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Education for Life. Education for Living.
The Changing Dynamics of Indian Agriculture

The pandemic has exposed both the strengths and the vulnerabilities of India’s agri food systems. It has emphasized the need for agricultural market reforms and digital solutions to connect farmers to markets, create safety nets, ensure reasonable working conditions, and decentralize our agri food systems to make them more resilient.

Agriculture has the power to revive the Indian economy post Covid. Are we on the right track for this mission? Do we have what it takes to meet the challenges of these changing dynamics?

Speaking at an event recently, Dr Ashok Dalwai, Chairman, PM's Taskforce on Doubling Farmers Income said, “We now need to bring equilibrium between the demand and supply. We need to focus on markets. Liberalize agriculture, make it more market friendly so that it is the demand and the prices that become an incentive for farmers to produce what the domestic and global markets demand.”

Rising income, urbanisation, a change in dietary preferences, socio-demographic factors, increased awareness about the health benefits of fruits and vegetables, food industry marketing and policies of trade liberalisation over the past two decades have been major market drivers for the growth of high value agriculture. Escalating agricultural exports are playing an important role in expanding the activities of the agriculture sector. They are generating robust employment opportunities and diversifying agricultural operations.

Digital innovations, effective climate risk mitigation strategies, start-up ecosystems, the strengths of Farmer Producer Organisations and water management initiatives will be some of the key emerging trends that promise an exponential growth curve for Indian Agriculture. Streamlining of policies and creation of the required infrastructure is essential. We shall also benefit from the infusion of digital solutions in agri-business. The digital innovation shall facilitate better quality, traceability, logistics and distribution and strengthening of all links in the value chain.

Indian agriculture and the allied sectors are discovering new technologies such as IoT and agri drones. The government, industry and research institutions should form a consortium to respond to this new normal. In this way, agri-tech start-ups can flourish and meet the demands of Indian farmers.

Happy Reading
Shri Ramesh Pokhriyal Nishank
Union Education Minister, Government of India

The CEO’s Desk 03
From the President’s Desk 06
From the Executive Editor’s Desk 07

GOVERNMENT SUPPORT
Will try to address all issues of seed industry:
Shri Parshottam Rupala 21

TRANSFORMING BHARAT
Additional Profit Generation in Farm Produce 24

PULSE MILLING OPERATIONS
NAFED: Meeting India’s Processed Pulse Needs 28

AGRI ECOSYSTEMS
Making Small Farmers Self-Reliant During Kharif 36

TECH SUPPORT
Technology Adoption Essential to Minimise Losses 38

WAY TO GROW
Entrepreneurship Through Oil Plant Establishment 40

ROUTE TO REVOLUTION
Transition Towards Energy-Smart Production Systems 42

AATM NIRBHAR BHARAT
Innovative infrastructure approach in Sukhet Model 46

VISION AND SUPPORT
Maximizing AI For Agri Growth 48

THE WAY AHEAD
Direct Seeded Rice - The Right Choice 50

AGRI VISION
Successful Kharif Season Amidst the Pandemic 52

AGRI SCIENCE
Mobile Apps: Timely Info, Better Decision-Making 54

AGRI CHALLENGES
Major Barriers for Sustainable Agriculture 56

EYE ON FUTURE
How Covid Has Changed the Rules of the Game 58

TECHNOVATION
Agri Logistics in the Age of Disruption 60
Duck Farming- A Profitable Source of Livelihood 64

AGRI ASPIRATIONS
Combining Agriculture With Cutting Edge Technologies 65
Effective Ways of Storing Post-Harvest Farm Produce 66

YOUTH IN AGRICULTURE
DR RAJ PARODA

HEALTHY FARMERS
MR AJAY S SHRIM

INDUSTRY SPEAK
MR DEEPAK JAIN

ONE PLANET, ONE HEALTH
MR RAM KAUNDINAY

EMERGING MARKETS
DR MADHAVIYA ANGAMUTHU

STRENGTHENING GRASSROOTS
MR GAGAN PAL
इफको-टोकियो का यही अरमान रहें सुरक्षित महिलायें, किसान, वाहन और मकान।

लॉन टॉर्म
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(ITG-M0-316-34-V01-16-17)

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कृपया जोखिम संबंधित नियम व शर्तें की विस्तृत जानकारी के लिए पॉलिसी ब्रोकर का अवलोकन करें।

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India’s agricultural exports have rapidly grown in recent years to reach $40 billion annually. With rapidly changing times and evolving market requirements, there are newer challenges that need to be identified and addressed for elevating India’s position in international trade. The government bodies, service agencies, exporters, agribusiness companies and agro startups have to play an aggressive role to tap the booming export market opportunities and sustaining growth.

Is the export of agricultural produce a dream that must be limited to only those farmers who own large tracts of land? No. Our small and marginal farmers can unlock their huge potential if they come together for a cluster-based approach to farming. The situation demands alternate models that shall increase the scalability and profitability of farming. There are many examples in the last few years where farmers have immensely benefited from the cluster-based approach. Formation of FPOs promises great opportunity to translate this dream into reality. The institutional mechanism, which farmers can leverage on for economy of scale and for professional support, can certainly help farmers effectively connect with the national and global markets.

The will of the farmers for pursuing collective success is crucial. At the same time, the farmers need a support system in which they can flourish. The public sector plays a crucial role here. The state government and other public institutions can play a vital role in the formation of a cluster in their respective areas which specializes in the production of some specific agro produce. States have crucial role to play. Under the new agro exports policy, APEDA is already entering into MoUs with the States to help them boost up export related efforts.

The various institutions of the state must come forward to provide the technical and commercial expertise to the farmers to develop the cluster, and also the loans to support the pursuit of development. State institutions can support the cluster in various other ways. The state marketing boards can collect technical and market information for producers. The agriculture produce marketing boards or even the agro industries corporations of the states can take the initiative to collaborate with the support agencies and farmers in order to support the cluster. The state governments can provide guidance and training sessions and quality testing systems for farmers so that their produce meets the international standards.

The collaborative approach of the national level institutions also plays a vital role in the development of a state-specific cluster. Agricultural and Processed Food Products Export Development Authority (APEDA) has initiated a number of steps to support the export of agricultural produce from various specialized clusters in the country. Through such collaborative approaches, agri-export zones have been developed in various parts of the country. These initiatives have been successful, and promise immense possibilities for the farmers and the country’s future of agro exports.
Black Wheat, and How Our Youth Are Leading The Change

Covid has gifted us immense learning in terms of food products that build our immunity and resilience. In several farmer groups on social media, I observed a spike in the production of black wheat as a premium product. I learnt that black wheat has many health benefits and has many important nutrients which boost immunity.

When a young farmer engaged in the production of black wheat in Punjab connected with me through the reference given by a friend, I was intrigued by the product. The sixth-generation farmer, Vidur Ahuja, has taken up the production of black wheat at his farmland in Fazilka district, one of our border areas. He has also taken upon himself to market the product.

One would think that Covid stress and the demand for immunity boosting products would make black wheat fly off the shelves. Such is not the case. Many such agricultural products have a relatively higher price tag. Hence only a select group of buyers can afford them on a regular basis. Vidur markets black wheat for Rs 100 a kg.

Vidur reveals that the production of black wheat is perhaps the simplest part of the value chain. He has taken care that black wheat is grown without chemicals. The tougher part has been ensuring that at the time of grinding, black wheat does not get mixed with the white wheat at the atta chakki. So the entire chakki has to be cleaned and washed and then black wheat is grinded. This entire process gives high overheads to black wheat, adding to its cost.

Vidur says he has realized that even though people have a high interest in immunity-building products, the shift to black wheat shall not be total. Culturally we identify with the golden brown roti.

Vidur has received a good demand for the product in cities like Delhi, Bhopal, Ludhiana, Shimla, Lucknow etc. So yes, there is a definite niche market where such products can flourish. With our youth leading the charge, the future looks bright.
Advisory Agents, Input Providers, Entrepreneurs

Youth Can Link Farmers to Markets More Effectively

Agriculture is an engine of growth in the economy of most Asian countries. It is quite diversified from country to country. This is the region which has experienced Green, White and Blue Revolutions. Lately, we are witnessing Rainbow Revolution also through increased fruits and vegetables production, which has even excelled total foodgrains production. All these revolutions had been science-led and contributed a great deal to the household food and income security despite four-fold increase in India’s population since independence. Agricultural sector has helped several countries such as India, Malaysia, Indonesia and Thailand in improving their economies. In fact, the then importing countries such as Bangladesh and Vietnam are now exporting rice and other agricultural commodities.

Currently, we are facing the second generation problems of Green Revolution like factor productivity decline, concern of poor soil health, water table decline, biodiversity depletion, greater incidence of diseases and pests and above all the adverse

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impact of climate change. The region is also faced with two important sustainable development goals (SDGs) - zero hunger and no poverty. In order to address these, we need to bring in perceptible change in our farm and farming practices. We need to focus more on innovations and bring a paradigm shift from genetic enhancement to that of sustainable use of natural resources, being the second pillar of sustainable agriculture.

**Need for Scaling Innovations**

In the present context, developing countries, including India, must lay greater emphasis on new innovations which definitely will help in improving production, diversification in agriculture and also value addition to reap higher income. In doing so, we need to ensure that the cradles of Green Revolution are there, viz., policy support from government, good number of proven institutions and human resource and willing and progressive farmers to adopt new technologies and policies.

Among the existing challenges, economic return to farmers is a major one. Over the years, the input cost has increased exorbitantly and the returns from inputs have considerably declined. Availability of water is also reduced. Therefore, scaling of innovations aiming at natural resource management is critical. We need to focus on ‘One Health’ concept, which includes soil health, plant health, animal health and also human health. In addition, farmers in Asia will have to embrace secondary and speciality agriculture.

Unfortunately, youth is not interested in traditional agriculture. They wish to diversify from cereal-centric approach to cereal-legume rotation, being more sustainable, for example, maize-soybean combination in the USA, which has sustained agriculture production for many decades now.

Also, the efficiency of nutrients being used (around 33.6 million tons) is barely 30 per cent. This has to be enhanced. Also, we must discourage flood irrigation and promote the use of micro-irrigation aggressively. Conservation agriculture (CA) in dryland areas using no till or zero tillage approach is likely to give rich dividends. CA has been found highly successful in many parts of the world, especially in Latin America, USA, Canada, Europe and Australia covering around 205 million hectares.

Also, it is critical to understand that we do not waste what we produce. This would require emphasis on value addition, processing and storage infrastructure and better marketing opportunities. In fact, we have done extremely well in all areas such as horticulture, animal, poultry/egg or fish production. Considering our rich agrobiodiversity, we see great potential for its adaptation to climate change. Also, the need for reorienting agricultural research from commodity and crop approach to that of farming systems approach, while addressing the needs of smallholder farmers is fully justified. To attain this, the country needs to at least double the current expenditure on agricultural R&D with emphasis on scaling innovations that make a difference in the income of farmers. In general, 1.0 per
cent of agricultural GDP is justified for meeting formidable challenges. Unfortunately, this support is currently ranging between 0.3 to 0.6 % in most of the developing countries in Asia (0.39% in India). On the other hand, the returns from investment in agriculture sector is much higher (10-15 times) than other sectors.

**Partnership for Farmers’ Welfare**

Smallholder farmers will have to align themselves to either established Farmer Producer Organisations (FPOs) or go for contract farming, or establish Self Help Groups (SHGs) or farmers’ cooperatives (FCs) so as to link effectively with the markets. For this, the role of youth to provide much needed advisory services as paid extension agents or input providers or entrepreneurs will be highly critical. This would need institutional backstopping, hand holding and easy access to credit. In the process, it must be ensured that inputs are provided timely, inputs that cut cost for the farmers, like biofertilisers, biopesticides, fertigation, micro-irrigation, etc. Farmers would also be required to adopt secondary and specialty agriculture like raising of mushroom, specialty vegetables, flowers, medicinal plants, etc. Obviously, there seems to be ample opportunities for raising farmers’ income provided there is willingness to change.

Farm and farmers of the future would require an enabling environment such as: proper land, input and credit policies, incentives instead of subsidy for the environmental services as well as good agricultural practices (GAP), including diversification and conservation agriculture for sustainable intensification (CAI). Farmers of future must ensure that the benefits of efficient farming also reach to the consumers.

In the next two decades, I do see a significant shift towards diversified and specialised agriculture. In this context, farmers shall have to address the concerns of productivity, profitability and permanency. For productivity, we will have to adopt innovations around genetically modified crops, whether soybean, corn, canola, and also have dependence on genome-edited crops for better resistance to diseases and pests and also for abiotic stresses. Youth will definitely come forward in adopting and scaling these new innovations. For profitability, they need to shift towards low volume high value crops such as some specialized vegetables and flowers, seed spices, medicinal plants etc and also go for value addition. In the area of permanency, the farmers will have to work towards regenerative agriculture (RA) involving conservation agriculture (CA) practices for sustainable intensification, organic farming, less dependence on inorganic fertilisers and more use of biofertilisers, biopesticides, etc. Future farmers will have to increase productivity through greater dependence on vertical agriculture, protected cultivation, artificial intelligence (AI), use of robots and drones for spraying pesticides, fertilisers and use of Big Data in solving specific problems. In the process, I see an important role of youth (including women) to make Indian agriculture more attractive and remunerative.

*(Based on Dr Paroda’s address in an international dialogue on ‘Farms and Farmers of Future’ organised jointly by Purdue University and USAID in March 2021)*
ABOUT THE PROGRAMME

The Post Graduate Programme in Food and Agri-business Management (PGP-FABM) is specifically designed to develop effective managers, leaders and entrepreneurs for an increasingly competitive and globalizing food and agri-business sector. The programme is a leader in agri-business management education and has been ranked Number 1 in Agribusiness/Food Industry Management in the World by Eduniversal, a global ranking and rating agency specializing in higher education, Paris. This sector-specific programme compares very well with other agri-business programmes as course curriculum has a leading-edge managerial foundation firmly rooted in IIMA’s management culture and proficiency with a focus on food and agri-business.

To enhance learning from multiple perspectives, first year of the programme is common with Post Graduate Programme in Management (PGP). Building on strong foundation in general management in the first year, 2nd year courses are designed to equip students with specialized multifunctional knowledge, perspective and skills required by agri-business managers for excellence in planning, decision-making, implementation and enhance their effectiveness as leaders.

COURSES AND PEDAGOGY

The programme curriculum has a solid managerial foundation, focus on food and agri-business marketplace, and is designed to build and enhance a global perspective among participants. The course comprises of three components: the core management courses, compulsory food and agri-business related courses and elective courses. The core programme consists of compulsory management courses in the first year and is common with the PGP. Following the first year of the programme, students undergo Rural Immersion for a period of about four weeks in two phases and summer internship for a period of about eight weeks, which provide students field and organizational experience.

The second year of the programme consists of compulsory and elective courses and is designed to impart specialized multi-functional knowledge and skills required by food and agri-business sector managers for excellence in planning, decision-making, organization and implementation in different sub-sectors and activities in food and agri-business sector. The students exchange programme is offered to the PGP-FABM students with a vision to enhance the international exposure. Under this exchange programme select second year students of PGP-FABM programme spend a term with a foreign university.

INDUSTRY INTERFACE

The PGP-FABM brings business leaders, senior industry executives and policy planners from different fields of agri-business into the classroom and facilitates continuous interaction among students, agri-business companies, faculty and alumni. These knowledge-building sessions are opportunities for industry leaders, alumni and recruiters to engage students in focused discussions that reflect real life situations, simulations of future scenarios and specific career tracks. Distinguished guests include CEOs, senior executives, development professionals, policy makers and thought leaders from various governmental and non-governmental organisations and private sector.

PLACEMENT PROSPECTS

The career prospects of professional managers from IIMA’s PGP-FABM Programme are incredibly bright and attractive. The placements reflect the increasing recognition and perceived relevance of the programme by the industry and include newer areas such as commodity trading, farm insurance, agri-business infrastructure and food retailing. Many alumni hold key CXO positions in several agri-business conglomerates and developmental organisations in India and abroad.

Major recruiters visiting campus include Bayer, P&G, Reckitt Benckiser, General Mills, Cloudfall, Godrej Agrovet, Olam International, PI Industries, Syngenta, DuPont, Kerry Group, Marico, RBL Bank, Rabobank Group, Amul, PwC, ADM, Tata Railis, etc.

YOU DESERVE TO BE HERE

We encourage bright graduates from food and agriculture disciplines and those who have demonstrated interest in agribusiness to apply to the FABM programme. Selection for PGP-FABM is done through a two-stage process. First, candidates have to appear for the Common Admission Test (CAT) that is held in November. The applicants are then short-listed and called for analytical writing test and personal interview. The applicant’s past academic record/achievements, understanding of agriculture and allied sectors, work experience and other relevant activities are also taken into consideration. The timeline for the admission process is as follows:

- CAT Advertisement: August 1, 2021
- CAT (Examination): November 28, 2021
- Analytical Writing Test & Personal Interviews: February-March 2022
- Session Starts: June 2022

Exact details of eligibility and CAT are given on IIMA website (www.iima.ac.in/web/pgp-fabm) or (www.irm.cat.ac.in). IIMA offers enough Need Based Scholarship/ assistance for economically disadvantaged students. Bank loans on easy terms are also available under policies promoted by the Indian Government.

For further information: Admissions Office
Indian Institute of Management Ahmedabad, Vastrapur, Ahmedabad-380 015.
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Human history is evident in how civilizations and empires have emerged and thrived on the foundations of great agricultural practices. For a long time, India has primarily been an agro-based economy, with more than 55% of our population engaged in agriculture and allied activities. In our culture, the noble profession of agriculture is worshipped while farmers are revered as Ann-Daata.

During the 1965 war, the then Prime Minister Shri Lal Bahadur Shastri gave the clarion call of Jai Jawan-Jai Kisan. This not only enthused our soldiers but also motivated the farmers to boost the agricultural productions. As our farmers toiled, India emerged victorious without depending on the food imports from other countries. Undoubtedly, agriculture is the key to achieving Aatmanirbhar Bharat. I believe that it is the synthesis of education and agriculture that will play a crucial role in realizing this goal.

There are a multitude of ways by which education positively impacts the agriculture sector. On the one hand, literacy enables a farmer to read and understand how to use chemical fertilizers and pesticides efficiently. On the other hand, numeracy allows a farmer to calculate the right amount of components to produce a greater output with better usage of current resources.

The continuous advancements in science, research, and technology also impact the agricultural sector massively. The Green Revolution in India is a case in point. With the subsequent progress in agricultural sciences and research made during the previous decades, the agriculture sector has contributed to nation-building. According to the Economic Survey 2020-21, the share of agriculture in In-
India’s GDP increased to 19.9% in 2020-21. Today, we are feeding millions of our citizens and sending tons of food aid to friendly countries during the pandemic, thereby enhancing India’s image globally. A robust ecosystem for agricultural education across the country can give further impetus to our agricultural sector.

It gives me immense pleasure to share that our premier educational institutes contribute to ameliorating the country’s agriculture landscape. To name a few, IIT Kharagpur has a dedicated Agricultural & Food Engineering Department, which has been contributing to human resources development in the agricultural and food engineering sector in India. Likewise, IIT Kanpur aims to create an enabling ecosystem for students and recent graduates to develop deep technologies in the agriculture sector to empower smallholder farmers in solving various challenges through the IAIN fellowship. I am sure that such initiatives being undertaken by our educational institutions will positively impact agricultural education in India in the long run.

I also believe that there lies a massive potential in agro-entrepreneurship in India. Our government has been undertaking several initiatives to support and give a boost to agro-entrepreneurship in the country. Last year, we had organized an Agri-Food Techathon, which was the first initiative of its kind and dedicated to the agricultural sector to empower smallholder farmers in solving various challenges through the IAIN fellowship. I am sure that such initiatives being undertaken by our educational institutions will positively impact agricultural education in India in the long run.

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RURAL HINTERLAND AMID THE SECOND WAVE OF COVID

Even as the rural regions have been badly affected by the more transmissible second wave, their plight has been compounded by the paucity of healthcare infrastructure. Vaccinating these cohorts first should be the top priority.

February 2021, and a sense of comfort and complacency had set in. The number of active Covid 19 were far and few and within manageable numbers. Economic activity was picking up with the hope that financial year 2021-22 will witness robust growth. Then, almost by stealth, in end March cases began rising rapidly and peaked to unprecedented levels causing despair and helplessness. The virus spared almost no family and the healthcare system was overburdened. Even under such trying times, medical personnel and vol-

About the Author
Mr Ajay S Shriram is Chairman & Senior Managing Director – DCM Shriram Ltd & Past President Confederation of Indian Industry (CII)
Volunteers worked tirelessly to save lives and assist people, often at great personal risk.

During the first wave, the virus spread was largely limited to urban areas while rural regions remained mostly unaffected. Unfortunately with the onset of the second wave rural India was overwhelmed. Inadequate healthcare infrastructure added to the enormity of the problem. Businesses that traded with rural India witnessed firsthand at the intensity of infections and loss of lives.

Agricultural activities continued uninterrupted during the second wave. But it was the non-agricultural segment that suffered greater losses because of repeated lockdowns and supply chain disruptions. Sectors such as construction, rural industries, transport and trade suffered a huge loss of income. Employment in such activities is dominated by daily wage earners and they had to bear the brunt. Even worse, the scope of recovering loss of income was not an option.

Thankfully some of the learnings from the first wave came in use. There was no hard lockdown, and limited services of trains and buses continued. We were spared of the sorry sight of migrant labour being left in limbo. With substantial decline in infections by end June, the impact on agriculture production is expected to be minimal. Rabi harvesting and procurement was conducted smoothly. The Agri input supply chain is now well-equipped to meet sowing requirements during the upcoming Kharif season. Stable prices of agri commodities, reduced instances of distress selling and a higher volume of exports have been a consolation.

Sadly, confidence level amongst rural households has been subdued due to decline of income, financial burden of health care and loss of human lives. Early feedback indicates lower spending on FMCG products and caution in acquiring consumer durables. Under these compelling conditions, the government needs to step in aggressively and help people reconstruct their lives post the second wave. MGNREGA has been a savior for count-

less landless labour. The question we need to ask ourselves is, is that enough?

Spur Rural Spending
The Central and state governments can take four steps to boost confidence amongst the rural population. Firstly, with vaccine supplies easing, priority should be for inoculating villagers. The hinterlands need greater and more immediate access to vaccination considering the lack of proper healthcare infrastructure.

Second, all primary health centres should be stockpiled with oxygen and essential medicines to so that there is adequate preparedness. Third, employment must be ramped up by aggressively by re-launching rural road and housing construction projects. Lastly and most importantly, money needs to be transferred into the hands of the rural poor. It has been done in the past and technology enables it to be done quickly through Jan Dhan accounts.

Spending by the poor will spur economic activity and get the get the economic cycle moving. We may worry about inflation, but the choice for the receiving segment is between no income and some income.
India is predominantly an agriculture based economy. Over 60 percent population is employed in this sector, and contributes about 17 percent to the national GDP. This figure in itself highlights the imbalance between employment and the corresponding GDP ratio of this sector.

Before going into strategic management of this problematic ratio, let me disclose some figures for a better understanding of the challenges faced in the agriculture sector.

The central government is giving financial support in the form of subsidy of around Rs 2 lakh crore to agriculture and related sectors in various forms. An additional Rs.15 lakh crore is disbursed as credit to farmers. Further, Rs 1.25 lakh crore is provided as infrastructure funds for agriculture and allied activities. India’s total food grain production is about 300 million tons, but the storage capacity is just 85 million tons. India produces about 350 million tons of perishable fruits and vegetables, the storage capacity is less than 70 million tons. Only about 7 to 10 percent food is processed in organized sector.

The central government has introduced various schemes to address these gaps. Some of them are as follows:

1. Upgradation of individual Micro Food Processing Units through credit linked subsidies (PM FME Scheme)
2. Capacity building and training support for the micro enterprise through entrepreneurship development, marketing, Udyog Aadhar, GST Registration etc
3. Common Infrastructure Support
4. Seed Capital to Self Help Groups
5. Various incentives on sales and investment

ABOUT THE AUTHOR

Mr Deepak Jain is an industrialist with over 40 years of experience. He is the Director General of Federation of Indian Industry, a non-profit organization to realize his vision for India’s economy. His expertise lies in the MSME industry and its ecosystem.
6. Production Linked Incentive Scheme for Food Processing Industry to support creation of global food manufacturing giants and support Indian brands of food products in the international markets
7. Strengthening of institutions focussing on R&D in area of Food Processing
8. Skill Development to produce skilled workforce for various processes involved in food processing
9. Concept of Mega Food Park based on Cluster approach for setting up of modern food processing units with well established supply chain infrastructure including collection centres, primary processing sectors, cold chains etc

Even with all the initiatives put forth by the government, it is clear that achieving full potential of this sector would require Indian companies to improve their competitive strength vis-à-vis their global counterpart in term of scale of output, productivity, value addition and their linkages with the global value chain.

Post-Covid Scenario
The projections of the market and the industry look different in the post-Covid era. With the changing dynamics, the plan of action for boosting the food processing industry needs to be strategized in a new light.

The initiatives taken by GOI have been formulated to address the current struggles faced by the sector, be it the need for skill development or incorporation of better technology for higher quality processed products. These are the areas where our MSMEs have always excelled in – skilled manpower and advanced technology. MSME sector boasts of both manufacturing and marketing strength. Both these are amiss in the agriculture sector.

In a typical scenario, there are roughly seven to eight members of a family, all engaged in farming of a single piece of land. There is a limited produce obtained at a higher cost of labour involved.

In an alternate scenario where there are advanced technologies at play, only one or two members of family would be engaged in farming activities. The other members of the family can be trained to be engaged in food processing business of goods obtained from the same piece of land.

In the alternate scenario, the cost invested in terms of human labour goes down. There is added profit from sale of processed foods, and an increase in contributing GDP from the same land.

Convergence of these two sectors can benefit crores of people.

India’s MSME sector is in trouble due to the Covid pandemic. Nearly 11 crore people dependent on it will become unemployed. Some became unemployed last year, some might face the repercussions this year. Trained manpower in MSME sector is struggling with unemployment. They are looking for opportunities.

On other hand, farmers are facing issues where they are unable to get a good price for their crop.

It is time to strengthen Food Processing sector by merging MSME and agriculture sectors, the joint strength can be used to benefit the country.

Bringing together the two sectors can lead to huge gains. In the Agriculture Sector, there will be value addition. Farmers will get better prices for their produce. Advancements in food processing industry will help produce higher quality and economically viable products. Marketing, food safety and Quality Assurance Infrastructure will be provided by the skilled MSME workforce.

This would boost the outreach of processed goods in local market and higher exports to international market through insulated/refrigerated transport, which are among the key strengths of the MSME sector. This is an untapped potential with huge success projections of all three sectors: Food Processing, Agriculture and MSME.

Mr Jain loves to listen to the ghazals of Pankaj Udhas and enjoys watching action thrillers. He sings, reads and writes for leisure. He is also extremely fond of nature, travel, photography and connecting with people.
The monsoon has arrived. Kharif sowing is in full swing in some places while it is completed in some others. There is a general feel good situation about the Kharif prospects. This is good news for the country in general and for the farmers in particular.

While we are very bullish about the Kharif prospects and the expected production of more than 150m tons of food grains from this season, we should also think of how we plan to manage the production that will come out. Come September, the harvesting season will start and eventually all crops are covered all over the country by November. Important crops are Rice, Cotton, Maize, Soybean, Ground Nut, Jowar, Bajra and Vegetables. Among them Rice, Bajra and Vegetables go for human consumption. Soybean and Ground Nut will go for oil extraction. Kharif Jowar is mainly for animal feed purposes. Maize goes for animal feed or for export purposes. Cotton gets into the textile value chain or into exports. Rice is the largest volume crop in this assortment. Most of it goes into warehouses, meant for buffer stock of FCI, domestic consumption or exports. With the Government’s programme to provide free food grains as COVID relief, these stocks of rice will be needed.

### Losses at post-harvest stage
Good storage conditions and practices are essential for holding the harvested crops in good condition.

### About the Authors
Mr Ram Kaundinya, is Director General & Dr Ratna Kumria is Director (Biotechnology), Federation of Seed Industry of India.
condition and for avoiding storage losses. The Economic Survey of 2021 reported the 2013 post-harvest losses at Rs. 44,000 cr at 2009 prices (page 254). The latest estimates at current prices must be much higher.

A paper titled *Assessment of Quantitative Harvest and Post-Harvest Losses of Major Crops/commodities in India* written by Dr SN Jha of ICAR, Dr RK Vishwakarma of ICAR-Central Institute of Post-Harvest Engineering and Dr Tauqueer Ahmed and Dr Anil Rai, both of Indian Agricultural Statistics Institute, was published in January 2016. It brought out certain interesting facts about post-harvest losses. Losses in cereals were estimated to be between 4.65 pc to 5.99 pc and in pulses from 6.36 pc to 8.41 pc, mainly due to harvesting, threshing and poor storage at farm and wholesaler level.

Use of improper threshers, delayed harvesting and improper storage practices were identified as the probable reasons. Losses in oilseeds were estimated between 3.08 pc to 9.96 pc. For ground nut, the losses went up to 12.3 pc. Reasons are almost the same as cereals and pulses. In vegetables, the losses were 6.7 pc to 15.88 pc. Harvesting, sorting/grading, transportation, storage at wholesaler and retailer level and lack of good storage at market level were the main reasons.

According to another report, the annual storage losses were estimated to be 14 million ton of food grains worth $16,000 million every year. About from 30 per cent to 40 per cent of the fruits and vegetables grown in India (40 million tons amounting to US$ 13 billion) get wasted annually due to gaps in the cold chain such as poor infrastructure, insufficient cold storage capacity, unavailability of cold storages in close proximity to farms, poor transportation infrastructure, etc.

The paper also recommended certain measures like cold chain and multi commodity cold storages and low-cost short duration structures for reducing losses in vegetables. The report shows that the post-harvest technology in use in India is mostly manual and dated. We need to adopt newer technologies and mechanization to improve efficiency, save time and reduce losses. Most well-developed operations are for sugarcane and oilseed. Vegetables are neglected.

As these are Kharif crops, there is a need to review how much we are prepared with these measures to reduce losses in this Kharif.

**Technologies for post-harvest management**

Post-harvest strategies serve to reduce respiration rates, ripening, decrease ethylene production, and consequently senescence, prevent dehydration, preserve quality and extend the shelf-life of produce. These technological implementations include temperature reduction, modification of the atmosphere, or mechanical or chemical treatments.

Postharvest the produce is submitted to abiotic stresses. Strategies are needed to activate different metabolic pathways to manage stress, attain homeostasis to avoid undesirable quality traits that limit shelf-life.

Inadequate management of controlled atmosphere packaging, industrial processing and transport can cause major losses in nutritional quality, outbreak of foodborne pathogens. This may result in financial loss of supply chain management system as well as farmers and consumers.

Technology improvement studies on fruits and vegetables have increased understanding of ripening, development,
and senescence of different commodities like tomato, grapes, citrus, strawberry, peach, papaya, mango, and banana. Also, the mechanism of fungal or bacterial disease progression post-harvest is being focussed on.

In case of staple grains primary processing produces decorticated grain, meal, and flour. Mechanization of these processes helps improve efficiency as well as prevents storage losses. Some of the harvesting techniques, threshing and field drying practices can improve the grain quality and prevent deterioration in storage. After harvesting and before reaching the warehouses the quality of grain has to be maintained well including moisture management, proper packing and transportation. About 4 to 8 pc losses occur before the grain reaches storage facilities. Good storage conditions including well-constructed warehouses, with timely fumigation and rodent control will help in storing cereals and pulses in a big way.

Fruit shrivelling and mechanical damage are another issue in maintaining fresh fruit quality. Quarantine procedures and new postharvest technologies, such as edible coatings to reduce nutrient losses (ascorbic acid and pigment oxidation) and dehydration, should be developed in order to expand the market for fresh fruit. These techniques must be applied on a commercial scale in order to improve the storability of fruit nutrients and ensure juice safety requirements. However, toxicity and potential allergenic hazards need to be studied, accompanied by a detailed fruit composition analysis for legal regulation compliance.

Studies are ongoing to explore the possibility of using electromagnetic energy in pest dis-infestation to shorten treatment times and to reduce the adverse thermal effects of current lengthy treatments with hot water and air on product quality.

All these new protocols of good manufacture practices require technological and credit support for better adoption and economic feasibility. Adoption is also impacted by food industry and consumer demand.

Many private players entered the warehousing market with arrangements for loans to farmers through Warehouse Receipt system. This is an emerging field. Similarly silo based storage can save our grains from spoilage in storage. This is gaining prominence at policy level now. Both these trends can help us to eventually minimize post-harvest losses.

But for this year, Kharif being a major season of production for us we have to ensure that all the above precautions are taken by both private operators and govt institutions to prevent post-harvest losses.

**Transformative changes needed**

We have to go down the path of taking other initiatives, in line with what was envisaged in the new farm market reforms brought through new Acts in 2020, to transform management of agricultural output through modern approaches like village level micro processing, value chain development for domestic and export markets and modernize farm gate infrastructure for drying, storing and transportation including village level mini cold storage systems and cold transport systems. Supply chains have to get shortened so that losses in the system are reduced, farmer and consumer are brought closer thereby increasing farmers’ share in consumer price. Digital platforms have to be created to overcome traditional bottlenecks in linking farmers to markets and to large e-commerce platforms and retailers. Contract farming holds the key to get private businesses to create the infrastructure in rural areas to minimise post-harvest losses. Large private investments have to be attracted by the states towards this end through a policy framework for a seamless system across country.

It is not possible to achieve all this for this Kharif but we must start making the right efforts. States should announce the policy framework, private industry should come forward, take up small pilots to demonstrate success and give confidence to the farmers to make use of this modern approach to transform their agriculture, reduce post-harvest losses and increase their income levels.
The government is committed to safeguard the interests of farmers as they are primary stakeholders in any discussion on issues concerning agriculture sector, said Mr Parshottam Rupala, Union Minister of State for Panchayati Raj, Agriculture and Farmers’ Welfare at an ASSOCHAM virtual seminar today.

“Farmers are primary for us, be it terms of suggestions, recommendations, policy or anything else that we come up with, all other stakeholders including the government, its officials and the industry are secondary,” said Mr Rupala addressing the ASSOCHAM Webinar on the theme, ‘Paradigm Shift on Agri Inputs: Challenges & way Forward.’

Noting that farmers should not suffer due to issues arising between the government and industry, the Minister said, “This will help us in achieving the Prime Minister’s vision of doubling farmers’ income which has given a new dimension to the entire agriculture policy of the government.”

Providing better seeds is priority as it is the basic need to improve productivity then comes the technology and other aspects, he asserted. “Whether we need to resolve issues pertaining to truthful labelled seeds or be it the smaller companies facing issues in terms of certification and other challenges, it needs to be seen that such issues do not impact the farmers in any which way,” said Mr Rupala. He added, “We need to ensure that farmers get timely, affordable, and quality seeds, there can be no compromise in this regard.”

Mr Kumar added, “We also intend to strengthen the seed certification agency and boost infrastructure and manpower support so that it brings down the cost of seed certification.” He informed that government is looking to produce newer varieties of seeds in the PPP (public private partnership) mode with the associations in the pulses and oil seeds sectors.

Mr Aayush Marodia, Co-Chairman, ASSOCHAM Agriculture Sub Council: Eastern Region and Director, Pan Seeds spoke on the farmers’ need for quality seeds. Amid other experts who addressed the ASSOCHAM webinar included: Mr J.V. Ratnam, Senior AVP - Crop Protection, Coromandel International Limited; Mr Ranjan D Sen, Chairman, ASSOCHAM Agriculture Sub Council: Eastern Region; Dr Sanjay Kumar, Director, ICAR- Indian Institute of Seed Science; Dr Gyanendra Shukla, President & Director (CEO), JK Agri Genetics Limited.
APEDA EFFORTS TO BOOST EXPORT

MILLETS: THE LITTLE JEWELS

Millets are the cereal crops generally small-seeded and known for high nutritive value. Increasing interest in reviving the consumption of millets across various countries is favoring the growth prospects of this market in recent years. The millets market is set to grow from its current market value of more than $9 billion to over $12 billion by 2025.

India is the global leader in millet production with share of around 38 percent, and also the largest exporter. India produces around 14 Million MT of Millets annually. Millets exports from India have continuously increasing at 12% CAGR in last 3 years. India’s major competitors are shown in table below:

INDIA EXPORTS OF MILLETS
As per the data availability from DGCIS, during April-February, 2020-21 the export of Millets was 79459 MT as against 71203 MT during same period last year, which represent a growth of 11.6%.

HIGH DEMAND FOR MILLETS
Water withdrawals are predicted to increase by 50 percent by 2025 in developing countries, and 18 per cent in developed countries. In 60 percent of European cities with more than 100,000 people, groundwater is being used at a faster rate than it can be replenished. Millet grows easily in dry climate, have smaller harvesting period and require minimal water quantity.

Growing inclination of urban population towards healthy food in Asia Pacific. Millets contain calcium, iron and fibers which helps to fortify essential nutrients for the healthy growth in children. The usage of millets in infant food and nutrition products is increasing and many manufacturers are expanding their business. Photo-insensitive and resilient to climate change, millets are hardy, resilient crops that have a low carbon and water footprint, can withstand high temperatures and grow on poor soils with little or no external

ABOUT THE AUTHOR
Dr Madhalyaan Angamuthu is an IAS officer of the Assam-Meghalaya Cadre, with ample experience in several key sectors of public administration. He is currently Chairman, Agricultural and Processed Food Products Export Development Authority (APEDA), an apex organisation of the Ministry of Commerce and Industry, GOI, created specifically for export promotion of agro and allied products from India.
Dr Angamuthu is fond of gardening and the beautiful play of the natural greens.

The demand for gluten free food products is increasing across the globe due to their benefits.

**APEDA’S INITIATIVES**

To give impetus to the export of potential products as well as to remove the bottlenecks in the supply chain of Nurti Cerelas, APEDA created Nutri Cereals Export Promotion Forum which also include Millets. A series of Virtual BSM meetings with Embassies, importers, Exporters and Product associations from India have been organized. The virtual sessions involved Millet exporters also.

APEDA organized its first Virtual Trade Fair – India Rice and Agro Commodity Show, where participation of millet exporters was also organized. Virtual Buyer Seller Meets with Farmer Producers Organization and Millet Exporters of Andhra Pradesh was organized. A Sensitization programme of Millet Start-ups was organized to familiarize them about export opportunities.

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### Top Global Exporters of Millets

<table>
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<tr>
<th>Exporters</th>
<th>Year- 2017</th>
<th>Year- 2018</th>
<th>Year- 2019</th>
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<tbody>
<tr>
<td>United States of America</td>
<td>25849</td>
<td>38941</td>
<td>58678</td>
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<tr>
<td>India</td>
<td>22670</td>
<td>23921</td>
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<tr>
<td>Ukraine</td>
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<tr>
<td>Canada</td>
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<td>153393</td>
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*Source: ITC Trade Map*
Indian agriculture confronts with its sheer complexity, inadequate factor conditions, weather uncertainties and vagaries, multiplicity of schemes and multiple of institutions at farm level. Indian Farmer producers, who undertake farming cultivation in about 140 million operational holdings, constantly face the problems of not getting adequate remunerative prices for their produces. Due to involvement of innumerable middlemen operating in agricultural commodity value chain, farmer producers need to sell their produces on a Fair Average Quality (FAQ).

We have attempted to discuss modest approaches (simple and attractive) to generate additional profit in farm produce, without any capital investment, through appropriate capacity building of Indian farmer producers, for value added produces, and also to Know Your Consumers (KYC) in the produce retail value chain, for generating additional profit in their farm produces, and by adopting Farm as a Business (FaaB) approach.
Market Oriented Farms. A Mission title *Use Every Part of a Crop and Use Every Part of an Animal* is appropriate. We have suggested some insightful golden principles as simple and attractive approaches which can be adopted to rekindle new and dynamic sources of growth and generate additional profit in farm produce and value addition.

The Doubling Farmers’ Income by 2022 (DFI-2022) Committee Report (2018), in its Volume 12 B (Chapter 10) has suggested digitalized value chain for about 400 agricultural commodities. The Central Farm Produce Trade Laws 2020 viz.(i)Farmers’ Produce Trade and Commerce (Promotion and Facilitation) Act, and (ii) Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act, are the legal instruments to produce and sell value-added produces to consumers – individuals, processing industries, public sector units (PSUs) etc. The Atmanirbhar Bharat Abhiyan has envisaged *Supply Chain Reforms for Agriculture* as the need of the hour, wherein the strength of our Demand-Supply Chain should be utilized to full capacity.

**Smart Farming and Understanding Market Dynamics**

Smart Farming is an emerging concept to managing farms using technologies like Precision farming equipment, IoT, AI, big data analytics, Unmanned Aerial Vehicles (UAVs or drones), robotics, etc., to increase the quantity and quality of produces, while optimizing the human labour required by production (i.e. Cyber-Physical Farm Management). Farmers in the 21st century have access to GPS, Soil scanning, Data management, and IoT technologies. Indian Agriculture is moving towards digital platform economy progressively.

Farm business is a part of large value chain. To be successful in market-oriented farming, farmer producers require basic knowledge of farm business management. Market dynamics is a basic concept for supply, demand and pricing economic models, and refer to the forces that impact the prices and the behaviours of Producers (Farmer producers) and consumers. Market-oriented farms can still be linked to a farm household. The goals and decisions for the farm are less influenced by the goals and decisions of the farm household. They are more influenced by markets, prices of produce and cost of the farm inputs. With the advent of the internet and e-commerce, there is a paradigm shift in sales and marketing functions around the world.

**Sustainable Source for Generating Wealth from Waste**

Agriculture is the largest generator of sector waste materials. The proper management of bio-mass from agricultural operations can contribute in a significant way to farm operations. Farmers and Micro, Small and Medium Enterprises (MSMEs) are unaware of the promising materials that can be extracted out of the waste and these materials can be utilized to make...
value added products. Bio-mass management is required for agro-wastes, categorized as: Paddy waste, Wheat waste, Sugarcane waste, Coconut waste, Cotton waste, Mustard waste, Horticulture waste, Jute Waste, Agro-Forestry waste, Bamboo (Grass) Waste, Minor Forest Produce (MFP)/Non-Timber Forest Produce (NTFP) Waste, Floriculture waste (Sunflower waste), Mushroom waste, Biogas waste, Livestock waste, Fishery waste, etc. Waste is not a waste until it is wasted.

In India, 8.9 lakh hectares of land is under banana cultivation, leading the world in terms of land under cultivation and total production. Banana plants not only give fruits but it has lot to offer after harvesting. In case of banana, once the fruits are harvested, the plants could not bear fruits again and farmers are forced to cut off the pseudo-stems and that cost them around INR 15,000 – 20,000 per hectare to get their fields cleared. Farmers throw away the stems on road side or burn them or crush them in fields. All of this results in pollution or waste of useful raw material. On an average, there are about 3,000 plants per hectare of banana farms which makes a total of 267 crore pseudo-stems, wasted every year.

Economic clusters at village level, for this purpose, will strengthen agrarian businesses facilitating (i) income generation from the wastes to the farmers, and (ii) huge employment opportunities at the bottom of the pyramid.

**Secondary Agriculture for Additional Income Generation**

The term “secondary agriculture” has not been defined in India. But it refers to a level above primary and commonly means agro-based manufacturing. In the United States of America (USA), secondary agriculture is “performed either by a farmer or on a farm as an incident to or in conjunction with such farming operations”. The essence of secondary agriculture was understood when the Ashok Dalwai Committee submitted its report on “adding value to primary agriculture and building agricultural enterprises in rural India” through “farm-linked activities and secondary agriculture”, to GOI in February 2018.

The Ashok Dalwai Committee has defined secondary agriculture as a production activity at enterprise/farm level, and it devised a four-fold strategy: (a) sustainability of production, (b) monetisation of farmers’ produce, (c) Strengthening of extension services, and (d) recognizing agriculture as an enterprise, and enabling it to operate as such, by addressing various structural weaknesses, and through three avenues: Value-addition to primary agriculture production systems; Alternative enterprises, but linked to rural off-farm activities, and Enterprises that thrive on crop residues and waste materials of primary agriculture.

**Agri-Tourism to fuel rural economy**

Agri-tourism can fuel rural economies through the multiplier effect. The acquired benefits will be shared amongst different businesses within the community. Further development of agri-tourism leads to profit margins for farm products and services, particularly for small farms in crisis. In the United States and in many European countries, farm and ranch stays continue to be popular. There is great potential for Agri-Tourism in the “Hill Agriculture” system of India.

**Simple and Attractive Approaches to generate additional profits**

The Primary responsibility for adopting any developmental approach is to increase farm income. Farmers face the problem of not getting remunerative prices for their produce. They are not aware of the demand of the consumers and the markets. Farmer, Producer and Consumer are the important actors (Source and Sink) in the agricultural value chain.

The minimum support price (MSP) is an agricultural product price set by GOI to purchase directly from the farmer. This is not enforceable by law. By definition, this rate is to safeguard the farmer to a mini-
mum profit for the harvest if the open market has lesser price than the cost incurred. GOI sets the price for identified agricultural commodities twice a year. This MSP is for a FAQ of the identified agricultural commodity. MSP formula ignores vital parameters like quality and efficiency including enhancement. The MSP system does not provide higher market price for good quality produce cultivated through good seed input and adopting certified Good Agricultural Practices (GAPs).

Farmers have always faced difficult situations like “not getting remunerative price for their produce”, “problem in selling their produce”, “where to sell?”, “what not to produce?” etc. This is an opportune time to examine the consumer’s point of view and their requirements. A common sense approach is appropriate. If the customer is willing to pay for the produce of choice and the farmer has opted for information-based cultivation over just hard work, he can ensure premium value for farm produce. The farmers and also the MSMEs need to appreciate this principle. This is what defined as “SMART Working” over “Hard Working”. In any business, Lifelong Learning (LLL) is vital. It equally applies to farmer producers to modernize their farming methods, as value creation is dynamically changing along with market. It is better to deliver what the market wants, and not what the farmer feels is right.

**Five Principles of Atmanirbhar Bharat Abhiyan**

Atmanirbhar Bharat Abhiyan rests on five major principles: Intent, Inclusion, Investment, Infrastructure and Innovation. Through out-of-box thinking and innovation, AgriTech StartUps are effectively changing the outdated and expensive management practices adopted in crop, land farm management, animal farm management, poultry farm management, fishery farm management, plant health management etc. In agriculture, nothing must be regarded as waste. Every part of the crop and every part of an animal generate additional profits in farm produces if there is value addition.

Without any additional capital investment, farmer producers may adopt the following common sense approaches as Golden Principles. These have been suggested by Mr Vijay Sardana to exploit the market potential for their produces, which is the result of hard work, and also to reduce farm level production expenditure.

1. Know Your Consumer
2. Communicate with Customer
3. Make Customers feel your produce
4. Ensure value added products
5. Conserve agricultural resources
6. Adopt “Farm as a Business” method
7. Grade Your Produce through five sensory approach – Eye (See), Hand (Touch), Ear (Hear), Tongue (Taste) and Nose (Smell), as normally adopted by Consumers / Retailers before making buying/purchasing agricultural produces
8. Opt for grade for farm produce to get higher than market price
9. Produce for tailored markets (affinity & emotional)
10. Undertake nutritional profiling of products
11. Document your agricultural practices
12. Develop agricultural system through Informatics approach
13. Adopt Technology: AgriTech and Digital Technology
14. Package your produce for product visibility and standout in the market place
15. Position yourself as a customer of your produce
16. Understand that business cannot be built on borrowed knowledge
17. Learn that good input, Good Agricultural Practices (GAPs) and hard work will yield “good quality” produce and not FAQ Produce.
18. Know that Government cannot give profit but customer can give profit
19. Connect with missing links in the value chain
20. Continuous Innovation and Exploration of market
Pulses are an important constituent of Indian diet and have long been considered as the poor man's source of protein in our country. The crop of pulses also helps increase soil fertility through nitrogen fixation and providing agronomic benefits to the succeeding crop in terms of better soil microenvironment, quality and yield. India is the world's largest producer, importer and consumer of pulses.

NAFED: The Pulse Arm of the Nation

The mega pulse procurement, processing and supply operations of NAFED during the last 6 years or so have made NAFED the pulse arm of the nation. It has also brought global acclaim to the Federation. NAFED has been playing an instrumental role in the domestic pulse management of the country. Unprecedented volumes of pulses have been procured in the recent years under the Price Support Scheme of GOI, providing remunerative prices to farmers. At the same time, on the direction of the government, NAFED also procures pulses for creation and management of the national buffer with the aim of preventing unreasonable spurt in the domestic pulse prices.

Pulse Processing Operations of NAFED

In India, there are two conventional pulses milling methods; wet milling method and dry milling method. The latter is more popular and used in commercial mills. Pulses are usually converted into Daal by decorticating and splitting. Basic processes in Daal milling are cleaning, de-husking, splitting, separation and bagging. Daals like Arahara, urad, moong and lentil are difficult to de-husk. As a result, repeated operations for de-husking rollers are required. Re-wetting and drying is done to loosen portions of husk sticking after repeated rolling. Linseed oil is used to impart shine or better appeal to the milled daal. The removal of the outer husk and splitting the grain into two equal halves is known as milling of pulses. To facilitate de-husking and splitting of pulses, alternate wetting and drying method is used.

NAFED has been supplying whole/milled pulses to various prestigious institutions like the Army, Central Para Military Forces (CPMFs) and the state governments for utilization under their various schemes like the Mid Day meal, ICDP etc. The Federation is well equipped with full fledged infrastructure and rich experience for supply of processed pulses.

The Institutional Supply Division of NAFED

In order to organize the supplies to the institutions, a full-fledged Institutional Supplies Division was created in NAFED in 2016. The Division was entrusted to handle all operations pertaining to supply of pulses to institutions which included engagement of daal mills for organizing milling of pulses stock of NAFED.
Pulse Milling Operation of NAFED

The Division is well-equipped with a highly competent and professional team of officers and staff.

The critical tasks in the supply process have been digitized for ensuring efficiency and timely supplies. The customized electronic portal nafed.agribazaar.com manages empanelment of millers, mapping, assaying deliveries, payments and logistics. The portal is managed by the professionals of the service provider engaged by NAFED. More than 300 millers have been empanelled across India through the portal for milling, packing and delivery to institutions. The work is assigned to the millers as per the prescribed procedure on the basis of highest out-turn-ratio (OTR) of milled pulses.

Voluminous Supply of Milled and Whole pulses by NAFED

From January to March 2021, NAFED supplied 10,500 MT of pulses to its esteemed buyers, Army and CPMFs. The total supply during 2019-20 was 38,500 MT. NAFED also supplied pulses to states and UT governments for their different welfare schemes such as ICDS, MDM, PDS, COVID relief kits etc. out of the national buffer. Around 4 LMTs of pulses was supplied to Arunachal Pradesh, Kerala, Rajasthan, Goa, Gujarat, Telangana, Mizoram, Uttar Pradesh, West Bengal, Orissa, Manipur, Lakshadweep etc. during 2020-2021.

NAFED was also entrusted with the task of supplying milled/cleaned pulses to states and UT governments under the PMGKAY announced by GOI in March 2020. NAFED was designated a nodal agency for the purpose. The duration of the scheme was eight months starting April 2020. NAFED arranged supplies of around 15 LMTs of different varieties of pulses during this whole period amidst extreme challenging conditions to benefit over 19.5 Crore NFSA beneficiaries every month starting from April-November 2020.

Quality testing at mills before dispatch of milled pulses

The supply mechanism established to organise the supply of pulses to Army and CPMFs now functions as a well-oiled machine. Its efficacy was tested in 2020 during the pandemic. NAFED rose to the challenge and fulfilled its commitments and supply obligations to all the esteemed buyers despite the pandemic and pressure of supplies under PMGKAY.
India has the second-largest arable land area in the world and a coastline of over 7,500 kilometres. Expectantly, agriculture is the primary source of livelihood for 58 percent of the population in India. The sector generates employment for 44 percent of the country’s workforce.

Last year when COVID-19 struck India and the world, it led to many challenges threatening livelihoods, restricting movement of people and goods, disrupting supply chains, increasing unemployment, eroding demand, production capacities, and withering liquidity, thereby impacting the overall economy. This ongoing pandemic also brought to the fore the realisation that agriculture activities in India are still largely labour dependent, which came to a complete standstill due to lockdown. Mass exodus of farm hands to their native places further precipitated the shortage of farm labour for various farming operations that require timely intervention to ensure optimal crop output.

Agri mechanization provides several economic and social benefits to farmers. Primary among the economic benefits is the improved yield that comes as a result of greater level of mechanization. Looming water scarcity crisis along with the need to ensure food security in the country can be effectively mitigated with rapid mechanization of various farm operations. The benefits of farm mechanization make it a crucial component of shaping the future of Indian agriculture.

Farm mechanization is at various stages of adoption in India. The use of improved farm implements has the potential to increase productivity by up to 30 per cent and reduce the cost of cultivation by up to 20 per cent. It helps in enhancing agriculture productivity and availability of food grains; increasing agriculture exports; mitigating la-

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bour shortage; and facilitating judicious use of scarce natural resources and farm inputs. Effective use of agriculture machinery helps farmers to undertake timely farm operations and enable them to quickly rotate crops on the same land.

According to Economic Survey, farm mechanization and crop productivity has a direct correlation. Farm mechanization saves time and labour, reduces drudgery, cut down production cost in the long run, reduces post-harvest losses and boosts crop output and farm income. Farm Mechanization also helps farmers in raising second/multi-crops on the same land thereby improving cropping intensity, making agricultural land commercially more viable.

The farm machinery industry is positioned at an inflection point, from where it is expected to move into a high growth period and is expected to transform the way an average Indian farmer works in the farm.

**Faster adoption of agri-mechanization**

At present, Indian farmers are adopting farm mechanization at a faster rate in comparison to recent past. Currently, penetration of farm mechanisation is approximately 40 percent in India. This is much lower than that in the developed economies, where mechanisation has reached beyond 90 percent. There are multiple reasons for it including fragmentation of land holdings, a large presence of small and marginal farmers, unaffordability of farm technology and the practice of subsistence agriculture.

Agriculture mechanization is crucial for modernization and commercialization of agriculture as it improves productivity and timeliness of agriculture operations, aids in value addition, brings down the cost of cultivation and enables climate change adaptation and not only provides optimal utilization of resources e.g., land, labour, water but also helps farmers to save valuable time and reduces drudgery. This judicious use of time, labour and resources facilitates sustainable intensification (multi-cropping) and timely planting of crops, leading to increased productivity.

Recognizing the issues that hinder farm mechanization rate in agriculture, GOI has introduced several schemes and policies that support greater mechanization of Indian Agriculture, in the light of its commitment to transform the agriculture sector and double farmers’ income by 2022-23. It has initiated several schemes to boost the mechanization prospects. The Sub Mission on Agricultural Mechanization (SMAM) is an important initiative by the Government in this direction.

**Boosting Efficiency**

For the last 35 years, Honda India Power Products Limited (HIPP) has consciously made efforts to facilitate mechanization in agriculture by introducing Honda’s legendary 4-stroke technology powered products like Portable Water Pumps, Power Tillers, Brush Cutters, Backpack Sprayers, HTP Sprayers, Honda engine powered Reapers & crop harvesters/weeders for various farm applications bringing optimal work efficiency. The Honda brand has been the preferred choice of customers in India and overseas markets powering the dreams of over 5 million satisfied users for over 3 decades.

Honda brand of power products has contributed significantly to ramp up the efficiency in various farm operations like land preparation, sowing, irrigation, spraying, de-weeding & crop harvesting. Unmatched portability, fuel efficiency and durability offered by these products make them gender neutral thereby equipping majority of the workforce available in farms to carry out routine farm operations efficiently thereby improving farm productivity remarkably.

In today’s context, as the economy slowly opens after the second wave of COVID-19 pandemic recedes, there is limited time window available to farmers to complete required farm operations efficiently. HIPP has carefully nurtured its vast network of over 600 servicing dealers spread across the country during its eventful journey of over 35 years and is very well positioned to offer effective, durable, timely and optimal solutions to the Indian farmers for their various farm needs in line with its vision of “Empower People, To Do Better”.

As the Indian farmer gears up for the ensuing Kharif season buoyed by the winds of another year of favourable monsoon, HIPP along with its country wide network of channel partners will continue to be their partner in progress as they challenge another year of golden harvest.
 Enhancing the awareness of farmers on safe and judicious use of agrochemicals, right time of usage, dosage; safe disposal of containers; etc. is of prime importance and is part of product stewardship.

India has the lowest usage of pesticides per hectare (307 g/ha) as compared to up to 13 kg/ha in USA, Japan, China or other countries (5 Kg/ Ha in UK, 7 Kg/ Ha in US, 12 Kg/ Ha in Japan and 13 Kg/ Ha in China). Yet India’s agricultural produce gets rejected in international markets for various reasons including lack of awareness of farmers. This can be overcome by effective product stewardship and policies, wherein CropLife India has been contributing immensely.

Sharing the common goal of sustainability and farmers’ welfare, CropLife India has been collaborating in the various initiatives of Ministry of Agriculture and Farmers’ Welfare. *Grow Safe Food* campaign is one of them. Our team has been actively involved in providing hands-on training to farmers on GAP (Good Agricultural Practices), IPM (Integrated Pest Management), Responsible Use of Crop Protection Products and ensuring quality crop protection products.

The *Grow Safe Food* campaign, launched by the Department of Agriculture, Co-operation & Farmers’

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**ABOUT THE AUTHOR**

Mr Asitava Sen is the Chief Executive Officer of CropLife India; an industry association of 15 R&D driven member crop science companies, jointly representing approximately 70 percent of crop protection market and responsible for 95 percent of the molecules introduced in India so far.

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**SAFEGUARDING THE FARMERS**

**ROLE OF STEWARDSHIP FOR AGROCHEMICAL INDUSTRY**

CropLife India’s outreach to help safeguard the food security of our nation
Agriculture Welfare, Government of India, is a key pillar of its efforts to improve sustainable production of adequate amount of safe food, and augment food and nutritional security for the billion-plus population. The nation-wide initiative is aimed at promoting awareness and capability-building efforts such as training for pesticide dealers and farmers particularly on food safety and quality issues.

CropLife India has taken various initiatives towards product stewardship. The following are the highlights:

**Safe & Responsible Use of Crop Protection Products**

Through its pilot projects in the districts of East Godavari in Andhra Pradesh Bharuch in Gujarat and East Champaran in Bihar, CropLife India’s initiatives aimed to cover around 6,000 farm families in three states. Trainings for farmers include classroom teaching and practical field training sessions for farmers. The training curriculum includes 16 elaborate modules covering a wide range of topics such as IPM, role of beneficial insects including pollinators, judicious and responsible use of Crop Protection Products, secure storage of pesticides, impacts of counterfeit and illegal products, use of PPE (Personal Protective Equipment) such as masks and gloves, correct spraying techniques, maintaining sprayers and nozzles, and triple rinsing of used containers.

**Outreach Initiative for Use of PPE in AP, Maharashtra, Punjab**

CropLife India along with its member companies have been working towards making the PPE kits available at retail outlets for farmers through the distribution channels in three key states, viz. Maharashtra, Punjab and Andhra Pradesh. CropLife India has been committed towards empowering the rural communities and raising awareness on the responsible and safe use of crop protection products along with importance and proper use of Personal Protective Equipment.

The project, in a total of 15 districts of Maharashtra, Punjab and Andhra Pradesh, is supported by local government bodies, farmer associations and Kisan Unions, and locally operational NGOs. Departments of Agriculture at state and district level are in sync with the outreach effort through communication channels targeted at farmers, spray-men and their families. More than two lakh farmers have been imparted training on usage of PPEs and safe use of crop protection products.

**Madhu Sandesh: Shared Benefits Approach to Shared Responsibility**

This is a project of CropLife India in association with Indian Council of Agricultural Research (ICAR) and Agriculture Development Trust, Krishi Vigyan Kendra (Farm Science Centre) Baramati, to provide subsidized rental bee hives to farmers in Maharashtra. This involves joint funding for the bee hives and the project staff to be based at in Baramati, training the staff on crop-specific knowledge of input and pesticide use. ICAR trained the project staff on bee health and hive management. As a result, an apiary with 250 beehives was set up to function as a knowledge hub and act as a bee rental library, with its staff on hand to troubleshoot any teething problems with first time renters.

**Crisis Preparedness – Doctor’s Training Program**

Doctors’ Training Programs combined with a digital module was specially designed for health practitioners to be able to treat patients affected due to accidental pesticide poisoning, caused by improper use of pesticide. CropLife India had organized workshops for doctors in Guntur District, Andhra Pradesh and Amravati district in Maharashtra. To amplify the voice,
CropLife India has developed a Health Practitioners’ Handbook; Prevention, Diagnosis & Treatment, elucidating the necessary information related to symptoms and treatment for different types of exposure to various crop protection products.

**Caring for our Annadata during onset of Covid**

CropLife India digitalized all the efforts towards Farmers’ education on Safe and Judicious Use of Crop Protection Products, which had been our motto. Farmer Education Poster on Safety points in farming during Covid-19 pandemic and a video was designed and shared digitally.

During the locust attacks in the country, CropLife India had issued an advisory for farmers and spray management agencies to follow the recommendations for the management of the locusts. We recommended the concerted efforts of the Centre and state governments in controlling the locust menace, including use of novel modern technology and spraying devices. Apart from the traditional spray system, CropLife India suggested extensive use of drones for spraying recommended agrochemicals to control locust and other invasive pests.

We created a CropLife India Farmer’s Training Film, an educational video featuring both stewardship and anti-counterfeiting messages for our farmers’ welfare. This is available in eight languages, viz. English, Hindi, Punjabi, Gujarati, Bangla, Marathi, Kannada and Telugu.

CropLife India in collaboration with Commissionerate of Agriculture, Govt. of Maharashtra, developed a video for health practitioners to provide necessary information to them on Recognition, Management & Treatment of Pesticide Exposed Patients during this unprecedented time.

CropLife India was awarded for Commendable Work for Changing Public Perception in India at India Chem 2021. The event was jointly organized by Department of Chemicals and Petrochemicals, GOI and Federation of Indian Chambers of Commerce & Industry (FICCI).

Despite lockdown toppling the various supply chains, aggravating the labour issues, etc., our farmer showcased irrepressible might, enhancing the agriculture output to record levels. One of the focus of our efforts has been boosting the farmers’ morale. During these troubled times, CropLife India maintained an emotional yet informative relationship with our Farm Heroes. Our efforts have been foremost for creating mechanisms to reach out to farmers effectively via various possible platforms. Our efforts shall motivate them and remind them to maintain and follow proper safety protocols along with regular practice of responsible use of pesticides.

As children influence opinions in our families, we reached out to them, with the help of a rhyme.

CropLife India has a long history of creating awareness and building capacity on sustainable practices among various stakeholders including farmers, agriculture input retailers, agricultural extension staff, custom officials, key stakeholders and several NGOs.
When you sow the seeds of safety
You harvest peace & health plenty

SAFETY POINTS IN FARMING DURING COVID PANDEMIC

Wear PPE
Be a Superhero!
By wearing Personal Protective Equipment (PPE) while handling pesticides ensure optimum safety from chemical residues & biological infections for you.
Wash it daily after work & don’t share it with anyone.

Social Distancing for Long Term Delight!
By keeping your coworkers, family members & animals at a safe distance, you can stop the spread of chemicals, drifts, viral infections and ensure sound health for your family.

Your Safety is In Your Hand!
Washing your hands frequently with soap and water during or when not in working with pesticides, keeps you safe from contamination of pesticides as well as Coronavirus.

Always remember to:
Triple rinse empty containers and dispose them properly while still wearing PPE.

Regularly inspect & disinfect machinery tools, tractor cabins and surfaces etc.

After handling pesticides, wash yourself and the protective gears thoroughly.

Always cover your face with a clean cloth or use a face mask when going out.

Fight Coronavirus with Awareness
Make sure that all workers in the field have access to adequate soap and water for frequent hand wash and also following the guidelines/safety protocols issued by the Govt.

If any worker shows symptoms like fever, cough, shortness of breath, arrange isolation and treatment immediately.

Use only registered pesticides & always read the instructions on the label to protect your crops and livelihood.

Ask these 3 questions when buying pesticides

| Q.1 | What proof do you have that the pesticide you are buying is authentic? |
| Q.2 | Who manufactured this pesticide and how can a farmer contact the manufacturer? |
| Q.3 | Is this pesticide legally registered/authorized with the Government and what proof do you have? |

A Health Awareness Initiative by CropLife India
www.croplifeindia.org
A timely and generous monsoon season is crucial for Indian farmers, bringing the promise of a bountiful produce and flourishing economy. Particularly for 86 percent small and marginal farmers, the Kharif season is decisive in securing food supply year-round and additional income. Several challenges such as mistimed inputs of seeds and fertilizers, quality concerns, lack of financial support, and limited knowledge on crop management, hold back the growth of smallholders—a community that is critical to nourishing India.

With the second wave of the pandemic significantly affecting rural areas, challenges are bound to arise. But predictions of timely monsoons and an overall downward trend in infection sustains our hopes. To secure Kharif produce and support the small farmers whose livelihoods depend on it, we must follow a three-pronged approach: We work closely with them to give impetus to their growth journeys by helping them expand their existing knowledge base, offering quality and timely inputs, and training them in productive agricultural practices.

IMPROVING ACCESS TO RESOURCES
Ensuring orderly and timely access to various input resources is the first and most fundamental step of extending assistance to small and marginal farmers. Land parcel-based planning for staple crops and high-value crops, coupled with training sessions about methodical farming practices, can boost crop yield and improve their incomes by at least 20-30 percent. Subsequently, it is necessary to make relevant market linkages and procure best quality raw material for sowing as well as produce marketing. For instance, under the Tata Trusts’ Lakhpati Kisan initiative, women-led community federations and farmer producer companies representing small farmers negotiate with traders for bulk purchasing of inputs, examining the quality of seeds and fertilizers carefully.

In addition to this, facilitating loans for farmers through varied linkages—or getting them in touch with the right market avenues that offer fair pricing post-harvest—can improve food security for the community, whilst generating stronger returns from their agricultural practice.

Another important aspect concerns irrigation provisions vis-à-vis the geo-

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graphic locations of farmers. Linking with critical irrigation, relevant agro-technologies such as solar irrigation systems and drip-mulch can substantially help increase productivity, given how many agricultural plots in tribal regions across India are in hilly terrains with undulating topography. Robust tech integration can solve access limitations for tribal farmers who often find it tough to manage water during monsoons, or any other part of the year.

**UPSKILLING THE FARMING COMMUNITY**

The training and upskilling of farmers help augment the implementation of proper cultivation practices. This includes conducting focused field-level training with the help of community resource persons in specific areas such as crop treatment, land preparation, and nursery preparation beforehand. Once monsoons arrive, these trainings can come into practice, and farmers can be given relevant pointers on crop management practices. This upskilling in better agricultural practices then continues sustainably by the farmers.

Only providing pre-season training is not sufficient. Extending constant holistic support to reduce chances of crop failure is an essential next step. This can involve general counselling on good practice, solving for specific problems farmers face, or tackling unforeseen roadblocks. This is especially relevant due to the unpredictability of circumstantial factors, such as crop infestation and climate change to name a few.

**CROP DIVERSIFICATION**

To have a good income from the Kharif season, farmers have promising potential to think beyond staple crops. Ergo, they must be encouraged to take up commercial vegetable cultivation of high-value agriculture (HVA) crops in addition to their existing staples. Seasonal vegetables such as tomatoes, chillies, eggplants, varied kinds of gourds through trellis cultivation – all these can significantly boost income as these crops are high in demand, but low in supply during monsoons.

The combination of staple crops with HVA vegetables ensures diversity in crop baskets, since these are essential parts of everyone’s diet. This reduces the farmers’ dependency solely on the successful harvest of staples. This vegetable cultivation value-chain approach additionally fetches inputs of healthy soilless saplings through micro-entrepreneurs, ultimately fostering holistic growth of the rural-agricultural ecosystem.

Despite constituting 86 percent of farm households in India, small and marginal farmers continue to face some of the gravest food security crises, with incomes that hardly justify their labour. Providing farmers with access to economic, agricultural, and intellectual resources; and upskilling them with requisite training and guidance in times of need, can take us a long way in empowering everyone’s lives and livelihoods. Together, our efforts can help create a culture of irreversible and sustained support during cultivation and fair prices in markets, ensuring nourishment for the entire community of India’s small farmers.
LOGISTICS FOR KHARIF

TECHNOLOGY ADOPTION ESSENTIAL TO MINIMISE LOSSES

In 2020, India’s area under kharif crops hit an all-time high of 108 million hectares. This is an increase acreage of 1.5 percent beyond the average growth of last five years. The future of our country with respect to agriculture seems booming, with many discoveries and innovations constantly enriching us.

Let us start off by understanding what are Kharif crops.

* They are harvested in during the month September and October.
* They require warm conditions to grow.
* Their growth depends on the rainfall pattern.
* They need shorter day lengths for flowering.

It is important for us to grow a quality crop. It is equally important to ensure the logistics of these crops.

Reports have found that every year, on India level, when we take the average of vegetables and fruits, farmers are unable to sell around 42 percent of their produce, which equals about Rs 63,000 crores. The primary cause for this loss is poor storage and transportation. In this era of globalization and modernization, it would be not less than a sin to underutilize the existing technologies and advancements to minimize the loss.

Till very recently, we had a lot of regulatory barriers constraining our

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Mr Gubba Kiran, CEO of Gubba Cold Storage, is regarded as the face of Gubba for the Indian seed industry. He has led the company into efficient service in cold storage preservation. He has been instrumental in creating the Gubba brand from 0.7 million cubic feet to one of India’s biggest cold storage companies with presence on 11 million cubic feet. He has played a key role in educating pharmaceutical companies in preserving critical products at Gubba.
development and growth. The following measures taken by the government have helped immensely.

- Agri-warehousing by RBI
- Subsidies
- Tax Incentives etc.

Our Challenges: We are open to more opportunities to bring sustainable and impactful changes. We first need to be aware of our challenges.

In the 2019-2020 Kharif season in India, the total produce recorded was around 143.38 million tonnes. According to a report by the Associated Chambers of Commerce and Industry (ASSOCHAM), only 11 per cent of the perishable yield is preserved. Here, we clearly understand the seriousness of the losses looking at the figures. Nearly ninety percent of the produce didn’t even have the opportunity to be preserved…resulting as a downfall in the quality and shelf life of the produce.

Emerging solution: The government shall encourage and support the youth to invest their talent and money in providing warehouse facilities, from a community angle as well as a business angle. Our country must expand its cold-chain and warehouse units. Establishing and managing a warehouse is very heavy on the pocket. Monetary support, directly or indirectly from the government is needed and desired especially in the following areas:

- Power supply
- Interest rates

Seeking support in these two major areas would enable many to enter into the field of storing and preservation to serve the farmers and in turn the country!

Inadequate Infrastructure: The gap between agri-warehousing demand and supply has been reported to be close to 35 million tons. The industry is still more on the unorganised sector side. There are so many technologies existing in the world and not yet in India, for reasons like cost and skills which has to be updated and addressed. Rightly-suited infrastructure will enable us to make the operations cost effective and reliable with regards to timelines ensuring higher level of accuracy.

Emerging solution: We must invest our potential resource in research and development in such a way that the domain experts in agriculture are supported in bringing latest trends and innovations, experimenting with machineries in such a way that we are equipped to minimise wastage.

Transportation: The losses incurred by poor transportation facilities accumulate to a loss of 24 percent approximately. The produces are mostly transported by road. Due to seasonally blocked roads, weather etc, heavy loss is incurred. To improve roads, especially in the rural, isolated areas is a must for the produces to be safe. When the mode of transport gets uninterrupted, we will see a hike in the figure of goods being preserved.

Emerging solution: We can think of effective solutions like reefer logistics to keep agri produce safe and fresh. It is slightly expensive but incurring the expense here is more feasible than bearing the loss

My stress buster is spending quality time with my wife and chatting with her. Sitting in my garden and chatting with my family. Watching TV and speaking to friends and relatives.

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Emerging solution: We can think of effective solutions like reefer logistics to keep the produces safe and fresh. It is a little on the expensive side but we have to look at the bigger picture. Incurring the expense here is more feasible than bearing the loss. The government has to strictly regulate and prioritise maintenance and construction and roads as and where needed.

India is a developing country. The next 10 years shall be crucial for our nation’s growth. Agriculture has and will always continue to be one of the most essential components to India’s growth economy, employment etc. The government and private sector must join hands together in favour of the farmers and ensure everything needed is done at the right time.
India's yellow revolution was conceived to increase the nation's yield of oilseeds. Uttar Pradesh is the first state in oilseed production whereas Rajasthan is ranked third. Oilseeds are the crops from which vegetable oil is produced in which sesame, mustard, peanuts, soy and sunflowers are important. Mustard, Sesame, Groundnut, Castor, Soybean, are the major oilseed crops arising in Rajasthan. Rajasthan ranks first in the production of mustard and mustard seed.

India is the largest producer of groundnut in the world. Gujarat ranks first in groundnut production in India and Rajasthan ranks fourth. Madhya Pradesh has the highest soybean production in India. India processes only 1 percent of its production, while developing countries process 40 percent of their produce. To get the maximum benefit from production, it is necessary to promote the processing of food grains. The food processing sector can play a major role in reducing post-harvest losses and aid in the creation of an additional market for farm produce.

Oil Extraction Enterprises
Youths can become entrepreneurs by setting up business of extracting oil from oilseed crops. Knowledge of the economy of oil is important to get maximum benefit.

About 3.5 kg oil can be obtained from 10 kg mustard which can be sold in the market at the rate of Rs 200 per kg. Apart from this, 6.5 kg cake which will be obtained by extracting oil can be sold at the rate of 25 per kg. From 50 kg of mustard, 17.5 kg oil can be obtained and 32.5 kg Khal can be used.

About 4.5 kg oil can be obtained from 10 kg linseed. In one day, from 50 kg of linseed 22.5 kg linseed oil and 27.5 kg Khal can be obtained to get a net profit of Rs 3495.

About 5.7 kg of coconut oil can be obtained from 10 kg of coconut. From 11.5 kg Khal, sweets can be prepared.
by adding sugar or jiggery. About 5 kg of almond oil can be obtained from 10 kg of almonds. From 50 kg almond, 25 kg oil and 25 kg khal can be obtained, which can be sold at the rate of Rs 1500 per kg and Rs 28 per kg respectively.

About 5 kg of sesame oil can be obtained from 10 kg of sesame. An entrepreneur shall need large containers and bottles for storage. Stickers must be prepared for labeling and packaging on the bottles. Food Safety and Standards Authority of India (FSSAI) registration number is needed for sale of all types of oils. The fee charged by FSSAI is only Rs 100 for a year for the purpose of promoting entrepreneurs. Scrub soap can also be made with almond and sesame seeds. Biscuits, toffee and other sweets can be made with almond and coconut cake.

Recommendations for Promoting Food Processing Industries

* The Agricultural Produce Marketing Committee (APMC) Act may promote direct trade between farmers and consumers.
* To boost exports, India should work on improving the quality of its supply.
* Government and industry should concentrate on the needs of the market and try to meet the demand.
* Producers and entrepreneurs should supply processed products according to demand.
* The government, agricultural universities and companies should focus on making entrepreneurs efficient through skill trainings and especially promoting the marketing of their products.
* Domestic start-ups and industries should be encouraged in comparison to international companies.
* There should be a centre of Food Processing Excellence in the state, where more and more food processing can be taught. In Rajasthan, skill development in the processing of soyabean, garlic, amla, coriander, potato, orange, guava, tomato, gram, mustard and flaxseeds and other foods is being promoted by the Food Processing Unit of Agricultural University, Kota.

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Dr Mamta Tiwari is Professor and Director Human Resource Development, Agriculture University, Kota

Dr Tewari is passionate about cooking nutrient-rich food. She grows organic fruits and vegetables of diverse colours in her kitchen garden.

About 4.5 kg of oil can be obtained from 10 kg of peanuts. The grains should be well dried. It is advisable to remove peanut shell before extracting oil. All these oils can be extracted easily through a machine costing Rs 1 lakh to Rs 1.5 lakh approximately. It is necessary to install a filter machine along with the oil dispenser. Quality assurance is essential.
India’s agricultural sector has witnessed a high rate of growth in electricity consumption, from 84.7 billion units in 2000/01 to 213.4 billion units in 2018/19, which is equivalent to 17.6% of total electricity consumption in India. A growing significance of electricity as preferred input in Indian agriculture, specifically for energizing irrigation pump sets results from aggressive rural electrification coupled with a policy of below cost pricing to farmers. This has led to major maladaptation in terms of water overuse and overexploitation of groundwater for agricultural production. In a climate constrained world, sustainable deployment of energy efficient solar irrigation pumps along with innovative business models for increasing water use and energy efficiency provides plausible entry points towards energy-smart agriculture in India. This promises immense opportunity in reducing the overall power consumption, improving efficiencies of ground water extraction, reducing grid dependency.

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Dr Manish Anand, Fellow at TERI, is an interdisciplinary researcher with basic training in agricultural sciences and advanced training in interdisciplinary field of science policy, innovation studies, and developmental studies. In his professional career of over 14 years, he has worked on several interdisciplinary projects encompassing diverse areas of agriculture, energy and environment, and emerging technology policy.
and reducing the subsidy burden on the states without sacrificing the service obligation to this sector. Furthermore, farmers can sell the excess solar power thus enabling additional on-farm income.

As of 2019, over 181 thousand solar water pumps had been installed across the country with a target of providing 2.75 million solar pumps (1.75 million stand-alone and 1 million grid connected) under the PM-KUSUM (Pradhan Mantri Kisan Urja Suraksha evam Uthahan Mahabhiyan) Scheme, 2019. This shall enable installation of over 10 gigawatt of solar capacity in the agriculture sector.

A diversity of innovative approaches has been attempted linking solar energy use to agricultural productivity and water reductions. Primarily these pertain to two areas: innovations in technical design options and policy/institutional innovations. Technical design options include interventions based on the level of integration such as integrated systems combining solar pumping with drip irrigation and/or water harvesting, dual solar-agricultural systems as well as interventions based on grid-connectedness such as mini-grid, grid-connected systems, net-metering of pumps and plants at farm level. Policy/institutional innovation broadly pertains to level of subsidisation, level of regulation of water use, level of cooperation among farmers and support for capacity building.

**Successful Interventions**

We have several examples of interventions encompassing technical and institutional aspects. At the Solar Pump Irrigators’ Cooperative Enterprise (SPICE) in Dhundi village in Gujarat, surplus of six net-metered pumps with a total capacity of around 56 kWp has been sold to the local power utility. A 25-year power purchase with the power utility at the rate of around US$0.07/kWh has been established and a Green Energy Bonus and a Water Conservation Bonus provided under the IWMI-Tata programme has brought the total feed-in tariff to $0.11/kWh.

In Bihar, a pay-as-you-go model has been attempted as a business model of providing water as a service. Here water user associations cooperate with a private company responsible for operation and management of a solar pumping system and associations charges government-fixed irrigation fees.

In Rajasthan, a programme to construct additional tanks and diggis to counteract negative impacts on ground-water recharge has been attempted linking solar pumps and water harvesting. Subsidised pumps are not connected to the grid. Farmers are required to deploy drip-based micro-irrigation systems and farmers with a diggi are preferred.

The Karnataka State initiative on Surya Raitha public programme promotes grid-connected solar irrigation PV pumps on a net metering basis through a 90% cost subsidy and a feed-in tariff of around US$0.15/kWh for non-subsidised plants, and US$0.11/kWh for subsidised ones.

Odisha’s project on “Ground Water Recharge and Solar Micro Irrigation to Ensure Food Security and Enhance Resilience in Vulnerable Tribal Areas of Odisha” under Green Climate Fund with a total investment of US$166.3 million has attempted to link community-based rainwater harvesting measures (recharge shafts in 10,000 tanks) and improved irrigation schemes through the use of 1,000 solar pumps. West Bengal under the US$300 million World Bank project on “West Bengal Accelerated Development of Minor Irrigation” addresses the issue of water use efficiency by deploying ICT based solutions such as equipping hybrid solar photovoltaic systems for pumping purposes with a GPRS wireless modem, automatically transmitting data on flow and energy use.

These innovations in technology and policy address objectives such as dissemination of clean energy, water use...
In Rajasthan, a programme to construct additional tanks and diggis to counteract negative impacts on groundwater recharge has been attempted linking solar pumps and water harvesting. Subsidised pumps are not connected to the grid. Farmers are required to deploy drip-based micro-irrigation systems and farmers with a diggi are preferred.

The diverse experiences from these interventions, summarised below, represent critical issues and are also indicative of current directions in energy efficiency measures promoting sustainable water and land use:

- High subsidies and inadequate farmers' capacities can lead to overexploitation of groundwater resources as a consequence of the dissemination of the oversized systems and increased access to solar energy in agriculture.
- Linking subsidised solar equipment with purchase of micro-irrigation systems and conditions for irrigation scheduling can minimize the trade-offs between on-farm renewable energy production and promote responsible water use.
- Solar pumping with power purchase agreements can be designed to improve participation incentives, financing, enforcement and water use reduction which may create an opportunity cost of inefficient and wasteful use of solar energy.
- For small and marginal landholdings decentralized systems/off-the grid provides avenues for using energy surplus for on-farm activities related to heating, chilling, drying, grinding and distribution.
- Solar greenhouses and solar based aquaculture for cold or temperate environments has been attempted for instance in China for breeding installations in fisheries, for waste water purification, in water pumping and for improving rural electrification.
- It is important to improve farmers' capacities by establishing links to extension services, water users association and institutions at the local level.
- Connecting mobile phones to the solar equipment, metering and farm-level water use efficiency plans.
- There is a shift in focus from subsidies on solar pumping systems and equity in groundwater access to options promoting groundwater use efficiency via tradable water rights, pro rata pricing systems and linking solar with micro-irrigation systems.
- Integrated and smart approaches such as grid-connected pumping, solar pump mini-grids, replacement of diesel pumps with solar pumps in off-grid areas, community based or water-as-a-service systems.
- Approaches for small scale farmers has focused on pay-as-you-go and water as a service to address issues of affordability and using the professional services of intermediaries.
- Role of system integrators in providing integrated solution at the farm level with regard to system, installations and maintenance through designated dealers and providing options to the farmers to choose the dealers and avail subsidised loans becomes important.

Such innovative interventions need to consider a range of push and pull factors with participation from water, agriculture and energy sector stakeholders. There is a need to examine the interventions through the lens of climatic variability and change, of economic viability (especially at the level of a farmer/entrepreneur), and of political acceptability.
Amrita Vishwa Vidyapeetham entered Agriculture Sciences domain in order to deliver value-based education in both letter and spirit. Amrita has designed programs that are analysed and changed on a regular basis in order to keep up with the latest advancements in the industry.

Despite great gains in modernity and India’s march toward globalisation, agriculture has always remained the backbone of our economy. It still employs over two-thirds of the country’s workers and contributes significantly to the economy. It satisfies both our basic dietary needs and the demand for raw materials in the manufacturing industry. Agriculture has benefited immensely from science and technology in terms of increasing output and improving quality.

Dr Sudheesh Manalil, Head Research, Chair Person Post Graduate Program, Amrita School of Agricultural Sciences says:

“The importance of agriculture education and research is going up day by day as food, its quality and nutrient completeness are of utmost importance to humankind and other living entities. The burgeoning population and changing climate further demand precise and eco-friendly practices to ensure maximum production from a unit area with a minimum impact on the environment. There is a need for shift in approaches as many of the conventional agricultural practices are energy-intensive (such as heavy tillage) and employ indiscriminate use of fertilizers. This leads to greenhouse gas emission from crop fields, reduces carbon sequestration, pollutes the environment and acts as a catalyst for a changing climate.”

Agriculture includes farm management, agricultural machinery manufacture, agricultural product procurement and processing, banking activities for financing and developing farms, research to increase the number and quality of farm commodities, and so on.

“Through a multidisciplinary approach and technology integration, the agriculture science sector is preparing to address such difficulties. In the strict sense, a major pest outbreak like the locust incursion that occurred in northern India in 2020 is an entomological problem. But the outbreak has a connection with rainfall pattern, wind movement, soil, tillage and vegetation in the area. The impact can be minimised through a multidisciplinary approach rather than disciplines working in isolation,” says Dr Sudheesh.

In contrast to traditional agricultural science teaching and research, students at Amrita receive advanced education in the field of agriculture science through embracing technology innovations. Expertise from both the national and international levels will be included into every aspect of the curriculum.

“To meet such challenging objectives, in Amrita School of Agricultural Sciences, contrary to the conventional teaching and research, the curriculum is designed by integrating technological advancements through a multidisciplinary approach rather than disciplines working in isolation,” says Dr Sudheesh.
the rural areas of Bihar, like other rural areas of the country, suffer from poor sanitation. There is no mechanism for the disposal of agro waste as well as household waste. The villages also lack suitable disposal of cow dung, mainly used for domestic fuel. With Ujjawala programme, it was expected that the cow dung cake will be replaced by LPG. Unfortunately, poor economic condition and patriarchal society made refilling of cylinders less than 50 percent. Thus, a unique solution of sustainable nature was conceptualized to achieve four objectives: (a) Rural sanitation by collection and recycling of household waste (b) Smokeless cooking (c) Restoring nutritional balance of soil and (d) Providing employment to rural youth.

With this concept, a vermicompost unit having capacity of 56 windrows of size 10/x 3/x 2.5/ (L x W x H) alongwith a shed for storing cow dung and agro waste was constructed. Infrastructure was created to collect household waste and shredding of agro waste along with daily collection of cow dung. Two dustbins were provided to each household for collecting household waste. A household contributing cow dung of two cattle daily was given an LPG refill every two months. For vermicomposting, batch process is being followed in which shredded biowaste is mixed with cow dung slurry in the ratio of 65:35 (waste: cow dung, w/w), at suitable moisture and temperature (50-65 percent and 35-40°C), the epigeic earthworm species (Eisenia fetida, Peryonix excavates and Eudrilus eugenii) was spiked @ 2 Kg per 1000 kg of bio waste cow dung mixture having 2000-2500 young earthworms (1.2±0.25 g/worm) with each cycle getting completed in 12 weeks accommodating for four cycle a year. The compost quality and maturity parameters i.e., C/N ratio, CEC/TOC ratio, Total N,P, K, and micronutrients (Fe,Cu, Mn, Zn) has been assessed and compared with standard compost quality parameters.

About 250 tonnes of vermicompost will be prepared every year giving gross revenue of Rs 15 lakhs per annum. The total annual expenditure will be 11 lakhs with total profit of 4 lakh per annum. The total capital expenditure is about 16 lakhs which include cost of structure, shredder, carts (including one e-cart) and chaff cutter along with arrangements of water supply and electricity. The requirement of working capital is about 10 lakhs per annum.

Presently the system is serving 56 farm families. It is expected that there will be annual production of 240 tonnes of vermicompost. With a rate of Rs 6000/- per tonne, the annual gross return will be Rs 14.4 lakhs with net profit of Rs 5 lakhs (approx).

The system, called the Sukhet Model, is in operation in a village in Madhubani district of Bihar. It shall be self-sustaining. Bihar has 2 crore farm families. To provide similar facility, we shall need about 2 lakh units. The system will provide employment to 10 lakh people, provide 5 crore tonnes of vermicompost, and will provide 6 cylinders annually to 2 crore families. This will bring a huge transformation in rural Bihar in terms of employment, wealth creation, smokeless domestic cooking and rural sanitation. There will be sufficient organic manure availability for restoring soil health and boost organic farming.
DR. RAJENDRA PRASAD
CENTRAL AGRICULTURAL UNIVERSITY,
PUSA, SAMASTIPUR

SUKHET MODEL: A Novel Concept by RPCAU
Strengthening Pradhanmantri Ujjawala Yojana by Exchanging Cow dung
with LPG Cylinder Refill

**OBJECTIVES**

- Rural Sanitation by recycling of Household and Agro Waste
- Smokeless Cooking
- Improving Soil health
- Providing employment to rural youth

**CONCEPT**

01. Waste collection and processing
02. Establishing 250 MT capacity vermi compost plant
03. Marketing of Vermi Compost
04. LPG Supply to Farm Families

**Potential for Bihar**

- 2 lakh units each for 100 farm families
- Generation of 10 lakh Employment (5 persons per unit)
- Production of 5cr MT vermi compost
- 6 LPG Cylinder/Year for 2 cr. Farm families

Sukhet is a village of Madhubani district of Bihar
The utilisation of technology will enable a radical growth of agricultural productivity and accelerate access to markets, data, advisory and inputs. AI usage is estimated to add USD 500 billion to India’s GDP by 2025, with agriculture adding USD 60-65 billion. Emerging technologies including sensors, Internet of Things (IoT), drones, and satellite images can consolidate and examine weather data, soil figures and market costs.

Core Issues
- The pricing structure characterises poor cost and weak demand-supply chains
- The Food and Agriculture Organization (FAO) predicts approximately a 20-40 per cent decrease in global crop production due to plant diseases and pests. India accounts for 25 per cent of global production. Well-structured pest management can help diagnose pest behaviour resulting in reduced crop damage.
- Uncertain climatic conditions damage crops, highlighting the need for weather prediction systems.
- Soil and crop regulation mechanisms are needed to determine the moisture and nutrition level, humidity, temperature and health indicators for well-timed farming measures
- During the past decade, the sector has seen a sharp fall in labour

AI, IoT and Tech Solutions for Agriculture
- An enhanced approach to price structuring can be enabled via a digital platform, which can customize and compare prices across regions and vendors creating cost clarity.
- The utilisation of AI technologies to identify and control pest behaviour. Consolidation of remotely sensed data, image categorisation and weather data helps differentiate weed from crops. This differentiation results in a reduction in harvest and environmental destruction.
- By using local farm pictures, AI models can be established for soil restoration and crop growth.
- Driverless tractors can work by replacing the scarce labour and generate quicker and nutritious production.

ABOUT THE AUTHOR
Mr Uday Nagaraju is Founder & Director, AI Policy Labs, London. He is also Co-Founder & Executive President, Global Policy Insights, and Conference Chair & Convener, AI Conference 2020. He proposed a Commonwealth Partnership on AI, actively works on UK-India AI partnership and is passionate about utilising AI & innovation for agriculture. Researcher to the author, Ms Naman Singha is Research Associate, AI Policy Labs
works towards tackling poor weather and Mahindra Ltd’s Seed The Rise initiative agricultural technologies. Mahindra & Vigyan Kendra spreads awareness on Foundation in association with Krishi cies. caused disturbances using space agen-

PMFBY), thus helping to tackle climate- with Pradhan Mantri Fasal Bima Yojna 20 states, implements agro insurance and warning of pest outbreaks. on enhancing crop and soil production collaboration with IBM, developed a crop and rabi sorghum. Niti Aayog, in crops including wheat, rice, jute, mustard, cotton, sugarcane, rabi and kharif crop and rabi sorghum. Niti Aayog, in collaboration with IBM, developed a crop yield prediction apparatus, shedding light on enhancing crop and soil production and warning of pest outbreaks.

Skymet, a start-up spread across 20 states, implements agro insurance and risk management in agriculture with Pradhan Mantri Fasal Bima Yojna (PMFBY), thus helping to tackle climate-caused disturbances using space agencies.

In terms of CSR initiatives, Adani Foundation in association with Krishi Vigyan Kendra spreads awareness on agricultural technologies. Mahindra & Mahindra Ltd’s Seed The Rise initiative works towards tackling poor weather and complex farming conditions.

Global Use Cases and Interventions
The Netherlands, the second-largest agricultural exporter globally after the United States, has shown great potential in utilising AI for food security. Polarkiks, a precision agriculture solution company identifies diseases, pests and optimum harvesting time towards better crop management. Another firm, SpectroAg examines field data to create real-time information.

In collaboration with industries and academia, the Japanese government launched policies on Smart Agriculture focused on resolving the challenges of ICT and enhancing productivity. A Japanese agricultural drone company, Nileworks, established a drone system to search and spray pesticide accordingly. A booming start-up, Vegetalia, installs camera sensors to track weather and soil parameters.

Canada invested $49.5 million towards expanding farming solutions and access to innovative technologies. They have the presence of start-ups like Elevate Farm which utilises tech-based vertical farming systems to grow vegetables.

Policy Requirements
Niti Aayog’s National AI Strategy identifies agriculture as a core focus with enhanced income, farm productivity and reduction in wastage. The motive is to double the farmers’ income by boosting productivity and expanding the market and supply chain.

FICCI, in collaboration with PwC, published a report “Ushering in New Growth Wave: From Artificial Intelligence to Agricultural Intelligence”, which recommends:

- identifying agencies to disseminate AI solutions to strengthen yield and profitability of farms.
- encouraging AI use among farmers and agribusinesses to enable growth without much effort.
- formation of skill development centres towards AI training for farmers to boost productivity and sustain growth momentum.
- promoting associations between private agencies and state agriculture universities which advances efficiency of irrigation and timely evaluation of soil health.

- adoption of connections between private players for efficient data accessibility to farmers
- Sowing prediction recommendations by AI tools provide stability for the agriculture community.
- reduction in wastage is monitored by AI tools by managing the environment of storage.

The Way Forward
There is a massive potential of utilising AI for agriculture. NITI Aayog’s National AI Strategy prioritising agriculture is headed in the right direction. The complex challenges prompt for more government interventions for short and long-term results.

The approach could be independent government initiatives along with multi-stakeholder in-country and external partnerships. An immediate intervention to expedite the enhancement of rural infrastructure is needed. In addition, bringing together a country level coordinated structure for pricing and other related processes is pivotal.

The start-up ecosystem is critical for innovation. Strengthening the agritech ecosystem through incentives, bursaries, advancing research and empowering research bodies through additional funding and private partnerships can encourage homegrown innovation. International collaborations can bring innovative methods working elsewhere and can aid research.

Data availability is a critical issue. Increased digitalisation and subsequent data availability can leapfrog technological advancements in the sector. The government needs to identify areas of digitalisation along with a structured form of data availability without compromising privacy and ethics.

Government initiatives in raising awareness regarding technology are paramount.

Natural Language Processing (NLP) advancements in Indian languages and dialects are crucial to benefit farmers in rural India. Strengthening the research ecosystem plays a major role.
Economically, rice is a farmer-friendly crop as compared to other kharif crops. But rice irrigation water productivity (IWP) is relatively low at 0.22 kg/m³. This reflects inefficient irrigation water use, causing depletion of groundwater to grey zones in the northern states of Punjab and Haryana. Further, paddy stubble burning causes severe air pollution in the National Capital Region.

It is a myth that rice is a water-guzzling crop. Its biological need for water is similar to other summer season crops like maize, sorghum, soybean etc and nearly half as compared to cotton, sugarcane etc. Summer rice crop needs only 450-700 mm for total growing period. This can be sustained without over exploitation of groundwater in the normal rainy season of IGP (500-800 mm rains). But water guzzling agronomic practices of puddle transplanted rice (TPR) increases need for irrigation to over 1250 mm. This causes imbalances between annual groundwater recharge by the rains and water consumed by rice crop. Water need of rice crop can be reduced to sustainable level at below 700 mm without any compromise with seed yield by shifting from TPR to DSR system. Excess use of water in TPR has no additional incentives to seed yield except for easiness to weed control.

TPR needs about 3000 liters of water to produce a kg of raw rice. This causes deple-
tion of groundwater to grey zone in the northern states. To counter this, a joint consortium of PAU-Ludhiana, HAU-Hisar, ICAR in collaboration with Australian Centre for International Agricultural Research (ACIAR), IRRI, CIMMYT and Pepsico developed Direct Seeded Rice technology during 2005-2012 with emphasis on weed control with chemicals namely Bispyribac Sodium (Nominee Gold).

Farmers have been slow to adopt it due to menace of weeds caused by defective recommendation of sowing dates (June 10 onwards, which coincides with pre-monsoon showers) and overdependence on frequent irrigation and herbicides. Many of those who adopted DSR reverted back to TPR, giving a serious setback to the new technology.

Our research team at ICAR-IARI (2014-2016) developed farmer-friendly improved DSR (TAR-VATTAR DSR, details enclosed in Box) by removing the defects faced earlier. In improved DSR, the date of sowing is advanced to May 15- June 5, a month before the onset of monsoon. Sowing done in moist field after irrigation (TAR-VATTAR fields like wheat crop sowing), application of pre-emergence weed killers (Pendamethalin etc) immediately after sowing and delayed first irrigation on the 20th day. Later irrigations through Alternate Wetting & Drying Cycle (AWD) of 10-15 days interval on the basis of rain and type of the soils. For DSR in sandy soils, we use locally-available natural gums.

We validated improved DSR at farmers’ fields during 2016-2021 in Punjab, Haryana, UP, Uttarakhand etc including sandy soils and rain-fed areas. This proved that “in DSR the first irrigation could be delayed by three weeks without mortality of seed and seedling even in hot and dry months. This helps in effective weeds control with application of pre-emergent weed killer pendimethalin etc. The incidence of pests and diseases is also less and crops become nearly free from bakanae disease.

Farmers have shown keen interest and have planted under improved DSR (TAR-VATTAR DSR) on about 16 lakhs acres in Punjab and 5 lakh acres in Haryana during the year 2020 (about 20 per cent of total area under paddy cultivation). This makes rice cultivation sustainable to climate change by saving about 30 percent consumption of groundwater, energy, labour, diesel etc. It maintains soils porosity for better recharge of water through rains in comparison to transplanted rice which forms hard layers in the soils.

DSR based cropping system can effectively control the incidences of stubble burning and air pollution by using early varieties (110 days maturity namely PB-1509 & 1692, PR-126 etc). These are harvested by mid September.

DSR-based cropping system with early maturity rice and zero tillage (without stubble burnings) can become even more environment and farmer friendly. Farmers can take benefit of additional short duration crops like Urd (black gram), Toria (rape-seed), Peas, vegetable or dencha (For green manure) before the sowing of wheat. This will effectively reduce paddy stubble burning. It shall make the country self sufficient in pulses and oilseed production, with addition incomes for the farmers. The government must promote farmer-friendly DSR as the permanent solution for groundwater conservation, control of air pollution, sustainability of agriculture and better incomes for farmers.

### SOP-Direct Seeded Rice

- **DSR sowing time:** 15 May to 5 June (one month before the onset of monsoon)
- **Sowing:** in TAR-VATTAR field after heavy irrigation and field preparation
- **Seed rate:** 8 kg seed/acre after treatment with 2 g Bavistin & 1 ml chloropyriphos per kg seeds
- **Seed depth:** 2-3 cm only.
- **Distance between rows:** 9 inches.
- **Weed Control:** Spray pre-emergence weed killer Pendimethalin@1.5 liter per acre in 200 liters water immediately after sowing. If weeds still cause problems, spray bispyribac sodium @ 100ml in 200 liter water in moist field after 25-30 days of sowing.
- **Irrigation:** First irrigation delayed at 20 days after the sowing. Later irrigations by adopting Alternate Wetting & Drying cycle (AWD Cycle) at the interval of 10-15 days on the basis of the rains and type of the soils.
- **Fertilizers & Pest Control:** As recommended for transplanted rice (TPR)
Agriculture sector had emerged as the only bright spot when the Indian economy faced headwinds of Covid-19 last year. India witnessed record production of foodgrains (303.34 million tonnes), which was 2 percent higher year-on-year.

While the central government is reviewing and assessing the preparedness for crop management, local agriculture agencies too will have to ensure optimum and timely availability of input materials such as seeds, pesticides, fertilisers, farm machinery and tools. Proper communication channels should be established among farmer groups, local traders, wholesalers and government agencies. Farmers must get timely and accurate updates about farming materials and techniques, weather forecasts, and market dynamics. Creating such platforms in the age of ICT will not be a difficult task. Farmers too will have to follow health advisories as the possibilities of Covid-19 infection remains. They must follow social distancing, use masks, sanitise farm machineries and avoid rushing to crowded markets to buy crop inputs.

There are uncertainties in commodity markets due to disrupted farm sector and volatility in demand and supply. In case of sudden slump in demand, commodity rates can drop and hurt farmers. This is a key area where government agencies will have to look at. Proper communication and advisories through different channels including Kisan Call Centres can help reach out to farmers effectively. Satellite remote sensing can be used to get precise and up-to-date information on the crop situation.

Also, we must encourage agri-tech start-ups with suitable policies and incentives. They can play an important role in providing artificial intelligence and digitization-based technological solutions when access of farmers to the outside world has become restricted due to lockdowns. These start-ups can help farmers obtain farm tools and equipment as well as certified seeds and nutrients. Ecommerce companies too can pitch in to deliver crop inputs to farmers wherever possible.

Though there might not be shortage of labour this time, farm mechanisation is a practical alternative. Farmers must rely on machinery and technological solutions for safe, stable and efficient farm operations. Cooperative and private custom hiring centres can play a crucial role in providing farm machinery and equipment, especially to the small and marginal farmers. The government can extend the scope of Sub-Mission on Agricultural Mechanisation (SMAM) to set up hubs for hi-tech and high value farm equipment and create awareness.
Since more than 100 years, Katarni Rice is grown in Bhagalpur and its adjoining area. During the Bhagalpur visit of Pt. Jwaharlal Nehru in 1952, Katarni Chura from a Jagdishpur block was gifted to him by the then District Magistrate. The word “Katarni” literally means an awl with a hook at the end for sewing and has resemblance of the tip of its husk (apicull) with awl. It has unique taste due to its palatability and special aroma which develops only when it is grown in a specific geographical territory comprising few blocks namely Jagdishpur, Sanhula, Sakhund and Sultanganj in Bhagalpur District; Tarapur and Asharganj in Munger District and Amarpur, Shambhuganj, Rajaun, Barahat, Chanan and Katoria in Banka District. The farmers in this tract are growing this special rice since long mainly in the surrounding catchment areas of a river namely Chanan.

The tag of Geographical Indication was given to Katarni rice in 2018. A registered farmers’ society ‘Bhagalpuri Katarni Rice Utpadak Sangh’ has been awarded by Intellectual Properties Rights, Govt. of India to utilize the GI tag which has provided an exclusive right to the growing farmers and will protect the high reputation and brand name of Bihar state for having such valuable natural and commercial assets. The GI tag of Katarni rice has helped the consumers and producers in enhancing the commercial value and the growers/stakeholders can intervene in the export and the domestic market. Like Basmati, It has potential to capture the Indian agriculture export market particularly in the Middle East Asian countries.
New mobile apps are helping farmers with vital information that enable them to take economically and environmentally sound decisions. Mobile apps are an effective platform for training, teaching, plantation, plant protection, marketing and many other roles. They provide farmers with timely information to enhance yield and income.

The mobile apps are designed in accordance with the needs of the farmers, extension workers and researchers. Many researchers working in different institutes of the Indian Council of Agriculture and Research, New Delhi, India have developed a number of mobile apps on forecasting and forewarning of pest incidence, synthesis of information on integrated pest management, and selection cum calculation of label-claim pesticides in the area of crop protection, like pesticide calculator, mobile apps on pest forewarning (Pest-predict EMS and RBS). Many good agricultural apps are available on Google play store. The following are some commonly used mobile apps.

### IKSHU KEDAR
This mobile application was developed by ICAR-IISR, Lucknow. It helps farmers to decide upon the date and duration of the next irrigation, which helps in water management. This app is based on the climatic condition of the area, weather forecast for northern states, and the impact on sugarcane farming. Limited usage of the app is reported in unfavorable situations like saline or alkaline soil, waterlogged areas, and areas with very heavy or loamy soil.

### CASHEW INDIA
This mobile app was developed by ICAR-Directorate of Cashew Research, Puttur, and Karnataka, India. The developer had collected all the critical inputs and information’s from all the centers of All India Coordinated Research Project on Cashew, under the program on Mission for Integrated Development of Horticulture (MIDH), Ministry of Agriculture and Farmers Welfare, GOI. It provides comprehensive statistics on cashew grafts, nursery, cultivation, plant safety, submits harvest processing, market records, e-

### ABOUT THE AUTHOR
Dr Meenakshi Malik is a scientist in ICAR-National Research Centre for IPM, New Delhi. For ten years, she has been working on the development of various information and communication tools for pest management in different crops.
marketplace, various stakeholders consisting of farmers, researchers, developmental corporations, processors at one place, and helps orchard growers.

**CHANA MITRA**
This mobile app was developed by ICAR - Indian Institute of Pulses Research, Kanpur, UP. Chana Mitra is an internet-enabled initiative of the institute for helping chickpea farmers with the latest information and advisories for higher chickpea production. The app presents the data related to location-specific improved chickpea varieties, crop manufacturing technologies, and crop plant protection technology, harvest technology as well as marketing and climate.

**CICR COTTON APP**
This mobile app was developed by ICAR-CICR, Nagpur, India for benefiting cotton farmers. It provides useful information on cotton, from sowing, varieties, hybrids, cultivation to management practices like protection and production technology. Farmers can use this app to know about market prices and cultivation scenarios. The key components are information on best varieties and hybrids, crop protection and production technology, and farmers outreach programs. It also gives weekly advisories and regular updates on facts and figures related to cotton cultivation, production, market, pricing, and schemes, which improve the farmers' decision-making skills.

**GROUNDNUT-IPM**
This GIPM mobile app was developed by ICAR- NCIPM, New Delhi, India on Groundnut pest management. This provides useful for dissemination across various stakeholders, extension functionaries, pesticide dealers, and farmers. It has features like pictorials of key pests, damage symptoms, monitoring of pests, management techniques, IPM schedule etc. The chemical options have a link to insecticide and fungicide calculator to facilitate their selection along with calculation of quantity for a required area and application technology.

**SOYBEAN GYAN**
This mobile app was developed by ICAR-Indian Institute of Soybean Research, Indore. It is very useful for researchers, scholars, students, agro-advisors, extension workers and soybean growers. The app helps in knowing the latest recommended production and protection technologies. It helps the farmer to know about the key pests of the crop and their management strategies. It provides information about the tools and equipment needed for harvesting, threshing, crop management, and some special treatment like seed treatment etc. By using this mobile app farmers are able to get information about scientific recommendations on seed rate, sowing time, varieties in seed chain location wise etc. It also helps other consumers with different soy food recipes, Good Agricultural Practices, farmer soybean advisories generated by the experts and provides links for farmer discussion platforms.

**ICAR-MUSHROOM**
This mobile app was developed by ICAR-Directorate of Mushroom Research, Solan, Himachal Pradesh to help mushroom growers, entrepreneurs, researchers, and students. It helps to disseminate about the use of mushroom and how it can be cultivated on agricultural waste. It provides the latest technologies of mushroom cultivation.

**AGRICULTURE: FARM EXTENSION MANAGER**
This mobile app was developed by Kerala Agricultural University (KAU) and contains information on 100 essential crops of Kerala. The information is categorized in ten heads which include tool, crop cultivation, plant protection, organic inputs, agrochemicals, agricultural quiz, video gallery, farm posters, expert support, contact directory and app information.

The crops are classified as spices, vegetables and medicinal plants etc. The crop production aspects cover information on planting, variety, fertilizer, after care and harvest.

**Mobile apps are an effective platform for training, teaching, plantation, plant protection, marketing and many other roles. They provide farmers with timely information to enhance yield and income**

**Dr Malik loves gardening, playing with children and listening to music**
AGRI CHALLENGES

SUSTAINABLE AGRICULTURE

MAJOR ROADBLOCKS TO COMPLETE ADOPTION

The term Sustainable Agriculture has less to do with the long-term sustenance of agriculture. Rather it is a way of doing agriculture in which there are enough economic returns for the farmer and minimal disturbance to the surrounding ecosystem. Agreeably, there are visible advantages to adopting modern agricultural technology. But one of the biggest drawbacks of technology-infused agriculture was the negative impact it had on the surrounding flora and fauna.

This is precisely what sustainable agriculture seeks to remedy. Primarily, it is holistic farming where there is an integrated approach without the negation of any natural element, which would ensure minimal impact on the surroundings.

There are only a few pockets within India where sustainable agriculture practices have found acceptance. The following are some of the major reasons.

- **Absence of Economic Incentive:** The government is yet to fully embrace sustainable agriculture as a critical component of the national agricultural policy. There have been initiatives on the government’s part like the National Mission for Sustainable Agriculture (NMSA). But a full-fledged roll-out of a policy document that spells out an economic incentive to the farmer for sustainable agricultural practices is yet to find a place among the government’s plans. This makes the farmer wary of switching to sustainable agriculture.

- **Lack of Awareness:** Although the...

**ABOUT THE AUTHOR**

Mr Nikhil Das is the brain behind Agdhi, an agritech startup based in Bengaluru which aims to create the next revolution in agriculture. The startup is revolutionizing agriculture by introducing digital technology and building alternatives solutions to facilitate sustainable methods in agriculture. Mr Das has designed and delivered a variety of products in the market that played key roles in Village Electrification Projects.
farmer receives help from regional agricultural centers, it is more to do with increasing crop yields and associated practices within the existing framework. There aren’t enough avenues for the farmer to get educated and informed about new paradigms like sustainable agriculture. Even if farmers start on their own, there aren’t enough resources and support that can be extended by government intermediaries in taking the sustainable initiative to its logical end. This makes even regional centers reluctant in getting started with sustainable agriculture.

- **Lack of Institutionalized Support:** Any initiative needs consistent institutional support to get operational. In the case of sustainable agriculture, except for the (NMSA) under the Department of Agriculture of the union government, there has not been an autonomous government body that can drive the adoption. The lack of coordinated efforts with regards to dedicated personnel, facilities, and motivation has kept sustainable agriculture in its infancy.

- **Lack of Organic Inputs:** While the government still provides subsidies for chemical fertilizers and pesticides, no such subsidy is extended towards organic inputs. There are certified organic seeds available, but there is no recognition for such seeds. This forces the farmer to go with conventional seeds even if they are ready to go with certified organic seeds. There needs to be a policy framework guiding the use and procurement of seeds among farmers.

- **Higher Cost:** One of the critical hurdles when it comes to adopting sustainable farming is the higher cost compared to conventional farming. Organic seeds are costlier, take time to grow and storage of the final product is expensive. Most farmers who do conventional farming are not likely to switch over easily considering the high cost. It is highly recommended that the government drives the importance of sustainable agriculture at the community and grassroots level. Mass adoption of sustainable agriculture can bring down the costs substantially.

**QUEST FOR SUSTAINABILITY**

Although the country is lagging in sustainable agriculture, it is imperative that our policymakers wake up to the realities of side effects of pesticide use, overexploitation of natural resources and climate change. All these factors are intertwined and are likely to have a significant impact on the lives of 1.3 billion Indians. The authorities need to put their best foot forward in bringing sustainable agriculture to the forefront as necessary need of the hour. Ultimately, it is about securing the well-being of coming generations.
Covid disrupted supply chains across agriculture and its allied sectors. It prompted the need for reforms in the agri-sector and digital solutions to link farmers to markets, build wage safety nets, and ensure equitable working conditions at the farm level. For the horticulture industry, an opportunity exists to enhance and strengthen its value chains.

In order to make these value chains more flexible and effective, digital technology, including geo-tagging, digital profiles of farmers, communication and payments will play a crucial role. Indian agri-industry is on the brink of a massive transformation. More steps are necessary to reboot the industry and ensure it exits the crisis more robust than ever as experts suggest that a third and a fourth Covid wave in the waiting.

The crisis accentuates the country’s prospects for strengthening our cold chain infrastructure along with agri-warehousing facilities. The lack of sufficient cold storage facilities in India force farmers to sell their perishable horticultural products at rates that are typically sub-standard. Decentralized cold storage infrastructure is the need of the hour to bring down the losses.

Needed: Network of Cold Storage Facilities
A network of cold storage facilities across rural and urban India can allow farmers to store their horticultural produce for longer durations until market prices become suitable. Such facilities can even operate on alternative energy sources like solar energy. As this area is still germinating, it has huge potential for growth, given the large share of horticultural produce it can cater to. A mix of government and private partnership can further boost its pace of implementation.

In terms of the consumer, a significant impact of the pandemic has been that it has imprinted mass consciousness for hygiene and safety. People have become increasingly conscious of their health and the safety of the food they consume. There has also been a significant shift in the buying habits as consumers became wary of stepping out of their homes for in-store purchases produce during the pandemic. They rely more on e-commerce for home delivery. These trends opened up

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Mr Pankaj Khandelwal is the Chairman and Managing Director of INI Farms, a vertically integrated branded fruit company. With its flagship products of banana, pomegranate and fresh cuts, INI is at the forefront of bringing ag-tech to Indian agriculture. It has built large scale operations spanning contract farming, aggregation, supply chain management and serving retailers in 35 countries globally.
new segments and created opportunities for business expansion for agriculture and horticulture companies beyond their traditional routes.

Subsequently, Ag-tech solutions that offer quality and safety have gained significant attention. Companies are shifting focus from aspects such as trade traceability to consumer traceability, providing a transparent mechanism to track the journey of the produce from farm to fork. This has been further enhanced through tech-enabled solutions such as QR Code-based stickers for individual fruits, the latest consumer-centric innovation adopted by the horticulture industry.

Consumers today can have access to real-time insights like where and who has grown the fruit, simply by scanning the dynamic QR code, and are willing to pay a premium to be able to do so. Packaging aims to retain food quality at its best. Companies continue to shift towards a ‘Direct to Consumer’ model. The emphasis is largely on providing the best ‘experience’ to the consumer, without compromising on quality.

Covid pointed out the need to incorporate policy frameworks that can sustain and uphold a resilient supply chain. GOI’s recent agri-reforms are expected to deregulate the market, a move that shall encourage greater competition and introduce best global agri practices. Keeping supply chains functioning well is crucial to ensure food security. It is crucial for farmers to have continuous access to markets, be it through private or government procurement mechanisms. The reforms are foreseen to revamp the Indian agri-food sector and empower farmers.

The above changes can materialise only if the health of the farmers is ensured. Agri companies can ensure that the farmers and the workers associated with them are vaccinated. Emphasis should also be placed upon the safety protocols at farms, citing the fact that the rural hinterlands have witnessed a spike in infection rates.

**Horticulture The Thriving Sector**

As the lockdown continues to unfold across the country, horticulture is emerging as a thriving sector. Despite the challenges posed by the pandemic, the impact of this global crisis can be mitigated. The pandemic is a fertile pivotal point to transition from conventional agri-business models to innovative advanced tech-based models.

The future of farming will reconcile with domains that were earlier not associated with agriculture. The digitization of databases, real-time monitoring of the distribution supply chain, and logistical traceability will shape our agronomy while adding value to the commodity and produce.

As the pandemic continues to unfold, it is difficult to predict how long this ordeal will last, and to what extent its impact could be. Therefore, the sector will need to rethink and continue to adapt towards resilient, sustainable and game-changing agri-models to widen the horizons for the industry. It will also determine how well we cope with the ramifications of the pandemic in the times to come.

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**Eye on Future**

Mr Khandelwal ranked among top 100 in IIT-JEE and graduated in Computer Science from IIT Kanpur. He studied management from IIM Calcutta where he won gold medal for outstanding academic performance. Mr Khandelwal co-founded INI Farms with his wife Purnima in 2009.
Questions have often been raised on the logistical capability of India and whether the logistics and warehousing industry is capable of successfully withstanding force majeure events like the pandemic. But since March 2020 when India announced the world’s largest lockdown to contain the virus’ spread, the country’s logistics & warehousing sector, particularly the agri logistics & warehousing segment, has performed its role seamlessly. The sector ensured a disruption-free agricultural supply chain and safety of the produce by facilitating its storage, transportation and warehousing. There were challenges aplenty. But proactive deployment of solutions offered by emerging disruptive technologies have enabled players like Sohan Lal Commodity Management Pvt. Ltd (SLCM) to quickly remodel and adapt their day-to-day working to continue providing their services 24x7 in these times of a major global crisis.

We imbibed a technology-enabled rural platform nine years ago. It stood us in good stead during this very testing period. Technology adoption came in handy when we were required to manage our operations remotely or work-from-home for the safety of our employees.

**TOWARDS EFFICIENT AGRI WAREHOUSING**

An enormous amount of food grain gets wasted due to archaic procurement, storage and inefficient warehousing methods every year. Scientific warehousing is the need of the hour and is a one-stop solution that can address the problem of wastage during storage to a large extent.

SLCM has done pioneering work to implement scientific warehousing in the country. Presently, all our warehouses are integrated with real-time data embedded in artificial intelligence (AI), enabling real-time tracking of the facilities to provide error-free results on the site’s status and the products stored within as well as in transit.

A patent-pending algorithm named AGRI-REACH developed by us combines a series of processes, audits and real-time tracking of the facilities to give error-free results and minimise the risk of crop damage. It uses techniques like geo-fencing to real-time tracking, bar-coded storage receipts to avoid thefts or pilferage, and internal audits with a maker and checker policy at each level. We have taken a lead towards paperless quality control by developing an AI-based mobile application to assess crop quality within a...
minute with up to 90 percent accuracy.

**HUMONGOUS GROWTH OPPORTUNITY**

Agri warehousing constitutes approximately 15% of the warehousing market in India and is worth between Rs 80-85 billion. At present, the agri warehousing capacity in India is more than 120 million metric tonnes (MMT) and has grown at 4 percent CAGR since 2017. The exponential growth and innovations like scientific warehousing, GPS tracking, geo-fencing, real-time monitoring, etc., have instilled confidence amongst stakeholders involved in the sector. This has brought in a lot of interest from private equity (PE) investors as well.

The segment can contribute by helping the Indian economy achieve the ambitious $5 trillion target. Typical storage losses for agricultural produce in India account for approximately 10% – only for the dry food grains – of the entire production, which works out to a staggering Rs 1 trillion! It is important that technological solutions are adopted at a rapid pace to help reduce the post-storage losses.

An independent study by the industry chamber Federation of Indian Chambers of Commerce and Industry (FICCI) concluded that SLCM’s scientific storage AGRI REACH technique had a remarkable impact on the quality of stored produce.

The May 2020 announcement by the Central Government of 11 measures for the agriculture sector as part of the Aatmanirbhar Bharat initiative was a welcome move. Among the measures announced, eight are for boosting the agricultural infrastructure, capacity and logistics. The allocation of Rs 1 trillion for farm gate infrastructure, including affordable and viable post-harvest management, clearly reveals the seriousness of the government's intent in developing and enhancing post-harvest agri infrastructure.

In a marketplace model, intelligent call centres have an extremely important role to play. Smart call centres when integrated with real-time data embedded in AI help in real-time tracking of the facilities. These provide error-free results on the status of the warehouse and the products stored within as well as in transit. A virtual customer service network is the need of the hour because it will enhance the service standards. It will also help in raising the bar on scientific storage by eliminating paperwork and providing evidence of the calling details.

The outlook for the agri logistics and warehousing industry is positive, and there is increased focus of policymakers on scientific warehousing and increasing confidence and depth of domain expertise and operational competence have emboldened Indian agri warehousing companies to look at the overseas markets for expansion. In keeping with the Central Government’s outreach to countries of South East Asia, we launched holistic warehousing operations in Myanmar in 2014.

The country’s South Asian neighbours like Bangladesh, Nepal and Sri Lanka also present an opportunity for homegrown players to establish an overseas presence owing to their geographical and cultural proximity. In addition, Africa presents a lucrative market for expansion because of its untapped agri warehousing potential.

In preparation for the future, the Indian Agriculture sector needs a modern and professionally managed agritech mechanism that is capable of successfully addressing the demands of a growing population, a rapidly expanding economy and competing with the world’s best.
THE ANNADATA IS HELPLESS, IS FACING MULTIPLE CHALLENGES

Rice is a representative Kharif crop. Farmers work hard on the entire cycle of plowing, bed-building, land-cleaning, seed-refining. Soon enough, farmers have to deal with the vagaries of nature. They face natural disasters, but there is nobody to listen to the major challenges faced by them. They have to take up work like storage maintenance, maintenance of agricultural machinery, building repair and construction and many other tasks. Every crop needs to be raised like a child.

The second wave of corona virus paralyzed in different ways. The farmers need supportive systems. They need hand-holding. They need appropriate, effective, strong welfare schemes. Agricultural grants and crop protection insurance are some of the support systems. Public representatives should come forward for the welfare of the farmers.

The welfare of the farmer is crucial to the welfare of the nation. Businesses, enterprises, employment – the entire economy is sustained because of the farmer. There must be total realization of this in order to drive farmer welfare.

REQUIRED: GOVERNMENT AND INDUSTRY SUPPORT FOR A SUCCESSFUL KHARIF

The second wave of Corona shook agriculture and farmers. The time for the preparation of Kharif crop is near. But we do not see the usual radiance, happiness and zeal on the faces of the farmers.

The second wave of Covid shook even a state like Uttarakhand. Due to Covid curfew, all the crops, fruits and vegetables that were ready were on the verge of ruin. The harvest was ready but there were no buyers, no market. Then farmers had to prepare for Kharif.

The entire government machinery was battling the pandemic. The government or the industry was unable to help farmers. But farmers know that life must go on. They are busy preparing for Kharif despite the many challenges. Small issues like getting the seeds, fertilizers or repair of farm equipments became difficult because of the pandemic. Over the last one year, farmers of this hill state have become very weak financially. We have suffered hailstorm, excessive rain and recession. In such a situation, farmers need cooperation from the government and the banks. Due to hardships, they were not able to repay the bank loan. Hence they are facing problems in Kharif cultivation. Many departments including the government are battling the corona epidemic. The first priority of the government is to deal with Covid. Hence farmers will have to prepare for the Kharif crop from their own resources.

No matter how challenging the circumstances, farmers have to discharge their duties. They shall have to patiently work in their fields to produce food grains for the country.
RESTORATION OF SUPPLY CHAINS ESSENTIAL

Agriculture is an age-old economic activity in our country. Over the years, cultivation methods have changed significantly depending upon the characteristics of the physical environment, technological know-how and socio-cultural practices. Farmers are facing many challenges during the current Covid times. The impact is more on the small farmers, especially those who grow vegetables and fruit. Due to the perishable nature of the produce, their earnings are impacted immediately.

Due to Covid, transportation is a challenge for farmers. Due to marketing issues, they are forced to sell their produce cheap. It is not possible for them to take the produce back home. Sometimes, produce has to be dumped as feed for animals. During the Kharif season, farmers may face financial problems. They may be unable to purchase essential inputs like quality seed, fertilizers etc. Other sectors too are feeling the heat. Poultry, dairy, goatery, fishery — in all these sectors, farmers are facing the problem of disrupted supply chains, marketing and pricing. It is essential to restore the supply chains so that the small farmers can get the right market and also the correct price. Financial assistance in terms of easily available loans with an extended recovery period will be a boost. Assurance of availability of production input is urgently needed by the small and marginal farmers.

Consumers and middlemen must support farmers in this hour of need. They should not try to benefit from the compulsion of the farmers. Significant financial aid in the form of loan waivers and no restrictions over transportation will immensely benefit farmers. In addition, subsidized supply of electricity and water shall benefit the marginalized farmers.

WHAT FARMERS EXPECT FROM GOVERNMENT, INDUSTRY

Agriculture is the basic source of rural prosperity. But small farmers are able to take food grains or vegetables for sale after fulfilling the needs of their families. They are forced to sell on the rate fixed by the trader. Farmers are forced to migrate due to less cultivation, unpredictable monsoon, stagnation in yield due to lack of proper price and other factors. The fall in demand due to Covid has led to concern in the farming community.

For increasing farmer income, models of farming must be developed in each Gram Panchayat. This can be a model of integrated farming over one or two acres. It can include animal husbandry, organic farming, poultry, fish farming. There should be provision for a small unit for value addition so that the farmer can have some income on a daily basis. Farmers can be encouraged to develop projects ranging Rs 10-20 lakh, with grant of 50 to 80 per cent. These model farms should be linked with the industry, which should support the farmer by buying and selling their produce.

ASSAM FARMERS NEED STRESS TOLERANT RICE VARIETIES

As the kharif season is approaching, Assam farmers have started preparing for cultivation of their main crop, Sali paddy. A major part of the total cultivable area of Assam is flood prone. Farmers always face uncertainty over the consequences of devastating floods. During the Kharif season, a major need of farmers is the availability of stress tolerant rice varieties (STRV). Of late, Department of Agriculture and Assam Agricultural University, with the technical support of IRRI under the World Bank-funded Assam Agri Business and Rural Transformation Project has distributed STRVs among farmers in order to popularize them. The Assam government must make STRV seeds available in large numbers for farmers. Growing community nursery in upland for supplying seedlings after recession of the flood to the needy farmers will be a major step in supporting their livelihood.

Most farmers are still not aware of crop insurance schemes. Awareness campaigns must be organized so that maximum numbers of farmers can avail the benefit of the insurance schemes. Labour scarcity is an emerging issue for Assam agriculture. Mechanization is at a budding stage. Custom hiring centers are emerging, but availability of machines is still a major issue for Assam farmers. Due to the narrow window of different crop operations during Kharif, farmers have to struggle for completing different agricultural activities on time. Increasing the number of machines among farmers is the only solution. This needs to be addressed on priority.

Marketing of the produce is also a major challenge. The government must ensure that the farmers can sell their produce at the minimum support price announced by government without any hassle.

U C Shukla
State Bureau Chief ATG
Uttar Pradesh

Yudhvir Singh
General Secretary
Bhartiya Kisan Union

Jyoti Bikash Nath
State Bureau Chief, Agriculture Today Assam

Jyoti Bikash Nath
State Bureau Chief, Agriculture Today Assam
Duck farming is a profitable source of livelihood. The availability of duck breeds and the convenience in raising them for meat and eggs makes poultry farmers focus on backyard duck farming. Starting a commercial duck farming business also depends on the factor that ducks can feed on agro-industrial wastes. Further, they can survive in marshy areas and in the areas where no agricultural crops can be grown which makes it easy for poultry and other farmers to shift to commercial duck farming for adding an additional source of income.

**Farm size**
A duck farming business starts with determining the farm size and number of ducks that can be reared. A fully functional duck house can be made with local resources, facilitating proper ventilation and ensuring their safety. In an intensive duck farming system, a floor space of a minimum 3 sq. ft. per bird is required while in a semi-intensive system, a minimum 2-2.5 sq. ft. area per bird is required for night shelter.

**Selection of breed**
The selection of breed depends on the purpose that a farmer wants to rear ducks for meat or eggs. Packing duck is the most popular and best breed in India for laying eggs. They are also known as the most profitable breed for fine quality of meat production.

**Investment**
The major factors determining capital investment are land prices, infrastructural costs (electricity, water, etc), feeding, compliances, purchasing ducklings, and medicines.

**Key benefits of duck farming**
Duck farms are considered highly cost-efficient as they are comparatively less expensive than raising chicken. Ducks require low-cost and non-elaborative housing facilities that save huge housing costs for farmers. Ducks have a shorter brooding period and ducklings grow faster. This offers tangible benefits to farmers. Ducks can live on a variety of low-cost food including copra, cassava, corn, rice, fruits, etc. They tend to obtain food like green legumes, algae, aquatic weeds, fungi, earthworms, maggots, snails and other types of insects.

Ducks require less care than any other bird. They are adaptive to environmental conditions and do not require heavy efforts on management. One of the major benefits of raising ducks is their cycle of laying eggs either at night or in the morning. This allows the farmer to collect fresh eggs every morning and continue with their other business practices.

Commercial duck farming can be highly profitable. There is a huge demand for duck eggs and meat in the market due to their quality of produce. Ducks usually live longer than chickens and have less mortality rate. This makes duck farming a stable source of income for poultry farmers.

**About the Author**
Mr Prasanna Manogaran is the CEO and Co-Founder of Aqgromalin, an innovative farm diversification company in India. He is spearheading the business operations of the company in Tamil Nadu, Andhra Pradesh, and Telangana. The company’s target is 1000 micro-farms by mid-2021.
Rapid emergence of the Internet of Things (IoT) based technologies has given us smart agriculture. Smart agriculture is a movement from an intuition-driven approach to a more data-centric, quantitative approach.

Across the end to end crop stages - soil preparation, seed planting, crop health/status, irrigation cycles, pest/insect management, harvesting, packing, and transportation, etc, technology is increasingly being used at each stage to aid decision making, enable faster turnarounds, and drive efficient use of assets. The key challenge that arises is the integration of modern technologies with centuries-old traditional farming practices.

Using sensors to collect soil data, and then relaying the data to regionally located labs using a communication network, without spending hours or even days physically transporting the sample to the lab, can a) have faster decisions taken b) remove challenges that may arise due to changes in soil parameters over the time it takes to get the results back.

The use of unmanned aerial vehicles for crop surveillance and tracking farming equipment (often rented) is already positively informing our current and future thinking about how India’s farm mechanization must move forward.

With the rise in the emphasis and the expanding scope of technology integration in the farming equipment sector, four specific ‘Agri-tech’ categories applicable to the farm sector have been identified, and together these future technology solutions are being called, ‘Mechanization 2.0’. They include:

1. ‘Farming-as-a-Service’ (FaaS)
2. Big Data-based mechanization technologies
3. IoT-based mechanization technologies
4. Artificial Intelligence (AI)-based mechanization technologies

In order to usher in farm mechanization, GOI has promoted Custom Hiring Centers (CHCs) in the country, where farmers can rent any high-end agriculture equipment. GOI has also launched the multilingual mobile app ‘CHC-Farm Machinery’ that helps farmers rent farm machinery and other assets through a CHC in their area.

As technology-centric innovation spreads across India, several technology startups are ushering innovative ideas. For instance, FaaS is an emerging model where farmers can rent out machinery as per the specific demand of individual farmers or farms.

Integrated IoT-based technologies such as drones, GPS, sensors, automated hardware, robotics, remote sensing could provide multiplier benefits for India’s nascent farm equipment rental market, especially as India rapidly integrates IoT-based smart agriculture into existing farming practices.

With an increasing emphasis on precision agriculture in India, most equipment manufacturers will need to ensure the integration of IoT sensor technologies with mechanized equipment to enhance their effectiveness and derive a competitive advantage in the market.

ABOUT THE AUTHOR
Mr Angira Agrawal is Chief Operating Officer, Skylo Technologies, an end-to-end solution that connects machine and sensor data via satellite. Mr Agrawal has been a senior leader at Vodafone Idea Limited, Tata Communications and Oracle earlier.
Agricultural warehousing has transformed itself from the godown era to modern and scientific management of post-harvest agrarian produce. Agricultural warehousing has been growing consistently at a CAGR of 4 percent, which amounts to a market of nearly Rs 8500 cr coupled with a progressive growth rate of over 10-12 percent per year.

The potential growth of agricultural warehousing is estimated to reach Rs 365 billion by 2024, and is regarded as a highly attractive area of investment. Despite this, Indian farmers have incurred mounting post-harvest losses of up to Rs 92,651 cr per year due to unscientific storage and transport facility. The agri warehousing sector needs to catch up with modern facilities like the e-commerce, pharma, and manufacturing sectors. Mechanization of warehousing operations is needed to promote spearheaded reforms.

Scientific storages promote the adoption of modern facilities in warehousing. While India has boosted its cold storage infrastructure, it is confined to particular crops only. A robust innovation system with scientifically built silos, geofencing, geo-tagging, real-time monitoring system, RFID’s (Radio Frequency Identification), AI solutions, sensor-enabled monitoring, cloud technology, and computer-guided robots shall ameliorate the fragmented and unorganized agri warehousing sector.

Temperature-controlled systems and hermetic structures that incorporate Warehousing Management System (WMS) shall reduce post-harvest losses and significantly boost farmers’ income, as Mr Ashok Dalwai’s committee foresees to achieve. These measures need to be coupled with accelerated planning and efficient inventory management, which will include quality parameters such as testing, grading, and certification services.

With an increase in adverse climatic events, scientific agri warehousing can be further fine-tuned based on pilot projects. In order to avoid distress sale by farmers, one needs to ensure end-to-end management of post-harvest produce. Integrated solutions with the establishment of multi-modal logistic parks and free trade warehousing zones are an excellent booster for the industry.

The efforts do not just end with a scientific storage system. Robust logistical connectivity is the path to a mammoth exponential growth of the Indian agri warehousing sector. The logistical arm plays a crucial role in the efficient functioning of supply chain management. This shall be achieved if the logistical costs are brought down from the current 13-14 percent to 7-8 percent of GDP when compared to developed countries. These efforts shall benefit farmers and consumers alike, and conclusively achieve the goals of the farm-to-fork concept.

ABOUT THE AUTHOR
Mr Abhijit Verma, Executive Director & CEO at Avigna Group, spearheads the group’s traditional business and also the Avigna Industrial & Logistic Park - state-of-the-art Food Terminal Markets and A Grade industrial warehouses across the country. The company has a turnover of more than USD 30 million
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