



Seed Connect

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The first National Level Dialogue on Agri-Food Systems was conducted in India last month. This is one of the first dialogues held in India in the run up to the UN Food System Summit to be organized in September 2021. The Summit will focus on pathways to shape food systems nationally and globally to accelerate progress in the SDGs. The Summit 2021 is focused towards being participatory and consultative by bringing experiences through the National, Sub-national (State) and independent consultations for the five action tracks identified as - safe and nutritious food, sustainable consumption patterns, nature-positive production, advance equitable livelihoods, and resilience to vulnerabilities, shocks and stress.

In India, the Government has constituted a high level Interdepartmental Group under the Chairmanship of Prof. Ramesh Chand, Member, NITI Aayog along with the representatives from Ministries of Agriculture and Farmers' Welfare (MoAFW), Rural Development and others. The prime function assigned to this group is to conduct National Dialogues with all the stakeholders of agri-food systems for exploring national pathways towards creating sustainable and equitable food systems in India and suitably contribute to transformation in global food systems to meet the needs of present and future.

During the National Level Dialogue, some of the views presented by FSII (represented by Mr Ram Kaundinya, DG, FSII) were that farmer's share of consumer price needs to be improved and he should be connected to market for better price discovery. Farm gate infrastructure has to be made world class so that post harvest losses are minimized. Modern science and technology (with potential to decrease chemical use, reduce water consumption and safeguard soils) and other proven farming systems (including traditional farming systems and organic farming systems) have to be deployed across the countries so that farmers economics improve. Farmers should be given the freedom to choose whatever he wants from the basket of approved technologies and farming systems. Farming efficiency has to improve so that his profitability improves and also farming becomes environmentally sustainable.

Alignment of science based regulatory policies and political support to deployment of latest science and technology in farmers fields across countries is pivotal. Regulations controlling the movement of farm produce and food produced using modern technologies have to be aligned between countries so that there are no barriers to movement. Farmers using scientifically proven and approved technologies should not be at a disadvantage due to such non-tariff barriers. There is a need for a global dialogue and agreement on aligning regulations on both these aspects.

A specific project to scale up private investments into development of nutrition oriented crops and orphan crops may be taken up to make nutritious grains available to the poorer sections of the society. Production of such crops should be made profitable for farmers through government support and procurement and subsequent distribution through Public Distribution System.

The associations of input industries and output industries should be made partners in this effort by the government. They are equally interested in the equitable welfare of the farmers whom they serve through their commercial activity. Such organizations can play a very positive role in creating the right support structures through private investments which will augment the investments being made by the governments. A suitable national platform is to be created to promote private investments in the priority areas of infrastructure and other supportive measures in research, supply chains, products & services, warehousing and logistics, financial & insurance services, etc which can provide end to end solutions to farmers in each crop.

In this newsletter we have also covered news around several important developments on agriculture across India, globally and in the area of research. Please refer to our section '[Thought & Views](#)' where we have interviewed **Dr Vijay Paranjape (Ph. D), Vice President of Life Science Advisory, Sathguru Management Consultants, Hyderabad and Visiting Fellow at the Global Development, CALS, Cornell University, USA.** We hope you find it a good read!



Shivendra Bajaj
Executive Director
Federation of Seed Industry of India and Alliance for Agri Innovation

[India's first digital soil map to help agriculture immensely](#)

(The Federal)

Using data collected over the last three decades, a team of scientists from IIT Kharagpur and other collaborating institutes has created the first digital soil map for India. The digitally accessible resource provides information about properties like soil's pH, texture, and the amount of organic carbon in the soil. Unlike traditional soil maps that rely exclusively on field surveys and laboratory data, digital soil maps combine field and laboratory data with geographical and environmental information, and eventually use mathematical modelling tools to infer soil properties for a location. They allow scientists to predict soil properties even for those regions for which field data is not available. Also, these maps can be easily updated as new soil data becomes available.

[Reforms must extend to making available the best technologies to farmers](#)

(The Indian Express)

Lifesaving vaccines such as Covishield and Covaxin are products of modern biotechnology, as are drugs developed in recent times for treating many ailments. The potential of genetic engineering is immense, with gene editing opening up the possibility of cures to hereditary diseases. Similarly, genetically modified (GM) crops are making big strides in bringing about improvement in crop productivity across farming nations.

[Agriculture Ministry inks pack with Microsoft for a pilot project to boost farmers' income](#)

(The Economic Times)

The Union Agriculture Ministry has signed a memorandum of understanding with Microsoft to run a pilot programme for 100 villages in six states to help farmers in reducing input cost and boost income. Agriculture Minister Narendra Singh Tomar was present at the signing ceremony, an official statement said. The minister said modern technology will help in making the agriculture sector profitable and also attracting youth towards farming.

[Agriculture Minister launches portal for traceability of source of honey](#)

(The Tribune)

Union Agriculture Minister Narendra Singh Tomar launched a portal for online registration to achieve traceability system in sourcing of honey and other beehive products, as part of the government's effort to ensure quality and check adulteration. The minister launched the online platform 'Madhukrantiportal', which is an initiative of the National Bee Board (NBB) under the National Beekeeping and Honey Mission (NBHM), a statement said. He also launched NAFED's 'Honey Corners', which are specially spaces for sale of honey.

[Vice President asks educational institutions to design courses to meet new world realities](#)

(Outlook India)

Vice President M Venkaiah Naidu called upon national institutions like IIMs to offer innovative courses and diplomas based on new market realities and demands of the fourth industrial revolution. He also stressed the need for reorienting higher education in tune with the realities of the world and called for bringing diverse fields like agriculture, business, technology, humanities and management together through these courses. "This is the spirit of the multidisciplinary push of the new education policy. Remember, we cannot solve the problems of the future with the same superficial, segregated approach of the past," he said.

[Sustainable agriculture has potential to herald the next green revolution](#)

(Forbes)

Even though India has become a surplus agri-producer, the sector still remains unsustainable, with misdirected subsidies, storage and logistical shortfalls, food wastage, archaic farming practices, inadequate access to finance, inequity in the value chain, land degradation, water depletion, and crop burning—just to name a few challenges. We need to bring together the principles of sustainable growth, innovative technologies, green financing, a progressive regulatory ecosystem, and leverage corporate social responsibility to overcome these obstacles.

[Agriculture policy should target India's actual farming population](#)

(The Indian Express)

How many farmers does India really have? The Agriculture Ministry's last Input Survey for 2016-17 pegged the total operational holdings at 146.19 million. The NABARD All India Rural Financial Inclusion Survey of the same year estimated the country's "agricultural households" at 100.7 million. The Pradhan Mantri Kisan Samman Nidhi (PM-Kisan) has around 111.5 million enrolled beneficiaries, with an average of 102 million-plus getting payments during 2020-21. India's official farmer population, in other words, is anywhere between 100 million and 150 million. But how much of this comprises actual farmers? Agricultural households, as per NABARD's definition, cover any household whose value of produce from farming activities is more than Rs 5,000 during a year. That obviously is too little to qualify as living income.

[NCDC secures Rs 600 cr loan from Deutsche Bank for on-lending to cooperatives](#)

(Outlook India)

In a first, the National Cooperative Development Corporation (NCDC) has secured a Euro 68.87 million (Rs 600 cr) loan from Deutsche Bank for onward lending to cooperatives in the country, the agriculture ministry said. An agreement in this regard inked between NCDC and Deutsche Bank, in the presence of Union Agriculture Minister Narendra Singh Tomar. The minister also presided over signing of an agreement between the Indian Chamber of Commerce (ICC) and NCDC to boost farmers' linkages with markets. "This is for the first time that one of the largest European banks in the world is lending to the NCDC, thus reflecting the confidence of the global financial institution in the Indian development finance institution, particularly at a time when global economic turmoil created by the Covid-19 crisis has made lending a challenging proposition," the ministry said.

[India Holds National Dialogue On UN Food Systems Summit 2021](#)

(Indian Education Diary)

The United Nations Secretary General has called for the first ever UN Food Systems Summit to be held in September 2021 to strategize the actions for positive change in Agri-food systems in the World to realize the vision of the 2030 Agenda for Sustainable Development. The Summit will focus on levers and pathways to shape food systems nationally and globally to accelerate progress in the SDGs. The Summit 2021 is planned to be essentially participatory and consultative and needs the game changing ideas from the experiences through the National, Sub-national (State) and independent consultation for the five Action Tracks related to safe and nutritious food, sustainable consumption patterns, nature-positive production, advance equitable livelihoods, and resilience to vulnerabilities, shocks and stress. The COVID-19 pandemic led vulnerability and challenges faced by the humanity in food and related system has further added to the need for reorienting our actions and strategies beyond specific cropping or farming systems to entire agri-food systems covering production, distribution and consumption.

[India has emerged as consistent, reliable supplier of agricultural products: APEDA Chairman](#)

(The Hindu Business Line)

Agricultural exports, particularly Agricultural and Processed Food Exports Development Authority (APEDA) scheduled products, were one of the bright spots of the last fiscal. There was an increased demand for food products to meet food security needs in other countries and despite challenges on the logistics front, the Indian government supported and helped at each step to facilitate shipments, says APEDA Chairman Dr M Angamuth. India supplied food items through chartered planes on demand from some countries. As a result, the country has emerged as a "consistent and reliable supplier". "We have gained significant goodwill this year for supplying interrupted quality goods despite limitations," says the APEDA chairman.

[Farm exports rose 16.9% in April-Feb. FY21](#)

(The Hindu)

India exported agricultural commodities worth ₹2.74 lakh crore till February of the 2020-21 fiscal, a 16.9% increase from ₹2.31 lakh crore in the year earlier, notwithstanding the pandemic, the agriculture ministry said. Similarly, imports of agriculture and allied commodities increased by 3% to ₹1,41,034 crore during the April-February period of 2020-21 from ₹1,37,014 crore in the year earlier

period. Despite COVID-19, balance of trade in agriculture has favourably increased to ₹1,32,579.69 crore from ₹93,907.76 crore in the said period, the ministry said in a statement.

[HUL, Google, MyGov India Announce AI for Agriculture Hackathon To Address Issue Of Water Scarcity](#)

(Business World)

Hindustan Unilever (HUL) and Google, in association with MyGov India, the Government of India's citizen engagement program, announced a hackathon with the aim to encourage and find innovative solutions for conserving freshwater usage, and to address water scarcity problems in India. In collaboration with MyGov India, Ministry of Electronics and Information Technology (MeitY), this effort brings together India's finest start-ups and experts who are participating in this Hackathon from 7-9 April 2021, in designing and deploying solutions for farmers. Prime Minister Narendra Modi's vision of AI empowering agriculture underlines the use of technology in agriculture to improve farmers' access to markets, inputs, data, advisory, credit and insurance.

[How millet production can empower women farmers, strengthen agriculture](#)

(Down to Earth)

Millets are traditional grasses or crops that are friendly to arid environments and considered to do well in drought-like conditions, according to Food and Agriculture Organization. Millet farming directly results in preserving and conserving biodiversity. This is one reason why women farmers, with their ecological acumen and their close association with climate protection, are best suited to be ambassadors of millet cultivation. They also universally succeed in practicing seed sovereignty principles and water conservation. With the creation of incentives toward promoting the woman farmer, these goals of millet cultivation and sustainable development, especially those related to agriculture and sustainable production and consumption, can be achieved. Around 4,000 litres of water is required to produce one kilogram of rice, it has been argued. Millets like jowar, however, require little water at all.

[Canada's 2021 budget to include climate action for the ag sector](#)

(The Cattle Site)

Farmers are major players in Canada's fight against climate change. The agricultural sector has the potential to scale up climate solutions, many of which are already underway across the country. Building on Canada's climate action programs for farmers—including the \$185 million Agricultural Climate Solutions program, and the \$165 million Agricultural Clean Technology Program—a new investment of \$200 million over two years, starting in 2021-22, will help launch immediate, on-farm climate action under the Agricultural Climate Solutions program. This will target projects accelerating emission reductions by improving nitrogen management, increasing adoption of cover cropping, and normalizing rotational grazing.

[How regenerative farming could help Canada meet its new carbon emission targets](#)

(CBC)

Carl's grandson Brett, 24, says that by adopting a series of regenerative farming techniques like the ones used by his family's 3Gen Organics operation, farmers can reduce agricultural emissions while simultaneously improving soil health. "Farmers are on the forefront of climate change, we are seeing more intense weather systems," Brett Israel said. "So we need to build resilient systems to overcome these issues and enrich the environment around us." Building those resilient systems starts with allowing soil to capture and sequester more carbon through cover cropping, promoting crop diversity, protecting watersheds and integrating livestock into the farm system, according to Claudia Wagner-Riddle, an agro-meteorologist at the University of Guelph who studies agricultural emissions and greenhouse gases. Agriculture is responsible for 10 per cent of Canada's greenhouse gas emissions. As part of its strategy to address climate change, the government earmarked \$270 million in its April 19 federal budget to support agriculture and climate-smart solutions, including regenerative farming.

[Canadian geothermal project explores agriculture opportunity](#)

(Think GeoEnergy)

Canadian geothermal development project company No. 1 Geothermal LP (Alberta No. 1) has announced that it has signed a Memorandum of Understanding with Annelida Casting Innovation (Annelida) to investigate providing geothermal heat to an industrial vermicomposting facility development. This geothermal direct heat use collaboration is the start of developing a sustainable agricultural cluster in the heart of Alberta's industrial gateway to the North, the Municipal District of Greenview.

[Tiny nanotechnologies are poised to have a huge impact on agriculture](#)

(Canadian Manufacturing)

Nanotechnology might sound like science fiction, but it represents technologies that have been developed for decades. Nanotechnological approaches have found real-world applications in a wide range of areas, from composite materials in textiles to agriculture. Agriculture is one of the oldest human inventions, but nanotech provides modern innovations that could dramatically improve the efficiency of our food supply and reduce the environmental impact of its production.

[DA calls on youth to find future jobs in agriculture](#)

(Inquirer)

The Department of Agriculture (DA) is calling on youth 18 to 30 years old to take part in activities and processes related to farming and fishing under the "Kabataang Agribiz Grant Assistance Program." DA said the program has a grant value of P74 million. It's available to Filipino youth aged 18 to 30 who are ready and willing to engage in agriculture and fishing business enterprise. Agriculture Secretary William Dar said young people leave rural areas for more lucrative jobs in urban areas. He hopes the program will help Filipinos start their own agriculture business. He said the youth's new way of thinking is the key to making agriculture sustainable.

[Tesda Bets On Drone Technology To Boost Agriculture, Forestry And Fishery Yield](#)

(Business Mirror)

The Technical Education and Skills Development Authority (Tesda) announced that it would offer a training program for Agricultural Drone Operation to boost the production of the country's agriculture, forestry and fishery sectors. "We also would want to provide a world-class and competent human resources for the Agricultural Drone Operation under the Agriculture, Forestry and Fishery Sector," Tesda Director General Secretary Isidro Lapeña said after Tesda, together with stakeholders and agriculture experts remotely piloted aircraft from the AgriDom Solutions Corp.'s Competency Standards (CS) for Agricultural Drone Operation, which will be used by training institutions. Last March 18, Lapeña issued a circular containing the guidelines in the deployment of the CS for Agricultural Drone Operation Level II.

[Can 1% of Singapore's Land Feed Its Population?](#)

(Bloomberg Opinion)

From fish farms bobbing in the Straits of Johor to industrial warehouses and the rooftops of hotels downtown, urban farming is all the rage in Singapore. Covid-19 has given the country, which produces only a tiny fraction of what its people eat, a big scare. Dependence on neighbors for sustenance is a huge vulnerability the government says it's determined to rectify.

[Green gold: Avocado farming on the rise in Africa](#)

(DW)

Baker Ssengendo's vision for the future of Uganda starts with an avocado seedling. "The avocado tree has a lifespan of about 50 years. The life expectancy of an average Ugandan is about 60 years. A tree can benefit them their entire life," he told DW. Ssengendo works on the 1,000 hectares (2,470 acres) of Musubi Farm in Mayuge district, eastern Uganda -- the largest Hass avocado farm in the country. "By working in avocado farming, I am fulfilling my life dream. We want to lift our communities out of poverty." Due to high global demand, the avocado has become a lucrative export product. Its consumption per capita increased by 406% between 1990 and 2017 in the US alone. The so-called green gold is rapidly gaining popularity on the African continent. Both Nigeria and Uganda aim to drastically increase their avocado production and become top exporters in the next decade. Kenya is

already among the global top 10. Export revenues in the East African country surged by a third between 2019 and 2020. Farmers are hailing the crop as an antidote to poverty in rural areas.

[Digital Opportunities In Agriculture-AFDB, FAO And CGIAR](#)

(Busiweek)

Drones, satellites, geographic information systems, weather stations and advanced analytics are some of the most promising technologies for providing solutions to Africa's agricultural challenges. This is according to the joint Digital Agricultural Profiles carried out by the African Development Bank, the Food and Agriculture Organization of the United Nations (FAO) and CGIAR in three countries. The profiles, covering Côte d'Ivoire, Rwanda and South Africa, map the challenges and opportunities to scale the adoption of innovative digital technologies in the agriculture sector. These include national digital technology and the policy landscape, user demands along the value chain and available digital agriculture services and applications. The profiles also examine the main barriers to adoption as well as the digital technologies with the greatest potential to transform the sector.

[Making the Farmer King: The Need to Shift Our Approach to Agriculture](#)

(Morocco World)

Small holder farmers constitute the lifeblood of the society. We often take for granted the sheer ease with which we can stop by the market and buy produce for nourishment. As a lawyer, I am aware that my services are not always needed. In fact, where people choose to be honest and peaceful, where there is no reason to doubt and people choose to be friendly, a lawyer has no real job to do – this is not the case for the farmer. As critical as the farmer is to our society, his position is oftentimes precarious due to the actions of the same society. The effects of climate change are most felt by farmers while the propositions that have been made to save the planet revolve around farmers. It appears that whichever way the conversation goes, farmers are placed squarely in the middle.

[Africa spends billions on food imports](#)

(Chronicle)

The demand for food in Africa is growing, with statistics showing current output is 20 percent below requirements. This saw the continent spending US\$80 billion on food imports last year, and that figure is rising at a rate of about six percent per annum, according to African Union Commissioner for Agriculture, Rural Development, Blue Economy and Sustainable Environment, Ambassador Josefa Sacko. This is despite the continent having immense acreage of under-used arable land. Ambassador Sacko was speaking at the launch of the framework to boost intra-African trade in agricultural products and services last week, a forum organised by the African Union and the United Nations Food and Agriculture Fund (FAO).

New Research

[Punjab Agricultural University develops new high yield 'Punjab Basmati 7'](#)

(The Indian Express)

Ahead of paddy sowing season, the Punjab Agricultural University (PAU) said that farmers in Punjab should opt for high-yielding new 'Punjab Basmati 7', it has developed. The variety has been developed by involving the strongly scented traditional varieties 'Basmati 386' and 'Pusa Basmati 1121', said PAU. Dr GS Mangat, Head, Department of Plant Breeding and Genetics, said the new variety yielded consistently better in the multi-locational trials. "Overall, it had an edge of 11.4 and 6.1 per cent, respectively over the popular Pusa Basmati 1121 and Pusa Basmati 1718. It gave an overall yield of 48.58 q/ha (19.4 q/acre)."

[USDA Invests \\$21.7M in Research Innovations to Improve Soil Health and Climate Smart Agriculture and Forestry](#)

(USDA)

Agriculture Secretary Tom Vilsack announced that the U.S. Department of Agriculture's National Institute of Food and Agriculture (NIFA) will invest at least \$21.7 million in several key programs to help agricultural producers manage the impacts of climate change on their lands and production. NIFA awarded \$6.3 million for 14 Soil Health grants and \$5.4 million for seven Signals in the Soil grants

through its Agriculture and Food Research Initiative (AFRI). NIFA also is investing at least \$10 million this year in a new program area priority called, “Extension, Education, and USDA Climate Hub Partnerships,” also funded through AFRI, to train the next generation of agriculturalists and foresters to incorporate climate change research into their management practices.

[Vertical farmer 80 Acres enters research agreement with University of Arkansas](#)

(PBB)

Vertical farming business 80 Acres Farms has entered into a collaborative research agreement with the Arkansas Agricultural Experiment Station to advance the science of vertical farming. Scientists with the experiment station, the research arm of the University of Arkansas System Division of Agriculture, will coordinate with 80 Acres Farms researchers to pursue a variety of vertical farming research topics, said Bryan Renk, director of commercialization for the division’s Technology Commercialization Office. “Vertical farming is growing and trending,” Renk said. “There are multiple companies forming across the U.S. that are trying to take advantage of that trend.”

[Delhi University to set up two new colleges including research center for Agricultural Studies](#)

(Times Now News)

Delhi University has announced to set up two new colleges for the department of agriculture Horticulture and forestry. The new co-educational college will be based in Roshan Pura and near Shabad Dairy Najafgarh. The establishment of these new entities will help the students and rural sectors of Delhi and Haryana and will help save time. The new center of Shahbad Dairy will also host Ph.D., postdoctoral fellows, and students at the UG level.

[Farming without disturbing soil could cut agriculture’s climate impact by 30% – new research](#)

(The Conversation)

In newly published research from farms across the UK, we discovered that an alternative approach called no-till farming, which does not disturb soils and instead involves placing seeds in drilled holes in the earth, could slash greenhouse gas emissions from crop production by nearly a third and increase how much carbon soils can store.

[Different quantification approaches for nitrogen use efficiency lead to divergent estimates with varying advantages](#)

(Nature)

Nitrogen use efficiency (NUE) is a key indicator with which to study nitrogen cycles and inform nitrogen management. However, different quantification approaches may result in substantially divergent NUE values even for the same production system or for the same experimental plot. Based on our investigation of the differences between and connections among the three principal approaches for NUE quantification, we offer recommendations for choosing the appropriate approach and call for long-term observations to assess the impacts of management practices.

[Double cropping and cropland expansion boost grain production in Brazil](#)

(Nature)

Brazilian grain production increased more than fourfold from 1980 to 2016. The grain boom was achieved primarily by soybean–corn double cropping and cropland expansion—both show changing spatiotemporal patterns since the 1980s. Here, we quantified the contributions of these two strategies to corn and soybean production in Brazil using municipality-level data from 1980 to 2016. We found the contribution of double cropping to the grain boom steadily increased to 35% and the largest driving force was the increasing demand for grain export. While double cropping dominated the conventional agricultural regions, cropland expansion was still the major strategy in agricultural frontiers such as the Centre-West and Matopiba. The implementation of double cropping offset the equivalent of 76.7 million ha of Brazilian arable land for grain production from 2003 to 2016. Double cropping in Brazil has the potential to help alleviate land burdens in other pantropical countries with increasing global food demand.



Dr Vijay Paranjape (Ph. D) is the Vice President of Life Science Advisory, Sathguru Management Consultants, Hyderabad and is a Visiting Fellow at the Global Development, CALS, Cornell University, USA. Dr Paranjape is an experienced seed Industry professional with over 35 years of academic, techno-commercial, and international development experience with focus on Agricultural Biotechnology. In his current role at Sathguru management consultants, he advises seed industry clients on research strategy, portfolio optimization, entry strategy, IP strategy, competitive assessment, and technical due diligence for M&A. Partnering with Cornell University, he has also been advising and overseeing activities associated with USAID funded Bt eggplant project in Bangladesh, focusing primarily on technology development, commercialization, scientific outreach, and product stewardship. Prior to joining Sathguru he was associated with Monsanto for about 17 years where he provided leadership as well as contributed towards different phases of plant biotech product development pipeline starting from gene discovery to product development, intellectual property protection, quality management systems, seed regulatory compliance and product stewardship to enable delivery of high quality of seeds to farmers. He has a Ph. D in molecular biology from Jawaharlal Nehru University, New Delhi. He was a post-doctoral research fellow at Imperial College, London and Washington State University, Pullman, USA.

Q1: Tell us your experience with farmers growing Bt Brinjal in Bangladesh. How have their socio-economic life changed?

A: Eggplant (brinjal) is an extremely popular vegetable in Bangladesh and a critical source of income for small, resource-poor farmers. Eggplant is grown by an estimated 150,000 farmers on ~50,000 hectares. Eggplant cultivation in Bangladesh is exposed to the threats of eggplant fruit and shoot borer (EFSB) that causes more than 60% loss in yield, forcing farmers to spray expensive and toxic insecticides more than 80 times each growing season to try and control the pest. This frequent application of insecticides results in very high pesticide residue levels on the fruit, kills beneficial insects, exposes farm workers to hazards, and pollutes the local environment.

The India-based Maharashtra Hybrid Seed Company (Mahyco) developed an eggplant expressing Cry1Ac (EE-1) for control of the eggplant fruit and shoot borer (EFSB). As part of USAID funded South Asia Eggplant Improvement Partnership project, Mahyco, Sathguru Management Consultants and Cornell University, EE-1 event was provided pro bono to the Bangladesh Agricultural Research Institute (BARI), who bred it into local farmer preferred public varieties. The Bangladesh government granted approval for the release of four public varieties developed by BARI in 2013. In the seven years since Bt eggplant was first approved, the number of farmers growing it has progressively increased to well over 60,000 in the 2020-21 season. The actual number of farmers growing Bt eggplant is likely to be larger as some farmers use seeds they saved from the previous season or share seeds with other farmers. The four Bt eggplant varieties currently available cover only a limited eggplant growing area and many farmers still do not have access to the technology.

The reasons for the high rate of adoption are clear: Farmers have benefited from the technology by getting higher yields and savings due to the reduced use of pesticides to control the eggplant fruit and

shoot borer (EFSB). Reduced use of pesticides also provides health benefits to the farmers. Independent studies conducted in the last few years show that farmers are realising a six-fold increase in their net returns, earning \$2,151/ha as compared to \$357/ha for non-Bt eggplant, and are saving at least 60% on pesticide cost compared to non-Bt eggplant farmers. Further decreases in insecticide use and increases in environmental benefits will occur as growers gain more experience with EFSB-resistant brinjal. Bt eggplant has proven to be far superior to its non-Bt counterparts with negligible fruit infestations compared to 45% in the non-Bt eggplants. Further, the technology has been able to bring in a 41% reduction in toxicity of pesticides applied. The technology has also witnessed an increased labor use or harvesting, grading, and packaging of Bt eggplant because of increased yield. The key motivation factors among farmers for shifting to Bt eggplant from traditional eggplant included potentiality of higher marketable yield, lesser insect (EFSB) infestation and better price. Having benefited from the technology, farmers now want the Bt technology in higher yielding, agronomically superior, wilt-tolerant and widely adapted varieties to achieve broader adoption of Bt eggplant in Bangladesh.

Bangladesh has gained by the release of publicly developed varieties that met the needs of the small farmers. In India, too, ten public Bt brinjal varieties were developed by public institutions, but in 2010 a moratorium on their use was implemented. If they had been approved, it could have made the technology affordable to small farmers in India.

Q2: After the success of Bt Brinjal, when do you think blight resistant potato and golden rice are set to be introduced in Bangladesh and how will it impact the farmers?

A: The Golden Rice which is still under review in Bangladesh was created at the International Rice Research Institute (IRRI) in Los Baños, Philippines. Researchers bred beta-carotene genes into a rice variety named dhan 29, which is grown widely during the dry season in Bangladesh and contributes about 14% to the national harvest. When Dhan 29 Golden Rice was planted at multiple locations, researchers at the Bangladesh Rice Research Institute (BRRI) in Gazipur found no new farming challenges and no significant differences in quality—except for the presence of vitamin A. BRRI submitted data to the Bangladeshi Ministry of Environment, Forest, and Climate Change in November 2017. The Biosafety Core Committee of the National Committee on Biosafety has since been reviewing environmental risks. BRRI is now awaiting approval from National Committee on Biosafety. If approved, Bangladesh could be the first country to cultivate genetically modified rice. Widespread adoption of golden rice would be incredibly valuable for Bangladesh and benefits from its cultivation would be associated with increased farmer productivity as well as positive health effects and reduction in per unit cost of rice production.

Late blight is the most serious potato disease worldwide, caused by the water mold, *Phytophthora infestans*, that destroys leaves, stems, and tubers. The disease spreads very quickly and can result in total crop loss. To protect crops, farmers spray heavy concentrations of fungicide which increases input costs and labour and increases potential risks to the population and environment. The Feed the Future Biotechnology Potato Partnership is finding effective alternatives to fighting late blight through biotechnology. Michigan State University in partnership with U.S. based Simplot Plant Sciences and USAID plans to develop and bring to market a three-resistance gene (3R-gene) late blight resistant potato in farmer-preferred varieties in Bangladesh. The late blight resistant potato is expected to improve livelihoods of smallholder farmers by reducing input costs, increasing yields and yield stability, and reducing the exposure to chemical fungicides which are harmful to human and environmental health. The genetically modified potatoes will undergo multi-year, multi-location field trials in both target countries to collect the necessary data in order to apply for regulatory approval and be commercialized. The project expects that farmers in Bangladesh can begin to see the benefits of this technology in their fields in five-ten years.

Q3: India allowed Bt Cotton in 2002 and the nation is struggling to get an NOC for Bt Brinjal field trials even after 19 years, how far behind is India now when compared to countries like Bangladesh, Canada, and USA?

A: India went ahead with the release of Bt cotton, primarily because it's not a food crop and is not directly consumed whereas the country has been dragging its feet far too long for commercialization or even providing NOCs for field trials of food crops like brinjal, mustard or even of next generation of Bt cotton that provides better resistance to insect pests and selected herbicides. The Indian regulatory framework is a robust one however, there are far too many pressure groups who either lack the scientific basis of the Biotech or genetic modification of crops or feign ignorance due to one reason or other best known to them. It will not be fair to compare India and developed countries like USA and Canada who are way ahead as far as the acceptance of genetic modification (GM) technologies and their wider acceptance in these countries from the perspectives of scientists, farmers, and end consumers whether it be for maize, soybean, sugar beet, potato, squash, oilseed etc. USA and Canada are also treating gene editing technologies (gene editing of the host plant, no introduction of foreign genetic material) as safe and treat them differently than Genetic modification technologies (incorporation of foreign genes into host plant).

When we compare India to Bangladesh, Bangladesh is doing well as far as the commercialization of GM crops is concerned. Bangladesh commercialized Bt brinjal in 2013 and is working towards releasing golden rice, late-blight resistant potato and GM cotton. The commercialization of Bt eggplant has been made possible by a strong push from the government despite opposition from various pressure groups. Ironically, the technology for commercialization has been transferred from Indian company to Bangladesh. Indian public sector developed ten varieties of Bt Brinjal as total indigenous development effort that has been denied to resource poor farmers in India. Varietal release by the public sector has created a significant impact in Bangladesh for small farmers to gain access to affordable seeds. The speed at which the Indian Government is moving for commercialization of GM crops does not augur well for Indian farming community as the threats from current and emerging pests are enormous and cannot be met by conventional means. Therefore, if India must be in the league of countries like USA and Canada or even Bangladesh, the government needs to start believing in the scientific evidence for commercialization of GM crops in the country, including but not limited to Bt Brinjal.

Q4: What would be your suggestion to de-bottleneck the regulatory process in India to get approval on the next GM crops?

A: The regulatory protocols in India are as well-defined and stringent as anywhere else in the world, however, the major challenge the government faces are from the various pressure groups who have practically no stake in believing the scientific evidence for the safety of GM crops. The government is also at fault for not respecting the recommendations made by the scientific committees comprised of experts drawn from various fields across the country. The government needs to abide by the advice of scientists/scientific institutions for taking a call on the commercialization of GM crops and not be pressured by activists/politicians. An overcautious Ministry of Environment and Ministry of Agriculture influenced by a small section of NGOs opposed to technology, projecting their opinion as 'public opinion' rather than scientific data (performance, safety) accepted by DBT for technology approval is killing the innovative approach among few seed companies of India who are spending millions of dollars to develop the safe products for the farming community and end consumers only to see it scuttled by unscientific opinions. These companies are now looking for markets outside of India! Further, a lengthy approval process seeking resubmission of the data from local experiments that too not customized but the entire set forces the innovators to waste time and money instead of recognizing what has been accepted by other approvers in different countries. A model similar to ISO or other quality standards or even what we have adopted for the release of COVID-19 vaccines within a year recently can be taken up for commercialization of GM crops. After all, the novel tools and technologies are for the benefit of society at large whether it be for medical science or agricultural/food sciences; if it has proven to be safe within the given regulatory framework, it should be made accessible to its users.

The GM product developers also need to take some blame for not creating enough publicity right from product development and 'pre-launch' stages about both the limitations and benefits of the technology that resulted in confusions among the users who would likely to be on the safer side and not use the product unless they are fully aware of the benefits and limitations. They need to invest in stronger communication and policy advocacy efforts. There is also a lack of clarity on who is the approver - GEAC is the appraisal committee but does not have the authority to "approve". GEAC gives permission for trials but states deny it. Further, the lack of inter-ministerial coordination, too many players to play spoilsport (agriculture being the state subject and each state imposes their power based on whims and fancy) coupled with the lack of political will for approval of GM crops was the biggest hurdle for the commercialization of Bt brinjal in India. This makes it tough for an applicant to explain the technology multiple times to new experts.

There is also one major bottleneck that requires states' NOC for conducting environmental toxicity assessment involving approval from multiple stakeholders making it impossible for applicants to do desired number of trials in different states. This can be done away and once the environmental toxicity studies have been completed, they need not be repeated for the same technology. There is also a lack of a clarity for study requirements – the guidelines for stacked (multiple traits) products are yet to be formalised.

There is a need in India for an independent authority that is free from political influence and should have the clear guidelines and authority for appraisal and approval for commercialization of GM crops. This should follow the model that USA, Canada and Australia have adopted and should be free from socio-political and not be influenced by pressure groups like so-called environmental activists and/or NGOs. This should be supported by clear timelines for approval process and the decision of same authority should be accepted by all the states without any contradictory signals from central and state governments. Removing these bottlenecks will help India become one of the leading adopters of the new tools and technologies benefiting farmers of the country as well as ensuring food safety and security.

Q5: What are your views on gene editing? How do you think it will revolutionize the agriculture sector and the food basket?

A: Gene editing has the potential to reshape agriculture. It has become a powerful tool in plant genomics research that can accelerate crop improvement and food production. With the discovery of novel and better enzymes and improved delivery methods of gene editing, the application potentials of CRISPR/Cas9-based crop improvement have been enhanced. It not only facilitates newer varieties to be produced quicker by cutting down on time, labor and costs compared to genetic modification but also will aid to develop high yielding, nutrient rich, disease resistant, herbicide tolerant and other abiotic stress tolerant varieties of crops and can significantly reduce input costs of farmers. Combining artificial intelligence and gene editing together could empower researchers to design plants with desired traits suitable for local conditions. In recent years there are multiple reports, including from India, that have shown successful application of genome editing in crop improvement.

Department of Biotechnology, Ministry of Science & Technology has recently released a comprehensive draft document on regulatory framework and guidelines for risk assessment of gene edited crops. This is a significant development and may pave the way for utilizing gene edited crops in India. However, the draft guidelines proposed by DBT takes the process-driven approach rather than a more desirable product-centric approach, where the novelty of the characteristics in the gene edited plants is evaluated. US and other developed countries take the product-centric approach to deregulate gene edited crops. The draft guidelines also propose a tiered regulatory approval process. Plants whose genome has been minimally modified (SDN-1), would have to conform that only the targeted genome is edited and rule out any significant off-types. Plants whose cells have few or several base pair edits (SDN-2) will have to undergo trait efficacy trials and would be assessed for equivalence with similar non-edited varieties. However, plants with large DNA changes (SDN-3) will be treated

similarly to genetically modified crops. Once the proposed framework is tested and few gene-edited crops get approved, regulators would certainly review and move towards a product-centric approach.

Genome editing in crops can significantly speed up the progress of breeding programs. It could drive the development of traits in new crops and allow improvements in yield and pest resistance, adaptation to climate change, and industrial and pharmaceutical applications. Hence it is time a widely acceptable regulatory approval process is in place at the earliest to revolutionize the agriculture sector. India must follow the regulatory systems of countries that are large producers and exporters of agricultural produce.

Disclaimer: The opinion expressed above are solely that of the author and does not represent the opinion of any institution or entity he is affiliated to or referred to in this interview.
