictory function was graced by Dr A.K. Pal, Joint Director (Retired), ICAR-CIFE, Mumbai and Fellows of NAAS.

Coimbatore Chapter

NAAS Coimbatore Chapter organized one day meeting on "Post-Harvest Technology and Value Addition" on 04.12.2019 in association with Society for Sugarcane Research and Development (SSRD) at ICAR-SBI, Coimbatore.

Apart from NAAS Fellows, about 80 delegates from various institutions viz. ICAR-SBI, Coimbatore, ICAR-CIAE RS, Coimbatore, TNAU, Coimbatore, Veterinary College, TANUVAS, Namakkal, KVK, Erode, Suguna Institute of Poultry Management, Farmers organizations, NGOs and entrepreneurs participated in the meeting.

Prof S. R. SreeRangasamy FNAAS chaired the Inaugural session and welcomed the delegates. After the ICAR song a video message from Prof M.S. Swaminathan founder of NAAS was played, in which he congratulated the NAAS for instituting Coimbatore Chapter and wished good future for the regional chapter. Dr C. Anandharamakrishnan FNAAS, Director, IIFPT, Thanjavur delivered the inaugural lecture on "Future Foods". Before the scientific sessions Dr Bakshi Ram FNAAS, Director, ICAR-SBI, Coimbatore welcomed all the delegates. After this session, two more sessions on Focussed Group Discussion on Sugarcane Products, and Brainstorming session on Post-Harvest Technology and Value Addition were also organised.

The following points emerged after brainstorming session and discussion

- To create awareness about the farmers and conduct training programme on value addition technologies to farmers and entrepreneurs.
- To create awareness about start-ups/ first generation entrepreneurs to avail incubation facilities created in the Institutions.
- Standards to be fixed for the traditional foods for commercialization.
- To develop technologies for utilization of non-utilization of non-edible portions and by-products towards commercial venture, eg bagasse from sugar industry for disposal plate/ jack fruit waste to edible plates, etc.
- To create awareness among the farmers and entrepreneurs on traceability in farm level value addition process.
- Need to establish specifications for multiple grades for various agricultural produces to meet edible and other requirements.

- Importance of trust in the value added products, non-tangible value addition and the future of block chain management

Dr R Viswanathan FNAAS, Head, Division of Crop Protection, ICAR-SBI, Coimbatore & Convener, NAAS Coimbatore Chapter and Convener of the Meeting presented the formal vote of thanks and with that the meeting came to an end.

II. Career Guidance Workshop for undergraduate students of Tamil Nadu Agricultural University, Coimbatore on 15.11.2019.

Centre for Students Welfare, TNAU, Coimbatore organized Career Guidance Workshop 2019 for undergraduate students on 15.11.2019. Dr. R. Viswanathan FNAAS, Convener of NAAS Chapter, Coimbatore delivered lecture on Career Opportunities in ICAR and preparation for ICAR JRF/SRF examinations during the meeting. In his talk he encouraged the students to avail opportunities in different CAUs, Deemed Universities of ICAR and SAUs through JRF/SRF exams and appraised about career benefits in ICAR. He also informed the role played by NAAS in spreading agricultural education, policy decisions and innovations in agriculture.

Mumbai Chapter

Under the auspicious of NAAS (Western Chapter), a lecture was delivered by Dr R. K. Singh, Director & Vice Chancellor, ICAR-Indian Veterinary Research Institute, Izatnagar, UP on Combating Zoonoses - "One Health" Approach at CIFE, Mumbai on 21 Dec., 2019. Dr Singh highlighted the zoonotic diseases and the interaction of humans, animals, fish and environment in the development of diseases especially due to bacteria. He also highlighted the different factors influencing the prevalence of zoonotic diseases viz ecological changes in man's environment, handling animal by-products & wastes (occupational hazards), increased movements of man, increased trade in animal products, increased density of animal population, transportation of virus infected mosquitoes and cultural anthropological activities.

Dr Singh also emphasised on commonly recognized food-borne infections and different ways and means of combating those diseases. The predisposing causes and their prevalence in different parts of India and the world were also presented along with case studies. The approaches in combating and reducing the diseases through "One Health" approach were emphasised. The talk triggered an active discussion with the participants about one health.

Dr S. D. Tripathi, Former Director, ICAR, CIFE, Mumbai and Convener, NAAS (Western Chapter) introduced the speaker to the audience which included participants from CIFE and Bombay Veterinary College. More than 80 scientists / students/ RA / SRF and researchers attended the programme.

Dr Gopal Krishna, Director and Vice Chancellor, CIFE, lauded the efforts of CIFE and other institutions in combating diseases through one health approach and thanked Dr R. K. Singh for creating awareness on one health.

The programme ended by vote of thanks to the Speaker and dignitaries by Dr K. Pani Prasad.

Improving Bioavailability of Food Bioactives and Nutrients through Novel Food Delivery Systems

Dr C. Anandharamakrishnan
Director, Indian Institute of Food Processing Technology (IIFPT),Pudukkottai Road, Thanjavur-613005

Food bioactives and nutrients are the compounds that provide potential health benefits beyond their nutritional values. The increase in global awareness of dietary habits and associated health benefits, has generated a demand for the development of functional foods and dietary supplements. Bioactive compounds, whether derived from various sources like plant and animal, must remain fully functional in order to exert any beneficial effects. But its hydrophobicity and sensitivity towards heat, light, oxygen and pH are the major challenges for incorporation and development of functional foods. Also its release from food matrices, low solubility in gastrointestinal fluids, poor interaction with gastrointestinal components, chemical degradation or fast metabolism, and low epithelium cell permeability limits its bioavailability. The challenges associated can be resolved through different strategies like increasing solubility, stability under gastrointestinal conditions, enhanced permeability through size reduction and targeted delivery. Considering the heterogeneous properties of food bioactives and nutrients, it is essential to design specific delivery systems for each bioactive compound to increase its bioavailability. Encapsulation is a technique employed to improve the bioavailability of bioactive compounds like polyphenols, micronutrients, enzymes, antioxidants, and to protect them from adverse environmental factors and also for controlled release at the targeted site.

Encapsulating material/excipient plays a major role in designing and fabrication of the bioactive molecule delivery system. The physiochemical properties, loading capacity, degradability, toxicity, compatibility, and cellular uptake of the wall material chosen for encapsulation are important parameters to be considered. Based on the solubility and permeability nature of the active molecule, it is broadly classified into 4 types viz, i) high soluble high permeable compounds, ii) low soluble high permeable compounds, iii) high soluble low permeable compounds, iv) low soluble and low permeable compounds. Thus bioavailability and bioaccessibility of the nutrients is highly dependent on solubility of the compound and its releases from the encapsulating material.

Designing an appropriate delivery system is crucial since the encapsulating matrix used to deliver the functional compounds influences the stability and bioavailability of the encapsulated compounds. Bio-based delivery systems enhance the functionality and stability of bioactive compounds within the food product. Different strategies used to enhance the bioavailability are micro/nano-delivery system, absorption enhancement technologies and excipient foods to improve biological activity. Different delivery systems like micro and nano emulsions, liposome, solid lipid nanoparticles, nanostructured lipid carriers, nanolaminated systems, nanogels and polymeric particles prepared through various techniques like coacervation, electro spraying/spinning, and nano-spray drying, have been widely employed to encapsulate nutraceutical compounds. Micro/nanoscale delivery system can be fabricated using different food components like polysaccharide, proteins, lipids, surfactants either used alone or in combination. These components play an important role in determining the functional properties like antioxidant capacity, digestibility, density, pH and salt stability, as well as thermal stability of the encapsulated bioactive components (Ezhilarasi *et. al*., 2013).

There are number of factors that have to be considered while selecting the delivery system include i) biocompatibility and safety (as consumed by all age groups), ii) commercial viability (capable of being fabricated with food-grade ingredients and processing methods, and be economically feasible and robust enough for practical applications), iii) food matrix compatibility (capable of being incorporated into the final food product without adversely affecting its quality attributes), robustness (must remain physically and chemically stable when exposed to the environmental stresses, as well as retaining its desirable functional attributes), performance and labelling requirements.

The bioavailability and efficacy of the bioactive molecule can be realized through the release of the molecule from the matrix at required time and at require rate which intends to increase the stability and effective protection against environmental conditions. Absorption of nutrients and its bioavailability from the food matrix during digestion process in human has to be validated with the *in vivo* studies. Before doing the elaborate *in vivo* studies various *in vitro* studies are available to investigate bioavailability improvement. Among them, “Engineered human stomach and small intestinal dynamic model system” (Fig.1) developed by IIFPT, MoFPI, for *in vitro* digestion studies, simulates the exact physiological conditions and predict food matrix disintegration, digestion, and absorption and permeability of both fat soluble and water soluble compounds. This system helps to evaluate both bioaccessibility and bioavailability of nano formulated bioactive compounds in shorter duration, without much ethical complications. Intestinal permeability of nano formulated food bioactives in the small intestine was also studied using the engineered *in vitro* digestive system. For example, resveratrol (known for nutraceutical benefits like antioxidant, anticancer, anti-inflammatory and cardio protective effects) has been encapsulated in zein nanoparticle through electro spraying technique. When tested for bioavailability improvement, intestinal permeability of nano encapsulated resveratrol increased by 1.15 fold than native resveratrol (Jayan *et. al*., 2019).

Fig. 1: Engineered human gastrointestinal dynamic system

Encapsulation of the food bioactives and nutrients in a suitable matrix at desired size is the evolving solution to increase its bioavailability and stability of the active molecules. Though there are many claims in effective protection of bioactive molecules by encapsulation, accessing the behavior of encapsulated molecules in real food processing condition need to be emphasized for functional food development. Evolving technological developments helps in realizing the potential of encapsulated nutraceutical compounds as an alternative to drugs/traditional medicine and in preventive care at commercial scale.

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Ezhilarasi, P. N., P. Karthik, N. Chhanwal, and C. Anandharamakrishnan. 2013. "Nanoencapsulation Techniques for Food Bioactive Components: A Review." *Food and Bioprocess Technology* 6 (3): 628–47. https://doi.org/10.1007/s11947-012-0944-0.

Jayan, Heera, M. Maria Leena, S. K. Sivakama Sundari, J. A. Moses, and C. Anandharamakrishnan. 2019. "Improvement of Bioavailability for Resveratrol through Encapsulation in Zein Using Electrospraying Technique." *Journal of Functional Foods* 57 (January): 417–24. https://doi.org/10.1016/j.jff.2019.04.007.

Awards and Honours

Dr Ch. Srinivasa Rao, Director, ICAR-NAARM has been elected as NASI Fellow in 2019 and awarded Honorary Fellowship of Andhra Pradesh Academy of Sciences, Guntur, Andhra Pradesh

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 Transboundary 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 Policy of Gene Edited Agricultural Products (Dr N.K. Singh)
- Brain Storming Session on Sugarcane based Ethanol Production for Sustainable Fuel Ethanol Blending Programme (Dr Bakshi Ram)
- Brain Storming Session on Ethano Medicine
- Strategy Workshop on Anti Microbial Resistance (AMR)

Fellows Views

The concept of agricultural innovation system is gaining currency, which recognizes the role of various sources of knowledge creators, including traditional knowledge, intellectual property rights, and interactions among the actors for sharing of knowledge and promoting innovations in use of this knowledge to address production constraints and harness growth opportunities in agriculture. In this context, the extension system should play a larger role in developing linkages with various stakeholders and help farmers gain access to markets and farm services and acquire necessary technical and organizational skills. The necessary condition for this is to create an enabling environment for interactions and knowledge sharing among multiple-stakeholders and to create capacity to innovate products, processes and institutions to respond to market opportunities and enhance economic efficiency.

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Importance of Indian ethnic fermented foods and beverages from Ethno-microbiology to Metataxonomics and Metagenomics

Ethnic food has a cultural connotation in India which is linked to diverse ethnicity that represents the traits of wisdom and knowledge of ancient Indian people on culinary and also on the right choice of 'bio-actively enriched balance diets' since Rig Vedic period. Ethnic fermented foods and alcoholic beverages are produced either naturally or back-slopping/by adding mixed starter cultures using indigenous knowledge of food fermentation in India. Diversity of microorganisms ranges from mycelial fungi to enzyme-producing to alcohol-producing yeasts, and Gram-positive and few Gram-negative bacteria with several functional properties enhancing several health-promoting benefits to the consumers. It has been noticed that consumption of few uncommon ethnic foods is declining in many states of India due to change in life style, shifting from cultural food habit to commercial foods and fast foods effecting drastically on traditional culinary practices, and also due to climate change in some places. More than 350 diverse types of common and region-specific ethnic fermented foods and beverages (234 fermented foods, 84 alcoholic beverages and 32 traditionally prepared amylolytic starters) which are traditionally prepared and consumed by ethnic people of India for 5000 years. However, only 17% of ethnic fermented foods and beverages have been studied scientifically and reported till date, and rest 83% of ethnic fermented foods and beverages are yet to be documented or studied in details. We have been working on interpretation of "ethno-microbiology" of ancient and cultural Indian fermented foods and alcoholic beverages focusing on metataxonomics, metagenomics, metaboliomics, proteomics, and predictive functionality using shotgun sequencing tool and omics, biochemistry, health benefits, etc.

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Need for breeding tomatoes suitable for processing in India

India is the second largest producer of tomato with 11 per cent global share and cultivated on an estimated area of 0.76 million hectares with productivity of 24 tonnes per hectare. Less than 1% of the produce is processed when compared to 26% in other major producing countries. Of the estimated more than 41 million tonnes of tomato processed globally, only 130,000 tonnes were processed in India and domestic demand for processed tomato products is expanding at an estimated 30% annually. At present traditional fresh market tomato cultivars are being processed though such cultivars are unsuitable for processing. Processors in India are looking for high yielding tomato cultivars with high total soluble solids (5-6 0 Brix), acidity not less than 0.4%, pH less than 4.5 and uniform red colour with a/b colour value of at least 2. In addition, firm fruited tomato cultivars with joint less pedicel (j2) which facilitate mechanical harvesting or rapid hand picking. Hence, there is a strong need for the development of high yielding processing varieties / F_1 hybrids in tomato to meet the country's requirements, to address market glut and to cut down import of processed items from abroad.

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Announcements

National Academy of Agricultural Sciences – Invites Nominations for Different Awards for the Biennium 2019-2020

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

4. Young Scientist Awards (6 nos)

Scientists below the age of 35 years are eligible for this award. Each award comprises of a citation and gold plated silver medal.

For details, please visit Academy Website at www.naasindia.org 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

Last date for receipt of nominations in the Academy is. **March 31, 2020**

Note : Self Nominations are not acceptable.

XV Agricultural Science Congress of NAAS at 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, penal discussions and number of satellite meetings. There will be ASC- AgriTech-2021. A large number of participants cutting across the disciplines 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 21st century including policy options in Indian Agriculture. Further, details will be shortly available on congress website.

Academy Fellowships

Nominations are invited for Election of Fellows and selection of Associates of the Academy for 2021. The last date of receipt of Nominations is **March 31, 2020**. Nomination forms and relevant details are available at website : http://www.naasindia.org.

Obituaries

Dr Coluthur Gopalan

(29th November, 1918- 3rd October, 2019)

Dr Coluthur Gopalan was born in Tamil Nadu, India on 29 November, 1918. Dr. Gopalan got his education at Chennai Medical College; M.R.C. Human Nutrition Unit, UK; M.B.B.S., and M.D., Chennai; Ph.D., D.Sc. and F.R.C.P., London.

Dr Gopalan started his professional career in nutrition research at the Nutrition Research Laboratory (NRL) during the British period, he continued his journey over the next six decades. In the late 1950s, when NRL moved to Hyderabad and turned to NIN, Dr Gopalan took over as Director and expanded research to several key areas. He created Divisions for clinical research, biochemistry, bio-physics, endocrinology, analytical chemistry, food toxicology and the field units. The National Nutrition Monitoring Bureau (NNMB) was also a result of his labour. Dr Gopalan continued as Director, NIN from 1960-74 and subsequently he moved to ICMR and served as Director General from 1974-1979. He later founded the National Nutrition Foundation and served as its Chairman until the end.

Dr Gopalan was decorated with top civilian honours of the Padma Shri and the Padma Bhushan and several professional awards, like D.Sc. (h.c.), Banaras Hindu University; Basanti Devi Amir Chand Prize, 1954; Basanti Devi Amir Chand Prize (Snr.), 1960; Amrut Mody Research Award, 1972; Ambhuj Nath Bose Prize, 1975; Ademola Prize, 1976; Dhanvanthri Award, 1978; FICCI Award, 1978; Sir C.V. Raman Gold Medal, 1988; WHO Health For All Medal, 1988; R.D. Birla Award, 1990; International Union of Nutritional Society (IUNS) Award, 1990; London School of Tropical Medicine and Hygiene Centenary Fellowship, 1999; Honorary President, International Union of Nutritional Sciences. Dr Gopalan was Fellow of Royal Society, London; Indian National Science Academy; Indian Academy of Medical Sciences; National Academy of Agricultural Sciences, New Delhi and Third World Academy of Sciences.

Dr Coluthur Gopalan passed away on 3rd October, 2019 and in his sad demise the Academy has lost en esteemed Fellow and an eminent nutritionist. The entire Fellowship mourns his demise and pays homage to the departed soul.

Dr Dev Raj Bhumbla

(6th December, 1921- 20th October, 2019)

Dr Dev Raj Bhumbla was born in Hoshiarpur, Punjab, India on 6 December 1921. Dr Bhumbla got his education at Punjab University for B.Sc. and M.Sc. Later he got Ph.D.in 1962 from Ohio State University, USA.

Dr Bhumbla served as Head, Department of Soils, Punjab Agricultural University, 1963; Dean, College of Agriculture, PAU, Hisar, 1966; First Director, Central Soil Salinity Research Institute, Karnal, 1969; Deputy Director General (Soils, Agronomy & Engineering), Indian Council of Agricultural Research, 1974; Agriculture Commissioner, Government of India, 1978-80; Vice-Chancellor, Haryana Agricultural University, Hisar, 1981-82.

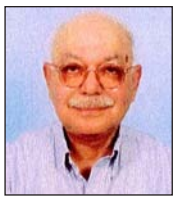
Dr Bhumbla got several Awards and Honours namely Rafi Ahmed Kidwai Award, 1972-73; IAUA Plaque for outstanding

work in Agricultural Education and Research, 1979; President, Indian Society of Soil Science, 1972 & 1973; Vice-President, International Society of Soil Science. Elected Fellow of National Academy of Agricultural Sciences in 1992; Dr. N.S. Randhawa Memorial Award, 1995-1996.

In the demise of Dr Dev Raj Bhumbla, the NAAS has lost an esteemed Fellow and an international famed soil scientist, policy planner and administrator. The entire Fellowship mourns his demise and pays homage to the departed soul.

Dr Surinder Mohan Virmani

(28th January, 1938- 20th November, 2019)



Dr Surinder Mohan Virmani was born in Bannu, India on 28 January 1938. He got his primary education at Government High School, Ludhiana, Punjab, from 1951-54 and B.Sc and M.Sc from Agricultural College Ludhiana, Punjab, from 1954-61.He did Ph.D. from Indian Agricultural Research Institute, New Delhi during 1961-64; and Post Doctorate from National Institute of Agronomy, Paris, France during 1964-65.

He served as Professor of Soil Science and Chief Scientist (Dryland Agriculture) at Haryana Agricultural University 1971-75; Visiting Scientist, Canadian Department of Agriculture 1973; Visiting Research Fellow, Farming Systems Research Program, 1975-76, Principal Scientist (Agro-climatology) Farming Systems Research Program, 1977-81, and Leader, Farming Systems Research Program, 1981-85, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Patancheru, A.P. India, Visiting Professor, Evapotranspiration Laboratory, Kansas State University, Kansas, USA, 1984-85; Principal Agro-climatologist, Natural Resources Management Program, 1986-91, and Team Leader, Agronomy, 1991-98, ICRISAT; Coordinator, ADB-assisted Asian Watersheds Research Program, 1999-2001. He also served as Advisor, Indian Resources Information and Management Technologies Ltd. (INRIMT), Hyderabad.

Dr Virmani was decorated with several awards like Lifetime Service Achievement Award, Soil and Water Conservation Society, India; ICRISAT Dedicated Research Service Awards, 1986 and 1996; Chairman, Commission VI, International Union of Soil Sciences, 1994-1998; Member, American Society of Agronomy; National Geographical Society, USA.

He was elected Fellow of National Academy of Agricultural Sciences, Indian Society of Soil Science and National Academy of Sciences, India.

In the demise of Dr Surinder Mohan Virmani, the NAAS has lost an esteemed Fellow and an international famed scientist of Natural Resource Management, Rainfed-dryland Agriculture, Agro-climatology and Sustainable Agriculture. The entire Fellowship mourns his demise and pays homage to the departed soul.

Dr. Narsingh Narayan Singh

(20th August, 1943- 16th December, 2019)

Dr Narsingh Narayan Singh was born on 20 August 1943 in Village Pali, District Gorakhpur, Uttar Pradesh, India. He got his primary education at TD College, Jaunpur, U.P., B.Sc. from Agra University, U.P., M.Sc. in 1964 and Ph.D. (Agricultural Botany) in 1971.

Dr Singh served as Principal Scientist, Maize Breeding at Indian Agricultural Research Institute, New Delhi from 1982-87; subsequently Project Coordinator (Maize) from 1987-94 and Project Director, Directorate of Maize Research from 1994-2005 along with, Director, Agro-ecosystem (Irrigated), NATP, ICAR, from 1998-2005; Joint Director, Research, from 2003-04, IARI, New Delhi and Vice-Chancellor, Birsa Agricultural University, Ranchi from 2005 -11.

Dr Singh was honoured with many awards and recognitions. He served as Member of review team of CIMMYT (Mexico) Maize Program, 1994; Vice President, Indian Society of Genetics & Plant Breeding, 2003-04; Seeds Men Association of Andhra Pradesh Award, 2003; National Seed Association of Indian Award, 2004; Vidyasagar Award & Viswa Vidya Bhusan Title by Indian Institute of Oriental Heritage, 2006; Chairman, Quinqunnial Review Team (QRT) and Research Advisory Committee (RAC) of ICAR Institute; Member of Governing Body of ICAR; President, Pusa Association of Retired Agricultural Scientists, 2016 to date. Dr Singh also served as Founder Secretary, Trust for Advancement of Agricultural Sciences, New Delhi from 2002 to date.

He was elected as Fellow of National Academy of Agricultural Sciences in 1997, Fellow of Indian Society of Genetics and Plant Breeding; Plant Breeding Association of India; Crop Improvement Society of India; and Entomological Society of India.

In the demise of Dr Narsingh Natrayan Singh, the NAAS has lost an esteemed Fellow and an international famed scientist of Genetics and Plant Breeding (Maize Breeding & Improvement). The entire Fellowship mourns his demise and pays homage to the departed soul.

Editors: Dr V.K. Bhatia and Dr Kusumakar Sharma

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