



Seed Connect

A monthly newsletter of Federation of Seed Industry of India



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On August 27th 2020, National Bureau of Plant Genetic Resources (NBPGR), Alliance of Bioversity International and CIAT under UN Environment implemented GEF project, Indian Society of Plant Genetic Resources (ISPGR), National Biodiversity Authority (NBA), Protection of Plant Variety and Farmers' Rights Authority (PPV&FRA) and Trust for Advancement of Agricultural Sciences (TAAS) jointly organised a National Webinar on Implementation of Access to Plant Genetic Resources and Benefit Sharing (ABS).

This webinar was attended by more than 200 participants from around the world. All relevant stakeholders such as NBA, ICAR, NBPGR, PPVFRA were represented by their heads, seed industry, legal experts and academia participated in this meeting and presented their views. India is a signatory to the international treaties, Convention on Biological Diversity (CBD) as well as International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and is a forerunner in the adoption of benefit sharing principle. India enacted Biological Diversity Act (BDA) in 2002 and established the National Biodiversity Authority (NBA) in 2003. Therefore the discussion around implementation of ABS in India and globally, has been happening since a very long time. The National Webinar however, has been very aptly timed.

A fair benefit sharing mechanism is critical for the growth of seed industry. Through a robust ABS mechanism, seed industry is able to access the genetic resources and pay a fixed percentage of sales after commercialization. In this webinar, the Federation of Seed Industry of India proposed that the ABS mechanism be governed by the ITPGRFA under the Ministry of Agriculture as it is the most appropriate authority for the seed sector. Also, it was requested to bring more crops under the multi-lateral system. We will be sharing the proceedings of the webinar when they become available.

We have also covered several important developments on agriculture across India, globally and in the area of research in this newsletter. Please refer to our section '[Thought & Views](#)' where we have interviewed Dr S. Rajendra Prasad, Vice-Chancellor, University of Agricultural Sciences (UAS), Bangalore. We hope you find it a good read!



Shivendra Bajaj
Executive Director
Federation of Seed Industry of India

News from India

[Self-reliant farmers a key to make India Atma Nirbhar: PM Modi at Red Fort](#)

(Live Mint)

Prime Minister Narendra Modi said making the agriculture sector and farmers self-reliant was a key to make India self-reliant. The government has set up a ₹1lakh crore agriculture infrastructure fund to give modern infrastructure to farmers. Modi said the government had taken steps to ensure that farmers will be able to get better pay for their produce along with selling wherever they want. He further said that a farmer in this country could not sell as per his terms. We have reduced those burdens now. A farmer can now sell on their own terms. We have also worked on increasing the pay for farmers. We have tried to take steps to reduce input costs. The need of the hour is that our farming sector including food processing, packaging be stronger. For this the Indian government has allocated ₹one lakh crore to an agriculture infrastructure fund to give modern infrastructure to farmers.

[Worst seems to be over for India, now farm sector will wipe out some pain: FinMin report](#)

(The Financial Express)

After Prime Minister Narendra Modi announced a nationwide lockdown to arrest the spread of coronavirus, India's economy trembled in the month of April. While the businesses and industries came to a standstill, the economy struggled for revenue sources. However, the worst may now be over for India and the road ahead will take the economy back on the track. With India unlocking, the worst seems to be over as high-frequency indicators show an improvement from the unprecedented trough the economy had hit in April 2020 as indicated in the monthly macroeconomic report by the Department of Economic Affairs.

[Seed war? Centre alerts states about unsolicited parcels](#)

(The Financial Express)

Even as the novel coronavirus doing the rounds around the globe fuelled unsubstantiated theories of germ warfare, a new threat is being perceived of foreign seeds harming India's food chain and biodiversity. The Centre has alerted state governments, agriculture universities, seed associations, certification agencies and research institutes under Indian Council of Agricultural Research (ICAR) to remain vigilant as unsolicited seeds reaching the country via courier. Mr Ram Kaundinya director general of Federation of Seed Industry of India (FSII) said that right now it is only an alert for a possible spread of plant diseases through seeds coming from unauthorised sources without orders. Seed terrorism is too big a word to use for it. There are limitations to what diseases a seed can carry. But nevertheless, it is a threat. He said everyone should be careful not to use any seed coming from

unknown sources while plant quarantine and customs checks at ports and airports have to be stringent.

[Kisan Rail Service For Carrying Perishable Farm Produce Begins](#)

(NDTV)

The Railways began the Kisan Rail service to transport perishable items. In good news for farmers, this is the first train service, carrying vegetables and fruits, running between Devlali in Maharashtra and Danapur in Bihar, the Railways said. Finance Minister Nirmala Sitharaman had announced plans to start Kisan Rail, in her Budget, earlier. It is aimed at seamless supply chain of perishable farm produce and these trains with agricultural products will run on a weekly basis. It will primarily cover regions that produce huge quantities of vegetables, fruits, flowers and other perishable items.

[ICAR centre to bring cloud computing and AI to farming](#)

(Live Mint)

Taking a significant step towards 'digital farming', the Indian Council of Agricultural Research (ICAR) has set up a new centre equipped with the latest deep learning software, AI platform and cloud computing infrastructure in Hyderabad. This will enable farm scientists in identifying pests in standing crops through image analysis and then providing vital required advisory services to farmers from anywhere in the country.

[Importance of technology in Indian agriculture](#)

(SME Times)

Indian civilisation is one of oldest civilisations in the world and similarly Indian agriculture is also of the same age. Ancient Indian farmers were quite rich because agriculture was the most advanced and prestigious occupation of that time. Fifty per cent of the population is still dependent on agriculture and occupations related to agriculture. Indian traditions, customs and religious culture were adversely affected along with agriculture due to foreign invaders and rulers and our advanced agriculture lagged behind as compared to other countries.

[Adani Calls For Leveraging New Technologies To Transform Agriculture](#)

(Business World)

Chairman of Adani Group called for cluster-based policies and adoption of digital technologies to promote agriculture and food processing units across the country. Cluster policies are crucial for small-scale farmers and agri-business, he said while addressing students at the Institute of Rural Management here. It enables them to achieve higher productivity, higher value-added production and minimise the back-breaking costs of logistics, storage, wastage and interference from the middlemen. Therefore, an agri-based cluster will be a set of local farmers, agri-businesses and institutions that are engaged in the same agricultural or agri-industrial sub-sector and work together to build value networks. Recent advances in areas like digitisation, seed quality and weather forecasting, combined with smart policymaking and general public awareness have opened up the agriculture sector in several ways.

[Can agritech fix India's fragmented farm-to-fork supply chain?](#)

(Money Control)

Driven by Covid-19 and market reforms, existing traditional players will invest in digital technologies for agriculture, which they hadn't done before. In addition, there is renewed investor interest in the sector driven by the attractiveness and resilience that an essential services sector brings with it. The demand side of agriculture, which has been fairly consistent and predictable, has been affected due to the lockdowns and changing consumption patterns such as avoiding eating out.

[Is India's Millets Policy Headed in the Right Direction?](#)

(The Wire)

The year 2023 will be observed as the International Year of Millets, following India's proposal to the Food and Agriculture Organization, which was approved in at the 160th session of the FAO Council in December 2018. Through decades, the country has enjoyed a rich association with millets, though the Green Revolution favoured rice and wheat. Millets survived, thanks to cultural traditions, but came to

be known as “coarse grains.” Today, millets are returning to farms and fields as a result of national and state-level initiatives. Termed as nutri-cereals, millets are finding favour among farmers for being climate-smart crops that are drought resistant, growing in areas with low rainfall and infertile soil.

['Agriculture and Atmanirbharta' Is a Noble Vision, but Needs Hard Decisions and Political Consensus](#)

(The Wire)

In January 2012, Commission for Agriculture Cost and Prices under Dr Ashok Gulati had submitted a report titled 'Oil Palm: Pricing for Growth, Efficiency & Equity – Towards a Rational Pricing Policy for Fresh Fruit Bunches and Potential Solution for India's Burgeoning Edible Oil Imports'. It was noted that one million hectares under oil palm can produce edible oil equivalent to 15 million hectares under other mix of oilseeds. One of the recommendations was to keep the import duty trigger at US\$ 800/MT. If domestic prices fall below US \$ 800 per tonne, the import duty needs to be increased so as to protect Indian producers. The recommendations and the road map suggested by CACP are still valid. The farmers can meet India's food requirement till 2032-33 provided they get support in the form of good seeds and other inputs and they are protected against cheap imports. The price of imported edible oils at Indian ports should never be lower than the Minimum Support Price for oil-seeds. The allocation of budget for promotion of oil-seed cultivation needs to be substantially increased if farmers of North West Indian States have to be incentivised to switch from wheat, rice and sugar cane to oilseeds.

['India must guard dairy, farm sector in trade pact with US'](#)

(The Hindu Business)

India must not give concessions in the agriculture and dairy sectors to the US in the mini-trade deal being negotiated and the subsequent proposed free trade agreement (FTA) as farmers' livelihoods could be severely hit when faced with competition from cheap and subsidised imports, some trade experts and farmer organisations have cautioned. India needs to be watchful in the next few months till the US Presidential elections in November 2020 as the US might increase pressure for concluding the mini-trade deal with concessions for its farmers, who were a big vote-bank for the Trump regime, warned Devinder Sharma, food and trade policy analyst.

[Accelerating the Growth of Smart Farming with Agri-tech in India](#)

(Dataquest)

Niche agri-tech startups are leveraging the latest technologies including artificial intelligence, machine learning, big data analytics, blockchain, drones, GIS, and Internet of Things (IoT) to solve pressing problems that have been plaguing the agriculture industry in India. From supply chains to more basic issues such as the quality of seeds or soil, scarcity of water, lack of storage facilities, and poor access to market, the agri-tech startups are helping the Indian agriculture sector overcome these hurdles. Apps using IoT and sensors help determine wind speeds as well as moisture content of the soil. Further, they help monitor the health of the crops. In India, there are over 450 technology startups focused on agriculture—also known as agri-tech startups—that are growing by 25% every year, says a 2019 NASSCOM report. The report further says that by June 2019, the agri-tech startups had already enjoyed funding worth \$248 million.

[Using satellite to give loans: ICICI Bank deploys unique technology to provide hassle-free farm loans](#)

(The Financial Express)

In a major step towards providing hassle-free loans to farmers, ICICI Bank will be using satellite images to assess credit worthiness of farmers. The bank added that the use of innovative technology helps farmers with existing credit to enhance their eligibility, while new-to-credit farmers can now get better access to credit. ICICI Bank has become the first bank in India to use such technique to measure an array of parameters related to the land, irrigation and crop patterns and use it in combination with demographic and financial parameters to make expeditious lending decisions for farmers.

[RBI flags concerns over climate change impact on India's farm outlook](#)

(Business Standard)

The Reserve Bank of India (RBI) flagged concerns about impact of climate change, in terms of volatile rainfall intensity, increase in extreme events and rising temperature, having implications for India's

agriculture outlook. As in many parts of the world, drastic changes in climatic conditions have also been observed in India and these include impact on onset and withdrawal dates of monsoon and the incidence of extreme events, the central bank said in its annual report. Amid these challenges, it said, agri and allied sector provided a "silver lining" in 2019-20 fiscal on the back of record food grains and horticulture production, coupled with resilient allied activities and an outlook brightened by expectations of a normal south-west monsoon in 2020.

[Punjab: Montek-Led Panel's Prescription for Agri Reform 'Is the Only Way Out', Says Member](#)

(The Wire)

Several farmer unions vociferously opposed the recommendations pertaining to the state's agriculture and called it 'anti-farmer.' The report has also once again opened debate on matters of agricultural reform in the state. A large chunk of the Montek-led panel's report is on Punjab's agriculture. The Group of Experts (GoE) have suggested rationalisation of power subsidies given to farmers. According to the panel, total power subsidy for agriculture has put an "unsustainable burden on the state's budget", is highly "regressive" and has had "damaging effects" for the environment because it promotes water-guzzling paddy cultivation.

News from Around the World

[As Amazon burns, farmers defend lighting fires to clear land](#)

(Global Times)

Agricultural fires like this are burning through the world's biggest rainforest at an alarming rate, according to environmentalists using satellite data from Brazil's space agency, INPE, to track the destruction. But Gomes, a 48-year-old farmer with a cowboy hat and leathery brown skin, smiles as he watches his field go up in smoke. "Can you believe the INPE's satellites register this as a fire?" he said, as two donkeys tied up nearby watch the flames. His blaze, he insists, is not a fire but a "queimada," the traditional agricultural practice of clearing land by burning it during the dry season. The fuel for the fires is trees felled to clear forest for farming and ranching. Environmentalists say the fires are also fuelled by the lack of consequences for those who illegally seize land and clear it.

[US, China reaffirm commitment to Phase 1 trade deal in phone call](#)

(LiveMint)

Top US and Chinese trade officials have reaffirmed their commitment to a Phase 1 trade deal, which has seen China lagging on its obligations to buy American goods, giving a boost to financial markets. The pledge was made in a telephone call between US Trade Representative Robert Lighthizer, US Treasury Secretary Steven Mnuchin and Chinese Vice Premier Liu He - their first formal dialogue since early May - amid concern the deal could be on shaky ground because of worsening US-China ties.

[Myanmar looks forward to further developing agricultural trade with China: official](#)

(Global Times)

Myanmar looks forwards to further developing agricultural trade with China, which in turn would further benefit the agriculture and farmers of the Southeast Asian nation. It will be a great help to the farmers if more agricultural products can be exported to China -- our largest trade partner, said Ye Tint Tun, director general of Agriculture Department of the Ministry of Agriculture, Livestock and Irrigation. Myanmar earned over 3.3 billion US dollars from agricultural exports in the first 10 months of the present fiscal year 2019-2020 which started in October, accounting for 22 percent of the total exports, according to figures released by the commerce ministry. As the agricultural sector plays a very important role in Myanmar, which accounts for more than 20 percent of gross domestic product (GDP), the government has attached great importance to its development and valued the cooperation with other countries including China.

[China to buy record amount of American soybeans in 2020](#)

(The Economic Times)

China is set to buy a record amount of American soybeans this year as lower prices help the Asian nation boost purchases pledged under the phase-one trade deal, according to people familiar with the matter. Soy futures in Chicago climbed to a seven-month high. The total from the U.S. will probably

reach about 40 million tons in 2020, the people said, asking not to be identified because the forecast isn't public. That would be around 25% more than in 2017, the baseline year for the trade deal, and roughly 10% more than the record set in 2016, according to data from the U.S. Department of Agriculture.

['Significant threat': The unsolicited mystery seeds arriving on Australian doorsteps](#)

(7 News)

An increasing number of unsolicited seeds is arriving at doorsteps across the country, prompting a federal government investigation. It's sparked fears of a potential biosecurity breach that could wreak havoc on local farm industries. Of those, one package was destined for an address in the Australian Capital Territory, seven in Victoria, 15 in Queensland, 15 in New South Wales, four in Western Australia, two in South Australia and two in Tasmania. The seeds, which were predominantly sent from China, Malaysia, Taiwan, Uzbekistan and Pakistan, were unidentifiable.

[How to buy direct from Australian producers: 'It's like having shares in a farm and your dividend is vegetables'](#)

(The Guardian)

Farmers Declan McGill and Melissa Charlick sell their produce boxes through the community-supported agriculture (CSA) model, where customers buy directly from the farmer – paying money upfront or over several instalments to finance the upcoming growing season. It's like having shares in a local farm, and your dividend is a regular box of freshly picked vegetables, rainbow-bright with yellow zucchinis, cherry medley tomatoes, watermelon radishes or whatever happens to be growing in the dirt right now.

[Traces of 2,000-Year-Old Banana Farm Found in Australia](#)

(Smithsonian Magazine)

New research suggests Australia's Indigenous communities have cultivated bananas for at least 2,000 years. The findings challenge the once-predominant view that these early humans were exclusively hunter gatherers, says lead author Robert Williams, an archaeologist at Australian National University, in a statement. As detailed in the journal *Nature Ecology & Evolution*, Williams and his colleagues unearthed an array of artifacts indicative of banana farming at the Wagadagam site on Mabuyag Island, which is located in the Torres Strait between the northern tip of Australia and Papua New Guinea. Finds included fossilized traces of fruit, stone tools, charcoal and retaining walls.

[Australia's farmers union calls for net carbon zero by 2050](#)

(The Cattle Site)

Australia's peak farm body has thrown its weight behind an aspirational economy-wide target of net carbon zero by 2050 (NCZ2050). Members of the National Farmers' Federation (NFF) have voted in favour of the landmark policy – which includes strict caveats regarding fair implementation and economic viability – at an online meeting this month. NFF President Fiona Simson said the strengthening of the NFF's climate goals was a strong reminder of the role farmers already played in tackling emissions.

[Why IoT is a key ingredient in Thailand's digitalization drive](#)

(Techwire)

Globally, it's estimated that there will be more than 75 billion IoT devices installed by 2025, five times as many as in 2015. A McKinsey & Company report notes that the percentage of businesses using IoT grew from 13% to 25% between 2014 and 2019. So, it's no surprise that Thailand is putting a great onus on the development of its IoT infrastructure, and several of the government's 'Thailand 4.0' initiatives – such as Smart City and Industry 4.0 – are focused on boosting the adoption of IoT. In their pacey pursuit of digital transformation, we look at where IoT comes in, and what infrastructural and developmental issues Thailand could face.

[COVID-19 reviving Africa's confidence in locally produced food](#)

(Alliance for Science)

Restrictions imposed to prevent the spread of COVID-19 have prompted a revival of locally produced food in Africa. As border closures make imported foods more expensive and harder to get, and political leaders rally support for the local agricultural economy, African consumers are showing renewed interest in local foods. Nigeria's President Muhammadu Buhari says he wishes the farmers could go and stay in their farms so that we can produce what we need sufficiently so that we don't have to import. In any case, we don't have money to import so we must produce what we have to eat.

[Golden Rice is 'trojan horse'](#)

(The Ecologist)

The push for corporate-led solutions to hunger and malnutrition is alarming. In particular, Golden Rice is now being proposed as a solution to the worsening hunger and malnutrition associated with the pandemic. Agrochemical transnationals (TNCs) and collaborating institutions such as the International Rice Research Institute (IRRI) are using concerns over food security during the pandemic to push for an industrial agricultural system that is already discredited. According to Pesticide Action Network (PAN) Asia Pacific, Jean Balie, IRRI's head of Agri-Food Policy, has said that they are "looking to increase the mineral and vitamin content in rice grains" as a response to the pandemic, alluding to renewed promotion of the genetically-modified Golden Rice, which has recently been approved for commercialisation in Bangladesh and the Philippines.

[Waste not](#)

(Bangkok Post)

The estimate is contained in a sobering report called "The State of Food and Agriculture: moving forward on food loss and waste reduction" by the Food and Agriculture Organization (FAO). Food loss and waste are recognised as a threat not only to global food security but also to the economy and the environment, says the United Nations agency. For poor smallholder producers in developing countries, quantitative losses mean less food available for consumption, resulting in food and nutrition insecurity. It also represents a loss of economic value in the food production and supply chain. A Boston Consulting Group study on tackling food waste has forecast that by 2030, annual food loss and waste will jump to 2.1 billion tonnes, worth roughly US\$1.5 trillion.

New Research

[Researchers help inform cassava breeding worldwide](#)

(Cornell Chronicle)

Scientists in Cornell's NextGen Cassava project have uncovered new details regarding cassava's genetic architecture that may help breeders more easily pinpoint traits for one of Africa's most vital crops. Their findings are reported in a study published July 31 in Plant Molecular Biology. The scientists analyzed large breeding populations measured extensively over successive years and stages of selection in multi-environment field trials in Nigeria. The genome-wide association analysis explored genomic regions most responsible for desirable traits in cassava, a food crop that provides the main source of calories for 500 million people across the globe.

[Grand theft water and the calculus of compliance](#)

(Nature)

Water crises constitute a challenge for humanity. Uncertain supply and growing demand are driving higher water theft, particularly by agricultural users who account for approximately 70% of global use. However, research into water theft is underexplored in all disciplines. Our findings suggest that while individuals and companies may be responsible for the act of theft, the phenomenon reflects a systematic failure of arrangements (political, legal, institutional, and so on). In addition, when regulators fail to understand the value of water, inadequate prescribed penalties increase the risk of theft.

[The green and blue crop water requirement WATNEEDS model and its global gridded outputs](#)

(Nature)

Accurately assessing green and blue water requirements from croplands is fundamental to promote sustainable water management. In the last decade, global hydrological models have provided

important insights into global patterns of water requirements for crop production. As important as these models are, they do not provide monthly crop-specific and year-specific data of green and blue water requirements. Gridded crop-specific products are therefore needed to better understand the spatial and temporal evolution of water demand. Here, we present a global gridded database of monthly crop-specific green (rain-fed) and blue (irrigated) water requirements for 23 main crops and 3 crop groups obtained using our WATNEEDS model. For the time periods in which our dataset matched, these estimates are validated against existing global products and satellite-based datasets of evapotranspiration. The data are publicly available and can be used by practitioners in the water-energy-food nexus to assess the water sustainability of our food and energy systems at multiple spatial (local to global) and temporal (seasonal to multi-year) scales.

[Economic and social constraints on reforestation for climate mitigation in Southeast Asia](#)

(Nature)

As climate change continues to threaten human and natural systems, the search for cost-effective and practical mitigation solutions is gaining momentum. Reforestation has recently been identified as a promising nature-based climate solution. Yet there are context-dependent biophysical, financial, land-use and operational constraints to reforestation that demand careful consideration. By taking a combination of on-the-ground financial, land use and operational constraints into account, we find that only a fraction of that mitigation potential may be achievable (0.3–18%). Such constraints are not insurmountable, but they show that careful planning and consideration are needed for effective landscape-scale reforestation.

[Neglecting irrigation contributes to the simulated summertime warm-and-dry bias in the central United States](#)

(Nature)

A vast number of weather forecast and climate models have a common warm-and-dry bias, accompanied by the underestimation of evapotranspiration and overestimation of surface net radiation, over the central United States during boreal summer. Various theories have been proposed to explain these biases, but no studies have linked the biases with the missing representation of human perturbations, such as irrigation. Here we argue that neglecting the impact of irrigation contributes to the longstanding warm surface temperature and lack of precipitation biases over this region. By using convection-permitting multi-season simulations over the contiguous United States coupled with an operational-like irrigation scheme, we show that irrigation increases surface evapotranspiration and decreases surface temperature by increasing evaporative fraction. By increasing the frequency of mesoscale convective systems, irrigation reduces the summertime model precipitation deficit and improves the simulated precipitation diurnal cycle over the Great Plains. The increased precipitation also alleviates the warm bias in our simulation setup, likely by damping the positive feedback between soil moisture and temperature.

[Net benefits to US soy and maize yields from intensifying hourly rainfall](#)

(Nature)

Many varieties of short-duration extreme weather pose a threat to global crop production, food security and farmer livelihoods. Hourly exposure to extreme heat has been identified as detrimental to crop yields; however, the influence of hourly rainfall intensity and extremes on yields remains unknown. Here, we show that while maize and soy yields in the United States are severely damaged by the rarest hourly rainfall extremes (≥ 50 mm hr⁻¹), they benefit from heavy rainfall up to 20 mm hr⁻¹, roughly the heaviest downpour of the year on average. We also find that yields decrease in response to drizzle (0.1–1 mm hr⁻¹), revealing a complex pattern of yield sensitivity across the range of hourly intensities. We project that crop yields will benefit by ~1–3% on average due to projected future rainfall intensification under climate warming slightly offsetting the larger expected yield declines from excess heat, with the benefits of more heavy rainfall hours outweighing the damages due to additional extremes. Our results challenge the view that an increasing frequency of high-intensity rainfall events poses an unequivocal risk to crop yields and provide insights that may guide adaptive crop management and improve crop models.

Thoughts & Views



Dr S. Rajendra Prasad is the Vice-Chancellor, University of Agricultural Sciences (UAS), Bangalore. Dr Prasad obtained his Master's degree in Seed Technology from College of Agriculture, Dharwad, and Doctoral in Seed Technology from University of Agricultural Sciences, Bangalore with distinction. To his credit, he also has a PG Diploma in Business Administration. He started his career as Research Assistant in University of Agricultural Sciences, Bangalore and subsequently has served National Seed Project with distinction for 27 years in various capacities such as Seed Research Officer and Special Officer (Seeds). Dr Prasad has been trained by internationally acclaimed institutions – International Agricultural Centre (IAC), Wageningen, Netherlands, University of Philippines Los Banos, Philippines and IAC and DOAE-Seed Division, Chiang mai Thailand on Advance Seed Production, Post -Harvest Seed Handling Technology and Plant Variety Protection.

1. Please tell us about the importance of plant breeding and its impact. How the technology is faring globally and in India?

Despite decline in arable land and water available for Agriculture, food grain production has increased from 50 million tons in 1950 to close to 300 million tons in 2020. Within a span of 70 years, productivity of major food grains and commercial crops has increased four to five folds. According to an estimate by Global Initiative on Plant Breeding Capacity Building, nearly 50 per cent of this productivity enhancement at least in major food crops has been attributed to adoption of improved cultivars bred through Plant Breeding Globally. This enhanced productivity has been possible due to introgression of genes controlling high vigor, semi-dwarfness, early maturity, biotic and abiotic stress tolerance including salinity and temperature stress tolerance in most of the food grain crops. Also enhanced nutrition in crops like maize (QPM), rice, (vitamin A, iron zinc and protein) wheat (iron and zinc) and sunflower (oil content). Discovery and introgression of genes controlling male sterility in crops like rice, sorghum, pearl millet, pigeonpea, sunflower, onion, chilli has resulted in the commercialization of high yielding heterotic hybrids in these crops. Plant Breeding continues to play a significant role in productivity enhancements across the globe and in India. Plant breeding offers no cost solutions at least to grower's production problems as both productivity per se and traits that stabilize productivity are packaged in seed (basic input in agriculture).

2. What are some other technologies/innovations that needs to be readily adopted by India to increase food security?

- a) Precision farming and Nanotechnology in delivery of nutrients and pesticides.

- b) Genetic interventions including precision Plant Breeding Tools such as Marker Assisted Selection, Genomic Selection, Phenomics and Genome editing coupled with Rapid generation Advance/Speed Breeding need to be readily adopted to increase genetic gains per cycle, and use of sensor based tools to manage the natural resources.
- c) Mechanization by small holding farmers.
- d) Post harvest processing of farm produce.

3. Cotton is the only crop where new technology has been adopted. What are the other crops where you think technology and innovation should be adopted?

Maize, sorghum, rice, canola, sugarcane and chilli (tolerance to herbicide and Lepidopteran pests), tomato (ToLCV & shelf life), brinjal (fruit borer), pigeonpea for sterility mosaic, Fusarium wilt and pod borer.

- Cotton is one of the important commercial crops and ranks first for its agro-based industrial share in India & it is the only Genetically Modified crop that is approved for commercial cultivation by GOI.
- Other crops where GM technology is required are staple cereals like rice, wheat & corn where biofortification with nutritional quality traits like rich in iron, vitamins and protein. This can help to solve the malnutrition problem in India.
- Other possible crops where GM technology is required are pest & disease resistant, transgenics in Maize specially for shoot borer and fungal diseases.
- Among vegetables, Bt-Brinjal for resistance to fruit borer and papaya for ring spot virus resistance are also important to adopt GM technology.

Another area to adopt GM technology is development of drought tolerant transgenic varieties in cereal crops like Rice, Wheat, Sorghum and oilseed crops like Groundnut, Brassica and other rainfed crops which are directly associated with food security and to meet edible oil requirement in the country.

4. Do you think PPP structured finance help to meet development goals?

It is indeed the Best Way Forward. Public and private organization have complementing roles and expertise's in product development, processing and delivery to the end user. For instance, in millets, public organisations are strong in developing improved cultivars, private organisations have assisted in diversifying the end product usage and reach out to stake holders due to their strong network, forward and backward linkages.

5. How important is research for agriculture and how can it help tackle impacts of climate change?

As the famous saying goes, "anything can wait but not Agriculture", greater investments in agriculture research needs to be made. Further, Investments should be focused on developing technologies including improved cultivars, crop production and protection practices that address negative impact of climate change.

Keeping in view the expected climate change in rainfall, temperature and other weather parameters in the coming years, an attempt was made to know the agriculture crop productivity by the year 2035, using the InfoCrop simulation model under the project **Karnataka State Action Plan for Climate Change 2020 (SAPCC-2020)**.

The output data for Karnataka state revealed that, cotton yield is gaining by 55.6 %, Soybean by 28.9 %, maize by 24.5 %, Sorghum by 20.3 %, redgram by 19.2 %, chickpea by 13.5 %, finger millet by 12.0 % and sugarcane by 6.1%; whereas groundnut is losing by 9.6 % and rice by 5.6% under the changed climate scenario during the year 2035.

In view of increasing the total agricultural production to meet the growing populations of the state, potential crops identified through the model prediction have to be promoted in the years to come. Therefore, the area under rice and groundnut in South Interior Karnataka, wheat and groundnut in North Interior Karnataka, chickpea, maize, rice, sorghum and redgram in hilly region and rice and finger millet in coastal regions have to be reduced and they should be replaced by other potential crops.

Weather based IFS, strengthening of the agromet advisory services in the State, rainwater management in rainfed areas, flood adaptation strategies, good agronomic practices and strategies to protect soil health are some of the adaptation strategies identified to enhance the food production.

In order to minimize the climate change magnitude, some of the mitigation strategies like reduction of methane emission from rice fields, amelioration of enteric methane emission in ruminants, reduction of nitrous oxide emission and sequestration of carbon in agricultural soils, has been addressed

Contingent crop plan for different weather aberrations have been prepared for south Karnataka in particular by UASB and for all the districts of the state in association with CRIDA, Hyderabad from research output of UAS(B).

6. Please tell us some of the breakthrough research done by your University. Further, how is your university managing technology in different aspects of agriculture for the benefit of farmer?

Our University (UASB) is the first to develop hybrids in cotton, rice and sunflower. Karnataka being the second most drought prone state in the country, it has prompted UASB to become the pioneer in development of soil and water conservation technology. Models developed at UASB are being followed by several farms and institutes.

7. How ready are Indian agriculture scientist for supporting farmers tackle severe and unpredictable weather changes? How is your university preparing the region to handle such challenges?

Micro level Agromet advisory services (MAAS) is being issued under NICRA project on every Tuesday and Friday, based on the block level weather forecast and technical input from subject matter specialist (SMS). Based on the success story, MAAS is being extended for each district under KVK (DAMU) and for each Agro-climatic zone under GKMS.

Cumulative benefits of NICRA project to the farming community in association with IMD and KSNDMC

Advisory to 23 lakh farmers throughout the state (block wise) in collaboration with KSNDMC and IMD is being issued.

Cumulative benefit through horizontal spread of our advisories is to the tune of Rs. 1782 crores per annum by timely agricultural operations starting from sowing to post harvest management.

8. Are you running any programmes or projects for the benefit of farmers? How is it helping them and their families?

All research projects of the University are addressing the State farmers issues which is one of the mandates of the university.

University of Agricultural Sciences, Bangalore is conducting various Research programmes about 300 projects including 32 All India Co-ordinated Research Projects. Among them, many projects benefited farmers directly viz., IFS, National Seed Project, Biofuel Project, Organic farming etc.

AICRP on IFS, UAS, Bengaluru centre is advocating IFS models to farmers comprising of crops / cropping systems + animal and other subsidiary enterprises having minimum competition, maximum complementarity, maximum recycling of byproducts thereby slowly reducing the dependency on the externally purchased inputs, improving the soil health. Providing additional employment opportunities for the entire family members, regular flow of income throughout the year.

University funded project under the various thematic areas like Farmer Centric Demand driven project and climate smart Agriculture projects addressing the field problems faced by farmers. These projects also help in understanding the farmers problems leading to problematic situation like farmers suicide. Also helps in addressing the problems like value addition to the agriculture waste both at farmers field and agriculture-based industries. Further in order to create awareness among farmers about the technologies, climate smart villages are being adopted to demonstrate latest technologies to create awareness among farmers.
