NAAS NEWS

RESEARCH EDUCATION AND TECHNOLOGY POLICY FORUM

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From the President's Desk

Agri-Science Communication

Everything is changing, changing by the year and by the day; be it the way we read, hear, or communicate. With increasing volume and kinds of economic activities as also specialisations, the constituencies of stakeholders in the society are also growing by leaps and bounds. When it comes to intellectual activities, it is not uncommon to come across questions in daily conversations at work, travel, homes, like 'tell me what you are doing?, why is this being done?, has it not been done?, what is new?, what is the use of it?,' and so on. The responses vary from casual replies to objective answers to defence to ridiculing the ignorance of those making queries. Analysing the question, understanding the context, clarity of the concept and the work, assessing the utility, expressing in an intelligible manner, hold the key to an effective communication; otherwise it is all confusion.

With the information explosion and access to diverse sources, it is only a click away to news on one hand, and distant divides in opinions on the other. Science with technology, with their contributions to the people's lives in all their dimensions, has received much acclaim and appreciation, but the same findings and discoveries are also received with hesitation and even suspicion. It is here that art of communicating science is different from science publishing or scientific communication; thus addressing the non-experts or the 'public' is assuming importance in putting new things in perspective. Starting from a student's presentation to project defence to moulding public opinion and policy formulation, a well framed science communication is critical in convincing the stakeholders for science-based decision making for the larger good of the 'society'. This sums up the ethos as also the mechanism of science communication.

Agricultural R&D and / or S&T have a large and diverse user constituency that expects everyday's researches, packages and technologies to be handed over duly customised to address complex problems, in a comprehensible manner. Farmers being the closest partners in food production, need a constant dialogue for identifying issues, prioritising the research agenda and look for alternative and affordable solutions. Both innovations and

investments are required for agricultural growth from 'plough-to-plate' and here come the diverse players, who would need to be on the same page, for enabling and facilitating 'new agriculture' that is science-led, technology-based, remunerative for the farmer and socially acceptable.

With competition for the same resources, land, water or energy, other sectors of economy also need to be kept in loop for convincing arguments with regard to their requirements for farming. This is also necessary in order to attract the good brains and skilled hands to agriculture if farming is to be made efficient in terms of both ecology and economics, as otherwise, the options before the youth have increased manifold compared to even a decade earlier. Social Accounting Matrix is becoming an important tool in prioritising the resources for investments and an input for Decision Support Systems.

The new tools of communication offer unprecedented opportunities for disseminating the approaches of enquiry, analysis, discovery, innovations to public in large measures at amazing speed. While we had the extension scientists and workers for the 'lab to land' work, with demonstrations, exhibitions and community participation programmes, a new generation of science communicators is coming up in recent years to provide for two-way interactions, group discussions, cloud sourcing, opinion polls and so on. Agricultural journalism is emerging as a discipline and Media Social Responsibility (MSR) as a code. In the recent past, science writers, writing on science for the public, are taking the messages of labs and farms in print and electronic media across the country. There is a need to equip them with correct, validated and objective information, so that they convert this into knowledge for the users and recipients, as also to ensure that misgivings do not fill the media space. Here is an opportunity for the agri-researchers for conveying the right thing at the right time, also as a duty in giving back to the society that nurtures science. This is also necessary for providing inputs to policy makers for decisions on investments on new methods of agriculture and a way forward for Public Understanding of Science.

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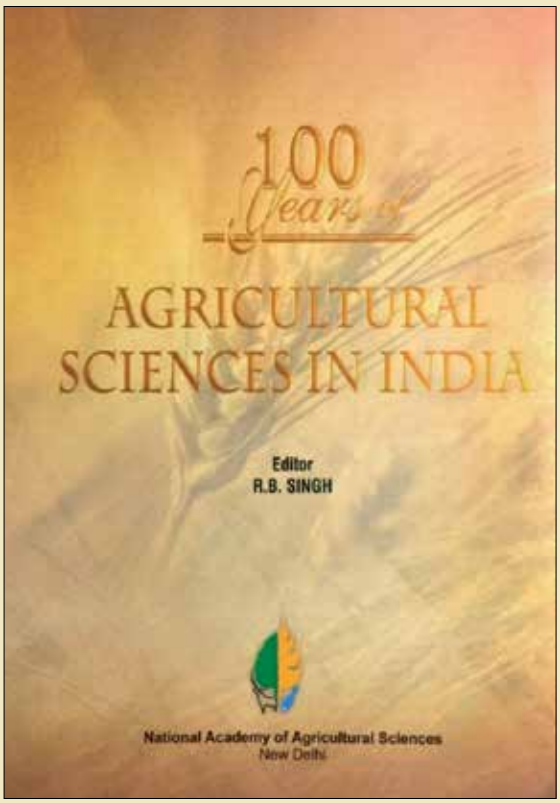

This book, a saga of generation, growth, development and application of agricultural sciences, technologies and innovations during the past 100 years for dynamically transforming Indian Agriculture, will be immensely valuable to agricultural science students, scientists and academicians, stakeholders and partners, science managers, policy makers, and farmers to further strengthen the knowledge-based evergreen agriculture to achieve the objective of green economy.

The comprehension of the experiences of the past one century has been documented in eight chapters *viz*: Crop Sciences, Horticultural Sciences, Animal Sciences, Fisheries Sciences, Natural Resource Management Sciences, Plant Protection Sciences, Agricultural Engineering and Energy, and Social Sciences, giving a lucid account of science-led ushering in of the Green (crops), Golden (horticulture), White (milk), and Blue (fisheries) Revolutions.

Other details of the book like the number of pages, cost, discount, etc can be seen at the website of the NAAS at naasindia.org.

National Innovations in Climate Resilient Agriculture (NICRA) - Salient Achievements

To meet the challenges of sustaining domestic food production in the face of changing climate the Standing Parliamentary Committee recommended taking steps for food security in India, under climate change impact scenarios. With this background, ICAR launched a major project '*National Initiative on Climate Resilient Agriculture*' (NICRA) during XI Plan in February 2011 and now during XII Plan it is renamed as '*National Innovations in Climate Resilient Agriculture*' (NICRA). The Major objective of NICRA is to enhance the resilience of Indian agriculture, covering crops, livestock, poultry and fisheries (Fig. 1) to climatic variability through development and application of improved production and risk management technologies; to demonstrate the site specific technology packages on farmers' fields for adapting to current climate risks; and to enhance the capacity of scientists and other stakeholders in generating and transferring climate resilient agricultural technologies.

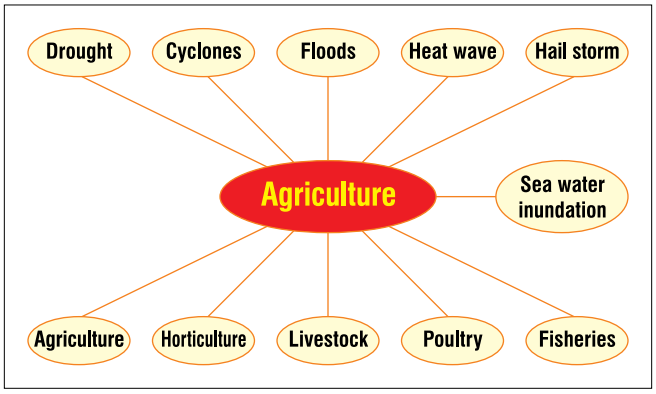

Fig. 1 : Agriculture sub-sectors and climatic vulnerability in Indian Agriculture

During XII Plan, the scheme involves 4 major components, viz., Strategic Research (40 ICAR Institutes); sponsored and competitive grants (16 + 20 Projects), technology demonstration, (151 villages across different states/ districts), capacity building and knowledge management.

i) Strategic Research

In the strategic research, both short term and long term research programs with a national perspective have been taken up for evolving adaptation and mitigation options in crops, horticulture, livestock, fisheries and poultry. The main thrust areas covered are (i) identifying most vulnerable districts/regions, (ii) evolving crop varieties and management practices for adaptation and mitigation, (iii) assessing climate change impacts on livestock, fisheries and poultry and identifying adaptation strategies.

Significant achievements of the project include extensive field pheno-typing of germ-plasm of target crops (rice, wheat, maize, pigeon-pea, tomato) to multiple a-biotic stresses, preparation of first ever vulnerability atlas of India at district-level for all the 572 rural districts (Fig. 2), technology development for climate resilient horticulture including inter-specific grafting of tomato, NRM in adaptation – Bio-char, CA, water foot prints and emission reduction through efficient energy management, quantification of carbon sequestration by soil and agro-forestry, quantification and techniques for measurement of GHG emissions in the rice-based system and marine ecosystem. Unique traits for thermal tolerance in livestock have been mapped, heat care mixture for poultry ready for commercialization, relationship established between increase in SST and catch and spawning in major marine fish species. The theme areas *viz.*, pheno-typing/breeding programs in

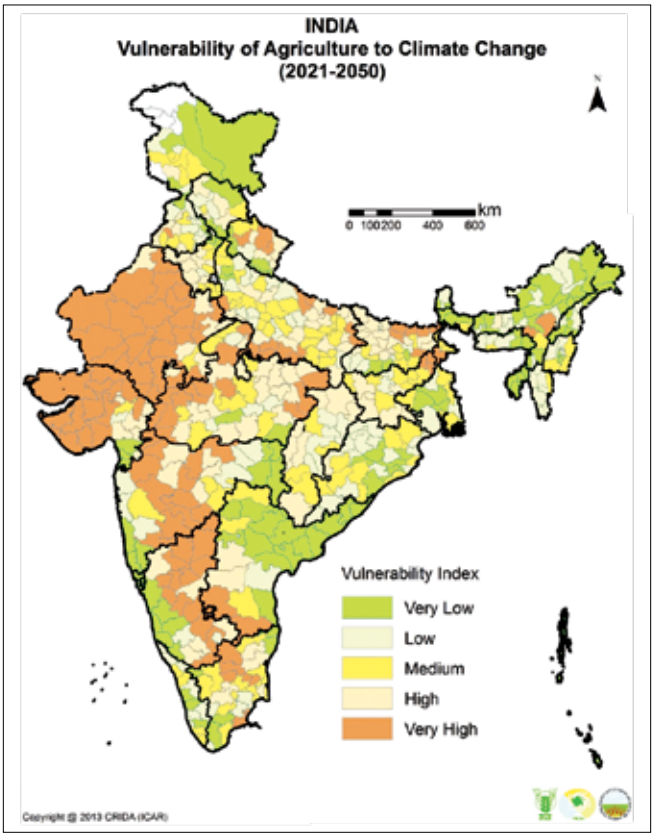

Fig. 2 : Vulnerability atlas of agricultural systems in India

crops, horticulture and livestock, simulation modelling to understand the impacts at regional/national level, address crops and regions which could not be covered in the XI Plan such as onion, cotton, sugarcane and temperate horticulture etc. are being emphasized in the XII Plan.

Strategic Research Component : Major Accomplishments

- State of the art climate change research **infrastructure** (Phenomics, FATE, CTGC, AWS, Eddy covariance, GHG analyzers, satellite receiving station, research vessel)
- First ever district-level **vulnerability atlas** of entire country has been prepared
- Extensive field **phenotyping** of germplasm in rice, wheat, maize, pigeonpea, and tomato to multiple abiotic stresses (Drought/saline/flood/heat)
- Climate Resilient **Crop Varieties / Hybrids** for flood, NUE, heat stress in rice, wheat, maize, blackgram and tomato
- **GHG inventory** for different crops and cropping systems, livestock, fisheries and agroforestry systems
- **NRM:** Biochar, CA, water foot prints and emission reduction through efficient energy management, quantification of carbon sequestration by agro-forestry
- **RCTs** developed for water harvesting, water saving irrigation methods, flood control, improved drainage for adaptation and mitigation of climate change
- Unique **traits for thermal tolerance** in livestock mapped, **heat care mixture** for poultry and small ruminants ready for commercialization
- Impact of climate change on crops, livestock, fisheries assessed through **modeling** approach

ii) Establishment of 151 Climate Resilient Villages (CRV's)

Technology demonstration component (TDC) is being implemented in a farmer participatory mode in 151 vulnerable districts of the country through 121 Krishi Vigyan Kendras (KVKs) spread across the country in 28 States and one Union Territory by premier ICAR research institutes. TDC aims at demonstration of proven technologies to enhance the adaptive capacity and to enable farmers to cope with current climatic variability. Location specific technologies, developed by the national agricultural research system, which can impart resilience against climatic vulnerability, are being demonstrated. A representative village in each climatically vulnerable district was selected for implementation. The interventions are broadly divided into four modules; namely natural resource management, crop production, livestock and fisheries and institutional structures for sustaining the activities envisaged and scaling up of interventions.

Improving soil organic carbon, crop residue recycling by avoiding its burning, soil health card based nutrient application and leaf-colour chart are the important interventions undertaken. Various other components under implementation are related to weather, carbon, water, crop, fertilizer and institutions.

Technology Demonstration Component: Major Achievements

- Over 700 RWH structures (farm ponds, check dams, percolation pond and jalkund) were constructed /renovated, and 80000 m^3 additional rainwater storage capacity was created resulting in improvement in the cropping intensity up to 120% in several villages.
- A number of drought and flood tolerant varieties were demonstrated in the NICRA villages along with resilient agronomic practices resulting in yield advantages in Soybean (22-37%), pigeonpea (23-33%), pearl millet (10-21%), paddy (5-14%), sesame (20-28%) and chickpea (14-39%) in *kharif* fallows. Flood tolerant varieties of paddy viz., Swarna sub1, MTU-1061, MTU-1140 have reached large number of farmers and replaced traditional long duration crops.
- Intercropping systems performed better than sole crops during dry spells, resulting in improving yields ranging from 10 to 35.2% in several states.
- *In-situ* moisture conservation and planting methods were helpful to improve the soil moisture availability at the root zone and increased the productivity of crops by 15-20% at several locations.
- Improved cultivars of fodder crops suitable for both the *kharif* and *rabi* season were demonstrated resulting in improvement in the green fodder availability and milk production in several NICRA villages.
- About, 1,20,000 farmers were trained on various climate change related issues through nearly 5000 different courses.
- Unique Institutional set-up Village Climate Risk Management Committee (VCRMC) established to drive bottom up approach.
- Custom hiring centres were established for farm implements to improve the timeliness of operations during the limited period of moisture availability in rainfed areas. The VCRMCs generated a total revenue of Rs. 43,39,513/- till 2015-16.
- About 18,000 soil health cards were distributed in the NICRA villages up to 2014-15.

Under the crop production module, demonstrations consists of drought and flood tolerant varieties, community nurseries for delayed monsoon, water saving paddy cultivation methods (SRI, aerobic, direct seeding), advancement of planting dates of *rabi* crops in areas with terminal heat stress, frost management in horticulture through fumigation, popularization of location-specific and risk-reducing intercropping systems with high sustainable

yield index. Under the livestock and fishery module, demonstrations on fodder production, especially under drought/flood situations, improved shelter for reducing heat stress in livestock, silage making methods for storage of green fodder and feeding during the dry season, breed selection and stocking ratios for fish production in farm ponds and monitoring of water quality in aquaculture and integrated farming system models in diverse agro-ecosystems are being taken up.

Village level institutional mechanisms such as Village Climate Risk Management Committees (VCRMC), custom hiring centers, seed banks, fodder bank, etc. are created for managing the infrastructure created and to improve the timeliness of operations during the limited window periods of moisture availability in rainfed areas and to promote small farm mechanization for adoption of climate resilient practices. These interventions helped farmers reduce the yield losses and enhanced their adaptive capacity against climatic variability.

Policy Support from NICRA

- Vulnerability assessment map prepared under NICRA is being used by different Ministries and several NGOs/CBOs
- NICRA is also contributing to National missions like NMSA, Water mission, Green fund and INDC
- GHG inventory by NICRA partner institutes contributes to BUR reports
- Outcome of NICRA project supported some of the policy issues in the States of Maharashtra (BBF Technology), Million farm ponds (Andhra Pradesh/ Telangana), Ground water recharge initiatives (southern states), NABARD action plans, NICRA model village expansion in Assam, etc.
- Contingency planning workshops organized every year in different States are helpful in preparedness to face weather aberrations

NICRA-Follow-up

Though the program is scheduled to close in March 2017, the activities that have been initiated need to be continued either through extension of NICRA in some form or the other. The investments made in creation of research infrastructure have to be utilized in an objective and focused manner so that the intended outputs and outcomes in the form of tolerant crop varieties, understanding physiological and molecular processes that impart resilience to crops, are harnessed by the country in a better position to deal with climate change. Model climate resilient villages need to be expanded horizontally and ensuring the flow of these resilient technologies through structured institutions in several national and state level programs. Equally important is to generate policy and institutional options that complement with technological options to withstand climate change impacts in overall objective of food security in the country.

Dr Ch. Srinivasa Rao
FNAAS and Director, CRIDA, Hyderabad

97th Executive Council Meeting

The 97th meeting of the Executive Council of NAAS was held on 17 September 2016 in the Academy Secretariat. In the business of EC the minutes of the 96th meeting of the EC held on June 04, 2016 were approved. The recommendations of Sectional Committees and the Conveners Group for finalization of Academy Fellowship including Foreign and Paravasi / Associateships for the year 2017 were presented by Prof Anupam Varma and endorsed by EC. Prof Varma also updated the EC on progress made so far in formulating revised format and the guidelines with regard to Nomination Form for election of Fellowship. He also briefed the house on the progress in implementation of the Academy programmes during 2016 and informed that for finalizing programmes for 2017 suggestions have been invited from the fellowship. Further, EC also deliberated in detail on the revised Guidelines about election process of Office Bearers/EC Members, submitted by Dr C.D. Mayee committee, and were approved unanimously by the EC for further consideration of the General Body in its next meeting to be held in June 2017. The EC placed on record the efforts made by Prof Anupam Varma, Chairman, Committee Members and others in bringing out the Policy Brief-1 entitled "*To Accelerate Utilization of GE Technology for Food & Nutrition Security and Improving Farmers' Income"*. The EC also appreciated the efforts made for preparation and submission of the Policy Briefs on '**Water**' by Dr S.K. Ambast and '**Soil**' by Dr C.L. Acharya. Dr B.S. Dwivedi was requested to submit on priority the Policy Brief on '**Organic Farming**'.

The EC desired that the publication of Status / Policy papers may be expedited. It was reiterated that a draft policy paper / status paper may be submitted within three months of holding the brainstorming session.

The EC accorded post facto approval for award of Institutional Membership of the Academy.

National Consultation on System of Crop Intensification (SCI)/System of Rice Intensification (SRI) (Convener : Dr B.C. Barah)

The National Academy of Agricultural Sciences (NAAS), the National Consortium on SRI (NCS) and National Bank for Agriculture and Rural Development (NABARD) organized a one day National Consultation Meet on SCI/SRI on 10th September 2016 at the NAAS, NASC, New Delhi, for assessing the prospects of up-scaling the technology. Dr S. Ayyappan, President, NAAS welcomed the partcipants. Dr B.C. Barah, Convener and former NABARD Chair Professor, introduced the subject.

The discussion evolved around food and nutrition security as the core of the Sustainable Development Goals (SDGs) set by the United Nations for 2030. Sustainable food production along with productivity and profitability enhancement are the prime requirements for a vibrant agricultural sector. With the increasing volatilities of climate change, the mitigation and adaptation strategies through agro-ecological systems should drive the policy agenda.

From the overview presentation and discussions, it emerged that SRI is an approach based on global best management practices of properly spaced, young, single seedlings, periodically drained and aerated soils, and weed free fields. It is getting fairly popular among the farmers in Tripura, Bihar, Andhra Pradesh, Tamil Nadu and other states. SRI principles have variably been adopted for developing crop and location specific good agronomic practices for other crops, referred to as SCI. Though SRI has been advocated for widespread adoption in the country, the spread is patchy both in space and time.

Dr S.K. Pattanayak, Secretary, DAC&FW, New Delhi; Dr H.K. Bhanwala, Chairman, NABARD, Mumbai; and Dr T. Mohapatra, Secretary, DARE & DG, ICAR were the Guests of Honor. Dr H.K. Bhanwala mentioned that improvement in agriculture sector can be brought with a 3-pronged strategy: (i) technology led, (ii) change in cropping time scale and expansion of post-harvest technology to avoid a glut situation, and (iii) reorienting extension mechanisms for enhanced outreach and increase in yields by reducing the yield gaps. He informed that in pursuance of this objective, NABARD has already invested Rs. 25 crores, covering 1.4 lakh farmers, on promoting SRI across 13 states, wherein productivity gains have been reported to be about 50% with simultaneous decrease in cost of production and saving of natural resources. He argued that full potential of SRI, or any proven technology, can be achieved with the help of Farmer Producer Organizations (FPOs) for aggregation, input procurement and output gains. In view of the past experience in promotion of SRI, a joint mission mode programme under the Agriculture Ministry and NABARD, also involving the states, would be a game changer, argued Dr Bhanwala. The lessons learnt from the success stories may be used for developing implementable models.

Dr S.K. Pattanayak dwelt upon the issues of doubling the income of farmers by 2022. He appreciated the need for further promotion of crop intensification initiative as the way forward for food security in the country. The possibility of fund allocation for promoting and upscaling of SRI under RKVY, besides NFSM, was discussed. It was emphasized that the role of ICAR will be critical in validating various principles of SRI and for giving recommendation under various ecosystems. Need was felt for skill improvement/development for adopting SRI in various ecologies.

Dr T. Mohapatra, Secretary DARE and Director General, ICAR, elucidated that sustainable crop intensification and development of best management practices, including new varieties and associated most suited agronomic practices, is the hallmark of ICAR research for development. SRI is not a new technology and is not a fixed package of practices. Situationally, the farmers differentially adopt the SRI components, but seldom in toto. Many feel that the approach is more of a social phenomena.

Notwithstanding the enhanced yield, water-saving and environmental friendliness advantages of SRI, it emerged that the overall adoption of the package is sluggish, and there are several bottlenecks in SRI's scientific basis. Its adoption is often linked with subsidy and other governmental support, and the withdrawal effect is high. As NABARD, RKVY and NFSM have been promoting SRI for the past several years, the disaggregated impact of SRI in these programmes should be critically analysed to provide future guidance.

In general, the major constraints observed in adoption and spread of SRI included: seedling mortality (due to high water temperature and excess rainfall), high labour cost (transplanting/weeding), more weed and nematode infestation (due to partially aerobic conditions), multiple micronutrients deficiency (Fe, Cu, Mn) and difficulty in water management in high rainfall situations killing young seedlings. Further, farmer needs to drain out the precious rainwater to meet the principles of SRI (aerobic condition), though farmer would not like to drain water from paddy fields, particularly in the rainfed region because of uncertainty of the next rainfall event.

There is substantial diversity in SRI extension and practice across sites, making it very difficult to draw general conclusions about the impact of SRI as a singular technological package. The overall effect of SRI adoption on total factor productivity remains unclear. Although reported yields under SRI cultivation methods are often higher than reference practices, the cause(s) of these increases remain obscure. Yield variability under SRI management is often reported to be larger in comparison with conventional practice. This difference may stem from either unobserved farm characteristics, or truly represent a source of elevated risk associated with SRI management, making SRI less attractive for the most vulnerable farmers.

Socio-economic analysis of trends in SRI adoption, farmer experimentation and practices in key areas, economy, labour use, resource and water savings should be undertaken. Farmers' changing perceptions on SRI with and in relation to subsidies, state support and other establishment methods should also be understood. In order to bridge the further knowledge gap, collaborative research should be undertaken for understanding longer term effects of different crop intensification systems. Researchable issues include: differential varietal response to BMP/SRI, real water saving, change in nutrient use efficiency, status of soil available nutrients, root and shoot dry mass, microbial development, incidence of insect pests, and advantages in terms of intensification and risk reduction.

Consultation Meet on Qualitative and Quantitative Assessment of Glauconite as Source of Potassium and More (Convener: Dr J.C. Katyal)

Consultation Meet was organized on September 13, 2016 at NAAS, New Delhi. The Session was Chaired by Dr S. Ayyappan, President and Prof. R.B. Singh, Immediate Past President. Participants representing NAAS, SAUs, ICAR institutes and Central Institute of Mining and Fuel Research attended the meeting. This Meet was set against the backdrop of falling productivity growth rates

due to insidious spread of potassium (K) deficiency in Indian soils and crops, thus mounting burden of foreign exchange on importing potash fertilizers. The main goal of the discussions was to present a graphic account of the indigenously available K-bearing mineral glauconite (an iron potassium silicate; K_2O content 4.5 to 8%) as a substitute to imported potash.

Dr J.C. Katyal made a comprehensive presentation centring on the extent and severity of K deficiency in soils; differential needs of diverse annual and perennial crops and agronomic value of galuconite as source of K in the management of K under-supply. He also informed on the available biological and industrial routes of enrichment and beneficiation of glauconite ore. This thematic presentation was supported by 3 independent talks with focus on: (i) assessment of glauconite mining for agriculture; (ii) delineation of niche crops and soils vis a vis management of K deficiency by locally available minerals and ores; and (iii) role of K solubilising microorganisms in mineralizing glauconite-bound K. It emerged that economic and environmental considerations point to potential of glauconite as K source and soil ameliorant. The outcome, however, favoured initiating a well laid out scientific study to further validate the soil and crop-specific merits of indigenously available glauconite as the limited information on agronomic performance of glauconite, economic data on its enrichment and beneficiation is mostly sketchy and superficial.

Highlights of the recommendations emerging for future programmes and activities are itemized below:

1. Initiate exploration and identification of bench-mark sites endowed with high-grade glauconite *i.e.* greensands having high glauconite content and glauconites with high K enrichment. This would necessitate inclusion of glauconite in the schedule as minor mineral in accordance with 'Mineral Concession Rules 1960' contained in the 'Mines and Mineral Development Regulation Act 1957'. In the mean time GOI can be requested to declare green sand mines as 'experimental mines'.
2. Identify and prioritize niche crops and soils responsive to glauconite application. Since glauconite is known to

additionally benefit soil physical parameters, equally necessary it would be to set up lab and field studies to meter improvement in characters like soil compaction, structure, aeration, water holding and transmission properties.

3. Launch comparative evaluation studies of improved glauconite developed through processes like size reduction, enrichment with soluble K sources and management practices.

4. Investigate potential of K solubilising micro organisms (KSM) (bacteria, fungi and actinomycetes) for enhancing availability of otherwise sparingly soluble glauconite-K. Studies, besides isolating efficient KSM (ability to solubilise and colonise), would also include assessment on improvement in K mineralization of glauconite enriched organic materials on composting.

5. Prepare an evaluation report highlighting beneficiation technologies encompassing threadbare discussion on each. In this regard, narrating relative advantages and disadvantages from the Indian standpoint would be necessary. On the one hand, the preferred route must be capable of low-cost exclusion of the commercially worthless entities (alumino-silicates) of the ore, and on the other, it ought to effectively improve quality of the indigenously available glauconite with favourable economics.

Brainstorming Session

Strengthening Agricultural Extension Research and Education (Conveners: Dr A.K. Singh, DDG (Ag. Extn.), ICAR and Dr C. Ramasamy, FNAAS)

A Brainstorming Session on Strengthening Agricultural Extension Research and Education was organised on July 09, 2016 at NAAS, New Delhi. Dr S. Ayyappan, President NAAS, Chaired the Session. Dr A.K. Singh presented an overview of the Agricultural Extension Research and Education in the country and the need to strengthen the system for global learning. He emphasized that the efforts required to strengthen the extension research and education would come from extension professionals only and not from outside agencies. It was also highlighted by him that there is a need to explore the role of Agricultural Technology Application Research Institutes (ATARI) in designing and implementation of core extension and multi-disciplinary research in the respective zones. Dr R. Parshad sketched the trend of application of effective research methodologies and tools in extension research while Dr J.P. Sharma gave a glimpse of various issues and challenges in agriculture extension research and education and advocated the need for reorientation of research and education. Dr Premlata Singh and Dr R.N. Padaria outlined the agricultural extension curriculum, bringing out clearly the present status and changes required to be made to make it effective and purposeful. The presentations were followed by open-house discussions.

Dr S. Ayyappan was of the opinion that this Brainstorming Session has facilitated a 360^{O} analysis of the strengthening of extension research and education. Immediate needs identified in the session are to be addressed on priority basis. The discipline needs to match with organizational needs. Publishing the Handbook of Agricultural Extension will definitely help the extension practitioners. The social sciences should be promoted as they are most relevant in present day context.

In order to draw roadmap for reorienting and prioritizing Extension Education and Research and Course Curriculum in Extension Education, institutional support, networking of extension scientists, capacity building, and identification of new research areas, etc., following recommendations emerged:

i) Appropriate use of statistical sciences may be made in data designing and data analysis for improving the quality of research.

ii) A network of extension professionals would be very effective in promoting and strengthening extension activities and extension research. Virtual platforms like Facebook/WhatsApp/Blogs etc. may prove effective.

iii) Capacity building of extension scientists/teachers need to be strengthened. Courses on entrepreneurship, agri-business, technology generalization etc. may be included in the curriculum. E-learning and E-advisory need to be encouraged.

iv) Integrating gender and nutrition should be priority in extension. Feminization of agriculture and its impact may be studied. Gender sensitization of

extension professionals is needed to capture the extension need of farm women.

v) Linear model of technology transfer is no longer valid. Participatory research projects involving different disciplines may be taken up. The scientists in disciplines like agronomy, plant protection, and food processing may be called upon to include extension scientists as a part of the project team.

Activities of Regional Chapters

Hyderabad Chapter

The NAAS – Hyderabad Chapter and Indian Society of Dryland Agriculture (ISDA), jointly organized a quiz competition for class X students to celebrate the 88th Birth Anniversary of Late Dr M.V. Rao at ICAR – CRIDA on 18th June 2016. The main purpose of organizing such a quiz competition was to create awareness among the students about the career opportunities in agricultural research and education. Nine teams from different schools located in Hyderabad participated in the competition. The teams from Bhashyam Public School, Dilsukhnagar; The School, Karmanghat; and Sri Chaitanya Techno School, L. B. Nagar won the 1st, 2nd and 3rd prizes, respectively. The Chief Guest, Dr Ch. Srinivasa Rao distributed certificates to the participants. The trophy and prizes were distributed to the winners during Late Dr M.V. Rao Birthday celebrations held at PJTSAU, Rajendranagar.

Dr Ch. Srinivasa Rao
Convener, Hyderabad Chapter

Bhubaneswar Chapter

The Bhubaneswar Chapter of NAAS organized a discussion meeting on "Minimizing water use in Agriculture" on September 03, 2016 at ICAR-IIWM, Bhubaneswar, with four broad components as (1) Minimizing water in agriculture and horticulture; (2) Minimizing water use in livestock and fisheries; (3) Water management issues in the context of climate change; (4) Water governance and policy.

Dr K. Pradhan, former VC, OUAT, Bhubaneswar was the chief guest who informed that NAAS has documented 5 water related policy papers, which need to be implemented by different state Governments and also urged the water management experts and researchers to update the information of those documents.

To minimize the water use in cropping systems it was recommended that technologies like resource conservation, laser-aided land levelling, ridge-furrow method, use of sprinkler and drip irrigation, and integrated farming systems developed by ICAR institutes can be very useful. It was highlighted that with a 10% increase in water use efficiency, an additional 14 million ha area can be brought under irrigation with modest investment and enabling policy support.

For livestock it was recommended that use of technologies like superior germplasm, improving indigenous species, improved nutritional management, shelter management can effectively improve water productivity from the sector. To reduce the water footprint from capture fisheries and aquaculture, reduction of seepage and water exchange losses, integrated aquaculture, recirculation and re-use of water for aquaculture, organic aquaculture, feed and nutrition; waste water fisheries are recommended. Possibilities should be explored for utilizing grey-water for aquaculture and fisheries.

Agricultural water management issues in the context of climate change were also deliberated upon. The house advocated that strategies for mitigating methane emission from rice cultivation could be achieved through improved water management, including promoting mid-season aeration by short-term drainage, wetting and drying methods of irrigation, SRI and aerobic rice cultivation, improving organic matter management by promoting aerobic degradation through composting or incorporating it into soil during off-season drained period; use of rice cultivars with few unproductive tillers,

high root oxidative activity and high harvest index; and application of fermented manures like biogas slurry in place of unfermented farmyard manure.

The valedictory session was chaired by Dr A.K. Singh, VC, Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, Gwalior, who urged the house to take challenges of utilizing waste water or marginal quality water for aquaculture and fisheries purposes.

Dr D.P. Ray
Convener, Bhubaneswar Chapter

ICAR/SAU/NAAS-MSU Partnership for Agricultural Research and Education

India's agricultural research and education system has increasingly been internalizing major global initiatives and foresight in transforming its food and agriculture systems through developing leadership in agricultural sciences and knowledge economy towards achieving Green Economy and meeting the Sustainable Development Goals. Comprising mainly of the ICAR institutes and agricultural universities (AUs), it continues to strive to academically contextualize the dynamic national and international development trends, including international Experiential Learning. In this context, the DARE/ICAR and AUs are already pursuing several bilateral and multilateral international collaborations, especially with SAARC, ASEAN, and African countries, other BRICS members, and with developed countries, especially USA.

The Land Grant Universities (LGUs) of USA have been pioneering partners in establishing agricultural universities, particularly the State Agricultural Universities (SAUs), in India on the Land Grant pattern. International collaboration and cooperation has been a hallmark of the LGUs. Among others, Michigan State University (MSU), a world famous LGU, has played a leading role in international collaboration. MSU brings a deep commitment towards agricultural development and natural resource management across the world towards enhancing global food security and quality of life. Over the past several decades, MSU has been actively collaborating with various public and private sector institutions in India and the South Asia region towards building global knowledge partnerships.

Towards the above commitment, MSU launched the South Asia Partnership (SAP) initiative in 2009. Under this initiative, faculty members across several Departments and Units of College of Agriculture and Natural Resources (CANR) are actively engaged in collaborative programmes with agricultural research and educational institutions across India. In addition, through this initiative, MSU is partnering with private companies, non-profit organizations, and international agricultural research centers in India. MSU has signed formal MoUs with the Indian Council of Agricultural Research (DARE/ICAR), several SAUs, and with a number of public, private and non-profit organizations in India and the South Asia region.

Under the auspices of the National Academy of Agricultural Sciences (NAAS), New Delhi, the brain trust of India's agriculture, a round table meeting was organized on September 9, 2016. Seventeen senior officials and members of NAAS, ICAR, IARI and MSU participated in the roundtable meeting. The roundtable meeting was coordinated by Dr S. Ayyappan (President of NAAS) and Prof R.B. Singh (Chancellor of Central Agricultural University and Immediate Past President of NAAS). Dr Steven Hanson (Vice Provost and Dean of MSU International Studies and Programs), Dr Karim Maredia (Professor and Director of MSU South Asia Partnership), and Dr Vibha Dhawan (Executive Director of Biotechnology and Bioresources at TERI and Consul General of MSU in India) represented Michigan State University.

The purpose of the roundtable meeting was to discuss and identify key areas and innovative approaches for sustained long-term collaboration among the DARE/ICAR, NAAS, SAUs and MSU. It was recognized by all the members present that innovative approaches, programmes and partnerships are needed across multiple domain of agricultural research, education, outreach and technology transfer to create the desired impacts to enhance food and nutritional security and livelihoods. Both, DARE/ICAR and MSU aim to become global leaders and expressed strong interest to partner and promote South-South and North-South collaborations, including trilateral partnerships, to help strengthen institutional capacity and human resources in countries of South Asia and Africa. MSU expressed strong interest to collaborate with DARE/ICAR, including under the proposed World Bank funded National Agricultural Higher Education Project (NAHEP), to build knowledge networks and enhance institutional capacity through interdisciplinary collaborative research, education, training and outreach programmes in cutting edge areas.

The following 10 broad areas were suggested for collaborative programmes between DARE/ICAR and Michigan State University:

1. Biotechnology, Biodiversity, Plant Breeding and Seed Systems
2. Water Resources and Water Management
3. Animal Agriculture, Dairy Science and Technology

4. Bioenergy and Alternate Energy (biogas, solar, wind, etc.)
5. Food and Health (bioactive natural products)
6. Post-harvest Management of Agricultural and Food Products (food processing, food safety, storage, packaging, and value addition)
7. Fisheries and Aquaculture
8. Agroecology, Soil Health, Organic and Sustainable Agriculture
9. Gender Equity and Social Empowerment
10. Impact Evaluation

The collaborative programmes established through the above mentioned ten programmes will aim to encompass the following:

1. **Joint Centers of Excellence** for collaborative research, education, training and outreach programmes offered both in India and at MSU; Scholarship through **joint publications**; **Joint proposals** development for attracting external grants for collaborative programmes.
2. **Faculty exchanges** for collaborative research, co-teaching, and course curriculum development (including on-line courses/modules using the modern tools of ICTs).
3. Institutional cooperation for **research-led curriculum enhancement and academic programmes** development in cutting-edge emerging areas.
4. **Student exchanges** through study abroad and research abroad programmes, **sandwich degree programmes, and internships** for practical on-the-ground experiential learning; **student mentorship / co-advisorship** through serving on thesis research committees of post-graduate (M.S. and Ph. D.) Students.
5. **Technology Transfer Platforms** for South-South and North-South exchange of technologies (sharing of technologies with countries in Africa, and South Asia).

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Obituaries

Dr Amrik Singh Sidhu, a renowned vegetable breeder, left for heavenly abode on April 16, 2016. Born on January 06, 1952, Dr Sidhu obtained his Ph.D. from the Punjab Agricultural University, Ludhiana in 1988. He started his academic journey as a Research Associate at Haryana Agricultural University, Hisar in 1976 and held many coveted positions in PAU from 1980 to 2003. In 2006 he held the position of Head, Vegetable Science at IARI and the decorated position of Director, Indian Institute of Horticultural Research, Bangalore from 9th February 2009 to 31st January 2014.

Dr Sidhu made extensive contributions to research, teaching and extension activities. During more than 33 years of his academic and research career his focus was development of vegetable crops through breeding. Dr Sidhu had been associated with the development of high yielding varieties and F1 hybrids of vegetable crops, several of which have been identified at the national level. Variety Punjab Naroya and PRO-6 of Onion and Punjab Sada Bahar Baingan, Punjab Barsati, BH-1 and BH-2 of brinjal are among the best varieties at national level. Kharif onion cultivation popularized among the onion growers and many farmers have taken this technology in a big way.

Dr Sidhu had been a prolific writer and published more than 220 research papers in various national and international journals and 129 popular articles in scientific magazines. He was Chairman / member of important committees in PAU, IARI and ICAR. Dr Sidhu trained number of farmers for hybrid seed production and several farmers trained by him are producing hybrid seed / nursery on a commercial scale.

Dr Sidhu had been decorated with several awards including Rafi Ahmed Kidwai Memorial Prize (1995); Punjab Sarkar Parman Patra (2001); Shrimati Harpal Kaur Memorial Award (1995); Shri Hans Raj Pahwa Memorial Award (1997); Gold Medal in Vegetable Science (2004); Horticultural Society of India Gold Medal (2005) and Shri L.C. Sikka Award (2009). He was Fellow of National Academy of Agricultural Sciences, Horticultural Society of India and Indian Society of Vegetable Science.

The Fellowship of the National Academy of Agricultural Sciences deeply mourns the sad demise of Dr Amrik Singh Sidhu and expresses heartfelt condolences to the bereaved family.

Dr Neelamraju Ganga Prasada Rao, a distinguished agricultural scientist and father of the hybrid sorghum, left for heavenly abode on July 28, 2016 at Hyderabad. Dr Rao was born in Korisapadu, Prakasam, Andhra Pradesh. He completed his education from the Agricultural College, Bapatla, the Indian Agricultural Research Institute, New Delhi and the Bihar University. He was conferred D.Sc. degree by the Chandrasekhar Azad University of Agriculture and Technology.

Dr Rao held various coveted positions like Consultant to the FAO of the United Nations; Sorghum Botanist and Associate Coordinator, IARI; Project Coordinator (Sorghum), IARI, New Delhi; ICAR Professor of Eminence, Regional Station, IARI, Hyderabad; ICRISAT's Regional Sorghum Breeder for West Africa, Ahmedu Bello University, Samaru, Zaria, and Nigeria; Vice-Chancellor, Marathwada Agricultural University, Parbhani, Maharashtra; Chairman, Agricultural Scientists Recruitment Board, ICAR.

Dr Rao was well known for his basic and applied research in breeding and agronomy of several dry-land crops. Due to his efforts sorghum hybrids, CSH1, CSH5 and CSH9 became very popular. The advent of hybrid sorghum gave rise to the sorghum seed industry on a large-scale. An improved sorghum variety S35 gained popularity in drought prone areas of West Africa. Dr Rao also made significant contributions to the improvement of dry-land crops, particularly long staple desi cotton, pigeon pea, castor, and novel cropping systems.

For his outstanding contributions, Dr Rao was decorated with the Bharat Ratna C. Subramaniam Gold Medal (1966) for the development of the first Sorghum Hybrid; S.S. Bhatnagar Prize for Biological Sciences (1967); Rafi Ahmed Kidwai Award for Plant Breeding (1974); and the VASWIK Award for Agricultural Sciences (1979). The Atma Gaurav Award (2003), and the Distinguished Agricultural Scientist Award (2008), were bestowed upon him by the Government of Andhra Pradesh. He was also the President of the Indian Society of Genetics and Plant Breeding, and President of the Society for Millets Improvement.

He was elected Fellow of the Indian National Science Academy, New Delhi; National Academy of Sciences (India), Allahabad; National Academy of Agricultural Sciences, New Delhi; and the Andhra Pradesh Akademi of Sciences.

In his sad demise, the Academy has lost a prominent farm scientist and a distinguished hybrid sorghum breeder. The Fellowship of the academy deeply mourns and expresses its deepest condolences to the family at the sad demise of Dr Neelamraju Ganga Prasada Rao.

Editors: Dr K.K. Vass and Prof V.K. Gupta

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