NAAS NEWS

RESEARCH, EDUCATION AND TECHNOLOGY POLICY FORUM

Vol. 18 No. 1 January-March 2018

CONTENTS

From the President's Desk

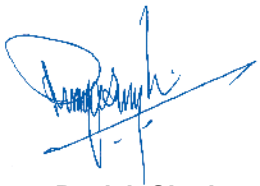
Rainfed / dry lands' potential underutilized

At the global level, it is estimated that 80 percent of agriculture is rainfed and contributes to about 58 percent of the food production. India ranks first among the rain-fed agricultural countries of the world in terms of both extent and value of produce with 77 million hectares without assured irrigation. Similarly, more than one-third of the world's population lives on drylands, where, because of fragile natural resource base, achieving food security has been a great challenge. Farming in such regions is a survival mechanism rather than a growth oriented activity. Therefore, it is imperative to improve the productivity and income of farmers of this region to achieve the goal of more inclusive economic growth. Rainfed agriculture, largely practiced in the semi-arid and sub-humid tracts of Maharashtra, Madhya Pradesh, Gujarat, Rajasthan, Jharkhand, Bihar and the Deccan Plateau, contributes to about 40 per cent of food grain production and a bulk of 85 percent coarse cereals and pulses, 70 percent of oilseeds, 65 percent of cotton and 45 percent of rice. It also supports more than 60 percent of the livestock population. The Green Revolution, driven by the development and use of high-yielding rice and wheat varieties, supported by vast irrigation schemes and high fertilizer inputs, ushered an era of wide disparity between productivity of irrigated and rainfed agriculture, besides neglect of rainfed agriculture despite it being a significant contributor to agricultural production. This demanded science based interventions to remove the great divide created between the rainfed and irrigated eco-systems. Alarmed by such a situation, the Fourth Plan (1969-74) emphasized the urgent need for focusing attention on hitherto neglected farmers of the dryland to participate meaningfully in the agricultural development process. The Indian Council of Agricultural Research (ICAR) and many other Government of India Departments formulated a comprehensive program on dryland research by launching many research programs and centrally sponsored schemes to give focused attention to rainfed areas of the country.

Over the years the National Agricultural Research System (NARS) has contributed significantly to development and transfer of technologies for a more viable and sustainable rainfed agriculture. The technologies developed included both embodied technologies such as identification of suitable crop varieties for different regions, improved farm implements, better conservation and rainwater harvesting measures as well as disembodied (knowledge) technologies such as optimum time of sowing of various rainfed crops, efficient cropping systems, nutrient management practices, district level contingency crop plans, etc. The concept of watershed based development in rainfed regions of the country played a key role in development of model watersheds and subsequently delineated micro-watershed into Land Management Units for sustainable land management for diverse rainfed agro-ecologies and soil types.

Agro-ecology specific doable rainfed technologies developed in the country have been effectively integrated in action plans of various states under PMKSY, NMSA, MGNREGA, IWMP, RKVY, NFSM, NHM, NLM, Dryland Farming Missions of Karnataka, Maharashtra and Comprehensive District Agriculture/Land Development Plans of various districts in the country. Many technologies like water harvesting, intercropping systems and *in situ* moisture conservation practices are being widely adopted by the farmers across the country bringing stability to production in drought prone regions and contributing towards strengthening preparedness to meet the emerging variability of the monsoon during both *kharif* and *rabi* seasons.

However, there is still a long way to go to exploit the full potential of agricultural growth for income generation as well as to reduce the risk and uncertainty associated with rainfed agriculture. Climate change and associated global warming has further impacted significantly farmers of the rainfed region who are resource poor, vulnerable, and poverty stricken with negligible risk bearing and coping capacity. The R&D on production systems, food security and climate change in rainfed areas merit high priority for many reasons. The agrarian crisis and rainfed agriculture are closely linked. The high cost of cultivation, disturbing phenomenon of farmers' suicides, lack of institutional credit, land degradation and depletion of soil fertility, complexity in diffusion and adoption of NRM based technologies, which hold the key for the success and inadequate public investment, are some of the serious issues affecting its sustained growth. The total arable land for crop cultivation has plateaued, and rather shrinking in the wake of rapid urbanization. Therefore, R&D efforts need far greater attention concerning methods of water harvesting, harnessing and conservation, under very complex and trying circumstances. The value of small ruminants, especially goats and sheep increases with increasing harshness of the biophysical environment and decreasing quality of the available feed resources. These species have a multifunctional role to ensure nutritional and food security in the face of rising demand of animal products, incomes and changing food habits of a growing urban population. A different paradigm of development of rainfed/ dryland areas with focus on climate smart crop-animal systems may significantly contribute for future agricultural growth and increased farmers' income. R&D efforts and policies for these ecosystems must aim at sustainable management of already scarce natural resources in order to optimize adaptive mechanism and risk aversion elements. Final destination should be to convert this grey land into green. Paradigm shift in R&D focus with coordinated and cohesive information flow among different stakeholders would be the key to success. Further, there is also a need to explore the strengths of public-private partnerships in extending the watershed approach for development of natural resources in the drought prone areas, attracting more investments for on-farm water harvesting and providing adequate extension and mechanization services to poor farmers. Private sector can also help small and marginal farmers of rainfed regions in the areas of crop insurance and establishment of community seed and fodder banks. A comprehensive and holistic programme rather than stand alone programme is the need of the hour for bringing a positive change.



Panjab Singh
President

103rd Executive Council Meeting

The 103rd meeting of the Executive Council (EC) of the Academy was held under the Chairmanship of Prof Panjab Singh, President, NAAS on February 20, 2018 at Conference Hall, Division of Plant Physiology, IARI, New Delhi. It was attended by 12 EC members and 4 special invitees from IARI namely Dr Ashok K. Singh, Organising Secretary, XIV ASC, Dr D.K. Yadava, Head, Division of Seed Science and Technology, Dr C. Viswanathan, Head, Division of Plant Physiology, and Dr (Mrs) Shelly Praveen, Head, Division of Biochemistry, Dr Anil K. Singh, Secretary, NAAS welcomed the participants, especially the newly elected office bearers and Executive Council members. Prof Panjab Singh extended a warm welcome to all EC members and special invitees and invited the XIV ASC organising team members to update the EC about the status of preparations being made to host XIV ASC-2019. A presentation was made by Dr Ashok K. Singh. All the EC members expressed satisfaction on the status of preparations of this Congress and appreciated the concerted efforts being made by the core group. Subsequently, item-wise agenda was taken-up for discussion. The notable decisions taken by the Executive Council were: Approval to the constitution of Sectional Committees for election of Fellows/selection of Associates for the year 2019, Constitution of Judging Committees for selection of Awardees for the biennium 2017-18, Approval of the proposed programme for AGM and Approval for establishment of a new NAAS Regional Chapter at Varanasi. This will be the 15th NAAS Regional Chapter covering parts of Western and Eastern UP and Bundelkhand.

NAAS Programmes

New Year Get-together

The Academy organized a get-together of Delhi based Fellowship at NAAS complex on January 1, 2018 with Prof R. B. Singh, Past President as the Chief Guest. Others present on the dais included Prof A.K. Srivastava, incoming Vice President, Dr T. Mohapatra, Secretary DARE & DG, ICAR, Dr Anupam Varma, outgoing Vice-President, Dr K. V. Prabhu, outgoing Secretary, Dr J.K. Jena, Secretary, and Dr Anil K. Singh, newly elected Secretary. Dr Jena extended a very warm floral welcome to all the dignitaries on the dais and introduced the newly elected members of EC, Fellowship and Associates present in the house.

Prof R.B. Singh, Past President of the Academy also welcomed the Fellowship and greeted them with best wishes for the New Year, which gives the Academy a perfect chance to start something new and fresh in an innovative manner so as to achieve sustainable growth of agriculture in the country. He further stressed the need to prepare NAAS Fellowship as think tank to address food security, equitable access of food resources, enhancing livelihood opportunities and contributing to economic stability of the people at the end. He lauded the recent initiatives of the Government to resolve the farmers' plight. He exhorted the Fellowship to serve as a strong arm to the Government, especially for the Policy Makers and contribute in developing strategic framework for an active involvement of youth in the development of agriculture on scientific lines.

New Year Get-together of NAAS Fellowship

Dr A. K. Srivastava, Vice President emphasised that the academy must play a role for dissemination of scientific knowledge to public at large. In this context, he referred to the ongoing debate about the nutritional value of both A1 and A2 milk. He highlighted the structural difference in the amino acid chain number 67 of Beta- casein between A1 and A2 milk that features histidine and proline, respectively. The claim that consumption of A1 milk produced by exotic breeds produces harmful health effects is yet to be proved beyond doubt, he asserted. Dr Srivastava was of the view that there is also lack of ample proof that switching to A2 milk intake can make a huge beneficial impact on health and wellness.

Dr T. Mohapatra extended his warm greetings and best wishes to all dignitaries, and NAAS Fellowship for participation in this important New Year get-together event. He also congratulated incoming Vice President, Secretary, Editor, Fellows and Associates. He lauded

the role of NAAS in providing continued guidance to the Government, ICAR and various scientific bodies. He recalled the achievements and significant contributions of ICAR in the areas of food, pulses, oilseeds, milk and horticulture production. He highlighted prevailing malnutrition in the country as a serious concern despite impressive progress in agricultural production and subsidized availability of food to the target population. He also mentioned that the mechanism of fixing minimum support price (MSP) and procurement of major crops at MSP need to be strengthened to ensure that farmers get the benefit of the support prices. Dr Mohapatra pointed out that ICAR is continuously working to tackle the challenges faced by the agriculture sector in a holistic manner through its research programmes. In this context, he appreciated the valuable contribution of the scientific community despite financial constraints.

Release of Academy Publications

Several fellows expressed their views in the open discussion and gave valuable inputs on the various issues related to Rating of the journals, Distress of farmers, General IPR policy, Farmer guided policies, Impact of Policy Papers, Concept of seed hub, Threats of bio-safety, Post-harvest Management and Integration of Production value chain, Projecting the independent view of Academy in print media, Doubling farmers' income and Marketing of new crops.

On this occasion, Academy's Strategy/Policy Papers, NAAS Yearbook 2018, NAAS-NEWS October-December 2017, and NAAS Planner 2018 were also released. The programme ended with a vote of thanks by Dr Anil K. Singh, Secretary, NAAS.

Policy Dialogue on Innovations in Ensuring Remunerative Prices (MSP) to Farmers: Challenges and Strategies

Ensuring remunerative prices to the farmers is one of the several pathways to achieve the objective set by the Government of India to double the Farmers' income by the year 2022. The Government of India has accepted long awaited demand of the farmers regarding the new minimum support price (MSP) at 1.5 times more than the cost of production in the Union Budget 2018. It appears that Cost A2 + FL to be paid as MSP covers the cost of production, interest on working capital, and imputed value of unpaid family labor. The government has also announced the development of mechanisms to ensure that farmers receive at least MSPs of their produce. To make the proposed policy effective, government proposes to develop and up-grade 22,000 agricultural markets (*Grameen* Markets), to link these with the APMC (Agriculture Produce and Market Committee) *mandis*, and e-NAM (electronic-National Agriculture Market) so that the benefits of the new price policy penetrate to the last mile.

The NAAS in collaboration with IFPRI and ICAR organized a policy dialogue on "Innovations in Ensuring Remunerative Prices (MSP) to Farmers: Challenges and Strategies" on 23rd March 2018 to enlist possible ways of ensuring remunerative prices, and explore feasible solutions of improving the existing institutional and market arrangements. Dr Rajiv Kumar, Vice Chairman, NITI Aayog was the Chief Guest in the inaugural session, which was chaired by Dr T. Mohapatra, Secretary, DARE & DG, ICAR. The key note address on Global Food Policy Report-2018 was given by Dr Shenggen Fan, DG, IFPRI after its release. It was attended by progressive farmers, policy makers, scientists, NAAS Fellowship and other stakeholders. The policy dialogue deliberated on various issues related to minimum support prices and alternative ways of ensuring remunerative prices to the farmers. Based on the Panel Discussion on MSP to Farmers: Challenges & Strategies, and presentations/ deliberations on the New MSP and its Implications, New Institutional Arrangements, Market Instruments and Collective Action for Ensuring Remunerative Prices, the following issues were underpinned with action points:

Release of IFPRI Global Food Policy Report - 2018

New MSP and its Implications

The origin and aim of MSP was to provide guaranteed prices to the farmers in the event of glut in the market. It is

important to make market driven economy by improving market efficiency, strengthening agro-processing and promoting trade. It is not possible for the government to handle so many crops to procure at MSP, therefore institutional innovations, agri-infrastructure and private sector will play important role in future. The role of the government should be to ensure that farmers are not exploited and share due benefits of opportunities in domestic and global markets.

There are apprehensions that higher MSPs will be disincentive for production of non-MSP crops. This policy distortion will generate surplus of MSP crops at the cost of non-MSP crops. A strong market structure that assures remunerative prices coupled with effective crop insurance can provide income insurance to the producers of non-MSP crops.

New Institutional Arrangements

Deficiency price mechanism is always cited as one of the ways to compensate farmers in the event of prices falling below MSP. The Government of Madhya Pradesh has piloted the scheme '*Bhavantar Bhugtan Yojana*' (*Price deficiency payment scheme)* for few commodities during the last monsoon season. The scheme is still at pilot stage and needs corrective measures in its implementations. There are some media reports that traders are suppressing the prices but no such evidence has been observed with large participation of sellers and buyers. The scheme appears to be cost effective as there is only 2% procurement cost compared to FCI's 15%.

Market reforms are needed to integrate markets and connect with smallholders. Karnataka model of electronic agricultural marketing platform with NCDEX spot exchange is a success. At national level, e-NAM (electronic-National Agricultural Market) is based on similar pattern to connect buyers and sellers. Farmers appointed aggregators for marketing will help in consolidating produce for trading in e-NAM or any remunerative market.

Market Instruments

To develop new market architect, there is a need to invest in creating market infrastructure, especially to develop wet and cold storage, cold chains, and agri-packers and movers. Studies have shown that smallholders gain more during post-harvest period, if adequate storage and transport facilities are available

Warehouse receipt is one way of postponing sale of food commodities to realize higher prices. Unfortunately, very few warehouses (980) have registered with the Warehouse Development and Regulatory Authority (WDRA) out of 20,000 warehouses, storing nearly 20 thousand tonnes of food commodities. There is a need to have more warehouses so that farmers can take advantage of warehouse receipt to defer the distress sale.

Global experiences reveal that futures trading is an effective tool of price discovery. Unfortunately, farmers, especially small and marginal farmers, are unable to participate in futures trading due to lack of knowledge, and meager marketable surplus. Therefore, there is a need to educate framers about the benefits of futures trading and mechanisms to aggregate their produce for taking its advantages.

Liberal export and careful import of agri-food commodities will help framers to share some benefits of global opportunities. Stable trade policy, effective global food outlook monitoring mechanism and responding to taste and preferences of importing countries will signal farmers to decide their production portfolio for harnessing the global opportunities.

Collective Action

Majority of the farmers in India are marginal and small with meager marketed surplus. Their marketing and transactions costs are very high. Therefore, most of the farmers dispose their produce to the village traders at lower than MSPs or wholesale prices in main *mandis.* Collective action in transport and marketing is therefore, necessary to reduce the transactions and marketing costs and realize the wholesale prices.

Cluster farming linked with self-help group will benefit more if produce is transported to remunerative markets. Cluster farming helps in improving bargaining power, market access, and price realization.

Contract farming, if implemented effectively, ensures better prices to the framers. Government of India has prepared a model Contract Farming Act to overcome various problems in contract farming. It has protected the interests of farmers.

The Way forward

Following suggestions emerged to strengthen the government policies to assure better realization of remunerative prices to farmers:

1. Ensure procurement of agricultural commodities at MSPs through a strong network of collection centers for different commodities. The procurement can be done either by the public or private sector. Deficiency price model can also be tried to compensate farmers when farm harvest prices fall below MSPs.

2. Engaging private sector will be important but appropriate and transparent mechanisms are to be evolved to check leakages.

3. There is a need to reduce market inefficiencies. Consumers are already paying much higher prices than the MSP. This is an indication of huge inefficiencies in marketing system. More institutional reforms are needed to contract supply chains so that farmers get larger share in retail prices.

4. There is a need to transform marketing arrangements for improving market efficiency by strengthening existing institutions, like FPOs, contract farming, cooperatives, and self-help groups (SHGs). These institutional arrangements will help in aggregating farmers' produce to reduce transactions costs and access remunerative markets.

5. Significant investment in agri-infrastructure is needed to make markets accessible to the farmers. Investment in developing agricultural markets, warehouses, cold storage, cold chains and transport will integrate farmers with the remunerative markets.

6. Universal price policy will not solve the problem of price volatility. There is a need to classify commodities according to their status. These may be classified as: (1) commodities required for social safety net program (e.g., rice and wheat), (2) surplus but not needed by the government (e.g., maize, coarse cereals), (3) deficit commodities but available in the global markets (e.g., edible oil), (4) deficit commodities and not available in the global markets (e.g., pulses), and (5) perishable commodities (e.g., fruits and vegetables). For each group, different price and trade policy will be needed.

7. Pro-farmer trade policies need to be implemented for better price realization. Farmers need to be integrated with the global markets for commodities where country has comparative advantage. There is a need to identify commodities and niche markets for tapping the global opportunities.

8. Role of artificial intelligence (AI) will be helpful in effectively monitoring and forecasting the prices of agri-food commodities. Establishing monitoring and forecasting units at state and national level will help in taking informed decision well in advance.

It was concluded that higher MSP will be important in raising farmers' income in the short-run, but price-driven growth may not be sustainable in the long-run. In future, technology will play key role to drive farmers' incomes. Technology-led income growth will make agriculture more efficient, competitive and sustainable.

Activities organized by the Regional Chapter

Hyderabad Chapter

President, NAAS at the Hyderabad Regional Chapter Meeting

An interactive meeting of National Academy of Agricultural Sciences (NAAS), Hyderabad Chapter was conducted at ICAR-National Academy of Agricultural Research Management, Hyderabad on 12th January 2018. The meeting was Chaired by Prof Panjab Singh, President, NAAS and some of the Hyderabad based NAAS Fellows attended the meeting. The faculty members from NAARM also attended the meeting. The event was coordinated by Dr S. K. Soam, Joint Director (I/c), NAARM. Dr Sammi Reddy, Director, CRIDA presented the activities done by Hyderabad Chapter. Following are the major recommendations:

- More visibility to NAAS through collaborations with local ICAR institutions and other organizations.
- Localized policy level research studies may be conducted by NAAS Fellows.
- Contribution to national level planning and policy activities, which are of current national requirement.
- Expertise of the retired NAAS Fellows to be harnessed pro-actively.
- The regional chapter to be more proactive in conducting several activities related to local farming/farmers needs.

Towards a More Climate Resilient Agriculture

Dr K. Sammi Reddy
director.crida@icar.gov.in

Climate change is manifested in terms of rising temperatures, more variable rainfall patterns, rise in sea level, increased frequency of extreme climatic events such as drought, floods, cyclones, heat wave, etc. Though it is a global phenomenon, the impacts are more inequitable in the sense that developing countries will be more affected. India, being a developing country with a large population depending on agriculture, will be more affected by climate change as it affects agriculture directly through crop yields and indirectly by influencing water availability and changes in pest and pathogen incidence.

The predicted temperature rise for India is in the range of 0.5-1.2°C by 2020, 0.88-3.16°C by 2050 and 1.56-5.44°C by the year 2080. India is a signatory to various international bodies such as UNFCCC related to climate change. Both the domestic requirements to meet the growing food, fibre and industrial needs of the country sustainably as well as the obligations flowing from being part of international fora make it necessary to take steps towards adaptation and mitigation. The First and Second National Communications submitted to UNFCCC reflect what the country is doing in terms of dealing with climate change.

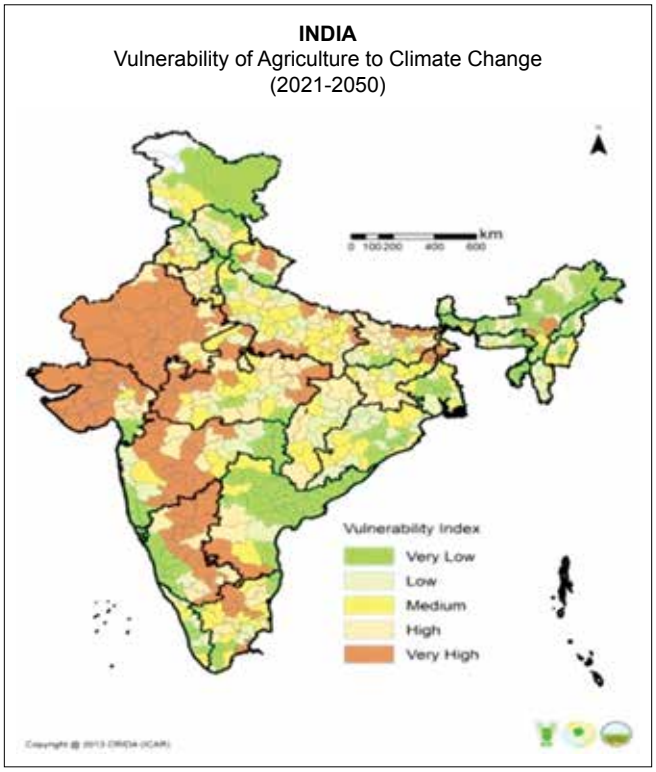
With this background, the Indian Council of Agricultural Research (ICAR) launched a flagship network project '*National Initiative on Climate Resilient Agriculture*' (NICRA) during XI Plan in February 2011, and during XII Plan it was rechristened as '*National Innovations in Climate Resilient Agriculture*' (NICRA). The major objective of NICRA is to enhance the resilience of Indian agriculture, covering crops, livestock and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies; demonstrate the site specific technology packages on farmers' fields for adapting to current climate risks; and enhance the capacity of scientists and other stakeholders in climate resilient agricultural research and its applications.

NICRA has created some of the state-of-art facilities established for the first time in Asia. A huge number of genetic resources were collected in target crops viz., rice, wheat, maize, pigeonpea, chickpea, black gram, green gram, tomato and mango and work on phenotyping for characterization of the germplasm is under progress at different partner institutes. Some of the promising genotypes identified so far have been used in genetic enhancement for new varieties and hybrids that can withstand climatic stress like drought, heat, flood etc. Country-wise studies on effect of temperature on flowering behaviour in mango led to development of a spray formulation with agro-techniques to overcome synchrony of flowering. The issue of drought and flood in tomato has been addressed through inter-specific grafting of tomato using location specific brinjal rootstocks for different scion combinations of tomato varieties/hybrids.

A nation-wide climate induced pest and disease outbreaks in the target crops was carried out for the past five years. With this database, it is possible to build pest and disease forewarning models that will help in timely initiation of location specific pest control advisory. Efforts have been underway to characterize heat stress induced genes in different livestock breeds for validating unique genes and proteins that can be used as biomarkers of climate resilience. Mapping unique traits in livestock and poultry, development of several technologies for feed, breed and shelter management to cope with heat stress and diseases in animals are some of the major achievements. Relationships were established between sea surface temperatures and catch/spawning in major marine fish species. Simulation modelling was used for assessing climate change impacts at regional and national level. Integrated modelling studies using 54 General Circulation Modules (GCMs) indicate that rise in minimum temperature is likely to be more than rise in maximum temperature. It shows that temperature may increase more in northern India compared to south, also temperature to increase more during *rabi* than during *kharif*. However, rainfall amount and variability will increase more during *kharif* than *rabi*. It is estimated that a rise of 1°C in mean maximum and minimum temperature for vegetative and grain filling periods can reduce wheat yield by 360 and 265 kg per ha respectively. Changes in soil organic carbon in different cropping systems, soil loss in different river basins, water foot prints and ground water table at different locations for different Representative Concentration Pathways (RCPs) have been estimated through modelling studies.

Coordinated research efforts on GHG emissions resulted in standardized protocols for their measurement across

different cropping systems and production systems. Carbon sequestration potential of different agro forestry systems across the country was quantified. Adaptation and mitigation potential of different conservation and agricultural practices was assessed through experiments across different production systems. The first ever district level vulnerability atlas of all the 572 rural districts has been completed. It is proposed to revise and update these Atlas considering CMIP-5 climate projection data. Efforts are under way to identify and fine tune NRM technologies viz., Biochar, Conservation agriculture and Emission reduction through Efficient energy management that offer adaptation and mitigation benefits.



The Real-Time Contingency Plans (RTCP) were conceptualized and implemented through double-pronged approach i.e. preparedness and real-time measures. Contingency plans, for each district, were the unique conceptual approach in developing location specific contingent strategies for crops, livestock, poultry and fisheries. This approach has identified 5 weather aberrations: i) delayed onset of monsoon; ii) early withdrawal of monsoon; iii) intermittent dry spells of various durations; iv) prolonged dry spells causing changes in the strategy; and v) prolonged monsoon. Introduction of short duration varieties of various crops to cope with delayed onset of monsoon resulted in yield increase up to 20%. Real-time contingency measures to cope with early/midseason/terminal drought enhanced yield by up to 25-40% across different rainfed production systems. Technology Demonstration Component (TDC) of NICRA is being implemented in farmer participatory mode in climatically most vulnerable districts of the country through 121 *Krishi Vigyan Kendras* (KVKs) spread across 28 States and 1 Union Territory. The objective of this component is to enhance resilience in agriculture of the country by demonstrating site specific climate resilient agricultural practices. Many interventions have been successfully demonstrated and farmers have shown keen interest in following those practices to cope with climate variability. The interventions are categorized into four major modules viz., Natural resource management, Crops and cropping systems, Livestock and fisheries and Institutional interventions.

One component of NICRA created over 80000 m^3 additional rainwater storage capacity through farm ponds alone and the cropping intensity increased by about 20%. *In-situ* moisture conservation through ridge furrow and raised bed planting in soybean, cotton, maize, pigeonpea, short duration pulses, vegetables, wheat, mustard, sugarcane, potato and vegetables resulted in higher benefit: cost ratios (2.6 to 4.7). Adoption of *in-situ* moisture conservation measures in crops was helpful in improving the soil moisture availability at the root zone (30-40 days) and eventually increased the productivity of crops by 15-20% in dry regions of the country in comparison to the traditional farmers practices.

Demonstration of short duration and stress tolerant cultivars and resilient intercropping systems in place of sole crops contributed to stabilizing productivity in vulnerable districts which tolerated dry spells up to 25 days without impact on yields. Farmers realized yield advantage and higher net incomes with intercropping of the main crops such as cotton, pearlmillet, pigeonpea and soybean ranging from Rs. 9000 to Rs. 12000/ha. Contingency crops such as sesame, castor, black gram, pigeonpea, sunflower, foxtail millet, pearl millet, horse gram and basmati rice were adopted by farmers at different locations. Average increase in crop yield in famers' fields was found to be 25-30% over that of the conventional varieties grown by farmers.

Livestock farmers were encouraged to take up fodder cultivation of sorghum and pearl millet in *kharif*, and oats (JHO 822) and berseem (Vardan) in *rabi* to enhance fodder production by 22-25% more than the local varieties. Increase in availability of quality fodder throughout the year increased milk production by 39%

and farmer's income increased by Rs. 70/day/ animal. Demonstrations showcased efficiency of integrated poultry cum fisheries production in farm ponds impounded with harvested rainwater. Efforts are also on to demonstrate the positive impact of improved housing for cattle and poultry in terms of withstanding heat/cold stress in vulnerable areas. Awareness is also being created about the vulnerability of livestock population and inland fisheries activity to climate change among the farmers and fishermen by conducting campaigns and workshops. Specific issues in livestock health management are being addressed by converging with the local animal husbandry departments.

Strength of the project was institutional interventions viz., Village Level Climate Risk Management Committees (VCRMC) and Custom Hiring Centres for farm implements. The former was helpful in taking decisions on choice of technology as well as for implementation and to run the custom hiring centres established to facilitate access to improved farm implements critical to adopt certain technologies. There were also efforts to promote seed and fodder banks which are important constituents of safety net mechanisms. A number of sensitization and training programmes were conducted for farmers and other stakeholders on how to deal with changing climate. NICRA has brought out a policy document on Custom Hiring Centres after thorough deliberations among various stakeholders such as public, private, and non-government organizations those who have experience of running custom hiring centres.

A number of successful interventions that were found quite useful in enhancing climate resilience to be scaled-up through various development programmes funded by state and central governments. This requires investments in collaborations and convergence among various organizations responsible for technology transfer supported by adequate financial support by the governments concerned. The Government of Maharashtra has already launched a world bank funded mega Project on Climate Resilient Agriculture (PoCRA) built largely on NICRA-TDC component. Similarly, the research initiatives have to be taken through their logical course with adequate support from the policy makers.

Fellows Views

Achieving Malnutrition Free India

On the occasion of the International Women's Day on 8th March, our Prime Minister launched a National Nutrition Mission covering all the 640 districts of the country. To achieve the goals of the National Nutrition Mission, the following five areas need concurrent attention.

1. Overcoming calorie deficiency through the effective use of the provisions of the National Food Security Act 2013.
2. Overcoming protein hunger through the increased production and consumption of pulses, milk and poultry products.
3. Overcoming hidden hunger caused by micro nutrient deficiency through the establishment of genetic gardens of bio fortified plants and promoting a Farming System for Nutrition programme.
4. Ensuring the availability of clean drinking water, sanitation and primary health care.
5. Developing a cadre of Community Hunger Fighters who are well versed with the art and science of malnutrition eradication.

If all the above five areas are attended to concurrently, we can achieve the goal of the National Nutrition Mission.

M S Swaminathan
founder@mssrf.res.in

Climate Change and Agriculture

Climate change is now a reality as the recent occurrences of extreme weather events at the global level have indicated. As many as 21 Commonwealth Science Academies that included Britain's Royal Society and India's Indian National Science Academy have therefore signed a Consensus Statement on Climate Change released on 12th March 2018, the Commonwealth Day. It states, besides the main issues of worst impacts of climate change, that increased atmospheric CO_2 could be beneficial for increased plant growth. But at what cost such effects would lead to? It seems this could be a frontier research activity for agricultural scientists to determine by conducting experiments on different crops in greenhouses or other devices that can simulate increased levels of atmospheric CO_2.

Plants take energy from the sun, inhale CO_2 from the air and convert water from the soil into sugars and oxygen. With the associated rise in atmospheric CO_2 due to climate change, increased yields are expected due to

increased photosynthesis in C_3 category of plants like wheat, rice etc. Such crops may then be packing more of carbohydrates in grains at the expense of protein and other essential elements. This could be detrimental in the long run to produce what are known as junk plant foods. For C_4 category of plants like maize, sugarcane, sorghum, millets etc. the photosynthetic rates are, however, not expected to increase as much as those in C_3 category.

Prem Narain
premn877@gmail.com

Nanotechnology and Environment

The European Commission has recognized nanotechnology as one of its six "Key Enabling Technologies" that will contribute to sustainable competitiveness and growth in several sectors. In agricultural sector too, it is touted to usher in the second green revolution. Nanotechnology would allow targeted material delivery to plants, enable hi-tech biosensors for precision farming, provide early warning systems for pest and disease management, and bestow a slew of nanoencapsulated fertilizers, pesticides and herbicides that would allow sustained release of agrochemicals to the plants. These benefits notwithstanding, nanotechnology has spurred concerns about the potential adverse effects of nanoparticles (NPs) on the environment. Once released, there are no mechanisms to recall them, their fate in the environment is still a mystery and their capacity for bio-accumulation, bio-excretion and health ramifications for humans, plants, microorganisms, and other life forms are still unknown. It is, therefore, imperative to heed to the principle of safety-by-design by developing models to foresee the fate and ecotoxicity of NPs, generate exhaustive toxicology data, and establish safety standards for the environment and employ only those nanotechnologies that are considered safe.

R Dinesh
rdinesh2005@gmail.com

Science Technology and Spectrum

Hawking's search for a unified theory for everything!

Regarded as the most brilliant theoretical physicist since Albert Einstein, Prof Stephen Hawking, aged 76, died on March 14, 2018 at his home in Cambridge, England. He left behind a rich intellectual legacy that will dominate theoretical physics for years to come. His theories unlocked a universe of possibilities by bringing together general relativity and quantum theory, which describes how sub-atomic particles behave to come up with a grand unified theory for everything that would, as he put it, "provide a complete understanding of the universe". With Roger Penrose he showed that Einstein's general theory of relativity implied space and time would have a beginning in the Big Bang and an end in black holes. These results indicated that it was necessary to unify general relativity with quantum theory, the other great scientific development of the first half of the 20th century. One consequence of such a unification that he discovered was that black holes should not be completely black, but rather should emit 'Hawking' radiation and eventually evaporate and disappear. For normal-sized black holes, the process is extremely slow, but miniature black holes would release heat at a spectacular rate, eventually exploding with the energy of a million one-megaton hydrogen bombs. His proposal that black holes radiate heat stirred up one of the most passionate debates in modern cosmology. Hawking argued that if a black hole could evaporate all the information that fell inside over its lifetime would be lost forever. It contradicted one of the most basic laws of quantum mechanics, and many of physicists disagreed. Hawking came round to believing the more common explanation that information is stored at a black hole's event horizon and encoded back into radiation as the black hole radiates. Recently, he has been working with colleagues on a possible resolution to the black hole information paradox, where debate centres around the conservation of information. In *A Briefer History of Time*, Hawking concluded that "if we do discover a complete theory of the Universe, it should in time be understandable by everyone, not few scientists… If we find the answer to that, it would be the ultimate triumph of human reason— for then we would know the mind of God."

(Source: Dr Kusumakar Sharma, NAAS Fellow)

Awards & Honours

Dr S. Ayyappan, Past President NAAS and Former Secretary, DARE and DG, ICAR has been appointed as Chancellor, Central Agricultural University, Imphal.

Forthcoming Programmes

1. Strategy Workshop on Harnessing Full Potential of A1 and A2 Milk in India (Convener: Dr A.K. Srivastava)
2. Strategy Workshop on Development and Adoption of Novel Fertilizer Materials (Convener: Dr (Ms) C. Varadachari).
3. Strategy Workshop on Microbiome of the Rumen and Mitigation of Methane Production (Convener: Dr D.N. Kamra)
4. Strategy Workshop on Renewable Energy : A New Paradigm for Growth in Agriculture (Convener: Dr O.P. Yadav)
5. Policy Brief on Need for Uniform Policy for Fish Disease Diagnosis and Quarantine (Convener: Dr P.K. Sahoo)
6. Brainstorming Session on Biotic Stresses (Convener: Dr R.K. Jain, Co-convener: Dr R.K. Singh)

Change of Addresses

Dr A.R. Sharma, Principal Scientist (Agronomy), ICAR-Indian Agricultural Research Institute, Pusa, New Delhi 110012; Cell: 09425807290; Email: sharma.ar@rediffmail.com

Dr K.C. Bansal, Former Director, NBPGR, A-81, Carlton Estate 4, DLF Phase 5, Sector 53, Gurgaon 122001, Haryana; Cell: 9999105667; Email: kailashbansal@hotmail.com; kcbansal2001@yahoo.com

Dr J.S. Sandhu, Vice Chancellor, Narendra Dev University of Agriculture & Technology, Kumarganj, Faizabad 224229, U.P.; Tel.: Off. (05270) 262161; Res. (05270) 262842, Cell: 9582898978; Email: vcnduat2018@gmail.com, js_sandhuin@yahoo.com

Dr G.P. Mishra, Senior Scientist (Genetics and Plant Breeding), Division of Genetics, ICAR-Indian Agricultural Research Institute, Pusa, New Delhi 110012; Tel.: Off. (011) 258414817; Cell: 8140128622; 7317373679; Email: gyan.gene@gmail.com; gyan.mishra@icar.gov.in ***(Associate)***

Announcements

XIV Agricultural Science Congress

The NAAS in collaboration with the ICAR and IARI will be organizing XIV Agricultural Science Congress (ASC) at New Delhi from February 20-23, 2019 on the theme “Innovations for Agricultural Transformation”. The four-day event will include technical sessions, plenary sessions, public lectures, farmers sessions, poster presentations, inter-university student elocution contest, panel discussions and number of satellite meetings. The ASC- AgriTech-2019 will be a major associated event.

The National Academy of Agricultural Sciences has opened its account on social networking platforms viz. Facebook, Twitter, LinkedIn and YouTube. The Fellowship may access them through Academy website: www.naasindia.org

Obituary

Dr Yeshwant Laxman Nene (Dr Y. L. Nene) was born in Gwalior, India on 24th November, 1936. He received school and college education at Gwalior. For higher education he joined College of Agriculture, Kanpur and subsequently University of Illinois, Champaign, Urbana, Illinois, USA.

Dr Nene founded the Department of Plant Pathology at GBPUA&T, Pantnagar in 1960 as Professor and subsequently headed the Department from 1969-1974 before joining ICRISAT. At ICRISAT, he served as Principal Plant Pathologist (Pulses) from 1974-80, became Leader, Pulses from 1980-86, Director, Legumes 1986-89 and Deputy Director General from 1989-96. During his 14-year tenure at GBPUA&T, Pantnagar, he proved himself as a highly successful, valued, innovative and creative scientist. His path breaking research on the cause and management of Khaira disease in rice could easily be considered as the major discovery during the pre-green revolution period that influenced the agricultural production and human beings to a great extent. His wisdom and insight made Dr Nene unique as an agricultural scientist, a philosopher, a mentor and a true nationalist. His admirers recall him for his seminal contribution as a magnificent teacher, a proficient researcher, visionary leader and a person with obsessive human values. His contributions in modern agricultural sciences, especially Plant Pathology as well as in deciphering the Indian agricultural heritage are tremendous, which will serve as the foundation for future research for development in agriculture. He also served as Founder Chairman, Asian Agri-history Foundation, Secunderabad from 1997-2013.

He was honoured with several national and international recognitions and awards. Some of them are FAO International Rice Year Prize, 1967; D.Sc. (h.c.), GBPUA&T; OP Bhasin Award, 1991, Indian Society of Pulses Research and Development Gold Medal, 2001; Pest Control Association of India, Lifetime Achievement Award, 2005; Indian Phytopathological Society AP Misra Lifetime Achievement Award, 2008-09.

He was elected Fellow of National Academy of Agricultural Sciences in 1992 and was also fellow of American Phytopathological Society; Indian Virological Society; Indian Society of Mycology and Plant Pathology, Indian Society of Plant Pathologists and Indian Phytopathological Society.

He left for his heavenly abode on January 15, 2018 at Hyderabad. It is a tragic loss to the Academy and the country has lost a very valuable and high calibre scientist. The entire Fellowship mourns his demise and pays homage to the departed soul.

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

Published by: Dr Anil K. Bawa, Executive Director on behalf of the National Academy of Agricultural Sciences, NASC, Dev Prakash Shastry Marg, New Delhi 110012; Tel. (011) 25846051-52, Fax. 25846054; Email: naas@vsnl.com; Webside: http://www.naasindia.org