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www.agriculturetoday.in Page in the magazine: 60 October 2022 **AGRICULTURE TODAY**

Smart Agriculture for Sustainability

From the CEO's Desk...

Thank you for adding meaning to our Cover Title dear Samuel Praveen Sir !!

Agriculture has seen many revolutions, whether the domestication of animals and plants a few thousand years ago, the systematic use of crop rotations and other improvements in farming practice a few hundred years ago, or the "green revolution" with systematic breeding and the widespread use of man-made fertilizers and pesticides a few decades ago. We believe that agriculture is undergoing a fourth revolution triggered by the exponentially increasing use of information and communication technology (ICT) in agriculture.

Smart agriculture is a fairly new term and the majority of farmers are not familiar with what exactly stands behind it. This edition sheds light onto the concept of smart agriculture and why it is the future of farming. The term smart agriculture refers to the usage of technologies like Internet of Things, sensors, location systems, robots and artificial intelligence on a farm. The objective is increasing the quality and quantity of crops while optimizing human labour used.

A few popular technologies used in smart agriculture are:

- Precision irrigation and precise plant nutrition
- Climate management and control in greenhouses
- Sensors for soil, water, light, moisture & temperature management
- · Software applications

•

- · Location systems GPS, satellite, etc
- Robotics & Artificial Intelligence
- · Analytics and optimization platforms

The connection between all these technologies is the Internet of Things – this is a mechanism for connectivity between sensors and machines, resulting in a complex system that manages a farm, based on the data received. Thanks to this system, farmers can monitor the processes on their farms and take strategic decisions remotely. The result from this automated smart farming process is high precision and 24×7 control, eventually leading to considerable savings in all key resources used.

Smart farming has emerged to be the need of the hour for the Indian agriculture sector. It is much more efficient than the traditional methods of farming. Smart farming can help integrate digital and physical infrastructures which would benefit small farmers. Agro-based start-ups can reach out to the farmers and help them gain access to such viable and cost-effective solutions. Agri-based tech-driven start-ups have been very innovative in assisting farmers and revolutionising farming techniques.

The forthcoming edition of **Agriculture Today**, scheduled to be unveiled at the **4th Apollo Farm Power Summit & Awards 2022** deliberates upon how farmers, policy makers and industry can harness the power of mechanization for propelling the Indian agricultural economy forward.

Happy Reading

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4



The CEO's Desk	03
From the President's Desk	06
From the Managing Editor's Desk	07
ALTERNATIVES	
Avocado - A Blessing for Coffee &	
Tea growers	21
MILLET MANTRA	
Millets for Nutrition Smart Agriculture	28
PROMISING POLICIES	
Mega Food Parks are Transforming Indian	
Agriculture	30
TECH SMART	
Cold Chain to Unlock the Potential of Indian	
Agriculture	33
NUTIRTIONAL AGRICULTURE	
Rural Prosperity via Nutrition Security	36
NUTRITION SMART	
A GL@NCe at the Smart Agriculture	40
SUSTAINABLE SOLUTIONS	
Sustainable Solutions in Cold Logistics	43
FOOD SECURITY	
Smart Farming: Food for All	46
RURAL PROSPERITY	
Smart Agriculture for the India's Next	
Green Revolution	48
PROSPECTS	
Immense Possibilities of Cold Chain	50
ANALYSIS	
Unleashing the Potential of Cold Chain in India	52
SMART INNOVATIONS	
Low Cost Initiatives – The Game Changers	54
RURAL PROSPERITY	
Cold-chain infrastructure can improve India	's
rural economy	56
REPORT	
National Round Table on Eco Agriculture	58





ऐसी पकड़ ले ज़मीन जकड़ - APOLLO -VIRET डबल ग्रिप टेक्नोलॉजी के साथ

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IRAT

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SMART AGRICULTURE FOR SMART PLANET

t is the era of technology today. Every aspect of human life is dictated by technology. From health to education, from banking to governance and from shopping to communication we bask in the benefits of technology. This digital easiness is evident in agriculture too. Not yet pervasive, the digital technologies are slowly making their presence felt in different aspects of agriculture. They are making our agriculture smarter and better.

The connotation of smart agriculture is currently limited to application of digital technologies. Precision agriculture, artificial intelligence, Internet of Things, remote sensing, drones, block chain, big data the list is unending. So are the benefits arising out of their application. The precision with which the inputs are applied translates to reduction in cost of production for the farmers and efficient use of resources. The resultant increase in quantity and quality is arrived by maximum use of resources and minimising the impact on environment. Simplification of agricultural operations through drones, optimising the monitoring of farms through IoT and improving the traceability of the supply chain through block chain are making headways in Indian agriculture. Touted as the next revolution, India is on the path of integrating technology into its agriculture system.

But India's adaptation of the technology may not be in similar stead as that of the rest of the world. Our form of agriculture is different from others. Most of our producers are small. With their limited investment capacity, it will be challenging for our farmers to integrate digital technologies into their farming system. So it becomes essential that we focus on cost effective systems.



agriculture initiatives. Union Budget 2022 focuses on smart and modern agricultural practices. The government is also providing financial support to Agri-tech startups and promoting the adoption of Al to revolutionise agricultural and farming trends. New federal guidelines for a scheme called Kisan Drone have provisioned substantial subsidies for farmers and organisations alike for unmanned aerial vehicles. The government is putting into practice the Digital Agriculture Mission (DAM) and funding

is provided to state through National e-Governance Plan in Agriculture (NeGPA) programme. We have already achieved our goal in terms of food sufficiency, but for a price. Now we must strive

for an efficient production system - a smarter way which entails more production and less loss.



BLACK PEARLS CHANGING THE FORTUNES OF FARMERS IN BASTAR

he cultivation of black pepper is changing the life of the tribals in Bastar. A tribal woman farmer named Rajkumari Markam has scripted a success story by harvesting 40 kg of pepper. By selling her harvest at the rate of Rs 500 per kg, Rajkumari made a handsome earning. She has now decided to cultivate pepper on an even larger scale. Progressive farmers of seven villages in Bastar including Temgaon,

Ondrigaon, Udengagaon, Lubhagaon, Jadkonga and Katagaon have taken a pledge to undertake organic and herbal farming, and have found the road to prosperity. These villages are about 40 kms from Kondagaon district headquarters, considered to be one of the most backward and inaccessible areas of the country. Women are equally empowered by these farming activities and are benefitting as much as men.

Dr Rajaram Tripathi, who has played a key role in the upliftment of the farmers at Bastar, has appreciated the special contribution of Jano Bai Markam, the former district panchayat president, in motivating the farmers to dedicate themselves to organic farming, and herbal cultivation and plantation program. Dr Tripathi is the National Convenor of Alliance of Indian Farmers Associations (AIFA).



Dr Tripathi said that some progressive farmers of these villages have resolved to cultivate Ashwagandha through organic farming. These farmers were

provided free training for Ashwagandha cultivation. The seeds of improved Ashwagandha variety were provided to them by Maa Danteshwari Herbal Group. The Ashwagandha seeds were distributed by the people's representatives of the area.

Woman Farmer Inspires Many Others In Bastar

Under the cooperation and guidance of Maa Danteshwari Herbal Group, Rajkumari Markam planted plants of MDBP-16 species of black pepper, which were provided free to her. The vines were grown on the Sal trees in the backyard of her house. The vines of black pepper grew over 20 trees, and yielded a bountiful harvest for Rajkumari.

Farmers of the seven villages were greatly impressed by the pepper cultivation of Rajkumari Markam. They visited the spot and saw the Sal trees laden with pepper vines. Similarly, farmers are planting and harvesting turmeric in the area. Many farmers have planted new Australian teak trees in their gardens and fields. They are growing pepper vines on these trees.

Dr Tripathi said that the farmers of the region are greatly benefitting from the cultivation of spices and herbs. He highlighted that farmers of Bastar are earning Rs 5 lakh annually and more from one acre by growing black pepper on Australian teak plants, which yields a rich harvest for at least 50 years.



REIMAGINING

b practise Smart Agriculture we have to think smartly and try to achieve sustainable results with less efforts. There is a definite need to reduce the physical drudgery, increase efficiencies and improve the results of our farming systems. If we do it we will establish smart agriculture.

Our agriculture has to be reoriented towards achieving higher yields using lesser resources, conservation of natural resources, reducing chemical load in the environment, reducing physical drudgery of farmers, adoption of modern technologies to improve efficiencies, practising precision agriculture, following agronomic practices that promote sustainable agriculture, managing agricultural waste intelligently, providing science based advisory services to farmers, using biological inputs, restoring soil health, digitization of agriculture, building value chains, improving farmers profitability and similar activities.

Hai aw Kal

KAL

Digitization of agriculture picked up speed in the last 10 years. Use of smart phones has scaled up and availability of internet and data services in rural areas has improved. It triggered the use of digital platforms. A generational change among farmers and their use of e-commerce platforms for non-agri products have paved the way for agri tech enterprises to make their entry. About 2 B\$ was invested into agri tech enterprises in the last five years out of which 75% has gone into enterprises that link farmers to markets and value addition opportunities.

AAJ

The excitement around agri tech enterprises and their impact on agriculture is growing. More than 2 crore farmers use internet and access services online. While awareness about natural resource conservation is being created, it is not getting reflected in actual practice due to conflicting subsidies and policy measures.

Low hanging fruits to be plucked.

With our population growing to 150 cr very soon it is essential to increase yields in all crops. It is imperative that we change our crop portfolio to reduce the emphasis on Rice and Wheat and scale up production of edible oils and pulses. With the climate change looming large, seed industry needs to be encouraged to develop climate resilient seeds and technologies that can help farmers at higher temperatures.

Fruits at one level higher

A big revolution is happening with the agri tech and digital enterprises. There are more than 600 agri tech start ups offering several products and services in three clear buckets, i.e., pre planting bucket, the cultivation time bucket and the post harvest bucket. Some enterprises provide services like soil testing, weather stations, irrigation, moisture monitoring, technical advisory, on-field identification of pests and diseases and recommending control measures, providing robotics to conduct farm operations. Several mechanization services are on of-

About the **AUTHOR**

Mr Ram Kaundinya is Director General, Federation of Seed Industry of India

POLICY INTERVENTIONS REQUIRED

- Incentivize crop diversification towards oilseeds and pulses.
- Provide positive incentives for practising Direct seeded Rice Govt may facilitate earning of carbon credits by the DSR farmers as additional bonus.
- Divert subsidies on power and water, and part of the subsidy on fertilizers towards incentivising farmers to follow sustainable practices and natural resource conservation
- Develop an end to end policy framework for mechanization of key crops
- Build a Sandbox in each state for agri tech, food tech and fin tech innovations which may be tested out for marketability, value capture, business models, attracting finance and similar benefits with least risk. An agri data exchange is to be built at each state level as a public good which can be used by several data based service providers.
- Set up the necessary infrastructure for incubators in rural areas and encourage rural educated youth to set up such enterprises
- Develop regulatory policies that enable quick introduction of modern science and technology based products for the farmers through a predictable and science based regulatory coverage.
- Separate supportive regulations for e-commerce platforms facing several licensing requirements for supplying agricultural inputs hampering the last mile delivery of products and services
- Open and free output markets for the farmer to sell his produce anywhere.
- Encourage investments in research and innovation may be encouraged and provide robust protection of Intellectual Property.

fer from start ups which provide agronomic services for a charge so that the farmer is saved of capital investment.

Farm output management, market linkages and value addition is a major area of focus for the start-up system as they are perceived by the farmers as the most important help they need to realize better prices. All the other products and services being offered through the digital platforms carry much less value for him. Micro warehousing, financing of inventory, electronic platforms to link farmers with markets, online quality assessment of agricultural produce to help in making deals on digital platforms, aggregation and distribution platforms for farm produce are some of the areas that are under focus now.

We still need more innovation in ancillary sectors like poultry, livestock, fisheries and similar fields which are lagging behind. With the ancillary sector growing at a higher rate than the crop sector, they certainly need more attention, innovation and investment so that the complete coverage of agriculture takes place. Science based Farm output management, market linkages and value addition is a major area of focus for the start-up system as they are perceived by the farmers as the most important help they need to realize better prices.

innovation is another area that needs attention.

The highest level fruits that need more effort

Data based open source platforms that can provide public good digital tools to deliver high quality services to farmers including credit, insurance, technical advice, access to value chains and markets, etc., are required to leverage the huge farmer level data that exists at multiple locations within and outside the government. Unless the land records data is digitized and triangulated between the ownership details, the exact borders of each plot owned by a particular person and the geo spatial data of each plot available from the satellites, we will not be able to provide top quality seamless services to the farmer. This data base should be accessible in a usable form on a payment basis for both public and private sector players. While technically this is possible, it is a tough task because all the states and centre have to come together for this purpose and all political parties should be aligned with this objective. Additionally many agri tech enterprises are capturing a lot of data while they are delivering products and services to farmers which also should be available for access on a payment basis. There is no doubt that data will provide a transformational path to improve our farmers' lives.

KAL

It is predicted that the number of internet users in India will double by 2026 and most of this growth will come from rural areas. In the second half of this decade we should reach a stage where a farmer can outsource all his agronomic practices to service providers through his smart phone. He should be able to access all financial services on virtual mode. His assets including animals, crops, house, movables, etc., could be insured online. Farmer could sell his produce through electronic platforms to customers in different geographies. Rural youth could get into managing digital centres, aggregation centres and value chain linkages in villages. Open source data platforms would be used by all digital enterprises to offer multiple services to farmers in a seamless fashion. Farmers would diversify crops, reduce rice and wheat acreages by 20% and move to oilseeds, pulses and vegetables. Country's edible oil import bill will come down to 5B\$. Waste from farmlands will be converted into useful materials and all the subsidies would be converted and transferred to farmers through a direct transfer mechanism for following sustainable practices in their agricultural operations. Farmers profits would double.

It is time for us to reimagine our agriculture and re-mandate it towards turning profitable, smart and sustainable. If we do not do it during this decade it might be too late.

NUTRITION SMART AGRICULTURE: Decoding the myth

reakfast cereals at the top of the charts of popularity are the ones that are abundant in ragi, millets, quinoa, oats etc., and of course miscellaneous seeds. Essentially what used to be a famished pauper's diet in the past. An added proclamation of health benefit is "gluten free". Smart nutrition is, it appears, being influenced by smart marketing; agriculture and livestock farming is perhaps a mere cog in the smartness wheel. The produce farmer has been grow-

ing for generations is suddenly commanding a premium. What are commonly known as orphan crops i.e. millets, sorghum, jowar, barley, ragi, sweet potato, cowpea (lobia), cassava, moong bean etc. are back with a "According to the Food and Agriculture Organisation (FAO) about 95% of the world's food needs are provided for by just 30 species of plants."

vengeance and command a fortune in the market. It is not too distant in the past when the rich farmers were wary of using them even as livestock feed. But for whom do the returns of this "smartness" accrue? The processor, yes; the marketeer, yes. The primary producer? Certainly not.

> "Caution: Milk is Injurious To Health" in **BOLD** and CAPI-TALS is the caption of a two full pages advertisement and in an extra large multi-colour font on the front page of the Times of India a few days ago; following this outrageously crude and loud proclamation is a disclaimer in a much smaller font, and no caps, "if it contains antibiotics." Indian dairy is one of the biggest success stories of our agriculture and

cooperatives, besides emerging as a symbol of farmer empowerment, yet it is being scandalised and the farmer vilified. Making sweeping generalisations without reliable data is dishonest and misleading. Why should Smart nutrition be building its edifice on deceit? Smart has become Ignorant. Let smart not end up meaning clever, in fact more akin to cunning.

Agriculture has always been Smart, and Animal Husbandry Smarter

The origin of modern humans or Homo sapiens from the great apes is said to date back to 200,000 years ago, and till about 12,000 years ago hunting of wild animals and gathering of wild plants were the primary means of subsistence for our ancestors. The transition to domestication of plants and animals commenced when, as what is known as, the ice age began melting down. What a brilliantly smart idea at the time: collect seeds from the wild, dig the earth, sow the seeds, nurture them and harvest the crop for food. While it is good to extol the virtues of natural farming, we must recall that farming itself was unnatural to begin with. The advent and subsequent growth of agriculture owes to smart initiatives.

> Still greater smartness was taming the animals, which to begin with were all wild, and thereafter domesticating the entire species. Domesticated animals became an invaluable resource with smaller ruminants, goats, sheep, pigs and poultry kept for food production and

About the **AUTHOR**

Shri Tarun Shridhar is former Secretary, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India large ruminants providing the power to operate irrigation systems, ploughs and other farm implements. Further innovations, real smart ones, were exploitation of the milk of mammals, and this graduated to selection of individuals for prolonged lactation, leading to development of dairying; the discovery of methods for incubating birds' eggs without nesting hens leading to increased availability of poultry products. Domestication of animals has resulted in continuous genetic improvement, manipulation and modification, thus becoming more and more invaluable by the day in the human food and nutrition systems.

It is an inference universally accepted that domesticating plants, and more importantly animals marked a major and dramatic turning point for humans: the beginning of an agricultural way of life and more permanent and stable civilizations. Agriculture, including Animal Husbandry transformed man from a hunter to a farmer and thus gave birth to human civilisation. The domesticated creatures also became integrated into the most basic and widespread rituals of the culture. Curiously, all across civilisations and religions, the domesticated animals came to symbolize order as opposed to the chaos of the untamed world. Now, almost all people on Earth consume food that they produce themselves or that someone else produces for them. The few handful communities of hunter-gatherers are at the verge of abandoning their lifestyles and shall soon disintegrate, thereby ending our millions of years of commitment to the hunter-gatherer lifestyle. Therefore, Smart is not a recent phenomenon nor is it a radical departure from how affairs were being managed till now. Smart is not this or that, but this and that; it is dynamic, an ever evolving concept. What is smart today may be stupidity tomorrow.

Technology is a critical component of Smart, but certainly not the whole of it

Agriculture Scientists and managers define Smart Agriculture as management of farms, both agriculture and livestock,



using modern Information and communication technologies like Internet of Things (IoT), sensors, location systems, robots and artificial intelligence etc. with an objective to increase the quantity and quality of products while optimizing the human labour required. Though correct, this definition confines the concept to the domain of technology. Smart, simply stated, means being dictated by common sense; smart means innovative, maximising the gains of effort, resources, inputs etc.

What Smart Agriculture should recognise is that today's diet of most peoples around the world is dominated by the Big 3, rice, wheat, and maize, which account for about 50% of the world's consumption of calories. According to the Food and Agriculture Organisation (FAO) about 95% of the world's food needs are provided for by just 30 species of plants. In stark contrast 30,000 plant species are edible of which over 7,000 species, such as millets, vam, cassava, jackfruit, mangosteen, sesame, okra, jowar, bajra and many more were, or still are, a part of the diets of many communities around the world. However, with the rise of industrialized agriculture, the crop diversity on our plates has reduced and only the crops amenable to large-scale industrialized farming have come to dominate our diets.

"Smart" became too Discriminatory

Orphan crops have never received global importance. They have never, or rarely, been the focus of concerted efforts to improve productivity or quality, nor have they been the focus of global value chains. As referred to earlier, the situation is gradually changing. Besides consumer demand, there is a growing recognition of the role of orphan crops in maintaining biodiversity, besides contributing to improved nutrition and local incomes in rural communities, serving as an important safety net for resource-poor smallholder farmers as these crops need fewer inputs. They are also naturally resistant to pests and diseases as they are uniquely adapted to the environment they grow in. There is also an increasing awareness among consumers about the nutritional benefits of these crops. Tools and technology of Smart Agriculture directed towards these crops to improve productivity and quality would substantially enhance farmer income and the nutrition on our plates.

Smart Livestock management is already demonstrating impressive gains in introduction of healthy germplasm leading to breed improvement in all major species including productivity. Quite akin to the orphan crops, the indigenous breeds, apart from enriching the biodiversity, are resilient to climate change and resistant to emerging pathogens. Let Smart Animal Husbandry commit some of its resources, both technology and knowledge to native livestock species. These breeds may not contribute greatly to the volumes, but are significant in value for the farmer and consumer alike.

Smart is not an antithesis of tradition or conservatism. In fact, Smart is a harmonious blend of modern technology and traditional wisdom. Keeping things simple is Smart. Living in Smart homes in Smart cities administered by Smart governments with Smart phones as our most precious friend, we are actually becoming lazy, if not dumb. Alexa and her technology driven ilk are the Smart ones now. Farmer and farming have always been Smart.

INDIA'S FOCUS ON COLD-CHAIN PAST, PRESENT & FUTURE

old-chain, a supply chain mechanism that deploys specialised logistics tools and strategies, so that perishable goods can connect with a larger consumer base which is spread across distance and time, essentially helps to buy time for inherent perishable goods. The sustained commercial use of cold-chain, at scale in India, began in the 1830s when insulated ships and storage units were used to launch a cold supply chain from New England, USA to Calcutta. The item trafficked into India, using this cold-chain, was naturally frozen fresh water - ice itself!

In India, the demand for ice increased, and the ice trade to India continued for decades and remained the most profitable. The ice ships also began to carry return cargoes from India which also stimulated the ice trade. The key 'cold-chain technology' of the day was insulation barriers to isolate the cold from outside heat. With advent of commercial refrigeration in the 1870s, death knell of this natural-ice trade was sounded. In 1874 the International Ice Company was founded in Madras, followed by The Bengal Ice Company in Calcutta, in 1878. By 1925, British India had 66 ice making plants and artificial ice was

About the **AUTHOR**

Mr. Pawanexh Kohli, has been a professional in agri-logistics for nearly 4 decades. From 2012-20 he incubated and headed the National Centre for Cold-chain Development. In 2018, he was conferred the title of Professor by University of Birmingham. A member of its Editorial Board of Agriculture Today since 2020.



being locally produced for a variety of uses.

Indian Cold Chain Policies

Ready availability of ice on demand allowed experiments, like hitching small loads of dairy, meat and apples to the supply of ice. This birthed the commercial cold-chain of food items, initially over short distances, then on barges, ships, rail wagons and trucks. Suddenly perishable items could be supplied farther afield and by extending their market outreach, demand-led production growth was possible. By assuring market expansion, there was no looking back for the cold-chain. Ice was the primary cooling medium in earlier cold-chains, but soon, cooling technologies improved and the cold-chain could adopt smaller refrigeration systems. Even today, while insulation remains the steady core, the cold-chain can optionally meet its cooling needs through a combination of technologies that have active, passive and natural applications.

The keen interest in cold-chain, by policy makers of India is evident historically, including in reports of the Royal Commission on Agriculture in India (1928), the National Commission of Agriculture (1976) and in periodic Five Year Plans.

Even, post-independence, India's policy makers kept abreast of these needs. By 1955, towards the end of the first Five Year Plan period (1951-56), the country is reported to have created 83 cold storage depots capable of managing 43,000 tonnes of perishable produce, eight of which were in service of

"India was one of the founding members of the International Institute of Refrigeration"

storing fish. In the Second Plan period (1956-61), the fisheries sector got more attention and transportation of fresh fish in rail wagons to places like Delhi is reported. This was fresh fish in ice, and hence, coequal impact came from the speed of rail transport. The frozen trade which occurs at less than -18°C was not present then. The next plan period saw added emphasis on refrigerated road transport, besides on rails. In this Third Plan period (1961-66), the National Dairy Development Board was also set up, which became the driving force of the milk revolution. 'Operation Flood' as it was known, brought organisation to the milk supply chain and to a continually increasing demand for cold-chain intervention in the dairy sector.

National Commission on Agriculture encouraged Cold Chain Infrastructure

In 1970, the National Commission on Agriculture was appointed, which in its report in 1976 also delved deeply into aspects related to marketing of perishable produce. In case of potatoes specifically, this Commission noted that its production was not taken up by small farmers in villages that lay far from the cities and towns - where the demand was concentrated. It hence said, "only when cold storage and marketing facilities become widespread that the area under the crop could be extended to interior villages". This Commission also said, that the efforts to increase the production of foods like milk, fish, meat and eggs, should be intensified in a phased manner and in correlation to the availability of "adequate infrastructure for cold storage, quick means of transport and marketing facilities". It stated that without these means for efficient delivery to consumers, the production will have a setback.

These facts are relevant even today, and any increase in production of perishable items, including fruits and vegetables, without commensurate development of cold-chain, only adds to the distress of the producers. The Commission recommended increasing the number of refrigerated and insulated wagons attached to faster-moving express or mail trains, to facilitate the speedy transport of fruits and vegetables. It also laid emphasis on reducing transhipment delays on railways. For the supply of fish within the country, the Commission suggested that to save investments in actively refrigerated transports, it could be undertaken on "insulated" transport systems, supported by "cold and freezing storage plants". Regarding handling and marketing of milk the Commission bemoaned that in several instances, chilling plants were set up indiscriminately without considering the viability of its economics. For efficiencies, the Commission recommended that the determining factors on the size of milk chilling plants to be installed, be the availability of milk (local production) and the operational economics (cost of distributing to demand). In that period of India's cold-chain history, the milk supply chain was already getting organised by ways of establishing village collection points, to pool the fresh liquid produce. Such first-mile aggregation is critical from the perspective of any perishables supply chain, as it helps to evolve the subsequent capacity to efficiently move the produce up the market chain to buyers, be it consumers or processors. It was obvious that the integration between growth in production and cold-chain was understood.

COLD STORAGE DEFINITION

India passed a Cold Storage Order in 1980, replacing the earlier of 1964. The Order aptly defines the cold storage to mean "any chamber or chambers insulated and mechanically cooled by refrigeration machinery for storing foodstuffs". It demonstrates the understanding that a warehouse or depot could have space to serve ordinary storage, as well specialised chambers with the means for storing cooled perishable items. This fine distinction, where a chamber(s) is defined as a cold storage (not the entire warehouse) was lost in translation, and the concept of a truly multi-product, multi-utility, dry and cold logistics hub got skipped. Very soon, a cold storage came to be interpreted as a complete warehouse facility used in its entirety for refrigerated storage, and furthermore, dedicated to storing only a specific type of perishable commodity. In India a cold store is still called cold storage, and the plural cold storages came into use to when counting the numbers of cold stores. To be pedantic, the term storage should refer to the types of storing capabilities (chilled, frozen, racked, palletized, crated, etc) available in a cold store.

The Number of Cold storages in India rises

In India, more cold storage was the mantra and the myth was perpetuated by way of misunderstood and poorly worded policy direction which then led to misshaped subsidy schemes. The promotion of cold store units (now labelled cold storages) reigned supreme, with past notations for speedier refrigeration transport ignored and new concepts like precooling packhouses missed.

The first decade of this century saw a spurt in creation of cold stores, with nearly 13 million tonnes of space being added, the growth being almost 3 times faster than in the previous decade. This aggressive creation resulted in India now being host to the world's largest capacity in refrigerated warehousing - more than 160 million cubic metres of refrigerated space. In this interim, the National Commission of Farmers provided references to both cold storages and coldchain. However, cold storage order primarily encouraged the creation of more cold storages at auction markets and farms, besides asking for increased focus on cold-chain. Strategic course corrections, to guide policy makers on the kind of development to pursue, to advance the cold-chain as a holistic system, were not expressed.

In 2007, renewed focus on cold-chain development was hoped, when a special task force was created under the ministry of agriculture, with the purpose to develop terms of references for nodal agencies that could accelerate policy execution and ensure the participation of crucial stakeholders. However, instead of formulating the guidance to administer and monitor policy execution, the task force took upon itself to direct the policy itself. In all eagerness, it even chose to extend opinions on technical aspects of cold-chain.

Misconceived Notions Leads to Inconsistent Recommendations

In this task force's report, misconceived notions were propounded, like requirement of ripening chambers at farms, creation of packhouses in city markets, controlled atmosphere cold stores at terminal city markets, modified atmosphere stores, a proposal of half a billion dollars for procuring solar powered reefer transport, and more. A multitude of mixed messages included recommending higher subsidies for energy efficient equipment for cold stores, as well to subsidise their electricity usage. Field-heat removal was interpreted literally, to mean it must happen on-farm fields, without packaging. While it spoke of the concept of integrated cold chains, such integration was only given an infrastructure dimension. However, the integrated cold-chain actually refers, and demands, for the functional integration of procedures and supply chain operations, irrespective of asset ownership. In fact, single ownership of all infrastructure in the chain is not sustainable and mostly subsidy driven. Unfamiliar with the context and the real gaps in cold-chain, emphasis was only laid on infrastructure instead of

"NCCD became the first public private knowledge partnership, to re-examine strategic assessments and to maintain relevance with future developments" supply chain services, focused only on costs instead of effectiveness and utility, and modern technology professed for archaic business models. For an adept, the suggestions were inconsistent, but many others - who felt that higher capital support from the exchequer was crucial to their business - were satisfied.

Though its recommendations were not fully accepted by the government, nevertheless it did give excuse to a further increase of the capital subsidies for cold stores. This allowed funds to go in a direction disproportionate to the need of the country, especially hurting the case of horticultural crops. The higher subsidy attracted more investment in new cold stores, which the layperson perceived as panacea, and the cold-chain was taken hostage by cold stores. 'Make more cold storages' remained the catch phrase, ignoring other developments and real requirements.

The Cobra Effect

In case of perishable fruits & vegetables, a 'Cobra Effect' occurred - where a particular strategy or solution is not mindful of the secondary fallout and in turn adds to the dilemma. The production of such crops was on the increase and without access to packaging and precooling at first-mile packhouses, the majority of these crops could not benefit from the presence of refrigerated warehousing. And without reefer transport for onward connectivity, they did not have appropriate access to markets and would only perish, in situ - un sold in cold stores. Barring a few crops like potatoes and apples, the cold storage is a mid-chain and shortterm function, and must be preceded with precooling and have the intermediation of reefer transport. Without the full chain, cooling

NARRATIVE

as an input was wasteful. The fallout was that as production of fruits & vegetables increased, without access to an increased market radius it fed existing static demand, and an inverse relation with pricing ensued. Higher the production, lower the market price. Only the integrated development of cold-chain could break this vicious circle, by ensuring that higher production volumes had the tools to reach a wider demand base. Critical for this sector, is having first-mile aggregation, like the collection centres for pooling of milk, which allows for a forward aggregation supply chain model to flourish. These first-mile hubs are the modern packhouses.

Conversely, the cold-chain for dairy, meats and fisheries did progress aptly, at times directly linked with market demand and at times lagging. Nevertheless, these sectors, thanks to the cold-chain, did achieve staggering heights. These achievements include making India the largest exporter of beef and among the top players in fisheries and poultry, besides globally topping the dairy sector by far. It is not to say that this is satisfactory, as their potential is not yet fully tapped. The story of the ice trade is recalled to demonstrate that cold-chain development need not only merely follow market demand, but can be used to open and expand into hitherto untested markets. The development efforts need not merely follow an incremental sequential process but can be strategically driven to achieve a transformation.

National Centre for Cold-chain Development forms

In 2012, the Government approved setting



up a nodal body on cold-chain development. Originally a recommendation of the aforesaid task force, as an agency to execute erstwhile subsidy schemes and programs, the National Centre for Cold-chain Development (NCCD) was to take a different turn. It was decided that NCCD should serve as an advisory body, primarily to review and guide policies and programmes to develop and modernise the cold-chain. To be manned only by experts from the industry, the organisation's governing councils are also designed to have co-equal representation of private sector and government. It is required to operate in a self-sustained manner and kept distanced from day-to-day government involvement. NCCD became the first such public private knowledge partnership, to re-examine strategic assessments and to maintain relevance with future developments. NCCD was evolved as a policy think-tank and its primary task is to assist policy makers, in rationalising the government's programs for

greater effectiveness and efficiency, keeping in touch with new advancements and in the light of developments in India. This PPP body is not driven from the joining of funds but on the sharing of domain knowledge.

From its initial days, this nodal body reviewed the existing schemes on coldchain development and noted the lack of cohesive policy. While NCCD was required to provide inputs across all cold-chain subsectors, it was quickly realised that the horticultural cold-chain had lagged the most and required priority attention. Adopting a systems approach to cold-chain development, multiple changes were proposed in the existing support mechanism, some requiring radical measures. Though all were accepted, their roll out had to be graded to various degrees. In 2014, these efforts came to first stage of fruition, with the launch of the Mission for Integrated Development of Horticulture, where the support mechanism for coldchain components was drastically modified and upgraded. Taking note of the logic behind the revisions, the strategic allocation of funds was also revisited and the share for post-harvest & cold-chain components was increased from hitherto 8 to 25 per cent. in case of productivity increased from 15 to 25 percent, while for area expansion it was reduced from 49 to 21 per cent. This set off a clear directive that production growth targets of perishable horticultural crops must be linked with the associated development of logistics connectivity for perishables. The Government of India also saw fit to approve a more than three-fold jump in the budgetary outlay for horticultural development. In effect, 2014 saw



the start of the largest support program for coldchain, in the world.

Partners in Cold Chain Development arrive

It is relevant to realise that the cold-chain development is driven by private sector, with support of Government, by way of various facilitation including capital subsidy, fiscal support and resource development. With the rationalising of indiscriminate subsidies, funds were diverted to encourage development of packhouses and transport systems. Yet, funds for infrastructure creation alone do not make cold-chains, and comprehensive knowledge dissemination and upgradation is also required. The agriculture ministry supported this missive and relevant programs were commenced with partners, nationwide. International cooperation on cold-chain was taken up, including under aegis of the Indo-France Joint Agriculture Working Group. With the support by the Govt. of France, a partnership with Cemafroid (akin to NCCD of France) was initiated and training modules for government and private sector officers started. India was one of the founding members of the International Institute of Refrigeration and its laggard membership was rejuvenated.

To close the knowledge gap, in 2015 the first comprehensive study on cold-chain infrastructure capacity was undertaken by NCCD, with Nabcons as project partners. The study revealed drastic anomalies in cold-chain development and mismatches in throughput capacities. Soon, the minimum system standards for cold-chain development were released and adopted by the government, across ministries. A dedicated call-in centre was launched in 2014 to allow reefer transporters to lodge complaints when facing in-transit harassments. Earlier, the first-ever baseline survey and geotagging of cold stores was developed and guided by NCCD. In 2018, NCCD gave inputs to ensure that cold-chain got included in the National Cooling Action Plan. The Committee on Doubling Farmers Income (DFI), accorded maximum priority to agri-logistics in general and cold-chain in particular in its reports between 2017 and 2019.

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Perception around Cold Chain changes

Knowledge outreach and exchange of ideas for a changed approach was taken up by NCCD with a wide range of participants. These included farmer groups, investors, logistics service providers, traders, bankers,

vernment stakeholders, researchers and academia. Commercial pilots to demonstrate the economic benefits through cross geographical cold-chain connectivity, alongside drastic reduction in food loss and carbon foot print were taken up. Taking note of these varied efforts, the Government of India specifically exempted NCCD of GST on its knowledge dissemination services. In time, the primacy given to cold stores was corrected. where surprisingly, ready acceptance for this changed approach came first from veteran cold storage federations, while the most intractable were the policymakers and desktop researchers. Today, many of these concepts are echoed freely and become common parlance.

The minimalism of storing produce in cold warehouses, holding to sell locally at a later date, had way-laid the more empowering aspects of cold-chain. This was also fostered with the provision of government subsidies that eased the creation of cold stores alone. Commencing 2012, and in greater strength after 2014, India's cold-chain development was delineated, rationalised and various activities and initiatives were commenced. However, the course corrections made so far were piecemeal, and they need to be continued to a logical conclusion. The strategy to enable cold-chains as a conduit to access and widen markets for perishables requires to be driven without pause or may push the development back a few steps.

The last decade, saw busting of some of myths around India's cold-chain, the restructuring of the government support programs, a renewed focus on knowledge dissemination and heightened awareness on the fact that the cold-chain in not defined by cold stores but is delivery system. Understanding is rising, that cooling does not reduce food loss by itself, Food loss mitigation can only happen when food reaches its intended use, consumption, and this requires cold-chain connectivity. Storage is merely one component of this chain. The system approach requires that perishable foodstuff is not merely perceived as storable commodities for time based arbitrage, but also driven keenly by models that allow for geographical arbitrage. The latter is what allows to expand into market, domestic and



foreign, with associated market led growth. Market connectivity can in turn justify related efforts for greater productivity at source.

The cold-chain is colloquially seen as the conjoining of two separate nouns, Cold + Chain, and is interpreted from the singular perspective of cooling, the Cold taking precedence in a lay person's perception. Domain practitioners, however know that it designates an enmeshed set of activities and procedures to safely communicate perishable goods from source to final destination. Just as the concept of a 'green-house' (which regulates temperature, humidity, pests and the composition of air and light), is not confused with a green coloured house, the cold-chain also needs to be understood to involve more aspects of post-harvest care and not merely cooling. It is with this purpose that the author insists on hyphenating the term 'cold-chain', to emphasise the compound nature of this complex concept.

What the Future holds

The Covid19 pandemic in 2020 also brought to light the importance of supply chains and more essentially in case of cold-chain, for food and medical supplies. Cold-chain is the sole delivery mechanism for high nutrition foods such as fruits, vegetables, all meats and dairy. Most countries are interdependent for their food supply and this makes cold-chains even more relevant and indispensable. The strategic strengths of a nation will therefore also depend on how well they manage and develop their cold-chains. Luckily, India already has an example in its enviable dairy



network, especially liquid milk. Even in the frozen category, India's cold-chain made it a global leader in the trade of meats and fish. In the chilled category, pharmaceutical and ready-to-cook or eat saw similar market-led development. For these segments, the future is steady and incremental.

In the case of fruits and vegetables, the fresh produce cold-chain still requires to be actively pursued in holistic manner. In this segment, a transformative future is possible. Today, with production being in abundance, the demand from local market is lesser and storage is not always justified. The produce can still perish in cold store and the cultivator still has to sell in distress. The producer must be empowered to connect with new demand destinations, if growth is desired. Depending on the motivation and the product, the coldchain executes the transfer of value, which can be over a time period, and/or across geographical space. Extending of saleable life is the first-order effect and connecting with markets is the higher-order result from coldchain. Across all activities when handling and marketing perishable foods, speediness is often the key to success.

India must maintain a clear understanding that in the cold-chain, each component must complement the carrying capacity of the other. Further, cold-chain is not to be treated as an infrastructure business. Such a perspective must lead its strategies to drive the trade, domestic and international, through the coldchain. At the moment, India is yet to declare its national policy on cold-chain. Such a policy should clearly define the long-term purpose, with medium-term objectives and measurable outcomes, to assure that future direction cannot be changed easily on unconsidered whims. To remain in context, such a policy will also require to focus on sustainability aspects in the cold-chain. Most importantly, a cold-chain policy must give emphasis on both capacity building as well as training.

India has yet to develop and take up the appropriate level of extension education and training, to touch the wide variety of actors and activities in the cold-chain. The country also needs to keep abreast of global developments, ensure that the spirit of enquiry, scientific investigation and solution making is continually fostered and take opportunity to lead cold-chain development.

FOOD & NUTRITION

MILLETS AS NUTRITION AND CLIMATE SMART CROPS



ndian population suffers from severe & different kinds of malnutrition, though there are indications of change for the better in the recent years. A comparison of National Health Family Survey (NHFS)-5 with NHFS-4 (2015-16) reveals, that malnourishment in children (stunting, wasting & underweight) under 5 years of age has reduced from 38.4% to 35.5%, 21.0% to 19.3% and 35.8% to 32.1% respectively. Similarly, malnutrition among women aged 15-49 years has also reduced from 22.9% to 18.7%.

India's Evolving Food System

India's food system has been evolving gradually over the last 75 years since independence, but is yet to gain definition-completeness. Food security has been perceived & promoted primarily around carbohydrate-security as seen from the dominance of cereals in the food basket. While the cereal-basket itself excludes some healthy food crops like millets, other sources of proteins (pulses) and fats (oil seeds) are also short of the total domestic demand, and desired consumptionlevels.

The animal sources of macro-nutrients including meat and fish have been registering higher annual growth rates, but are yet not affordable because of lower than needed supply, resulting in prices that are beyond the reach of the majority. From the perspective of micro-nutrients, fruits and vegetables are an important source. Since 2005,

About the **AUTHOR**

Dr. Ashok Dalwai is a senior civil servant by profession and, an agricultural economist by training. As Chairman of the DFI Committee, he contributed to the country's paradigm change in agriculture sector. He is presently serving as CEO, National Rainfed Area Authority (NRAA) and Chairman, Empowered Body on Doubling Farmers' Income, Ministry of Agriculture & Farmers' Welfare, Govt. of India, New Delhi.

FOOD & NUTRITION

Nutrition-security is a function of availability, accessibility, affordability, and awareness, which aspects will be fully addressed comprehensively only when the country puts in place a fully compliant food system defined as *"the complex web of activities involving the production, processing, transport, and consumption of food"*. This implies, that enhancing the output of various agri-commodities, particularly those containing the desired sources of the nutrients and, are critical to raising the standards of balanced consumption is pivotal to nutrition-smart agriculture.

the country has been recording robust increase of the horticultural produce, which at 329 million tonnes surpassed that of food grains in the year of 2022-23. Notwithstanding this, the output of fruits and vegetables that hold a predominant share in the horticultural basket is not commensurate with the demand, and will prove still shorter if the demand rises to meet the recommended levels of intake.

Redesigning India's food basket

Against the background of food shortage which manifested more severely in the 1960s, the country responded by adopting Green Revolution (GR) technology revolving around select crops (wheat and paddy), that are resource-intensive while being high producers. The technologyled and policy supported G.R technology has over the decades engendered two problems. At the production stage, there has been compromise of biodiversity and mining of natural resources beyond sustainable levels and, at the consumption level, the intake pattern has got imbalanced, resulting in over-consumption of carbohydrates and sub-par consumption of other macro - and micro-nutrients.

This situation is crying for urgent correction and, as appropriate amendments are imparted to the production-cafeteria, the current production-environment has to be taken note of. This is discernible from the loss of soil fertility as is obvious from low soil organic carbon and negative climate change influences as seen from rising temperature and increasing events of weather extremes. This paradigm presents a new challenge to sustaining the desired production levels, and suggests the need for practising climate-resilient and climate-smart agriculture. Since carbohydrates will continue to be the largest share-holder of the cumulative nutritionintake, the first focus in redesigning the food-cafeteria should involve restructuring of the cereal-basket component. Millets emerge as a good fit in this context.

Why millets?

Millets offer twin advantages of addressing both production and consumption demands relevant to the country today.

Some Specific health benefits of millets are

- Offer hunger satisfaction due to the presence of high dietary fiber
- Reduce risk of diabetes and cardiovascular diseases
- Reduce occurrence of hypertension
- Reduce oxidative stress as they are rich in antioxidants
- Reduce anemia, liver disorder and asthma
- Prevent allergies reactions due to their hypo-allergic properties





"Millets are advised as promoters of good health as they are nutrition-dense, glutenfree and low in glycemic index".

Millets grouped as major (sorghum, bajra & ragi) and minor (foxtail millet, little millet, barnyard millet, & brown top millet) have been gazetted by the government as nutria-cereals in April 2018 in recognition of their nutritional value.

From the production angle, these are considered as climate resilient as their growth cycle is shorter, and are adaptable to a wide range of temperatures, moisture regimes and input status, besides being highly efficient in converting Carbon dioxide into oxygen.

Millets are advised as promoters of good health as they are nutrition-dense, gluten-free and low in glycemic index. They are rich in carbohydrates (65%), protein (6.0 to 12.5%) and fats (1.5 to 5.0%). They are also high in crude fiber, mineral matter, calcium, and phosphorous. All these contents are integral to balanced diet and well-being of an individual.

The millets are highly suited to poorly endowed production ambience as they are low in water footprint and, therefore suited to arid regions requiring as low as 300 to 400 mm of water. Besides they are crops of short duration maturing within 60 to 90 days as against staples like paddy and wheat which take under 100-140 days, and are therefore useful in water-scarce regions. Millets are resource-use efficient and, respond well to good agronomic conditions. They are cli-



mate-resilient, exhibit hardiness and are highly adaptable under critical drought conditions.

The millets besides being nutritively good for human consumption, are also a nutritious fodder as they are rich in iron, magnesium, copper, phosphorous zinc, calcium and potassium.

Challenges and Facilitating Enhanced Millet Output

Although a steep decline in the cropped area from a high of 38 million ha (1965-70) to around 15 million ha (2015-20) was experienced, the production level has been sustained over the comparable period at around 17 million tonnes - a marginal increase from the earlier 16 million tonnes, thanks to increase in productivity by more than 250 per cent.

Technology and policy are the twin drivers that can make a change in the state of any crop. Taking the case of bajra, it is seen that productivity went up from 3.63 qtl/ha (1963-67) to 12.57qtl/ha (2015-20) which is an increase of 3.45 times. In comparison, the wheat productivity rose from 8.92 qtl/ha (1963-67) to "The production-reorientation should mean achieving for the millets a ratio of around onethird in the total cereal basket of the country by 2047, for them to meaningfully impact the production & consumption environment of the country".

33.11 qtl/ha, a positive change by 3.71 times. The takeaway is that, while there has been technological intervention benefiting bajra, it is not adequate, given the low base of yield level. It suggests the need for a breakthrough technology to effect substantive jump in bajra productivity, and likewise for all other millets.

Policy framework comprising price support, procurement, integration into public distribution system apart from production incentives hold the key to triggering a popular interest in the millets among the farmers. Comparing millets with major cereals like wheat & paddy one can see obvious discrimination they suffer from. They are for example, not procured and used under NFSA, 2013 as robustly as are wheat and paddy which supported by favorable policy and improved irrigation infrastructure, have arrogated to themselves higher cultivable.

In appreciation of the positive impact that millets have at both production and consumption ends of the agri-produce, both technology and policy need to be brought into play for synergistic effect. This would entail concerted attention to research and development, agronomic practices and post-harvest management (agri-logistics, processing, value addition & marketing). This implies adoption of agricultural value chain that fulfills all the requirements at every stage of the millet cultivation. As a final word, it is worth emphasizing that the productionreorientation should mean achieving for the millets a ratio of around one-third in the total cereal basket of the country by 2047, for them to meaningfully impact the production & consumption environment of the country.

AVOCADO - A BLESSING FOR COFFEE & TEA GROWERS



he coffee farmers and Muranga (Kenya) tea farmers have turned to Avocadoes to boost earnings after growing impatient with the low returns from their tea bushes. Within five years of diversifying into Avocado, it becomes the second highest revenue earners (s h. 4.6 billion) after tea (sh 11.70 billion).

The Indian coffee Farmer, Veeru Arasu at Thandikudi, Dindigul District of Tamil Nadu also shares a similar story. As Avocado plants provide shade to his coffee shrubs, he planted 40 avocadoes trees in his 1 Acre coffee farm. In four years' trees bore fruits without much care

About the **AUTHOR**

Ganesh B Babar is the CEO of Shlokas Agro Pvt Ltd. He is also the Promoter of Avocadoes Cultivation pan India and he earned 1,00,000 Rupees from only Avocadoes.

Vietnam coffee Farmers have also turned to avocadoes as Ukraine war pushed up fertilizer costs, as also in South Africa the biggest coffee grower



turned into highest avocado growers. South Africa has the ideal conditions for growing coffee. However, few farmers are planting the crops as it is very labour intensive. Zender Ernst is one of a handful of farmers who has changed the coffee plantation into avocado Plantation and within 4.5 years he has become the biggest Avocado grower.

Global Avocado Farming

The estimated total world production for Avocadoes in 2022 was 80,59,359 metric tonnes which is an increase of 13.9 % from 70.77.148 tonnes in 2019. Mexico was the largest producer accounting for nearly 30% global Production. At 2020 people said that truck full of avocadoes was leaving the Mexican state of Michoacán every six minutes to U.S. market. In the last 15 years, avocado availability in the United States has tripled from 1 billion pounds to more than 3 billion pounds.

These increasing figures of production & consumption signals the emergence of Avocado as a super food & also Green Gold. Its beneficial characteristics such as improving digestion, decreasing the risk of depression & protecting against cancer, has made it a popular component of healthy diet.

The huge demand for this super food, low risk market, low labour demands have attracted farmers towards Avocadoes. Poor coffee and tea price and a ready export market of Avocadoes are encouraging tea and coffee farmers from India and other countries to Avocadoes to boost their earning.

In India there is vast scope for planting avocadoes as intercrops in coffee & tea plantations of Assam, Sikkim, Darjeeling, Ooty, Kodaikanal and Munnar.

CONVERGENCE OF AGRI INFRA FUND (AIF) WITH OTHER SCHEMES

he role of infrastructure is crucial for agriculture development and for taking the production dynamics to the next level. Agriculture Infrastructure Fund was launched by the Hon'ble Prime Minister on 9th Aug 2020 to mobilize a medium - long term debt finances facility for investment in viable projects for post-harvest management Infrastructure and community farming assets through incentives and financial support in order to improve agriculture infrastructure in the country under which Infrastructure worth Rs.1 lakh Crore will be set up over the course of 6 years, i.e. upto 2025-26.

One of the unique features of AIF scheme is its convergence with other central and state schemes. In other words, Agri Infra Fund is a Top-up scheme which can be converged with all other Central and State Government schemes. To leverage this unique feature, MoA&FW is creating modules with each of the schemes for easy access and availability of multiple scheme benefits by the applicants on a single platform. Convergence of multiple schemes will facilitate the "Whole of government approach" of putting the benefits on a single platform across ministries with ease for the targeted beneficiaries. Further, Agri Infra Fund Portal has already been integrated with the schemes of National Horticulture Board, PM KUSUM Component-B and C.

Many schemes are being integrated with AIF Portal for easy availability of benefits of multiple schemes on a single platform

- Integrated Scheme for Agricultural Marketing (ISAM)
- Pradhan Mantri Krishi Sinchai Yojana (Micro Irrigation & Per Drop More Crop)

Some key features of the schemes -

- Interest subvention of 3% with an interest cap of 9% p.a. on loan amounts <= 2 Crore.
- Credit guarantee under CGTMSE scheme for loan upto 2 crores
- Convergence with any other State or Central scheme
- Upto 25 projects can be setup in different villages having different local government directory code (Rs 2 Cr per project)
- Sub-Mission on Agricultural Mechanization (SMAM)
- Mission for Integrated Development of Horticulture, Integrated Scheme on Agricultural Cooperation
- Promotion of agricultural mechanization for in situ management of crop residue in the states of Punjab, Haryana, Uttar Pradesh and the NCT of Delhi
- Formation and Promotion of 10,000 Farmer Producer Organizations (FPOs)
- PACs as MSC.
- PM Formalisation of Micro food processing Enterprises Scheme (PMFME)
- PM kisan sampada yojana (PMKSY)
- Scheme of North East Council (NEC) and Component of Special Development Project
- Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Mahabhiyan (PM-KUSUM) Component-B and C
- · Gobardhan, Ministry of Jal Shakti





AGRI INFRA FUND



Convergence with other Schemes for Higher Income

www.agriinfra.dac.gov.in

tête-à-tête with Anjana

Arjun Singh Saini Changing Haryana's Farming Perceptions

Horticulture exponent with more than 25 years of experience, Dr. Arjun Singh Saini, has helmed the horticulture revolution in the state of Haryana. Being the Director General Horticulture in Haryana, Dr Saini's exemplary vision and wisdom has changed the horticultural landscape of the state for good .

A Brilliant Student

Born on 6th October, 1968 to Er. Bant Singh Saini and Dharm Kaur in Jamalpur village of Yamunanagar, district, Harvana, Arjun Singh Saini was second among their four children. He was an excellent student. His stellar performance in the board exams of eighth standard encouraged his father to transfer him to a new school, SMB Gita High Secondary School. He completed tenth standard with flying colours. " In Maths I scored 150 out of 150. While in my tenth standard, I did something mischievous and my Maths teacher caught me red handed. My punishment involved attempting sample question papers everyday continuously for 3 months. Thanks to that punishment, I scored full in Maths. My Maths teacher and Sanskrit teacher had great influence on me," remembers Dr Saini.

Being a brilliant student, his father decided to introduce him to something new and thus began his tryst with agriculture.





tête-à-tête with Anjana





"Initially I was not so attracted to Agriculture course, but slowly I developed taste for it and our occasional visits to our family agricultural land also helped." In the final year of his graduation from Chaudhary Charan Singh Haryana Agricultural University, Horticulture looked more appealing to Arjun and this prompted him to take horticulture major in B. Sc. Hons. He carried forward his academic sojourn and completed his M.Sc. in horticulture & Ph.D in horticulture where he undertook double research. "I was so studious during my post graduation, my peers thought I was preparing for Civil Services. But I never attempted for it".

"Dr Saini was the brain behind Haryana Horticulture Vision - 3.0, which was conceived with the plan to double the area and triple horticulture production by 2030 by infusion of technologies, smart farming systems and promoting farmers' agribusiness activities".

Professional Milestones

Dr. Saini's professional journey coursed around numerous positions in different organizations in government, public sector and private sector. His work experience extended from grass root execution of work to formulations of new schemes & programmes, from setting up of national projects with international collaborations to produce aggregation and cluster development in the state.

After his initial stint in the private sector, he entered the government sector in August 1998, and spearheaded many

POURING RECOGNITIONS

- Unnat Bharat Sevashri Award-2022 for extraordinary service in the field of horticulture.
- Agri-Food Empowering India Award 2021 for Best State in Horticulture category
- Agriculture Leadership Award 2021 for Best State for Innovation on account of exceptional contributions in supporting farmers and playing a leadership role in promoting agriculture and horticultural technologies and innovations in India.
- HARYANA GOVT. AWARD-2020 for diversification and agriculture growth in horticulture
- Honorary Fellow Award-2018 for the furtherance of commitment and outstanding performance in the field of Horticulture by Confederation of Horticulture Associations of India
- International Recognition-2016 Letter of Appreciation and recognition by Israel Govt for leadership and management role in establishment of Centre of Excellence in Haryana under Indo-Israel Agriculture Work Plan and Cooperation.
- AGRICULTURE LEADERSHIP AWARD (STATE CATEGORY)-2016 while working as Director General Horticulture in the Department.
- EXCELLENCE AWARD-2013 & 2014 Partnership Excellence Award received during 2013 and 2014 in the field of Horticulture by NABARD.



instrumental programmes and launched several impactful schemes in the field of horticulture. He served the horticulture sector of Haryana in the positions of Deputy Director, Joint Director and Additional Director in the Department of Horticulture, Govt. of Haryana. In his recent tenure as Mission Director of Haryana State Horticulture Development Agency (HSHDA) he has implemented around Rs. 120 cr. plan for development activities of horticulture. "64 Village of Excellence (VoEs) were started across the State to facilitate the farmers to adopt improved technologies".

Compelling Contributions

From being a green revolution state, Haryana has evolved into a state diversified in its agriculture agenda. Today Haryana horticulture contributes significantly in the overall growth and GDP of the State. This was the result of the conception and implementation of certain curated horticulture development initiatives under the leadership of Dr Arjun Singh Saini. He had played a stellar role in furthering the area under horticulture in the state.

The State horticulture budget has increased to 800 times from merely less than Rs. 1 crore rupees in 2005 to Rs. 825 crore in 2022, that has facilitated to transfer the technologies to the farmers with good assistance on various components. Through "Bhavantar Bharpayee Yojana" (BBY) - price protection scheme- more than 1.40 lakh ha area has been brought under horticultural crops. With more than 645 mushroom units, Harvana is amongst leading State in mushroom production. Vertical farming systems and low cost bamboo staking system were introduced in the state on a large scale. Through Dr Saini's intervention farm

water resource management received a major shot in the arm and around 3115 water farm ponds at farmers field were established bringing an area of more than 24000 acres under orchards into micro-irrigation system. He is a staunch supporter of micro-irrigation system and under his leadership this water conserving technology was adopted in more than 1.24 lakh hectare areas in the state.

Inimitable Initiatives

A promoter of horticulture supply chain, Dr. Saini's involvement led to the establishment of 40 pack-houses in different crop cluster regions of the State and connected 40 FPOs with 28 agri-business companies for 58 MoUs/ tie-ups for supply of fresh fruits and vegetables. Harvana is one of the leading states in the aggregation of farmers in the country and so far 599 FPOs are in existence in the state. Under his leadership unique programme was initiated for technology transfer.64 Village of Excellence (VoEs) were started across the State to facilitate the farmers to adopt improved technologies. E-Pest Surveillance project, a pilot project on fruit fly, planting material and hybrid seedling program and safe food programme are some other programmes that were integrated into the state horticulture sector.

Dr Saini was the brain behind Haryana Horticulture Vision - 3.0, which





was conceived with the plan to double the area and triple horticulture the production by 2030 by infusion of technologies, smart farming systems and promoting farmers' agribusiness activities. He also conceptualized unique assurance scheme - Mukhayamantri Bagwani Bima Yojna - for insurance of horticulture crops against weather vagaries with affordable premium for the horticulture growers. Mukhayamantri Bagwani Bima Yojna was also his idea that made all the horticulture services citizen friendly. Beekeeping Policy-2021, Potato Policy-2021 and Fruit Evaluation Policy-2021 were other important policies penned and implemented by Dr Saini. His interventions in Digital Horticulture made horticulture department into best e-governance department and is ranked amongst top in Govt. programs.

Family

Dr Saini is married to Ravinder Kaur Saini, who is employed in finance seg-

ment. His family comprising of his sons, Abhijeet Singh Saini and Animesh Singh Saini is settled in USA. Abhijeet, after business graduation is currently associated with P&G in Pennsylvania, USA as Robotics Analyst/ technician. He is also pursuing Masters in Technology Management from University of Illinois Urbana Champagne. Animesh is in final year of Aerospace Engineering in University of Illinois Urbana Champagne University.

"In my life I have worked on only one formula - hard work. That is the key to success . With focused approach with clear vision, one can bring tremendous change in one's life and to society as well." That is what Dr Saini has been doing. Once the hot bed of green revolution technologies where cereals took precedence, today the state is diversifying into other crop segments, and one cannot overlook the contributions made by Dr Saini. He is the face of the changing agriculture dynamics of Haryana.

MILLETS FOR NUTRITION SMART AGRICULTURE

or decades. the metric for food systems has been the calorie intake rather than the nutrients especially the micronutrients. More than 2 billion people suffer from hidden hunger in the world and India ranked 101 out of 116 countries in the 2021 Global Hunger Index. India might become one among the 88 countries to miss the 2025 targets of global nutrition according to the Global Nutrition Report 2020. Moreover, according to the National Family Health Survey 5, no significant improvement has been observed in the health and nutritional status of the population. Food manufacturers need to make informed decisions, and therefore need to be aware of their potential impact on malnutrition. It is necessary to recognize the benefits that can be achieved by

С.

Identification of NSmartAg investment opportunities involves these steps in brief

- (i) Identification of malnutrition issues from existing sources
- (ii) Identification of vital nutrients associated with the malnutrition problems
- (iii) Identification of food groups rich in these nutrients for bridging the gap
- (iv) Analysis of production data and post-harvest practices to check increase in productivity as well as economy from these food groups.
- These would be categorized under NSmartAg, if the answer is yes for both the parameters.



"India (12.49 MT) ranks first in the global millet production (30.39 MT) (2020)".

both farmers and agribusinesses to the overall nutritional overhaul.

Nutrition Smart Agriculture

An alignment between the food production and, health and nutrition outcomes is

required. It is necessary to push the agricultural stakeholders – farmers, processors, consumers – to become 'smart'. 'Nutrition smart agriculture' is the subset of 'nutrition sensitive agriculture'. The latter is defined as the 'sense of maximizing nutrition outcomes, while minimizing the unintended negative nutritional consequences of agricultural and food interventions and policies'. However,

About the **AUTHOR**

DR. C. Vasudevappa is the Vice Chancellor of National Institute of Food Technology Entrepreneurship and Management (Deemed to be University) 'nutrition smart agriculture' (NSmartAg) exhibits the objective of 'contributing to improving human nutritional status while achieving the farm and/or agribusinesslevel objective of increasing productivity/ income/profits'. It is necessary to optimize the staple food systems to provide higher amount of nutrients per square foot yield obtained from sustainable production. Re-envisioning agriculture as the sole source of nutrition as well as sustainable economy is the key.

MILLETS AS NSMARTAG

An important global health issue is the micronutrient deficiencies which affect key development outcomes like poor mental and physical development, loss of potential, mental retardation, blindness etc. Globally, people are affected maximum by anaemia than any other health issue. 40 and 42% of the pregnant women and children are globally anaemic and 20% of the maternal deaths are attributed to anaemia according to the World Health Organisation (2015). Higher percentages have also been observed for deficiencies of other key vitamins and minerals.

Dietary diversity is central to the concept of NSmartAg. The world is largely dependent on the three main grains wheat, rice and maize - for 90% of their calories. However, these food staples are not dense on micronutrients like vitamins and minerals like iron, vitamin A, B complex etc. which need to enhanced by the non-staple foods. Green revolution was mainly focused on food security, which reduced the production of more nutritious foods such as pulses, pseudocereals and millets, consequently resulting in increase in their prices. However, these can prove to be NSmartAg investment opportunities.

India- The Millet Hub

India celebrated 2018 as the National Year of Millets. 2023 shall be celebrated as the International Year of Millets. Millet cultivation is emerging as a feasible alternative in the face of global food insecurity, malnutrition, agrarian distress and climate change. India (12.49 MT) ranks



Millets are small-seeded crops with low water demand which has high impact on sustainability. They are excellent sources of macro- and micronutrients compared to major cereal crops. High iron content is observed in finger (37.7 - 69.5), little (45.7 - 51.5) and kodo (108.2 - 141.3) millets. Millets are also good sources of zinc – barnyard (6 - 10.3), little (3.7 - 16.1), proso (7.4 - 9.1) and finger (2.3 - 9.3 mg/100g) millets. The millets also contain vitamin A, thiamin (vitamin B1), riboflavin (vitamin B2) and vitamin E in the ranges of 8.3 - 10.5, 0.25 - 0.57, 0.05 - 0.23 and 87 - 96 mg/100g respectively. Other than these micronutrients, millets also contain essential amino acids and antioxidants like phenolic and flavonoid compounds which can act as regulators in the body

"Creation of millet hubs and mega food parks focused on locally produced millets will further improve the productivity and economy of all the stakeholders".

first in the global millet production (30.39 MT) (2020). The global export grew by 44.8% in 2018-19. The global millet market is expected to grow to 12 billion USD by 2025 and is projected to register a CAGR of 4.8% during 2022-2027. India is a key player to fulfill the global demand and contributes to nearly 20% of the global export value.

Millets are gradually gaining momentum as entrepreneurs are focusing on processing and manufacturing of products entirely prepared from millets. This implies that the post-harvest practices are aligning to improve the economy of the farmers and the manufacturers. However, the post-harvest practices in millets are significantly different from those of conventional crops. They require significant processing and value addition which are cost-intensive activities, owing to the coarse nature and taste of the grains. Multi-stakeholder intervention is the key to achieve an optimal balance. It is necessary that farmers, processors and the policy makers work in alignment to strengthen the farm-to-fork channel for local cultivators.

Millets prove to be NSmartAg since they fulfill the parameters of enhanced productivity and economy. With the increase in awareness amongst the farmers, processors and consumers, reqularization of production and consumption will further boost the market. Creation of millet hubs and mega food parks focused on locally produced millets will further improve the productivity and economy of all the stakeholders. As the world enters into the year of millets in the next three months, a sudden jump in the market of millets can lead to increase in production and consumption, consequently leading to nutritional benefits for the 'smart' consumers.



MEGA FOOD PARKS Are transforming indian agriculture



"When all 41 projects are complete and fully operational with their central facilities and food processing units, more than 10 lakh farmers in these project clusters would be benefitted."

About the **AUTHOR**

Shri Pranav Doshi, is the Director of Gujarat Agro Infrastructure Mega Food Park. He is a Serial Entrepreneur; with successful ventures in varied fields of Power Transmission, Mobile VAS, Distribution, and Post Harvest Infrastructure. ood processing sector is regarded as the growth engine that has the potential to provide the much needed fillip for India's agricultural sector. An efficient food processing sector, consistently growing at double digit rates, is a must for the agriculture sector to grow at > 4% and serve the ever-increasing food requirements of the country's population. It is also essential to make India's farmers' efforts, against many odds, worthwhile.

It is now well-recognized by all stakeholders – governments, farmers and industry – that the fortunes of agriculture and food processing sectors are intertwined and an integrated approach is needed to address problems of food spoilage and wastage, food security, inflation and dwindling farm incomes. Various government policies

PROMISING POLICIES

41

22

enacted in the last half a decade show the intent loud and clear.

It is in this backdrop that food parks have become a necessity to provide the crucial link between the farmers, trade, industries and consumers. This need led to launch of **The Mega Food Parks Scheme (MFPS)**, which is the flagship programme of the Ministry of Food Processing Industries, and a crucial element of the Pradhan Mantri Kisan Sampada Yojana that embodies Hon'ble Prime Minister Modi ji's vision of doubling farmers' incomes.

The Mega Food Parks Scheme

The primary objective of Mega Food Parks, launched under the current Avatar of MFPS scheme in 2008-09 is to provide state-of-the-art infrastructure facilities for the food processing; along the value chain from the farm to the market.

The Scheme Guidelines struck all the right chords;

• Mega food parks would adopt a cluster-based hub and spoke model with due consideration given to backward (to be read as sourcing) and forward (to be read as marketing) linkages.

• Mega food parks would help create modern infrastructure near the farm, transportation, logistics and centralized processing centers. It may be mentioned that the total food production in the country is likely to be doubled in next decade or so. Yet at present the country accounts for less than 2 per cent of international food trade and lack of processing facilities means that there is wastage of about 35 per cent of the agricultural produce worth 10 billion USD.

• Total Mega Food Parks:

•

- Operational Mega Food Parks:
 - Mega Food Parks under various stages of implementation: 19
- Cumulative project cost: Rs. 4624.17 crores/ Promoters' contribution: Rs. 2652.69 crores
- MoFPI Grant sanctioned Rs. 1971.48 crores / Released till April/2022: Rs. 1443.50 crores

• A grant of Rs. 50.00 crores per project was unheard of and everyone expected this Scheme to be a blockbuster.

• It was envisaged that each Mega Food Park would get completed in 30 Months – which, rightly so, proved to be an excessively idyllic target.

And, like all large infrastructure development projects, things were slow to take-off due to a variety of reasons such as time taken in land acquisition & CLU, financial closure, environmental approvals, unfavourable SPV structuring norms in the Scheme Guidelines, and in some cases unviable locations.

As a result, - by 2015-16, the Scheme was written off by many but the time of Mega Food Parks was still to come. The Ministry too introduced two major initiatives to infuse fresh energy in the Scheme – Setting up a food processing fund to give loans to units at concessional rates, launch of the CEFPPC Scheme with a grant-in-aid upto Rs. 5 crore grant and preference for food processing units established inside food parks.

Mega Food Parks Kicks off

A thorough examination of data over the last 3-4 years will show that things have gradually changed for the better as a number of Mega Food Parks have finally reached gestation and more than 50% of the allotted MFPs are now Operational. It would not be an understatement to say that the time of MEGA FOOD PARKS IS NOW. Some data points given below illustrate the present status

As regards CEFPPC(Units) Scheme, out of the 320 units approved by the Ministry as on 08/06/2022, approximately 90 units, or almost 30% of the total, are







inside Mega Food Parks sanctioned by the Ministry. Thus the CEFPPC Scheme provided the much needed boost for bringing food processing units to the Mega Food Parks.

India's Successful Mega Food Parks

The Mega Food Parks have started playing a significant role in giving a boost to the agribusiness sector and will continue to play an even more important role in the next 5-7 years. Many food parks have started generating revenues.

Patanjali's journey to become an FMCG power house started with its Patanjali Mega Food Park in Haridwar as the launchpad. Their food products revenue is going to touch USD 1 Bn soon (excluding Ruchi Soya) and it sources produce, directly and indirectly, from more than 10 lakh farmers. It has commercialized some seemingly irrelevant products such as buransh juice, and helped in increasing farmer incomes and developed many local entrepreneurs.

Gujarat Agro Infrastructure Mega Food Park has already secured investment of more than Rs. 400 Crores from processors against Ministry's own goal of Rs.250 Crores per Mega Food Park in a tribal dominated taluk and will attract a total investment of nearly Rs. 650 Crores with its related procurement benefitting huge number of farmers. Similarly, their fully operational storage facilities have supported scores of dairy farmers too, in addition to storage of other agricultural produce.

Himalayan Mega Food Park is

"The Mega Food Parks have started playing a significant role in giving a boost to the agribusiness sector and will continue to play an even more important role in the next 5-7 years."

helping Apple growers in Uttarakhand with their Apple Juice Concentrate facility and are already being considered amongst the top global juice concentrate players and Cremica Food Park is changing fortunes of Tomato farmers in Himachal and surrounding areas with a world class pulping facility.

All the 22 operational food parks including the 4 examples above are already sourcing a range of raw materials directly and indirectly from a minimum of about 5000-6000 farmers each.

Mega Food Parks are not Mere Business Units

Operational Mega Food Parks are already contributing in a big way in reducing wastage of agri and horticulture produce, through more than 2.5 lakh MT capacity of modern cold and ambient warehousing created by them. These storage facilities also provided logistical support and relief during COVID lockdown too as Mega Food Parks continued to operate and offer services.

With exports being the major market for processed foods; the State of the Art processing infrastructure created at Mega Food Parks by promoters and unit owners are helping in providing a boost to exports of processed foods.

When all 41 projects are complete and fully operational with their central facilities and food processing units, more than 10 lakh farmers in these project clusters would be benefitted. Similarly, when all 41 projects are complete and fully operational, more than 5 lakh MT of capacity would have been created. A similar capacity is also being established by units inside these food parks.

Some Mega Food Parks have encouraged and even assisted farmers in their project clusters to experiment and diversify. Many farmers have taken up horticulture for two main reasons – surety of buy back and farm gate infrastructure creation such as packhouses and logistics support given by food park. It has been seen in various locations that FPOs, being promoted heavily by governments, have found a market for their produce in these mega food parks.

Various food parks have been established in hilly states, tribal areas and difficult areas. This has not only helped the farmers of that region become a part of mainstream agriculture but has also fostered entrepreneurship among locals and resulted in overall economic development of the region.

Mega Food Parks are also becoming hubs for supply and for private labelling of products of many prominent Indian and global food brands and helping exports of food products to various parts of the world. Serving such markets and players requires quality and traceability across the entire supply chain. Some Mega Food parks are actively working with farmers and training them too to ensure both.

It is evident that such support will enthuse many more farmers' and FPOs to focus on better and processable produce and food parks are already playing and shall continue to play an important role in moulding the future of India's agriculture sector.

In the post-covid world, global food supply chains are undergoing major realignments. Given India's inherent strengths and renewed focus from Government, India can emerge as a major global sourcing hub and also a major consumption market, thus creating a huge opportunity for Indian businesses and start-ups. Mega Food Parks will no doubt pave the way to transform the Agriculture sector and unlock its real potential though processing and value addition.

COLD CHAIN TO UNLOCK THE POTENTIAL OF INDIAN AGRICULTURE

hen we speak about the cold chain in an Indian context our minds are automatically drawn to the large cold storage facilities, which are over 8,000 in number with a total capacity of over 375 lakh MT. Cold chain in India so far has been limited to larger cold storage being used for managing the distribution of commodities or doing longer-term storage for time arbitrage; 70-80% of investments have been on this front.

Cold Stores v/s Cold Chain

The existing cold stores in India form a part of the cold chain but are not 'the cold chain'. This distinction is important, and while there have been significant investments in the creation of cold storage capacity, more focus needs to be brought to the cold chain. An integrated cold chain ensures proper handling at the farm gate, cold stores and during transport. An effective cold chain increases the shelf life, reduces loss, improves produce quality delivered and increases market reach. Leveraging these benefits can increase farm income, prevent food loss and make countries hubs for perishable products, like Iran for Kiwis and



About the **AUTHOR**

Devendra Gupta, an alumnus of the prestigious IIT Kharagpur, is the Co Founder AND CEO of Ecozen Solutions Pvt. Ltd. A part of the Confederation of Indian Industry (CII) Taskforce for cold chain and the renewable energy committee of the National Center for **Cold Chain Development** (NCCD), he has been a part of various agriculture & cold chain forums chaired by key leaders in the country.

USA (Florida) for cherries.

In our work with strawberry growers in Maharashtra, we saw first-hand the impact access to cooling technology at the farmgate and an integrated cold chain can have. Growers in the region, using our decentralised cold rooms pre-programmed with strawberry-specific post-harvest precooling and storage parameters, were able to reach markets that are 5 times further away as compared to when they had no access to a cold chain. Our farmgate solar cold rooms (Ecofrost), also reduced up to 30% loss and allowed them to hold produce and sell only when the price was right, both of which increased farm income. Also, on a retail level, the retailers have an average loss of 25%. We also saw that due to the right post-harvest intervention this was brought down to 6%. The cold chain based produce on its second day was fresher than the market produce on its first day.

Consumer – Retailer Perceptions

While the cold chain drove tremendous value for the strawberry growers in Maharashtra, owing to the higher end-consumer price, many other commodities struggle with justifying the cold chain infrastructure cost on a per kg basis. Coriander is one such

"Unleashing the cold chain and building a brand around cold chain enabled produce can make Indian agriculture a provider for the world and address the growing concern around food security globally."

commodity. However, when we worked with coriander farmers in Karnataka, we found that coriander when sent by flight from Bangalore to Delhi landed at INR130/kg, whereas through the cold chain it landed at INR80/kg. However, this phenomenon exists



For me it's fitness. Working out, running, playing badminton competitively



for just 3 months and accounts for less than 5% of the national coriander volume.

And hence we come to the question of 'how do we scale up the cold chain in India?'. The key lies in both consumer and retailer perception. Consumers currently associate produce that is shipped through a cold chain to be of inferior quality, lacking nutritional value and not being fresh. The primary reason for this is that they draw a parallel between the cold chain, cold storage and frozen foods. In reality, produce shipped through an integrated cold consisting of decentralised (off-grid) farm gate cooling





solutions, pack houses, cold stores and reefer trucks are fresher, more nutritious, crispier and better-tasting food.

Retailers in most cases are not aware of the operational, food loss and commercial efficiencies that build with the cold chain. With the proper PHM guidelines being followed through an integrated cold chain, they can stock their shelves with produce that will stay fresher longer, ensuring they have more time to sell. With the reduction in loss, demand can be met without stiff supply-side competition, and with both these benefits, the retailers can earn more from their produce. Retailers can get an 8% benefit due to a reduction in loss of moisture, an 8% benefit by sourcing in higher volumes due to better negotiations, economies of scale on the logistics front and a 6% premium from the consumer for the fresher produces being supplied by them.

We ran a controlled pilot to test out the benefit the retailers get from customers by supplying cold chain enabled produce. Initially, we were met with resistance as the retailers were not willing to cover the extra cost of the cold chain which ranged from INR1-5/kg depending upon the commodity. Later when they saw that their customers preferred the cold chain based produce they were ready to even procure the cold chain enabled produce even for a 7-8% premium. This perception of the consumer and retailer "Produce shipped through an integrated cold consisting of decentralised (off-grid) farm gate cooling solutions, pack houses, cold stores and reefer trucks are fresher, more nutritious, crispier and bettertasting food."

once changed can lead to a significant scaling up of the cold chain in India, which transports just 4% of horticultural produce through a cold chain today.

Cold Chain Technology helps in Large Commercial Scale in Operations

These efficiencies and benefits have been demonstrated by certain commodities; for example, fresh milk. Even when in the cold chain, fresh milk is highly perishable. As Pawanexh Kohli, CEO of the National Centre for Cold-chain Development (NCCD), puts it in his article titled Agri-business Opportunities in Cold-chain; "instead of milk cold stores, the dairy cold-chain developed into one that is dynamic enough to allow for daily traffic of that commodity. More so, this sector demonstrated how proper use of cold-chain technology does not make the commodity more expensive, but instead, expands the selling range to capture a wider market, and thereby allows for large commercial scale in operations".

Unleashing the cold chain and building a brand around cold chain enabled produce can make Indian agriculture a provider for the world and address the growing concern around food security globally. It would enable us to unlock the potential of our agricultural sector. Through our market connectivity initiatives, litchis from Bihar and cherries from Himachal Pradesh, through the cold chain, have made their way to homes in Mumbai, Pune and Bangalore, and have boosted farm incomes by up to 30% and reduced food loss by 20%~25%. This impact can be seen in other countries as well. In Kenya, our portable solar cold rooms, Ecofrost, help the local farmers precool and store their mangoes, and avocados at the right temperature and humidity level. This gives the small-holders the muchneeded time to aggregate the produce to meet the minimum volume needed for exports. This process has prompted an increase in exports of these mangoes, and avocados with growing interest and demand from European customers.

RURAL PROSPERITY VIA NUTRITION SECURITY

istorically, India's food policy centred on ensuring food to all sections of Indian society and maintaining a reasonable level of stability in prices. India's food production has increased nearly five folds in 50 years between 1970 and 2020. This has resulted in an increase in per capita daily food production in the country from 0.91kg in early 1970s to 1.82 kg around 2020. This is a laudable achievement, however, many other goals remained unfulfilled, and the success also brought many challenges and problems.

The Debilitating Food System

Globally, although yields per hectare have increased significantly in the last few decades, over 680 million people go to bed hungry every day. Habitats, including soils, are increasingly degraded, causing an unprecedented decline in biodiversity, compromising our ability to produce food, and increasing the risk of new diseases with pandemic potential.Greenhouse gas (GHG) emissions from the food value chain account for up to 37% of the GHG emissions worldwide, and still, approximately one-third of all food produced is lost or wasted. Complex and often non-transparent supply chains hinder accountability, which can lead to exploitation and fraud. Biofortification is a scientifically underpinned, cost-effective and scalable approach to vitamin A, iron, and zinc undernutrition, providing nutritional enhancement or enrichment of staple crops through conventional plant breeding.

People in many parts of the world are shifting to high-calorie, low-nutrient unhealthy diets, a major risk for human health: non-communicable diseases like diabetes and obesity are on the rise. The transformation to more sustainable food systems will require profound changes in how we produce, process, retail, consume, and dispose of food. It will also require an approach that includes all voices in the decision-making process and recognizes the interconnection, trade-offs, and synergies across outcomes related to food security, nutrition, and environmental, social, and economic sustainability.

As a vast, diverse, and highly populous country, India faces major challenges in transforming its food system – though it is understood that the potential rewards of transformation are immense. Moreover, opportunities exist to learn from and "To date, more than 290 biofortified varieties of 12 staple food crops have been released or are in testing in more than 60 countries around the world".

About the **AUTHOR**

Mr. Ishank Mikhail Gorla is the Programme Lead at GAIN steering the Commercialisation of Biofortified Crops Programme. Ishank champions nutrition by previously managing a community-based management programme for severe acute malnutrition, and is now leading on strategy development, programme implementation and exploring innovative solutions for commercialisation of nutrient-dense crops through partnerships in six countries in Asia and Africa. develop not only national programming but also state and local efforts. In engaging with the United Nation's Food System Summit, India's primary focus was advancing equitable livelihoods. Within this, a major emphasis fell on farmer livelihoods and welfare.

Biofortification to Combat Malnutrition

One of the strategies to combat malnutrition is Biofortification, or Natural Micronutrient Enrichment, of staple food crops. Biofortification is an effective and proven innovation to reach rural communities in developing countries where consumption of staple foods is higher as compared to other micronutrient-rich foods and access to micronutrient supplements and foods fortified with micronutrients is limited. To date, more than 290 biofortified varieties of 12 staple food crops have been released or are in testing in more than 60 countries around the world. Through biofortification, the global public agricultural research community has offered an immediate and potentially far-reaching tool to make a substantial and sustainable contribution to diet quality for entire populations. Biofortification of crop varieties is the most sustainable and cost-effective approach where the nutrients reach the target people in their natural form. Incorporating biofortified staple crops such as wheat, millets and rice into the Integrated Child Development Services, school feeding programmes, Public Distribution System and other public good interventions for children, pregnant and lactating women will help improve the nutrition of the most vulnerable segments of our society.

Millets for increasing productivity and profitability

Not only biofortified crops play a significant role in ensuring nutritional security, but have the potential to provide livelihood opportunities to the underprivileged such as small holder farmers.

In the latest episode of 'Mann ki Baat', Prime Minister Narendra Modi talked about millets



India held a national Member State dialogue in April 2021 on 'Agri-Food Systems Advancing Equitable Livelihoods'. Some areas of action stressed in this dialogue were strengthening safety net programmes and women-led self-help groups to address inequity, hunger, and malnutrition; improving access to safe and healthy food for better nutrition to the most difficult-to-reach groups, strengthening biofortification and food fortification among others. The U.N. General Assembly in April 2021 adopted a resolution that was sponsored by India and declared 2023 as the 'International Year of Millets' with an objective to increase public awareness and to take a step closer towards ending hunger and malnutrition.

being the superfood packed with protein, fibre, and minerals which can help fight the battle against malnutrition in India and encouraged people to participate in this fight throughout September, which is observed as "Poshan Maah" every year. In his speech, PM highlighted the economic benefits of millets for farmers as these grains can grow in temperate and tropical climates, can be grown on



Ishank loves to work on motorcycles and practicing music.

marginal land, and have a high nutrient density thus yielding high produce which in turn increases productivity and profitability. With the governments aligning interest in promoting millets as a superfood, it goes without saying that nutrient enriched - biofortified - staples, that have been developed to have higher micronutrient concentrations, can greatly boost nutritional content and raise the nutritional security of rural communities.

It is important to have a holistic food systems approach to nutrition, therefore strategies like biofortification, paired with existing interventions such as food supplementation and industrial fortification are being committed by the government of India. It is pivotal to reorient our approach by reaching out to vulnerable populations with agricultural-nutrition innovations thus prompting a transformation in the food systems for enabling prosperity and nutritional security within the rural communities.

SMART FILST

ndia needs a robust and modernized agriculture towards food security for its growing rural and urban population of over 1.3 billion. For this, it needs sustained agricultural productivity for sustained growth of its agricultural sector. Simultaneously, climate change and it's negative impact on crop productivity is now a reality, that poses new challenges for sustainable agriculture. As a result, India has the highest number of severely malnourished children under the age of five, while 14 percent of the popula-

tion is undernourished. Besides, 51.4 percent of women of reproductive age between 15 to 49 years are anemic and need proper care and nutritious food.

Smart Farming for Zero Poverty and Zero Hunger

The most important sustainability goals (SDGs) such as zero poverty and zero hunger are interdependent, because agriculture employs over half of the Indian working population and contributes 17-18% of the country's GDP. As a result, managing farms using modern Information and Communication Technologies such as IoT (Internet of things) devices, precision agriculture, and livestock farming, drone technology, sensors, AI based solutions, smart

About the **AUTHOR**

Dr. Vibha Dhawan is the Director General of The Energy and Resources Institute (TERI). The Energy and Resources Institute (TERI) is working towards the development of next-generation sensors and devices, reducing GHG emissions, integration of energy with agriculture, carbon credits, machine learning, and nanotechnologybased solutions with a scope of further expansion towards developing a holistic approach for smart and precision agriculture. agriculture inputs such as nano-fertilizers and nano-pesticides, as well as biofertilizers could increase the quality and quantity of the agriculture products which leads to increased farmer's income, elimination of micronutrient deficiencies and the availability of food for all.

Artificial intelligence and machine learning are reshaping industries all over the world. The National AI Strategy of India aims to maximize the technology's potential for economic and social benefits. Agriculture has also been identified as a priority sector for the implementation of AI-driven solutions. (Niti Aayog, 2019).

This would obviously necessitate infusing more funds for agricultural research and development innovation. Additionally, deliberate efforts are required to integrate IoT (Internet of things), Artificial intelligence (AI), and machine learning into already available disruptive innovations such as hybrid technology, genome editing for crop improvement, accelerated breeding, conservation agriculture, protected cultivation, bioenergy/ biofuel crops, biofortified crops, pricing policy, and sales of agricultural produce could make these innovative technologies more controlled and accurate. Smart agriculture must become part of achieving the larger goal of sustainability.

Benefits of Precision Agriculture far outweigh the costs of the New Technology

Currently, only about 20% of global acreage is using advanced farming technologies. It enables farmers to purchase and apply pesticides and fertilisers in precise amounts, resulting in cost savings and a lower environmental impact. As smart agriculture must be smart sustainable agriculture, the application of new methods of fertigation including boom sprayers/ drones can help in increasing the efficacy of crop protection chemicals / nano-fertilizers, nano-pesticides through reduced manpower, time, resource consumption, thereby saving environmental drift and reducing human exposure to chemicals. Farm mechanization, especially through custom hiring, not only creates employ-

Obstacles to Smart Agriculture

Data security and accuracy are the first and most crucial factors to take into account. Because production, fertigation, irrigation, harvest, and postharvest management suggestions actually equate with food product quality. The high costs of implementing these technologies, particularly in developing nations like India, and the potential negative effects of digitalizing agriculture on employment opportunities and job creation in the sector are additional worries that will need to be addressed over time.

ment and leads to entrepreneurship development but has a much larger benefit of collecting the crop residue, which instead of being burnt, can be applied for multiple uses.

While the improvements in yield and soil quality that result from using these techniques are immediately visible, demand for carbon credits can also act as an additional financial incentive for smallholder farmers. Thus, the creation of carbon credits for agri-business would increase the resilience of Indian farmers by ensuring higher yields, improved soil health, and improved livelihoods.

Smart Farming means Profitable Agriculture

Smart farming can potentially make agriculture more profitable by improving resource use efficiency, consequently saving farmer's money and labour, and increasing reliability and reduced risk



My hobby is playing with cats. I have six cats at home. It is great to observe them and their psychology to seek attention and a sort of jealousy among themselves as who gets more patting.

"Smart agriculture must become part of achieving the larger goal of sustainability."

that are associated with conventional farming. Localized weather forecasts. yield projections, and probability maps for diseases and natural disasters could facilitate optimal cultivation of crops. Thus, information-driven smart farming that would allow us to make ecologically and economically meaningful decisions would soon become a trend. Intelligent use of information and communications would guide the farmers on efficient resource allocation such as fertilizers, pesticides. herbicides and water use. develop efficient pest management strategies, early detection and management of crop diseases and minimize postharvest losses in an energy efficient and economically viable manner. In addition, having all these information on finger-tips through apps on a smartphone and integrating them with the control systems would allow farmers to control their fields remotely. The key enablers will be smart and precision ground sensors, remote sensing technologies, smart devices and control systems, wireless technologies, unmanned aerial vehicles for crop monitoring and agri-input delivery, on-site renewable energy sources as enabler for total mechanization and automation of agricultural systems, earth observation and navigation satellite systems along with software that could process complex data sets and offer data in a user-friendly and easy-to-read manner.

There is urgent need to collect PAN India data of soil, irrigation, crop productivity, farm mechanisation, agricultural inputs with demand and supply of different agricultural products their profitability margins along with government schemes and policies for agriculture sector to analyse and generate decision-making tools to identify smart agricultural clusters for pilot study to frame recommendations or policies for commodities, support system, relevant industries as takers/ insurance providers be created to improve farmer income in the long term.

A GL@NCE AT Smart Agriculture

hat is the biggest question agriculture is facing today? Is it to maximize productivity? Or to reduce its carbon footprint? Or to ensure nutrition security? The reality is it's all of them. With the ongoing pandemic, climate change, Russia-Ukraine conflict, the goal for the agricultural sector is no longer to simply maximize productivity, but to optimize across a far more complex



About the **AUTHOR**

Ravinder Grover is the Program Lead for Harvest Plus, with more than 15 years of experience as a practitioner and advisor for the leading industry and consulting firms in the agriculture and food domain. At HarvestPlus, he is currently leading the commercialization of biofortified crops program of HarvestPlus across Asia and Africa region. landscape of production, rural development, environmental, social justice and nutritional outcomes.

What we need is a positive vision for our food system to unite us in a transformative change towards a sustainable future – one where we produce enough good food for 9+ billion people by 2050. As chorused by many experts- Is smart agriculture the answer? But more importantly, how should we define smart agriculture? Should it be only limited to mobile applications and digital dashboards or should it be a comprehensive food systems approach addressing climate challenges, inequality and social inclusion while keeping technology and sustainability at its core.

One of the ways to look at this is to have a multi-lens approach through a simple framework - GL@NCe which can allow stakeholders and policy makers to make smarter choices which are inclusive, responsible and sustainable.

Gender(G)

Women play an increasingly greater role in agriculture and their contribution can no more be ignored. Increased gender equity in agriculture is both a practical and a social justice issue. While designing smart agriculture solutions we need to analyze their access to inputs, knowledge, decision-making power etc. and accordingly, stimulate their participation as producer, enabler, user and change agents to drive smart agriculture at the community level.

In Kenya, a high iron bean variety called 'Nyota', cooks within almost half the time of the other bean varieties, giving women more time to engage in other activities. Text-free user interphases, Innovative IVR and non-mobile solutions like 'Amplio's Talking Book' and 'Gram Vaani' could be of immense help in reaching to the hard-to reach rural women communities.

Livelihood (L):

One of the important parameters to evaluate any smart agriculture solution is to measure its impact on rural livelihood and farm income. Any technology will be sustainable only if it is leading to any incremental farm income and livelihood generation across the value chain.

Smallholders in Haiti were not able to enter high-quality market segments, in which end users demand shelf life and want to know more about the origin of the product and its producer. Furthermore, small producers usually must sell their products immediately to intermediaries for lack of financing or technical capabilities, preventing them from capturing more value for their products. With the support of the World Bank, these producers started using a third-party cold logistics service provider to reduce spoilage, and a broker, equipped with distributed ledger technology, to connect farmers with buyers in the United States and Canada. These reduced spoilage rates and increased revenues eightfold.



One of the important parameters to evaluate any smart agriculture solution is to measure its impact on rural livelihood and farm income.

Nutrition (N)

Smart foods can only be produced in smart farms and hence nutrition smart agriculture must start with the smart seeds but need to go all the way to the consumer's plate. While replacing regular crop varieties with the Biofortified ones could be a good starting point for nutrition smart agriculture, a comprehensive approach to preserve nutrition and minimize losses across the value chain is needed. Approaches like crop



Ravinder loves talking about everything and playing corridor cricket with his five-year-old son diversification, biofortification and food fortification need to be stacked wherever possible. In India, more than four million people are growing and consuming zinc wheat, which is proven to reduce zinc deficiency and reduce days with illness such as pneumonia in women and children, but this number has to grow exponentially from here. Startups like Slurrp farm are helping reintroduce the millets in an appealing way to Gen X in India through their range of smart milletbased recipes and are helping create the strong market linkages for the millet farmers.

Climate (C)

On farms, climate change is reducing crop yields, the nutritional quality of major cereals, and lowering livestock productivity. Substantial investments are required to maintain current yields and food quality to meet demand. The problem also works in reverse. Agriculture currently generates 19-29% of total greenhouse gas (GHG) emissions. Without action, that percentage could rise substantially as other sectors reduce their emissions. Incentives are vital for the adoption of these technologies to reclaim degraded lands and increase yield. In Zambia, Better Life Alliance (BLA), funded by USAID's Feed

NUTRITION SMART



the Future initiative, provided farmers the product label "It's Wild!" and a possibility of selling products 10-20% above market prices for practicing conservation agriculture. The BLA project impacted GHG emissions and carbon sequestration through agroforestry expansion, soil and manure management improvements, crop-residue burning reduction, and fertilizer management.

Digital Pathways(@)

Agriculture needs to be powered by digital and disruptive agriculture technologies for a cost-effective and traceable supply chain. Fueled by advanced connectivity, it will contribute \$2 trillion to \$3 trillion in additional value to global GDP over the next decade, according to McKinsey. Keeping up with the times, IFFCO Kisan has developed around 25 smart technology-enabled farms to help farmers enhance output, reduce input costs and boost income, in India. The company deploys smart technologies like 'Automated Wireless Weather station (AWWS), Internet of Things (IoT) based automated drip irrigation system, IFFCO Kisan has developed around 25 smart technology-enabled farms to help farmers enhance output, reduce input costs and boost income, in India.

soil moisture sensors and GIS-based remote sensing satellite imagery analysis in these smart farms. Bangalore based ag-tech startup, Cropin has just announced the launch of world's first agriculture intelligence cloud designed to help agri-businesses, farmers and governments to manage risk and create predictable growth strategies, so that they can continue to meet growing demand.

Enablers (e)

Smarter solutions need favorable policy support and an enabling environment for their long-term viability. Achieving transformation of agricultural market systems requires a strong partnership between science and policy, as well as a collaborative dialogue between the private sector and multiple levels of government. A positive policy environment is helping scale up drone technology in India. FS-SAI has played a key role in the adoption of fortification in India and has paved the way for introduction of fortified rice into the welfare schemes. Similar role is being played by ICAR in spearheading the efforts in research which led to release of more than 71 biofortified varieties in India.

Agriculture is the key to securing food and prosperous livelihoods, but it also faces challenges that threaten both. Some of these are systemic, while others are the result of external factors, but all of them are connected and must be tackled accordingly. And the GL@NCe framework does just that. It ensures that every decision taken across the value chain is smart in true sense and emphasizes on nutrition and climate smart practices with an expected output of gender inclusion and livelihood security. Digitization and an enabling environment are underscored as the means to scale such efforts and sustain them. Agriculture accounts for a small share of the global economy but is central to the lives of a great many people.

SUSTAINABLE SOLUTIONS

SUSTAINABLE SOLUTIONS IN COLD LOGISTICS



About the **AUTHOR**

Mr. Samit Jain, MD at PLUSS, is passionate about the environment and drives Pluss with the purpose of all products being not only people centric but environment centric. He leads the strategy and overall business development of thermal energy storage solutions to enable sustainable temperature control. He holds an M.Sc. in Physics and BE in **Electrical and Electronics** from BITS, Pilani (1994) and an M.S in Electrical from Univ of Hawaii (1997).

- 43

ndia is amongst the largest food producers in the world. While this being true, more than 12% of India's population goes hungry every day. Although there is an abundance of food in the country, disorganized supply chains fail to transport, store, and distribute produce effectively. There is an immediate need of effective cold logistics which is reliable, energy efficient, robust and more sustainable as a practice.

Government Support

Meat and seafood, groceries and fresh produce, dairy products, fresh-cut flowers etc. have one thing in common: they all require thermal control transport solutions to enable the end consumer to get the products in intact or usable condition. This is where the concept of cold-chain management comes in. Failure to keep cold-chain products cold will render them unusable, which leads to a wastage of the products. When cold products go bad, both the shipper and their client lose money.

With respect to the dairy industry, India is the biggest milk producer in the world. The Government of India in association with the Department of Animal Husbandry and Dairying in June 2020 announced a US\$ 2.1 Bn infrastructure development fund with an interest subsidy scheme to promote investment by private players and MSMEs in dairy, meat processing and animal feed plants which in return is expected to create 3.5 million jobs. The food processing ministry is actively promoting development of integrated cold-chain and value addition infrastructure, food safety and quality assurance infrastructure, infrastructure for agro-processing clusters, creation / expansion of food processing and preservation capacities and operation greens through schemes like 'Pradhan Mantri Kisan Sampada Yojana (PMKSY)' with budgets of over INR 4600 crores allotted to these focus areas.

Globally, India is the second biggest aquaculture and fish producer. The country is the fourth biggest seafood exporter in the world, with exports of marine

"According to the Director of the National Horticulture Board, there is a 90% deficit of cold storage facilities in India"

products worth close to USD 7 billion. The country currently exports to over 115 countries, and the government has prioritized the goal of making India the world's top seafood exporter. India accounts for approximately 6.3% of the global fish production. The fisheries sector sustains close to 14.5 million fishermen and is growing at 7% per annum.



I am, is my stress buster!

In all these various sectors, conventional diesel run solutions or ice (amounting to millions of tons) is used to maintain temperature and is run without the overall objective of sustainability. The wastage of massive amounts of water and increase of emissions coupled with old practices is a cause of concern.

India needs an adequate coldchain network and sustainable technology

Even as India suffers from a serious level of hunger, here's something that's even more worrying: the country wastes a significant portion of its farm produce due to a weak cold-chain infrastructure, with 16% of fruits and vegetables being lost every year. Up to 10 per cent oilseeds, pulses and cereals grown in India are also completely wasted. Rameswar Teli, Minister of State for Food Processing Industries, provided this data in the Lok Sabha, attributing it to the study "Assessment of Quantitative Harvest and Post-Harvest Losses of Major Crops and Commodities in India". A successful cold-chain ensures temperature-sensitive products are kept



within optimal temperature ranges and maintain the desired states from start to finish.

For example, ice cream must be kept frozen to preserve its shelf life. If temperatures go above the sub-zero ranges, the product will lose its solid state and it'll no longer be considered to be usable. Suppliers of food and pharmaceutical products heavily rely on the cold chain to ensure shipment doesn't become compromised before they reach the market. Demand to provide the optimal customer satisfaction when it comes to product experience continues to escalate, and companies must continually seek out better ways and new technologies to deliver customer satisfaction. Many companies find that value-added logistics services help give their supply chain a competitive edge. Once limited to basic transport services, the industry has now evolved to configuring kits including marketing material for e-commerce to adding new technologies to maintain the product at its best quality.

Awareness, poor warehousing provisions and old infrastructure result need to be improved for us as a nation to overcome this challenge. Major side effects of this food wastage are poor health conditions, threatening the well-being of hundreds of millions of Indians, grave economic damage in lost crops alone and leading to substantial loss of resources like water, fuel, and land. To avoid such heavy hits to the nation, we need an adequate cold-chain network and sustainable technology/applications which drive the cold-chain network for agricultural practices towards better food safety and quality.

Conventional reefer trucks operate on diesel as the primary source of fuel and the refrigeration unit consumes around 40% of the fuel. Thermal battery using PCMs enables semi-electric reefer vehicles by decoupling the refrigeration unit from the diesel engine. The electric refrigeration unit is plugged onto an electric source when the truck is docked. During this time the refrigeration unit charges/ cools down the thermal batteries which caters to the cooling required during movement of the trucks. Another technological advancement has been the use of PCMs in chest freezer/coolers. PCMs have been incorporated into traditional chest freezers and coolers. These provide backup during power failures and also reduce energy consumption, by the virtue of having thermal mass to address sudden ingress of hot air. Till date these PCMs have enabled over 18 gigawatt hours of energy saving per year (through about 50,000 PCM based chest freezers and coolers).

Phase change materials – Energy Efficient and Sustainable

Advanced materials like Phase change materials or 'PCM' is one such solution that can provide energy efficient and more sustainable solutions for cold-chain in India. The market for PCM and its integration has huge potential in India and abroad and the acceptability for PCMs will only increase in the years to come from available conventional methods used today.

With India's commitment to achieve net zero emissions by 2070, companies

"With India's commitment to achieve net zero emissions by 2070, companies are switching to more energy efficient solutions in the market and reducing their carbon footprint in the market."



are switching to more energy efficient solutions in the market and reducing their carbon footprint in the market. Most companies have specific teams that cater to their brand's sustainability targets and are always on the lookout to find new opportunities to incorporate new technologies to make their operation more sustainable and efficient. PCMs will enable this, as they can store energy when available or reduce the energy requirements. They also provide thermal mass during transport, thereby maintaining desired temperatures.

India is in dire need to upgrade its cold-chain capacity in agriculture sector. According to the Director of the National Horticulture Board, there is a 90% deficit of cold storage facilities in India. This is creating a huge gap in the cold chain which is resulting in 20 to 30% of produce being lost to wastage due to lack of temperature control. We need to learn how to store and use the cold energy for longer durations using reliable and inexpensive solutions. PCMs are an answer to address this problem.

Not all temperature-sensitive products are created equal. Every product is unique and requires specialised handling and storage temperatures to maintain its integrity along the cold-chain. A variety of different PCMs enable this. These PCMs have found applications in reefer trucks:

A lot more can be done through innovation. We as a nation must actively focus on developing this segment to make a significant leap forward and secure our future for generations to come!

SMART FARMING FOOD FOR ALL

OVID-19 created an unprecedented as well as unexpectedly negative situation globally impacting human health, agricultural activities, economy and food security.

In case of India, the impact of lockdowns due to Covid-19 tremendously disturbed the lives of people, creating seemingly unsurmountable issues of health and livelihood. The economy of the country in general and among others, agriculture and the healthcare sectors in particular came under severe stress.

Smart Solutions are needed for Complex Food Supply Chains

On the world stage, in addition to food shortages caused by low production as well as disruption of supply chains, global farming as well as allied sectors is also facing many food safety challenges like compromised quality and unpredictable contamination etc. Paradoxically, on the one hand the world is grappling with food "One of the other important aspects of smart faming is the increasing use of data acquired through various sources (historical, geographical and instrumental) in the management of farm activities". security issues while on the other hand, there is increased demand for greater variety in food choices. These challenges are rendering agricultural production as well as food supply chains more complex.

As the food supply chains are getting more and more complex, only smart farming solutions can transform the way the entire agri supply chain is managed, of which smart irrigation technology is one of the foremost components, includ-



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Mr Primal Oswal is the Founder and Managing Director of HARVEL Group. An avid Global traveller and Industry expert, Mr Oswal is the immediate past President of Irrigation Association of India.

FOOD SECURITY

ing but not limited to use of weather data or soil moisture data to determine the irrigation needs for a particular parcel of land in a specific geographical location in consonance with crop sown. The use of these technologies lead to irrigation efficiency by reducing water waste while maintaining plant health and quality.

Data - The Keystone

One of the other important aspects of smart faming is the increasing use of data acquired through various sources (historical, geographical and instrumental) in the management of farm activities. An advanced technology shall not be fully effective unless the same is backed by relevant and credible data, necessary to attain actionable insights for managing all the operations on the farm in a cost-effective manner, both pre-and postharvest. Smart agriculture technologies differentiate themselves by their ability to record data and make sense of it using tools which ensure that the data is organized and accessible at all times, so that information on all aspects including financial impact can be monitored.

Data centrally stored on a digital platform makes it possible to analyse and identify suitable crop varieties and input requirements for optimization and profitability for varied parcels of the landholding. Early detection of various disruptions and application of inputs only in the affected region saves costs and other valuable resources. Use of satellite imagery techniques to monitor different zones in large farms and use of reliable weather forecasts maximizes resource usage and minimize losses which ultimately leads to good crop growth and higher yields. Automation of entire System increases productivity and cost-efficiency significantly.

IoT and Agriculture

Increasingly, Smart farming propelled by IoT driven agriculture is laying the groundwork for a "third green revolution." Combined application of information and communications technologies using devices such as precision equipment, IoT sensors and actuators, geo-positioning



"Increasingly, Smart farming propelled by IoT driven agriculture is laying the groundwork for a "third green revolution."

systems and robots lead to availability of real time data and effective decisionmaking and helps in better control of agricultural processes to reduce production risks and enhances the ability to foresee production results, ultimately leading to increased farm incomes.

loT in agriculture involves sensors, drones, and robots connected through

the internet which functions automatically and semi automatically performing operations and gathering data aimed at increasing efficiency and predictability. With increasing demands and shortage of labour across the globe, agriculture automation and robots are starting to gain attention among the farming communities worldwide.

To meet the increased demand of quality food, Smart Farming is the need of day. The various challenges associated with agriculture can be minimized by use of these technologies and it will definitely increase the per capita income of farmers, Improve human health status and makes the economy healthier.

SMART AGRICULTURE FOR INDIA'S NEXT GREEN REVOLUTION

ased on the latest 2021 report on Climate Change by the IPCC, each of the last four decades has been successively warmer than any decade that preceded it since 1850 and the likely range of global surface temperature increase from 1850-1900 to 2010-2019 is ~1.07°C. Environmental degradation has had a cascading impact on global crop productivity. By 2050, the global food demand is expected to increase anywhere between 59% to 98%. On the other hand, according to a map released by the US Geological Survey in 2017, India has the largest cropland of any country at 179.8 million hectares, compared with 167.8 million in the US and 165.2 million in China. India's food grain production has already grown fivefold since the Green Revolution. As per the Ministry of Agriculture's 2021-22 produc-

"The proliferation of biostimulants, biofertilisers, nano-based products, SCRFs, Customized WSFs, etc. are going to be the current drivers of the Smart Agriculture in India."

tion estimates, India has achieved record production in food grains at 316 million metric tons, oilseeds at 38 MMT and sugarcane at 432 MMT. Today, India is one of the largest exporters of wheat, rice, tea, spices among others. The point to note here is that with our natural resources, workforce, and growth potential, we have a major role to play in global food security. In this endeavor, the Agri-Tech industry, especially Smart Agriculture techniques are going to be instrumental.

The Philosophy of Smart Agriculture is centered on achieving MORE with LESS

From rising sea levels that risk catastrophic flooding, to erratic weather patterns that threaten food production, climate change is global in scope and unprecedented in impact. The agri-inputs of today are unmatched for the challenges of tomorrow and therefore, Product Innovation is at the core of Smart Agriculture. If we are to stir innovation, the funding for research and development of futureready productions must go up by leaps and bounds. The proliferation of biostimulants, biofertilisers, nano-based products, SCRFs, Customized WSFs, etc. are

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Mr.Sanjay Chhabra is the Executive Director & Business Head of Shriram Farm Solutions, DCM Shriram Ltd.

AGRIC

number of spraying service providers.

"The

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enable Smart Agriculture

in India".

An Ecosystem for Smart Agriculture

A common misconception is that by simply using technologically advanced products, we can reduce the environmen-

tal footprint, tackle climate change and practice Smart Agriculture. The negative environmental impact of products as well as their lack of effectiveness are often symptoms of their unscientific application. From 2014 to 2017, a corn farmer in Illinois went from using basic 4R principles to an advanced strategy that incorporated variable rate fertilizer applications throughout the growing season and other 4R practices. By 2017, his yields had increased, NUE had improved, and impressively, he saw a 34 percent reduction in CO2 emissions from his field. This is a powerful example to show that the true benefit of innovative products can only be realized when complemented with a proper ecosystem, in terms of infrastructure, farmer awareness and sound advisory. The collaboration between public and private sectors will be instrumental in setting up the necessary ecosystem to enable Smart Agriculture in India.

To conclude, one would have to admit that Indian Agriculture is in for some exciting times. We, as a nation with tremendous agricultural potential, have to feel obligated to assume a bigger role in the fight against climate change. We have to contribute in a more significant way to global food security. With the sheer pace of technological advancements in the last few years, the tools we need to take the next big leap in Indian Agriculture are now within reach and practicing Smart Agriculture could very well bring the next green revolution in India.

going to be the cur-

rent drivers of the Smart Agriculture in India. However, creating truly future-ready products necessitates a monumental shift in product innovation.

Crop Advisory is another key facet of Smart Agriculture. From satellite imagery and heat maps to handheld soil analysis gadgets to AI/ML based plant diagnostic platforms to systems capable of processing big data, the technological possibilities at the fingertips of today's technocrats and agriculturalists are plentiful. This is a high risk - high reward space that could be a game changer for Indian Agriculture. The problem that companies need to crack is the viability of their business models to profitably run an advisory business, and all this while taking cognizance of ground realities such as farmer's sensitivity to upfront investment. A natural move for companies in this space might be forward integration into areas involving regular cashflow such as farming services (eq; drone spraying, irrigation systems, rental services, etc.) or sales of branded agri-inputs or both.

From a farmer's perspective, one of the biggest pain points has been the accurate identification of certain pest attacks, diseases, and nutrient deficiencies. The AI/ML based plant diagnostics services can play a consequential role in ameliorating such a pain point. While some applications available today already address this challenge to an extent



but we are still a long way away from accuracy levels that are required. It is fair to assume that sooner rather than later, when this technology matures, it is going to be a handy tool for growers.

In India, drones have been the buzzword for the past year, and for good reason. Agricultural drones today can perform tasks that would be considered unthinkable a few decades ago. They can analyze soils and fields, monitor crop health from sowing to harvesting stages including pest infestations, diseases, etc., make yield estimates, monitor livestock, and most popularly, drones provide a medium for efficient, economic, and faster spraying of agri-inputs. With proactive measures from the authorities and growing acceptance within the farming community, we are likely to experience a marked increase in the industry's investments in drone formulations as well as the

IMMENSE POSSIBILITIES OF COLD CHAIN

ommodities travel through an intricate, yet dense network of air, roads, and rail; temperature and spoilage become critical concerns as we transport agriculture, especially 130 million tonnes of horticulture produce. As the world becomes smaller and better-connected, physical distances continue to challenge the way we procure, deliver and manage commodities.

Cold chains allow the supply of commodities in this condensed world, and technologies that can optimize and streamline cold chain logistics and help provide greater supply chain visibility become growingly necessary. Currently, there are 8200 cold storage facilities in India with a combined capacity of 39 million tonnes. These temperature-controlled refrigerated packaging solutions ensure we preserve the quality of products and adhere to committed temperature ranges as they travel through the supply chain, ensuring that they are fit for use and prevent waste.

due to limited investment in infrastructure and lack of consistent power supply are more significant issues that continue to plague the industry. Most facilities are in West Bengal, Uttar Pradesh, and Bihar; access to cold storage supply continues to be limited for the rest of the country.

Then comes the operational efficiency of the existing and available cold chain storage. The current capacities are being used at 30%, with most storage available for single commodities like potatoes, oranges, etc. Large repositories result in poor utilization. The high costs of real estate and power backup only add to the woes of the unorganized players in the sector. In India, fuel costs account for around 30% of cold storage operating expenses against 10% in the west. Efficiency falls with a lack of training in product handling and compliance with the management of temperature-sensitive products. Additionally, poor quality monitoring and control ensure commodity stability and viability.

However, during the pandemic, we saw an exceptional performance in the cold storage supply

"Currently, there are 8200 cold storage facilities in India with a combined capacity of 39 million tonnes"

Challenges Galore

The absence of cold storage across the country

About the **AUTHOR**

Anand Chandra, a graduate in Agricultural Sciences from AAI in 2002 (now SHUATS) and MBA specializing in Agri-Business Management from MANAGE in 2004, has close to two decades of experience in Agri-Commodity Based financing. The Co-founder and Executive Director for Arya.ag, India's largest integrated Grain Commerce Platform, Anand has been a part of ICICI Bank as the National Product Head for the Agri-Commodity Finance Business. Anand has been a part of the prestigious, "Accessing Global Markets" program at Cornell University. chain and derived some key learnings.

Size matters

The smaller the storage spaces in India, the better. Large units do not accommodate the smaller needs and the high operation costs. For operational efficiency, it is necessary to create smaller storage units available far and wide in rural markets to build in better access to commodities. Compartmentalization is key to allowing for multi-commodity storage.

Every Inch Counts

Real estate costs and power supply can be disruptive. Therefore, unused and insufficient storage capacities cost us doubly. Building cartridges or compartmentalized storage within these large units with individual power supplies can solve our market needs. We can cool spaces in use and disconnect unused compartments saving electricity and related costs. Another solution is solar panel-powered cooling spaces. Thermal technology is 100% fuel-free and environmentally friendly.

Time costs

Vegetables have a shorter shelf life and leave storage faster. Their churn rates are quicker too. Fruits have more extended durability and need larger structures. However, fruits and vegetables are often considered together, while both have very different supply chains, churning durations, and storage needs. Designing cold storage in keeping with their needs will benefit us both in cost and quality.

Change is the only constant

The last mile supply needs require that we design beyond the traditional forms such as two-wheeler carriers, provide for temperature cooling without a power source while maintaining temperature from 24-48 hours. No matter the form, the critical constant is optimal asset utilization of accessible, flexible, cost-effective solutions.

What you see is what you get

Supply chain visibility is crucial for any product. The science of storage enables us to view the temperature, humidity, real-time location, condition, utilization, and anomaly detection. It can give us diagnostic and predictive insights to manage our produce.



"Compartmentalization is key to allowing for multicommodity storage"

Immense Possibilities

While the challenges seem towering given the state of the cold chain in the past decades, there is reason to believe this sector has immense possibility. The emergence of organized food retail, the growth in the processed food sector, and the increased need for organic fruits and vegetables are great enablers for developing the Indian cold chain. During the pandemic, its footprint expanded significantly across the country and is expected to grow at over 20% CAGR by 2025.

Technology can help optimize cold chain supply logistics for agricultural products.



I love drawing connections between numbers. Since I am on the road a lot, I get ample time to play number games with my kids. And hopefully they too will fall in love with numbers like me. IoT (Internet of Things) sensors installed in container units monitor the temperature and humidity every ten minutes, giving real-time data on our smartphones. We can discover chiller failures and human error before goods are lost or contaminated. Agri-startups use decentralized ledgers or Blockchain tech to develop solutions to ensure that all key stakeholders have real-time access to information relating to the quality of the product at each and every phase of the value chain. GPS (Global positioning systems) and GEOFENCING help track temperaturesensitive cargo in real-time. The creation of Digital Twins in the supply chain refers to virtual representation that works with real-time data to induce improvements in day-to-day activities and build efficiencies in the system by predicting challenges and outcomes.

Transforming the supply chain and optimizing it through technology, and adopting newer and sustainable practices would ensure that the commodities can be stored for longer periods. Better packaging will bolster the industry's growth and increase the producer's income by increasing the shelf life, reducing damage in transit, and increasing access to distant markets. Cold storage solutions preserve the product while keeping quality intact during longer hours of transport can further facilitate the movement of produce without a reduction in quality and are easily supplied to various parts of the country, even if they are remote. Tech enables traceability, visibility, and transparency to ensure compliances across levels and enhanced customer experience.

ANALYSIS

UNLEASHING THE POTENTIAL OF COLD CHAIN IN INDIA

he cold chain is a network of facilities and transportation systems that maintain a consistent low and desirable temperature throughout the supply chain. It's an essential part of food safety and quality control, ensuring that perishable goods remain fresh and edible from farm to table. perishable items such as food and pharmaceuticals fresh and free from spoilage. The cold chain begins at the point of manufacture or harvest and continues through distribution, storage, and retail.

In India, the cold chain infrastructure is not well developed, which results in

Farm to Fork

When it comes to Indian food, the options are endless. From spicy curries to flavourful rice dishes, there's something for everyone to enjoy. But in order for these meals to be enjoyed by all, they need to be properly stored and transported. That's where the cold chain comes in.

The cold chain is a system of refrigerated transportation and storage that helps keep food fresh and safe to eat. In India, the cold chain is essential for ensuring that perishable items like fruits, vegetables, and dairy products reach consumers in a timely and efficient manner.

There are many different players involved in the Indian cold chain industry, from farmers and manufacturers to distributors and retailers. By working together, they can help ensure that the food we eat is of the highest quality and safe to consume.

What is Cold Chain?

The cold chain is a temperature-controlled supply chain. It is used to keep



About the **AUTHOR**

Mr. Ravi Gulgulia Incubated North East India's first "Integrated Cold Chain Project' with all modern technology. Received compliments, acknowledgments and National Awards. Authored "Food Fahrenheit" significant losses of perishable products. In order to unleash the potential of the cold chain in India, there is a need for better infrastructure and coordination among all stakeholders.

The Need for a Cold Chain in India

The cold chain is an essential part of the food supply chain and with India's population projected to exceed 1.5 billion by 2027, the need for a well-functioning cold chain is more important than ever. India currently has a very limited cold chain infrastructure, and as a result, much of the country's food supply is wasted each year due to spoilage. This not only results in economic losses for farmers and food producers, but also contributes to food insecurity and malnutrition.

There are many challenges to expanding and improving the cold chain in India. These include the high cost of investment, lack of trained personnel, and poor infrastructure. However, the potential benefits of a well-functioning cold chain are enormous. A better cold chain would help reduce food wastage, improve food safety, and ensure that more people have access to nutritious food.

In order to realize the potential of the cold chain in India, it is essential that government policies and regulations provide incentives for investments in this sector. Additionally, there needs to be a focus on capacity building and training so that more people are able to operate and maintain cold chain facilities. With



the right investments and policies in place, the cold chain can play a vital role

Why the Cold Chain is Important for India ?

The cold chain is a vital part of the food and pharmaceutical industries, ensuring that products are kept at the correct temperature from production through to distribution and sale. In India, where temperatures can reach 47 degrees Celsius (116 Fahrenheit), the cold chain is essential for maintaining the quality and safety of perishable goods.

There are many benefits to developing a strong cold chain infrastructure in India. Perhaps most importantly, it would help to reduce food wastage. According to the National Centre for Cold Chain Development (NCCD), up to 40% of fruits and vegetables produced in India are lost due to a lack of storage and transportation facilities. A well-functioning cold chain would help to prolong the shelf-life of these products, reducing wastage and increasing farmer incomes.

In addition, a reliable cold chain would allow Indian manufacturers to export more perishables products such as seafood, meat and dairy. At present, these products cannot be reliably exported due to concerns about their spoilage during transport. A strong cold chain would enable Indian producers to tap into new international markets, boosting trade and economic growth.

Finally, an efficient cold chain would improve access to safe and nutritious

According to the National Centre for Cold Chain Development (NCCD), up to 40% of fruits and vegetables produced in India are lost due to a lack of storage and transportation facilities

food for all Indians.

The Various Stages of the Cold Chain

The cold chain is a process that begins with the production of food and pharmaceuticals and continues through distribution to the consumer. In between, there are many steps and different players involved in ensuring that products maintain their quality and integrity.

In India, the cold chain is an emerging market with great potential. Currently, there is a lack of infrastructure and coordination among the various stakeholders, which leads to inefficiencies and wastage. However, with proper planning and investment, the cold chain can be developed to meet the country's growing needs.

The first stage of the cold chain is primary production, where food and pharmaceuticals are manufactured. This is followed by storage and transportation to distribution centers. From there, products are delivered to retail outlets or directly to consumers.

Each stage of the cold chain requires different infrastructure and procedures.

For example, primary production typically requires large refrigerated warehouses for raw materials and finished products. Storage and transportation facilities must be designed to maintain product temperature and prevent contamination. And finally, distribution centers and retail outlets must have adequate refrigeration capacity to keep products fresh until they are sold.

Why the Cold Chain is Critical for India's Economy ?

The cold chain is a vital part of India's economy, and it is critical for ensuring the quality and safety of perishable goods. In recent years, the country has seen significant growth in the demand for cold chain services, due to the increasing popularity of online grocery shopping and the need for safe food storage and transportation.

The cold chain is also an important part of the healthcare system in India, as it is used to transport vaccines and other medical supplies. With the recent outbreak of COVID-19, the need for a reliable cold chain has become even more evident.

There are many challenges that need to be addressed in order to improve the efficiency of the cold chain in India. These include infrastructure development, regulatory issues, and training of personnel. However, with the right investments and policies in place, the cold chain can play a key role in boosting India's economy.

LOW COST INITIATIVES — THE GAME CHANGERS

ften perceived as a nonessential element and a luxury for supply chains, cold chain management is actually an essential component of the supply chain, integral to maintaining temperature and air quality for many products, to ensure they don't spoil in transit, processing, storage, or display. Cold chain logistics caters to diverse industries from agricultural produce, to seafood, pharma, and chemicals. A good cold chain supply channel ensures that the shelf life of the product increases and allows the producer to access distant markets and for consumers to savour a variety of products true to their original flavors, to say nothing of life-saving medicines and vaccines. Yet even the slightest disruption or failure within the cold chain management life cycle during transit, processing, storage, or display has dramatic impacts on economic productivity, greenhouse gas emissions, and food

security due to spoilage or loss. Maintaining the correct temperature and air quality makes for a critical success factor in the supply chain for all stakeholders involved, from the manufacturer and producer to the shipper and end-consumer.

However, the ground reality for producers, especially in developing countries like India, is starkly dismal. According to the World Food Programme, about 1/3rd of food for human consumption gets wasted. While in the more developed western countries, the majority of this can be attributed to households and restaurants, in developing countries, it is the lack of effective supply chains that forces farmers

"Studies by the UN Food and Agricultural Organization reckon that 40% of food products are wasted at the pre-consumption stage in India"



to watch their produce rot.

Studies by the UN Food and Agricultural Organization reckon that 40% of food products are wasted at the pre-consumption stage in India. The FAO further estimates that 8% of global greenhouse gas emissions are caused by food that is currently being produced but not eaten. Our problem with wastage is not limited to food alone but also to pharmaceutical products. Nearly 20% of drugs and pharmaceutical goods arrive in damaged condition because of a broken supply chain rendering them useless.

Overcoming the Challenges of Cold Chain Management

Yet, the rising demand for cold chain management makes little difference to the Indian ground reality. The cold chain industry in India is still at an infantile stage, largely limited to the storage of perishable horticultural produce. Moreover, even when produce is kept in cold chain refrigerators, farmers are unable to maintain cold chain quality throughout the value chain from farms to transport and retailing for perishables and huge investments being one of the biggest reasons behind it. The fragmented and broken transit and distribution approach, low compliance, lack of skill and awareness in handling perishables and lack of multi-commodity and multi-temperature storage facilities are other challenges for the cold chain industry.

About the **AUTHOR**

Mr. Varun Khurana is a 3X serial entrepreneur, currently Founder & CEO at agritech startup Otipy. Previously CTO at Grofers/ Blinkit; an IIT Delhi alumnus." Plus there are additional risks like transportation accidents and poorly maintained retail outlets, which makes it tough to maintain either the shelf life or the quality of the products. Furthermore, in developing countries like India, costs of staples need to be affordable. Investments in cold chains tend to add to costs, which are not viable for staples. For these reasons there are very few organized retail cold chains in India.

Another major hindrance for the sector is the lack of consistent energy supply and frequent power cuts which play havoc with the produce. This makes it mandatory to install power backups on the site pushing up investment and operational costs. By ensuring consistent and affordable power supply, the state can help reduce significant costs and wastage. Similarly, improving road infrastructure can help connect farmers to the markets and reduce travel time as well as wear and tear on refrigerated trucks. Hence, government intervention can help ease some hindrances for this segment, but it is not possible for the state to subsidize the entire cold chain value system across the country. With the rise in urban population, the real estate demand is bound to grow. This also acts as a constraint as cold storage facilities need to be set up as close to the end consumers as possible. Renting or buying land close to the end market increases the investment costs substantially. One way to help could be with easy, subsidized loans for investors to reduce their burden and increase profit margins in this sector. Since the entire project of cold chains from start to finish depends heavily on technology, the machines must be handled by skilled workers. Finding such resources is a challenge, especially at the rural end of this chain. The need of the hour is to train people to handle and fix machines that they are working with. There are instances where farmers are aware of the technologies, yet there is still a significant knowledge gap on how to purchase the right equipment or look at alternative energy sources to power them, for example solar power.

Game Changer for the Cold Chain

Despite, or perhaps because of, the current rather grim ground reality, the demand for cold chains is growing and experts predict great potential for their growth in the Indian markets as well as globally. This growth in demand can be attributed to the following factors:

- Size of the retail market: As the demand for exotic fruits and vegetables grows, with people wanting to taste food from around the world--retail stores are expected to offer these products to consumers not just to thrive but indeed, just to survive in business.
- Medicinal needs: The need for medical supplies to be transported from one country to another and also within the country has increased greatly during and after the pandemic. Analysts are only expecting it to rise further in the coming years.
- Growth of e-commerce: With businesses going digital in every corner of the world, the B2C and B2B models depend on cold chains to deliver their products to the consumer.

"The cold chain industry in India is still at an infantile stage, largely limited to the storage of perishable horticultural produce"

Industry

While these are conventional solutions to improve existing cold chains, they continue to be prohibitively cost-intensive. Hence, some newer startups are rethinking the paradigm to redesign the entire cold chain segment in India by relooking at the science behind cold chain storage and transit instead of making huge investments in heavy equipment. This is being done with ways to build a more frugal infrastructure, to recreate a similar temperature and air quality control impact on the process which can be done alternatively with pre-cooling exercises; instead of washing the produce with normal water. it can be washed with pre-cooled water which has been cooled



and loves long distance running

with solar energy which brings down the temperature of the produce almost by eight to 10 degrees below the environmental temperature. The produce can then be put into mobile cold containers again powered through solar energy for 3-4 hours. By making these mobile, full optimization of the containers can be ensured across geographies, when produce is being harvested in different areas.

In normal cold chain warehouses, food wastage of as much as 25% has been observed in the warehouse alone, companies should work towards eliminating that with low-cost precooling and straight to consumer measures for decreasing food spoilage and extending the shelf life of agricultural outputs by eliminating the barriers to cold storage. These are groundbreaking disruptive changes in cold chain management ecosystems.

The role of food cold chains in climate vulnerable countries like India can hardly be exaggerated. With the pandemic making the new normal, most people have started opting for doorstep delivery for most of their needs. Cold chain channels need to catch up with this development. Less wastage and better handling of the products will ensure that they satisfy the consumer and realize their growth potential. For a country like India which aims to take its products to the world market, policy frameworks to support these new low-cost initiatives will go a long way to establish India as a market leader in the segment.

COLD-CHAIN INFRASTRUCTURE CAN IMPROVE INDIA'S RURAL ECONOMY

once produce-deficit lhe country, India, has emerged as one of the world's secondlargest producers of fruits and vegetables. With an agrarian economy, where 54.6% of the total workforce is engaged in agricultural and allied sector activities, India's evolution from produce deficit to produce surplus status took years, with a significant role of the green revolution (comprising government push and technological advancement) and farmers. Even though the country has become a food surplus nation, the sector continues to experience significant post-harvest losses, which are a cause of rising distress for India's smallholder farmers.

At around 126 million in number, these farmers own about half of the arable land, according to provisional numbers from the 10th agriculture census 2015–2016. Such large numbers pose enormous challenges for the government's exten-



A targeted and tailored 'cold chain' approach is essential for India's small-holder farmers who represent and will continue to a define-a significant share of agroecology. sion arms to reach them with relevant technologies and farm support schemes. Most small farmers cannot afford the services of conventional post-harvest management facilities such as cold storage. This leads to a significant loss in value and income for the farmers as they are constrained to sell their produce at low prices through distress sales and due to lack of access to market information.

The CIPHET study (2015) highlighted that Indian farmers incur Rs 92,651 crore per year in post-harvest losses primarily due to poor storage and transportation facilities. Ironically, according to the high-level Dalwai committee report, an investment of Rs 89,375 crore—a figure

> Mr. Bhaskar Natarajan is the Director of Alliance for an Energy Efficient Economy (AEEE) and Dr Khushboo Gupta, Senior Research Associate in AEEE

marginally lower than the annual postharvest losses—is all it takes to improve the current state of storage and transportation facilities for food crops. Furthermore, without post-harvest management facilities, fruits and vegetables decompose into greenhouse gases, contributing to an increased carbon footprint.

There is a critical 'gap' in the availability of affordable and suitable post-harvest management solutions specifically targeted at small and marginal farmers. According to the State of India's Environment in Figures, 2018, if the critical gap in cold-chain infrastructure can be bridged, the sector can create over 3 million jobs, most of which will be at the village level. And bridging this gap is a socio-economic imperative to enhancing farmers' economic well-being and supporting India's food security goals.

Need of the hour

A targeted and tailored 'cold chain' approach is essential for India's smallholder farmers who represent and will continue to a define-a significant share of agroecology. While the idea of an integrated cold chain in India, catering to export-oriented and supermarket-oriented produce, is already gaining traction in India, in parallel, we need to move forward on cold chain solutions focused on small-holder farmers. These solutions would typically incorporate: localized and shared cooling services for short-term preservation of produce, opening possibilities for indigenous and low-climate impact cooling solutions, enablement of market linkages and, therefore, broader opportunities and upskilling farmers on good agricultural and post-harvest management practices.

On ground experiences

Our past and ongoing engagements in the states of Bihar, Tamil Nadu, Karnataka, Gujarat and West Bengal with the state officials in the department of agriculture, individual farmers and farmers' associations and cold-chain facility owners have highlighted several bottlenecks in developing a smallholder-focused



cold-chain in India-starting with an unclear understanding of their cold chain needs and the need to move away from a one-size-fits-all approach to the cold chain. Other challenges include institutional and policy constraints- the lack of standards/guidelines on cold-chain infrastructure and siloed functioning of the various agri-departments-limited knowledge and availability of affordable coldchain technologies and innovative business models and skill gaps. Additionally, most farm-level solutions are deployed and driven by entrepreneurs and are primarily unknown to farmers. While some indigenous low-climate impacts cooling solutions and innovative business models are emerging, their reach and scale are limited. Concerted support will be required to connect these solutions to the small-holder farmers, scale up their commercialization and bridge any skill gaps in their appropriate use.

The Way Forward

To reduce food losses, improve farmers' income and ensure sustainable development of cold chain infrastructure, a series of steps must be taken at the national and sub-national level with support from government agencies, foundations, state cold-chain champions and policy think tanks. This can contribute to developing an action plan for cold-chain infrastructure development and its successful implementation, including short, medium and long-term actionable steps for the stakeholders. In this direction, AEEE, along with its partners, is working on:

Conducting need assessment of the existing/to be built cold-chain infrastructure, in parallel to creating awareness about cold-chain infrastructure's importance amongst small and marginal farmers and other related stakeholders

■ Interacting with both, the government authorities implementing cold-chain projects at the state level to understand the hiccups in disbursing funds and building facilities and hearing out the challenges faced by the cold-chain facility owners and farmer associations in accessing and using the facilities

Promoting evidence-based, affordable and sustainable cooling solutions through lighthouse cold-chain projects to strengthen market linkages for the farmers

■ Initiating policy level discussions to promote scaling-up of affordable and innovative technologies at the central level and the state-level agencies, which may directly benefit the farmer associations

The above approach to strengthening the cold-chain and enabling market linkage can have several socio-economic benefits such as improving the livelihood of farmers and mitigating food loss and associated emissions which will translate into actions that support Sustainable Development Goals (SDGs) like SDG-2 (Zero hunger) and SDG-3 (Good health and well-being). In addition to being critical to increasing farmer livelihood, such an approach also improves India's overall rural economy.

NATIONAL ROUND TABLE ON ECO AGRICULTURE

10th August 2022 | Indian Chamber of Food and Agriculture, New Delhi

national round table conference was held at ICFA, Headquaters at New Delhi on 10th August 2022, to discuss about the Eco Agriculture working group, its action plan, strategies and the recommendations for the same.

The meeting was chaired by Dr. M.H. Mehta, Chairman of Working group of Eco Agriculture, ICFA and attended by many other eminent personalities. A large number of members also participated through video, telephone or emails.

Dr. MJ Khan, Chairman, ICFA

Sustainability is the driving force for safer food production. Farmers should not suffer for the yield losses and the cost of production should be minimised for the benefit of the farming community, in which eco agriculture can prove to be a boon.

Dr. PVSM Gouri, ED, Association of Indian Organic Industry

The main objective of farming systems should be to improve farm productivity and sustainability, reducing the input cost of farming, minimising the crop losses and farmer's well being. Use of chemical fertilizers should be minimised and use of eco-friendly bio inputs should increase. There should be different package of practices defined and designed for different existing agro climatic zones of India. Eco Agriculture must be seen with commercial perspective for better success and how it goes to market should be considered.

Dr. M H Mehta, Chairman of Working group of Eco Agriculture, ICFA

Globally there is appreciation and need for bringing Eco Agri Revolution for Ever Green Revolution and India is in an ideal situation to take the lead.Eco Agriculture is the broader term which encompasses every other idea like organic, natural farming, agro ecology, Regenerative etc and has several aspects. Bio Industry in India and globally is growing at the rate of more than 18%. Agri B i o

Input Industries – mainly in SMEs are growing at a very fast rate and need to be encouraged and monitored as a huge new generation opportunity. As an example,



Based on comments from Dr.Marwaha (Ex-Chairman, PPCB), Dr. Debbrata Sarkar (Algael Energy), Dr. Brahma Singh, (President, Horticulture Society of India), Dr.Vipin Saini, (CEO, BASAI), Dr. Roger Tripathi, (Global Bio AG), Dr. Sudhakar Reddy (AP), Dr. Sanjay Nath Singh(Indian Farmers Federation), Harish Bhatt (Assam) etc., the following points were noted.

- Crop residue and other agro waste should be treated with multi-microbial sprays.
- Bio input industries mainly in SME sectors are growing well and playing a critical role in Eco Agri Revolution.
- For organic farming, the trend is towards certified bio input packages.
- · Bio products are increasingly being used in conjunction with chemicals.
- In India the amendment in Fertilizer Control Order (1985) for inclusion of Bio stimulant is a significant step.

the Solidaridad 20-20 model is very practicable and implementable for farmers and has been successfully implemented for Soyabean crop in Rajasthan and Madhya Pradesh. 1) B i o Composts from agricultural wastes and crop residue should become an integral part of Eco Agriculture.

Dr. Suresh Motwani, General Manager, Solidaridad Asia

We should define the end objective and government and policy makers should be told that any methodology, that is implemented, should be eco friendly. The 20-20 model is rather a methodology than a technology and its principal is to bring practices, which minimise the inputs.

Dr. Harpal Singh Grewal, Organic Farmer

There should be transparency and traceability in the farming system and we should focus on farmer's need and perspective to do the same. The ultimate objective of the government and policy makers should be one, focussed on the benefitting the farmers.

Prof. Moni Madaswamy, President, Horticulture Society of India

National trade value chain is important and it should be there for each commodity and the working groups should take the task of expanding it globally. Tasks should be carried out for networking with farmers and propagating the technology to farmers region wise. This can be done through organising RTCs, workshops and trainings etc. Reaching out to people through capacity building programmes like Digital education etc can be taken into consideration.



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