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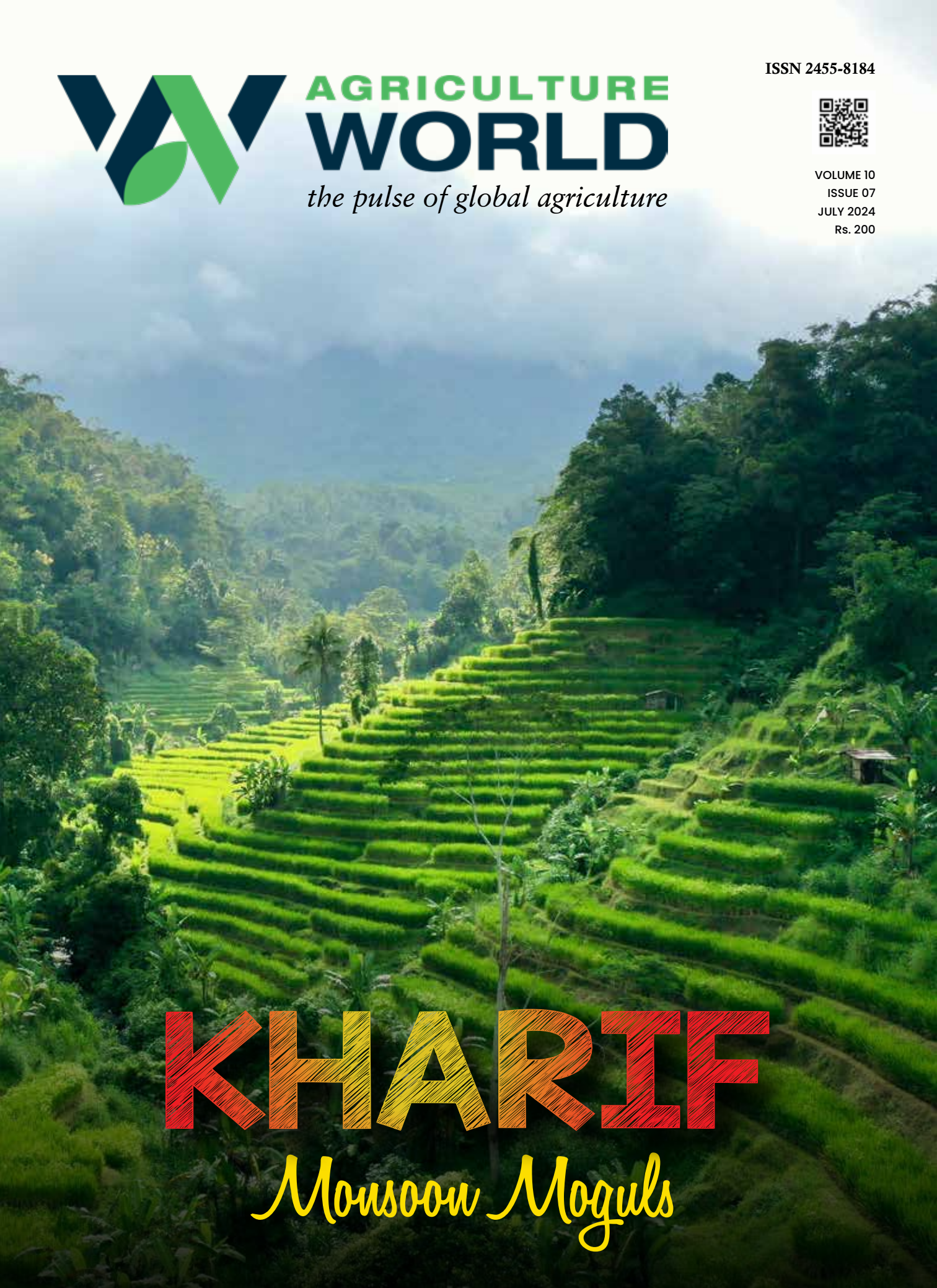

KHARIF

Monsoon Moguls

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CONTENT

THE VISION

M C Dominic
Founder & Editor-in-Chief

MFOI - The Gateway To The Heart Of Rural India

The "Millionaire Farmers of India" initiative by the Krishi Jagran Group is a commendable effort aimed at spotlighting the success stories of Indian farmers who have transformed their agricultural practices into highly profitable ventures. This initiative is particularly significant in a country where agriculture is the primary livelihood for a substantial portion of the population but often remains underappreciated and financially unrewarding. In this way, the MFOI initiative of the Krishi Jagran Group has emerged as the gateway to the heart of rural India.

Through this initiative, the Krishi Jagran Group seeks to change the narrative around farming. Our constant endeavour is to showcase individuals who have broken the traditional barriers of agriculture. These millionaire farmers have adopted innovative farming techniques, embraced technological advancements, and leveraged sustainable practices to maximize their yields and profits. They serve as the most inspiring role models for the farming community. These farmers have consistently proved that agriculture can be a lucrative career choice with the right knowledge and approach.

The stories featured in the "Millionaire Farmers of India" series often highlight the diverse ways in which these farmers have achieved their success. They have battled failure and they have struggled against challenges to emerge as role models. Some have adopted organic farming, while others have invested in high-value crops, modern irrigation methods, or agro-processing units. A large number of successful farmers have effectively utilized government schemes and subsidies. In this way, they have demonstrated the potential benefits of policy support when combined with entrepreneurial spirit and determination.

The MFOI initiative of the Krishi Jagran Group underscores the importance of education and continuous learning in farming. Many of these successful farmers actively seek out new information, attend workshops, and stay updated with the latest agricultural trends. This proactive approach to learning and adapting is a key factor in their success.

By bringing these stories to the forefront, the Krishi Jagran Group not only celebrates the achievements of these farmers but also aims to inspire a broader change in the agricultural landscape of India. The "Millionaire Farmers of India" initiative encourages other farmers to innovate and aspire for higher profitability, ultimately contributing to the economic growth and sustainability of the agricultural sector in India.

KHARIF - Towards Agricultural Prosperity

Kharif crops, sown at the beginning of the monsoon season and harvested in the autumn, play a crucial role in bringing prosperity to Indian farmers. These crops, which include staples like rice, maize, soybeans, and cotton, thrive on the ample rainfall that characterizes this season, leading to bountiful harvests that form the backbone of India's agricultural economy.

The success of Kharif crops is directly linked to the monsoon rains, which provide the necessary water for these crops to grow. Good monsoon seasons result in higher yields, translating to increased income for farmers. This not only ensures food security for the country but also enhances the livelihoods of millions of farming families. For many small and marginal farmers, the Kharif season represents the most critical period of the year, as the income generated during this time often supports them for the entire year.

In addition to providing staple foods, Kharif crops contribute significantly to the country's agricultural exports. Rice, for instance, is a major export commodity, bringing in valuable foreign exchange and boosting the national economy. The prosperity brought by successful Kharif seasons thus extends beyond individual farmers to the broader economic landscape of India.

The cultivation of Kharif crops stimulates various allied industries. Increased agricultural activity during this period leads to higher demand for seeds, fertilizers, pesticides, and farming equipment. This, in turn, supports local businesses and generates employment opportunities, further contributing to rural development and economic prosperity.

Government policies and initiatives play a vital role in ensuring the prosperity of Kharif crops. Subsidies on seeds and fertilizers, access to credit, and effective implementation of crop insurance schemes help mitigate the risks associated with farming, encouraging farmers to invest more in Kharif cultivation.

Kharif crops are a cornerstone of Indian agriculture, bringing prosperity through high yields, export opportunities, and stimulation of related industries. Their success, heavily reliant on monsoon rains and supportive government policies, ensures food security and economic stability for millions of Indian farmers.

Shiny Dominic
Managing Director

KHARIF – Emerging Perspectives

Climate change is affecting **Kharif,** worldwide. Erratic rainfall patterns, increased frequency of droughts or floods and rising temperatures pose challenges to productivity. Hence, farmers are adopting precision farming technologies to mitigate these challenges. The pandemic had exposed both, strengths and vulnerabilities of India's agri food systems. It emphasized the need to create safety nets and decentralize our systems to make them more resilient… for an ***Aatmnirbhar Krishi***.

Understanding the global perspectives of Kharif is crucial for policymakers, researchers, and farmers to address challenges, promote sustainable agricultural practices, and ensure food security.

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

Digital innovation, effective climate risk mitigation strategies, developing the start-up ecosystem, leveraging the strengths of Farmer Producer Organisations and water management initiatives will be some of the key emerging trends that promise an exponential growth curve for Indian Agriculture. Streamlining of policies and creation of necessary infrastructure will surely boost the infusion of digital solutions in agri-business. The digital innovation is expected to facilitate better quality, traceability, logistics and distribution and other areas of value chain.

Progressive farmers are beginning to understand how Artificial Intelligence offers them greater climate resilience, higher crop yield, and better price control. With Indian agriculture and allied sectors on the verge of adopting new technologies such as IoT and agri drones, government, industry, and research institutions have to form a consortium, so that agri-tech start-ups can flourish and meet the demands of Indian farmers. Smart farming that uses modern digital technologies such as sensors, robotics and analytics is fast changing the face of agriculture in India.

Liberalize Agriculture… make it more market friendly so that it is the demand and the prices that become an incentive for farmers to produce what the domestic and global markets demand. This edition of Agriculture World attempts to explore the Changing Dynamics of KHARIF – Contemporary Practices and Emerging Perspectives.

Mamta Jain
Group Editor & CEO

Tax Rate On Ghee Must Be Low

“

We need more milk collection centers, processing centers, better veterinary services, affordable semen, and better productivity infrastructure

In India, we need to increase productivity per animal. Cross-bred cows' average productivity is 8.5 liters per animal per day. For desi cows, the average productivity is 3.4 liters. Average buffalo productivity is 6 liters per day.

Our productivity is growing at the rate of 2.1 percent per annum. Consumption is growing at the rate of 5 to 5.5 percent per annum. Hence, it is clear that we must increase the productivity of each animal. We already have more than 300 million cattle and buffalo. We cannot afford more.

Consumers can't keep paying higher prices every year. There is an urgent need to reduce the cost of milk per liter. This shall make milk more affordable for the Indian masses.

On one side, we want the milk business to be more remunerative for the milk producers. On the other hand, we want to make milk affordable for consumers. This shall happen only with higher productivity.

Major Issues Of Concern

We need a higher feed conversion ratio. That is possible with better breeding and better feeding practices. Coming to the better breeding side, more and more animals must be covered under AI. There is a need to achieve a higher conception ratio.

ABOUT THE AUTHOR

Dr. R S Sodhi is President, Indian Dairy Association and Chairperson NIFTEM -T, Under Ministry of Food Processing Industry, GOI. Dr Sodhi is former Managing Director, GCMMF Ltd (Amul)

More trained human resources is essential for efficient AI. Sex-sorted semen needs to be more affordable. In sex-sorted semen and embryo transfer, we need a better conception ratio. If farmers have better breeds of animals, we can reduce the inter-calving period, and achieve faster first calving.

In India, there are 23 per cent NECO (Never Even Conceived Once) animals. There are practices to treat infertility among cattle. 10 to 15 pc of the NECO animals can be brought in the fertile range. In this way, more milk can be produced.

Our dairy farmers face a shortfall of feed. There is a 36 pc shortfall of green fodder, an 11 pc shortfall of dry fodder and a 44 pc shortfall of concentrate. We need higher availability of crop roughage.

In India, we feed the animals whatever is left over after human consumption. Our model is low input and low output. Because of low productivity, a significant portion of our feed is only for maintaining the body. Rs 90 to Rs 100 is the feed cost to maintain the animal's body. Whatever feed is given above is converted to milk.

With better feed, the animals shall yield more milk, and the cost of production shall be reduced. We need fewer animals and more milk per animal for a higher feed conversion ratio.

Rising Demand For Desi Ghee – Does Type Matter?

Ghee is made of many fatty acid profiles within milk. Each ghee will have a different profile of fatty acids based on the species of the animal.

Within the same species, the fatty acid profiles of milk may differ based on region and the type of feed given to the animal. It can vary depending on the lactation cycle of the animal, etc.

No scientific or clinical evidence can conclusively establish that desi cow ghee fatty acids are better than buffalo ghee or cross-bred cow ghee.

A1, A2 is a kind of protein present in milk. A2 milk or A2 ghee, or any other kind of milk are marketing gimmicks. A2 is a type of protein. Ghee is all fat.

All cows, all buffalos, all camels, all sheep, even 50 pc of cross-bred cow is A 2 milk. We can get some percentage of A 1 milk in some desi cows.

When it comes to ghee, people question whether desi cow ghee, cross-bred cow ghee, or buffalo ghee are the best. There is no established clinical research or evidence to support any statement for or against any kind of ghee.

We can kind of see the way ghee is made. The traditional process is the Bilona ghee. As per scientific evidence, bilona ghee has more CLA. It is considered healthier, has higher therapeutic value and has higher antioxidants.

Scientifically, it is stated that ghee made of curd has more health gains. Buyers must be careful of buying genuine ghee. In India, the supply is largely 47 pc buffalo milk and 53 pc cow milk. Buffalo milk has double fat as compared to cow milk. Regarding milk fat available in India, 60 pc comes from buffaloes, and 40 pc from cows. Among cows, 50 pc comes from desi cows and 50 pc from cross-bred cows.

Tax Rate On Ghee

The issue of tax levied on ghee is of concern to the dairy sector. Currently, the tax levied on ghee is 12 percent, while the tax levied on imported edible oil is 5 percent.

We are not able to understand that ghee is being taxed 2.5 times more than imported edible vegetable oil. It has been proven globally that dairy fat is better than refined vegetable fat. By levying higher taxes, we are taxing healthy produce more. We are taxing farmers to produce more. This is impacting farmer income.

The situation now is that for one liter or kg of fat, which costs approximately Rs 600, the government is levying Rs 72 as tax. To make one kg of ghee, 15 to 20 liters of milk. With such a high tax, the farmer is being taxed Rs 4-5 per liter for the milk he is producing. It is very high.

Policymakers think ghee is a luxury. The fact is that ghee is consumed – and should be consumed – by all classes. Ghee is made from the milk produced by poor farmers. And it is a healthy fat. It is unfortunate that high taxes is being imposed on poor farmers and also on healthy fat.

We have represented the GST Council to the Ministry of Animal Husbandry and Dairy in this regard. All state governments and state finance ministers must support this cause. We are requesting state cooperatives to take up this issue with the respective states.

Success Of The Cooperative Model

Our strong cooperative model is a major reason for India's leadership in the dairy sector. Farmers own the whole supply chain. They get 70-80 pc of what the consumer pays. This has brought tremendous efficiency in the supply chain.

The cooperative model has also set benchmarks for the private. Of the total organized milk sector in the country, 55 percent is the cooperative sector, and 45 per cent is the private sector. The private sector follows similar benchmarks to those set by the cooperative sector.

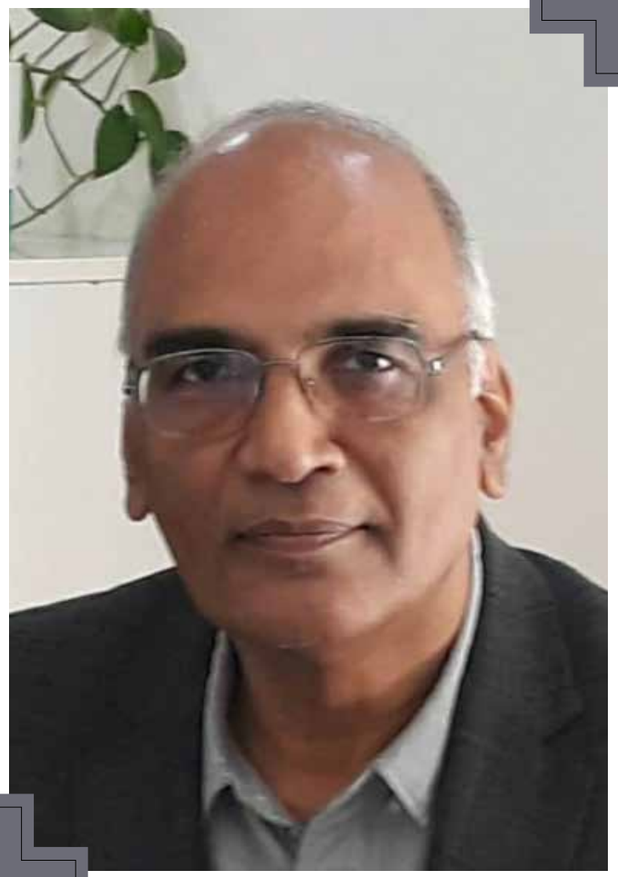
We Need White Revolution 2

The dairy sector contributes to 26 percent of total agriculture GDP. Hence, 26 pc should be allocated to the dairy sector in the Center and state budgets. We need to bring White Revolution 2 to provide more infrastructure, especially in the states where the unorganized sector is huge.

We need more milk collection centers, processing centers, better veterinary services, affordable semen, and better productivity infrastructure – the same that was provided in White Revolution 1.

Diversify Is the Mantra

> *Kharif 2024 is a very important season in changing some of the existing models in agriculture and giving a new direction to our farmers and consumers*



Kharif is a very important season for monsoon dependent Indian agriculture. Rice, Cotton, Soybean, Maize, Ground Nut, Millets, Red Gram and Vegetables are some of the major crops grown during Kharif. Last year Kharif was sown in about 110m ha while the Rabi acreage was about 90m ha.

Crop Shifts

There is an urgent need to diversify the crops being grown in Kharif. We have to increase acreages in oilseeds like Soybean, Sunflower and Ground Nut. Additional demand for Biofuel production is coming up for Maize in addition to feed requirements. Some acreages in North need to shift to Maize and Soybean (where suitable agroclimatic conditions prevail) from Rice.

During May we have seen an unprecedented drop of almost 40% of Cotton acreages in North. Devastation caused by Pink Bollworm (PBW) in last cotton season and lack of tools to control it, dropping yields and profits in cotton cultivation are some of the reasons. Favourable crop economics and low investment requirements have pushed up the sowing of Millets, Green Gram and others. While it is a desirable crop shift that is taking place in North, it is a pity that cotton acreages suffered when the country needs more cotton production. This demonstrates the need to fix the problems of cotton soon.

DSR Rice

Production of one Kg rice consumes high water investment, making it unsustainable! Transplanted Puddled Rice (TPR) method of cultivation is adopted by almost 80% of the global farmers. Transplanted rice produces 1.5% of the global Green House Gases and about 10-12% of the methane emissions. There is an urgent need to promote the alternate method of rice cultivation – Direct Seeded Rice (DSR). This has many advantages over TPR like faster sowing and earlier maturity, Better Water Use Efficiency (almost 40% water saving), Ground Water Replenishment, Labour Use Efficiency, Higher profitability to farmer (almost 25% higher returns), better physical properties of soil and decreased GHG emissions. Yields are better or comparable to TPR.

However, scaling up of DSR is lagging behind in spite of India facing tight water situation. Some of the enablers which will help in scale up are Mechanization (Precision Levellers and Seed Planters) and Weed Management Systems (Heavy infestation of weeds in DSR can be overcome through the use of Non-GM Herbicide Tolerance Rice system with facility to use multiple herbicides), breeding DSR amenable rice varieties and hybrids and good extension.

A populous country like India will not be able to ignore the demand for rice. Hence it is imperative that scientists, industry, administrators, farmers organizations and policy makers work towards scaling up DSR. It is debatable whether free power and free water policies of some of the states can motivate the farmer strongly to shift to water saving DSR. In the next 5 years at least 20% of rice acreage should be shifted to DSR.

In this Kharif we should target at least 30 lakh acres under DSR. Large scale farmer education and providing the enablers will be the key. Project teams of multiple stakeholders should take up this work in this Kharif.

HDPS Cotton

It is a well-known fact that our cotton yields fell from 530Kg/ha to 450Kg/ha in the last 6 years. 62 districts contributing to 37% of the cotton area produce very low yields at 230Kg/ha and another 69 districts contributing to 35% of area yield medium at 420Kg/ha. The rest of the 28% area produces a reasonably good 615 Kg/ha. It is very important to increase yields in the 62 low yielding districts on high priority. These districts are spread equally among cotton growing states of West and South.

High Density Planting System (HDPS) is the way to go forward in these districts. HDPS promotes close spacing. Depending on the local conditions regular cotton is planted at 15000 to 25000 plants/ha whereas in HDPS short duration, semi compact cotton hybrids are planted at populations ranging from 75000 to 1 lakh plants/ha. The objective is to maximise the number of bolls/unit area and realize a high yield in the shortest possible period. This will increase yields by 30% averaging 628Kg /ha.

Scale up of HDPS cotton needs enablers like pneumatic planters in sufficient numbers to plant large acreages in a short time. Switch from HDPS to mechanical picking will require plant growth regulators and defoliants along with the picking machines. This ecosystem needs to be built within the next five years.

But this Kharif, it is important to increase HDPS acreages substantially. At least 1 lakh hectares. This has to be done by multiple stakeholders coming together. CICR Nagpur, state governments, textile industry and agri input industry including the farm machinery industry must form project teams in important cotton states with low yielding districts and take this up in this Kharif.

Mechanization

There is a great need to scale up mechanization of farming. While the machines are developed in most cases, the commercial performance of custom hire centres has not been up to the mark. Additionally, innovations like drones for spraying of pesticides need attention and scale up by finding the right business model for the custom service centres. Lack of funds, seasonality of work and lack of capacity utilization of machines are major issues that are inhibiting scale up. Government, with the help of private industry, has to crack this puzzle this Kharif so as to improve farmers profitability.

Demand driven agriculture

We have to educate and encourage farmers to grow crops that are demanded by the consumers, food industry and other user industries. Crop planning at the micro level can improve farmers profitability, improve soil and water conservation, avoid storage losses and scale up value chain development. We should start this advisory and extension work this Kharif.

This has to be a very regionalized approach, depending on the local agro climatic conditions. There is a clear need to produce more of oilseeds, maize, cotton, millets, vegetables and fruits. State governments need to develop value chains for the priority crops. This, coupled with establishing traceability systems, will encourage feeding of the produce to value chains, export markets and other avenues.

Emerging Solutions

Kharif 2024 is a very important season in changing some of the existing models in agriculture and giving a new direction to our farmers and consumers. Some of the current practices have to be replaced with new, emerging solutions for the betterment and modernization of our agriculture. Multiple stakeholders have to work towards this objective.

ABOUT THE AUTHOR

Mr Ram Kaundinya has 45 years' experience in crop protection and seed industries. He is currently an adviser to Federation of Seed Industry of India. He is a partner with a strategic advisory firm AgVaya LLP

Kharif Dynamics

Making It More Productive And Climate Resilient

Dynamic crop weather calendar with improved weather forecasts may make agriculture more productive and climate resilient

ABOUT THE AUTHOR

Dr. A.K. Singh is Vice-Chancellor, Rani Lakshmi Bai Central Agricultural University, Jhansi

Today India is self-sufficient in food grain production. However, there is ever-growing demand to grow more food and thus there is enormous pressure on natural resources. Still about 45 percent of net sown area is rainfed which supports livelihood of about 40 percent of the population.

Recent studies reveal a significant increase in temperature, frequent heat waves, droughts, extreme precipitation and intense cyclonic activities. Indian agriculture mostly depends on the Southwest monsoon (June-September) contributing around 70–90 percent of annual rainfall. The rainfall pattern, onset and withdrawal, its spreads across the country, quantum of rainfall and its distribution during the monsoon season are crucial factors for determining agricultural production. The seasonal variability in monsoon rainfall, and occurrence of dry spells during the season are main challenges for kharif production.

Government of India has set up the target of 340.40 million tonnes of foodgrains production during the year 2024-25. The share of kharif production is targeted around 160 mllion tonnes. Major Kharif crops like rice is targeted to contribute 136.30 million tonnes, millets 14.37 million tonnes, groundnut 10.65 million tonnes, soybean 15.80 million tonnes, pigeon pea 4.5 million tonnes and Urd bean 3.05 million tonnes. It is essential to adopt/ upscale climate-smart agricultural practices for ensuring the food and nutritional security in sustainable manner.

Weather-Based Management Decisions

There is a prediction of normal rainfall this year. Timely information of the onset of monsoon & related events are crucial for pro-active crop planning for mitigation of ill effects in the *kharif* season. The dynamic crop weather calendar with improved weather forecasts may make agriculture more productive and climate resilient. Though normal monsoon is expected, district specific contingency plans should be ready in the event of any unforeseen floods or droughts in different pockets.

Crop Residue Management

In recent past residue burning of paddy crop has emerged as a major challenge causing serious environmental threat in the states like Punjab, Haryana, Western Uttar Pradesh, Delhi, and Madhya Pradesh. The major reason is attributed to growing of long duration paddy and thus, the availability of a few days only for disposal of residue between the harvest of paddy crop and sowing of wheat. In such a situation, farmers resort to residue-burning. Therefore, selecting short and medium-duration rice varieties may provide more days for management of residue after harvest of paddy. Also, the farm machinery may play a big role in in-situ and ex-situ residue management and timely zero till wheat sowing.

Crop Diversification For Sustainable Agriculture

The Indo-Gangetic plains of India could witness significant jump in foodgrain production but area under pulses and oilseeds reduced drastically along with the serious depletion of natural resources. It is noticeable that area under kharif cultivation has increased by 14.30 % and 1.93 % in rice and Nutri Cereals (Shri Anna) respectively while area under kharif pulses and oilseeds have declined during the kharif-2023 as compared to kharif-2022. Therefore, suitable strategy is required for increasing area under oilseeds and pulses during kharif season.

Central and some state governments are coming up with various schemes with incentive provisions to shift farmers from rice to other crops or adopt Direct Seeded Rice with medium duration varieties rather than transplanted rice to overcome the issue of depleting ground water table. Steps are needed to reduce the oilseeds import and increase the oilseed production by improvement in the productivity of kharif oilseed crops.

The yield gaps are huge in soybean (50%) and ground nut (40%). Reducing the yield gaps by 20%in oilseeds in the next five years may lead to 13-14 million tonnes of additional oilseeds production (3-4 million tonnes of edible oil). Diversification of rice-wheat cropping systems can take place in many forms, involving different crop species and/or varieties (intra and/or inter-specific diversification).

Most of the millets are kharif season crops (sown during May-June) and come to maturity during September to October which makes them more sustainable, and it also ensures timely sowing of Rabi crops. The momentum gained during International Year of Millets 2023 should be continued to improve nutritional security and climate resilient sustainable agriculture production.

Integrated Pest Management strategies need be adopted to tackle prominent problems like Fall Army Worm in Maize, Yellow Mossaic Virus in Urd/Moong crop, and pink ball worm in cotton. Several new varieties and traits which help in better tolerance/ resistance to drought, heat, salinity, diseases etc. have been evolved and it must be taken to farmers' fields. The yield gaps need to be bridged in case of millets also.

Water conservation

Surplus runoff must be harvested, stored and recycled for supplemental/ life-saving irrigation and soil moisture should be conserved in-situ for successful production especially of rainfed crops. There is a potential to harvest about 24 million ha-m of rainwater through small-scale water-harvesting structures in different rainfall zones of India. With this, an additional foodgrain production of about 60-65 million tonnes can be easily realized, along with multitude of physical to social benefits, food supply and income, increasing water and fodder for livestock, better recharging shallow groundwater sources.

Crop Establishment Techniques

Soybean is the leading kharif oilseed crop with an area of 125.13 lakh ha followed by groundnut crop (43.37 lakh ha). The, area of maize under kharif-2023 has also increased up to 82.86 lakh ha with an increase of 2.20 % over kharif-2022. Proper crop establishment methods like Broad Bed Furrow for ground-nut and soybean while Ridge and Furrow for maize, soybean, urd and moong crop should be upscaled for making the system more productive and climate resilient.

Raised beds/ridges offer the potential to reduce water logging stress through improved surface drainage and the opportunity to overcome drought tolerance due to in-situ-rain water harvesting.

The Critical Test

In today's media landscape it isn't easy to know who and what you can rely on. With the introduction of internet and social media, mass media came in the hands of everybody. In a way this was a democratic evolution, but it also puts higher demands on media consumers when there is no editor or ethic rules between the sender and the receiver of the communication.

As a media consumer you have to be very careful, and preferably also have some knowledge, to be able to judge which information and news are reliable. Sadly enough, there are many who want to spread either fake news or misleading information of different reasons. Even towards what you would think is a reliable source, you have to be critical.

Benefitting Farmers, Benefitting People

When consuming media or other information you should always ask yourself: who is the sender, why is it spread and what can be the purpose of it?

At the same time, as we more than ever need a prosperous global agriculture, both to feed a growing population and as a solution to climate changes and other future challenges for our planet, less and less people have any knowledge in farming and food production. This makes it easier to mislead people and use false information to win political advantages.

The International Federation of Agricultural Journalists, which AJAI is part of, is fully aware of this problem. Our mission is to enhance agricultural journalism, educate and support international colleagues so they freely and professionally can conduct their work, to the benefit of farmers, politicians and consumers. Experienced and well educated journalists can see through and not forward false information.

The Responsibility Of The Media

Where I live, we have an election for the European Parliament this weekend, and prior to this there has been a lot of rumors and false news in order to win political points. With the latest technics, such as artificial intelligence, you can make fake news look very realistic and reliable.

It is of course very important to counteract this, and media itself has an important role to play. With exposing and opposing fake news and guarantee reliable information, media can maintain its trust. And people's trust in free media is very important in a democratic society.

I therefore want to congratulate the Agriculture Journalists of India for launching AgriCheck. On behalf of your colleagues from all over the world I want to thank you for taking this initiative. It is a crucial step for the future of media to show the rest of society that our overall goal is to provide reliable and honest information.

Good luck with your important work!

ABOUT THE AUTHOR

Ms Lena Johansson is president of the International Federation of Agricultural Journalists, with 61 member countries including India, and former Editor in Chief of Sweden's largest agricultural magazine

ABOUT THE AUTHOR

Mr Ricky Thaper is Treasurer, Poultry Federation of India; Executive Member of All India Poultry Breeders Association and Honorary Vice President of North India Broiler Producers Association

Poultry Prosperity

Rising Consumer Demand for Economical Protein Sources is Driving the Poultry Industry's Growth

> India has transformed its poultry farming industry through major investments in breeding, hatching, rearing, and processing of chicken

India has the vast resources of livestock and poultry, which plays a vital role in improving the socio-economic conditions of rural masses. While the production of agricultural crops has been rising at a rate of 1.5 to 2 percent per annum, that of eggs and broilers has been rising at a rate of 8 to 10 percent per annum.

Poultry production in India valued at $ 30 billion has taken a huge leap in the last four decades, emerging from conventional farming practices to commercial production systems with state-of-the-art technological interventions. Currently the sector is estimated to employ more than 6 million people either directly or indirectly. The small and medium size farm (5000 birds onwards) mostly engaged in contract farming systems under larger integrators or companies.

According to the ministry of fisheries, animal husbandry and dairying, the poultry sector grew 8% annually during 2006-7 to 2021-22. The poultry meat output of 4.5 million tonne (MT), contributed to 51.4% of the total meat production of 9.3 MT in 2021-22. A report titled 'vision 2047: Indian Poultry sector by Confederation of Indian Industry (CII) has stated that the growth in the poultry sector in the country has been attributed to the commercial poultry industry which accounts for 85% of production while the rest of 15% of the output comes from the traditional backyard poultry.

Transformation In The Poultry Industry

India has transformed its poultry farming industry through major investments in breeding, hatching, rearing, and processing of chicken. India, as the third-largest producer of eggs (129.60 billion) and the fifth-largest producer of poultry meat (4.5 million tonnes) globally. As per the FAOSTAT, the USA has 17% share in global poultry meat production followed by China (12%), Brazil (11.7%), Russia (3.8%) and India (3.5%).

The government has been supporting the growth of the poultry sector through several initiatives like dedicated funds for setting up units, disease surveillance and providing support for ensuring supply of animal feed for the sector. Under the Animal Husbandry Infrastructure Development Fund was launched with a corpus of Rs. 15,000 crores in 2020, was recently extended for three years till 2025-26 under Infrastructure Development Fund (IDF) with an outlay of Rs. 29,610 crores.

The centre government provides a 3 per cent interest subvention to the borrower and credit guarantees up to 25 percent of total borrowing. The interest subvention is for 8 years including two years of moratorium for loan up to 90% from the scheduled bank and National Cooperative Development Corporation (NCDC), NABARD and National Dairy Development Board.

Incentivizing Investments

There are more than 5000 project proposals have been received under the fund which aims at incentivizing investments for dairy processing and product diversification, Meat processing and product diversification, animal feed plant, breed multiplication farm, animal waste to wealth management (agri-waste management) and veterinary vaccine and drug production facilities. Investment proposals for the modern poultry farms and feed plants have availed funds under this scheme.

The stakeholders including All India Poultry Breeders Association (AIPBA), Indian Dairy Association (IDA), Compound Livestock Feed Manufacturers' Associations (CLFMA), All India Livestock and Meat

Exporters' Association (AILMEA), Poultry Federation of India (PFI) and other associations have been suggested by Animal Husbandry Department to create awareness about the scheme.

The World Organisation for Animal Health (WOAH) has approved India's self-declaration of freedom from Highly Pathogenic Avian Influenza (HPAI) or referred to as bird flus in specific poultry compartments. Compartmentalization is a crucial tool that enhances animal health, reduces the risk of disease outbreaks within and outside the compartment, and facilitates the trade of poultry and poultry-related products, according to an official statement. The Department of Animal Husbandry & Dairying has submitted a self-declaration of freedom from High Pathogenicity Avian Influenza in 26 poultry compartments in four states - Maharashtra, Tamil Nadu, Uttar Pradesh, and Chhattisgarh to the WOAH. During the 2022-23, India exported poultry and poultry products worth $ 134 million to 64 countries. The approval of this self-declaration is expected to boost Indian poultry in the global market.

Under the National Livestock Mission's submission on Breed Development of Livestock & Poultry aims at bringing sharp focus on entrepreneurship development and breed improvement in poultry, sheep, goat and piggery by providing the incentive to the eligible entities like Individuals, Farmers Producers Organizations, Farmers Cooperative Organizations, Joint Liability Groups, Self Help Groups, Section 8 companies for entrepreneurship development and to the State Government.

Challenges

There has been increasing diversion of maize towards industrial use and ethanol production. Due to limitation of diversion of sugarcane towards ethanol production and to meet rising demand from animal feed and biofuel manufacturing, the government is aiming to increase production of maize by 10% to 42 million tonne (MT) by 2025-26 from 38 MT in 2022-23 crop year (July-June) through initiating measures such as crop diversification, cluster development for ethanol plants and involving private sector in seed development.

About 60-65% of the output of maize is used as poultry and animal feed while 20% is used for industrial use. The current growth level of maize and soybean production in the country will be insufficient to meet the demand of the poultry industry.

The industry associations have urged the government to allow imports of GM maize and soybean because of 'unprecedented increase' in prices while adding that interest of the domestic producers should be protected too. Several south Asian countries including Bangladesh, Nepal and Sri Lanka have allowed imports of GM soymeal.

In August 2021, the government had relaxed import rules to allow the first shipment of 1.2 MT (million tonne) of Genetically Modified soymeal to support the domestic poultry industry after a record spike in feed prices.

Poultry Protein Promotion: A Collaborative Effort

Chicken meat and eggs are perceived as healthier alternatives to red meat, driving up demand. Poultry products are often more affordable than other protein sources, making them accessible to a broader segment of the population. In the post Covid19 pandemic phase also because of demand for the protein rich food like poultry meat and eggs have increased sharply. The growing awareness regarding health and wellness is further driving the demand for a protein-rich diet.

To promote poultry meat as key driver of increasing protein intake, he Poultry Federation of India recently organised the press meet at Press Club of India, New Delhi, on Poultry Protein jointly with the United Soybean Board, USA Poultry & Egg Export Council, and the World Veterinary Poultry Association.

The objective of this meeting was to pitch for promotion of chicken and eggs as the premier source of protein for consumers. Additionally, various other associations including CLFMA of India, NECC, All India Poultry Breeders Association, IPEMA, Vets in Poultry, INFAH, North India Broiler Producers Association, Karnataka Poultry Farmers & Breeders Association, Andhra Pradesh Poultry Federation, Telangana Poultry Federation, Poultry Breeders Association-Telangana, Poultry Farmers' and Breeders' Association-Maharashtra, Broiler Breeders Association-North, Central Haryana are a Poultry Farmers Association, West Bengal Poultry Federation, along with other regional and state-level associations, are collaborating towards promote chicken and eggs within their respective regions.

A major chunk of the country's population eats non-vegetarian food. The poultry meat and eggs remain one of the healthy and economical sources of protein. Post Covid-19, several consumers have added poultry meat and eggs to their diets.

There are several companies willing to invest in the Indian poultry sector which is witnessing a steady growth rate over the decades. The government must take proactive measures to improve feed supplies so the growth and value-addition of agriculture and allied sectors such as poultry, dairy and shrimp farming is sustained. As 100% Foreign Direct Investment is permitted through automatic route in the food processing sector including poultry sector, there is a huge opportunity for upgrading infrastructure, breeding, medication, feed production, vertical integration and processing and there are several multi-national companies that have envisaged plans to invest in the Indian poultry sector.

The Changing Dynamics of Kharif Farming

Technology Practices and Crop Evolution

> Continuous innovation is key to a resilient and sustainable agricultural sector

A vital component of the agricultural landscape in nations such as India, Kharif farming involves cultivating crops during the monsoon season, usually from June to October. Largely reliant on monsoon rains, advancements in technology and changing farming methods have brought about considerable changes to Kharif farming. This article examines these modifications, emphasizing the incorporation of contemporary technologies, modifications to crop patterns, and the effects of these advancements on the environment and socioeconomic conditions.

Traditional Kharif Farming

Traditionally farmers used to sow seeds at the onset of the monsoon signalling the beginning of the Kharif farming. The principal crops rice, maize, millet, and pulses such as pigeonpea, are well suited to the rainy season. Given the rain-dependent nature of these crops, their yields were determined by both the amount and distribution of rain. Techniques such as manual sowing, basic irrigation methods, and natural fertilizers predominated. While these methods sustained agriculture for centuries, they often resulted in inconsistent yields and were vulnerable to erratic weather patterns.

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Technological Advancements

Technologies has completely changed Kharif farming by bringing efficiency and precision to farming methods. Drones, Internet of Things (IoT) devices, GPS, and other modern technology have become integral to farming operations.

- **Precision farming:** By monitoring field fluctuations with GPS and IoT devices, exact applications of herbicides, fertilizers, and water are now possible. As a result, there is reduction in cost and enhancement in production.
- **Biotechnology:** Improvements in biotechnology have produced crop varieties with high yields that are resistant to pests and drought, ensuring higher yields even in challenging environments.
- **Drones:** Drones are utilized for pesticide spraying, aerial monitoring, and plant health assessment. They capture data in real time, facilitating well-informed decision-making.
- **Automated Irrigation Systems:** Smart irrigation systems with sensors optimize water use, conserving water and ensuring consistent crop hydration.

Modern Practices

Modern farming methods have changed to become more effective and sustainable as a result of technological integration.

- **Organic Farming:** Growing awareness of health and environmental sustainability has sparked a trend toward organic farming, avoiding synthetic inputs and relying on natural fertilizers and pest control.
- **Mobile Apps and Platforms:** These help with knowledge exchange and enhance decision-making by offering real-time information on market pricing, weather forecasts, and best practices.
- **Artificial Intelligence and Machine Learning:** To help farmers manage their operations more efficiently, lower risks, and increase yields, algorithms evaluate data to forecast weather trends.
- **Integrated Pest Management (IPM):** IPM reduces reliance on chemical pesticides and promotes healthier crops and soil by combining biological, cultural, and chemical techniques to manage pests in an eco friendly manner.

Impact on Crop Patterns

The Kharif has witnessed a notable impact on crop selections and patterns due to technological developments.

- **Diversification:** Farmers vary their crops to improve soil health, lower pest outbreaks, and provide a variety of revenue streams in an effort to reduce the hazards associated with monocropping.
- **Changes in Crop Choices:** Farmers are choosing more crops that can withstand climate change such as millets, which is gaining popularity due to its resilience and nutritional value.
- **New Crop Varieties:** Thanks to biotechnology, there are now early maturing and more disease- and pest-resistant crop varieties available, guaranteeing consistent production even in the face of weather variations.

Socio-economic Impacts

- **Increased Productivity and Profitability:** Modern technologies and improved practices lead to higher crop yields and better quality produce, translating to higher incomes for farmers.
- **Difficulties for Small Farmers:** Due to their low knowledge and high expenses, small and marginal farmers frequently encounter difficulties implementing new technology. As a result, they require specialized assistance in the form of subsidies and training programs.
- **Government Policies:** Through initiatives and policies, such as funding for modern equipment, investments in rural infrastructure, and training programs, governments encourage the adoption of technology.
- **Labour Dynamics:** Mechanization reduces the need for manual labor, shifting labor dynamics. While this eases physical strain on farmers, it also poses challenges for laborers who rely on seasonal agricultural work.

Environmental Considerations

- **Soil Health and Biodiversity:** Crop rotation, organic farming, and a decrease in chemical use are examples of sustainable practices that support soil health and biodiversity. On the other hand, overuse of pesticides and fertilizers in conventional farming can damage beneficial species and lower soil quality.
- **Sustainable Agriculture:** Precision farming, waste reduction, and a reduction in the environmental impact of farming operations are all made possible by technology.
- **Water management:** In areas where water is scarce, smart irrigation systems and rainwater harvesting strategies encourage effective water use. By maintaining the water table, these actions guarantee the availability of sustainable water resources.

Challenges and Future Prospects

Despite the benefits, several challenges hinder the widespread adoption of modern technologies in Kharif farming.

- **Cost and Knowledge Barriers:** High initial costs and lack of technical knowledge are major barriers. To meet these obstacles, farmers need training and financial support.
- **Infrastructure:** Inadequate rural infrastructure, such as poor internet connectivity and limited market access, hampers effective use of technology.
- **Future Trends:** New technologies like genetic engineering, vertical farming, and blockchain for supply chain transparency hold promise for further enhancing productivity and sustainability.

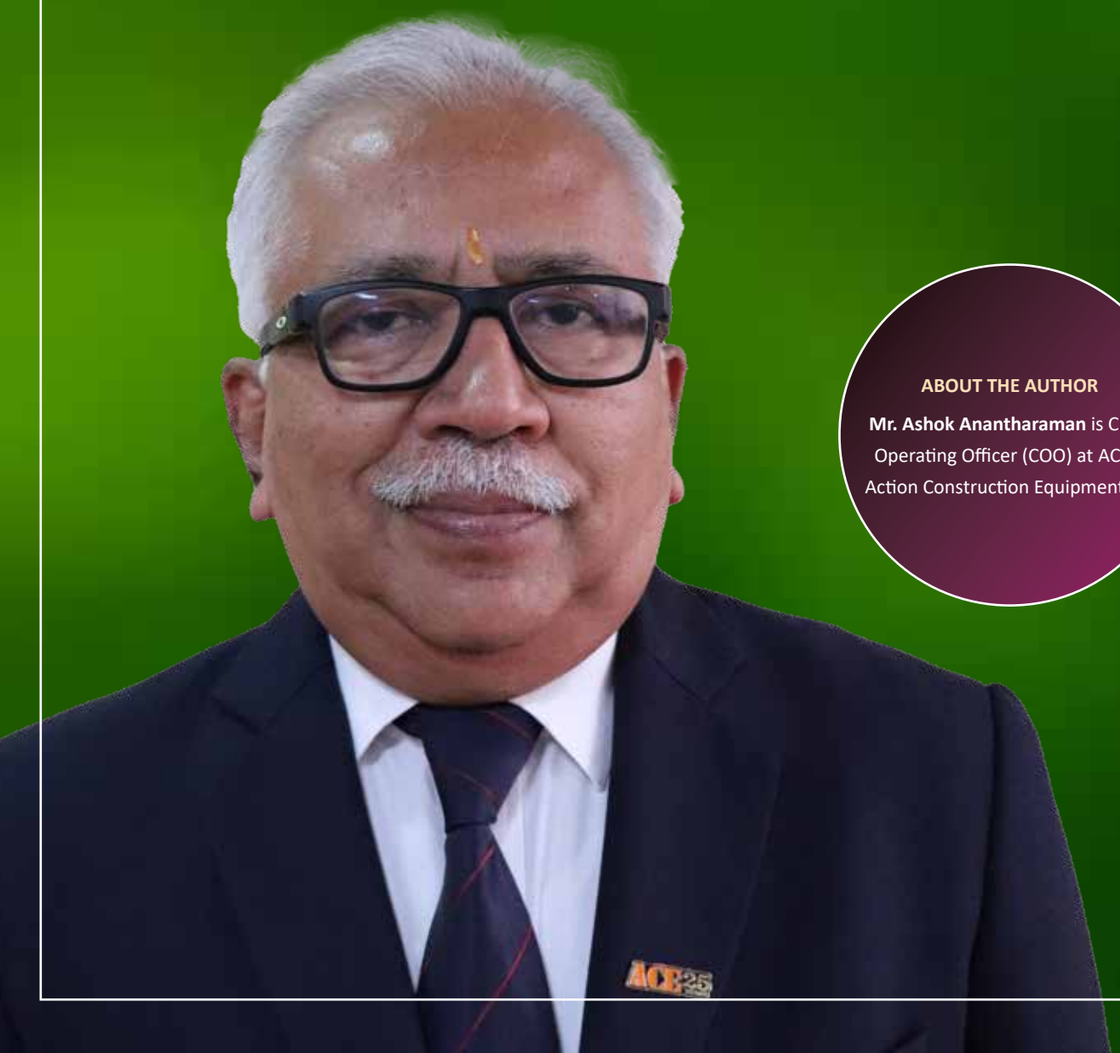
The Road Ahead

Technology and contemporary farming methods are driving a rapid evolution in the dynamics of Kharif farming. These changes promise higher productivity, sustainability, and profitability for farmers. However, addressing the challenges of cost, knowledge, and infrastructure is crucial to ensure all farmers benefit from these advancements. Continuous innovation is key to a resilient and sustainable agricultural sector.

Climate Smart Agriculture

Empower Farmers, Assure Food Security, Protect Our Ecosystem

> Precision farming therefore is not a luxury. It is a necessity to ensure food security, protect our natural resources and build resilience against the increasingly challenging climate



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Food insecurity and climate change are among the most pressing challenges facing humanity. We are witnessing the severe impact of climate change. India continues to be hit by heatwaves, flash floods, droughts and cyclones. All this has a negative impact on agriculture production.

As a result of climate change, traditional farming practices are becoming less productive. Climate change is increasing the dangers faced by farmers, prompting them to re-evaluate their practices.

We need a holistic strategy to address the above concerns so that agri production can be increased by 50%-60% by 2050 in order to fulfill food demand.

New Technologies & Innovations for Smart Agriculture

Agriculture is undergoing a major trans-formative shift with integration of smart technologies into the current landscape of traditional farming. These interventions are leading to enhanced productivity and sustainability in the agri sector.

Empowering Agricultural Production Systems

The cutting-edge technologies which are driving Smart Agriculture are Artificial Intelligence (AI) and Internet of Things (IOT), Robot Technology, Big Data Analytics and Block chain Technology.

With the help of IOT, one can monitor Real Time data. AI helps in optimization and enhancing the decision-making process. The amalgamation of all these technologies empowers Agricultural Production Systems.

Advantages of Smart Agriculture for Farmers

- Using fewer Inputs.
- Reducing Chemical usage.
- Preventing Soil erosion.
- Increased productivity.
- Higher Yields.
- Timely decision making.
- Reducing Environmental footprint.
- Manage Crop health more effectively.

Precision Farming and Its Benefits

When one looks at Smart Agriculture, one of the major solutions is Precision Farming. It is a systems approach to farming. Automation plays a pivotal role in modern precision farming. Autonomous Tractors, Drones, Robotics Systems used for monitoring crop health – all these are critical to precision farming. Farmers use fewer inputs, thus reducing chemicals usage and preventing soil erosion.

Reduced tillage and precise application of inputs also help mitigate soil erosion, nutrition runoff and greenhouse gas emission.

All this helps farmers to monitor and manage crop health more effectively, thus leading to improved food quality. Automation and Robotics also reduce labour requirements in agriculture. The path to sustainable agriculture is a collaborative one. All stake holders - Farmer, Researchers, Policymakers and Consumers play an important role.

As global population continues to grow, demand for food will intensify. Precision farming therefore is not a luxury. It is a necessity to ensure food security, protect our natural resources and build resilience against the increasingly challenging climate. By nurturing healthy soils and ecosystems, we are factoring a sustainable foundation for agriculture.

Challenges & Barriers for Smart Agriculture

- Expensive for Small scale farmers - (cost of equipment software etc.)
- Farmers need to acquire technical skills to operate and maintain the Precision farming equipment's. Regular training is required for ensuring technological literacy.
- Data protection by all stake holders + safe usage of data.
- Data Interpretation
- Compatibility issues.

Future of Smart Agriculture

Smart Agriculture has excellent possibilities for all the stakeholders.

- Newer technologies are set to further transform agriculture.
- Government policies and initiatives being aligned with the "Smart Agriculture" goal.
- Meticulous data collection which will facilitate Optimizing Farm Management decisions.

With all the relevant stake holders implementing these new intervention/ tools, increased efficiency sustainability and resilience is expected in the face of stiff challenges.

Changing Dynamics of Kharif Farming in India

To ensure sustainable growth and resilience, it is crucial to continue investing in technology, promoting sustainable practices, and supporting farmers through favourable policies and infrastructure development

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Kharif farming, characterized by the cultivation of crops sown at the onset of the southwest monsoon in India, spanning from June to September, is crucial for crops such as rice, maize, cotton, and soybean has witnessed substantial transformations in recent years. However, the traditional practices associated with Kharif farming are being reshaped by various dynamic factors i.e., Climate change, with its erratic rainfall patterns and rising temperatures, poses significant challenges to farmers, affecting crop yields and increasing vulnerability to pests and diseases. These changes are propelled by various other factors, among which technological advancements, innovative farming practices, and shifts in crop patterns stand out prominently. This evolution is reshaping the agricultural landscape, presenting both challenges and opportunities for enhancing productivity and sustainability. Technological advancements, including the development of high-yielding and resilient seed varieties, precision agriculture tools, and modern irrigation techniques, are revolutionizing farming practices, enhancing productivity and resource efficiency.

Technological advancements have played a significant role in transforming Kharif farming. The introduction of high-yielding, drought-tolerant, and pest-resistant seed varieties has helped farmers mitigate some of the risks associated with changing weather patterns. Precision agriculture technologies, including GPS and remote sensing, have enabled more efficient use of resources such as water and fertilizers, thereby increasing crop productivity and sustainability. Modern irrigation techniques, like drip and sprinkler systems, are being adopted to cope with water scarcity, ensuring that crops receive adequate moisture even in the absence of regular rainfall.

One of the most profound shifts in Kharif farming is driven by technological advancements. The integration of technology into agriculture has revolutionized traditional farming methods, enhancing efficiency, productivity, and resilience.

Key technological developments include:

- High-Yielding and Resilient Seed Varieties; advances in agricultural biotechnology have led to the development of high-yielding, drought-resistant, and pest-resistant seed varieties. These genetically improved seeds ensure better crop performance even under adverse climatic conditions, thereby securing farmers' incomes and reducing the risk of crop failures.
- Precision Agriculture involves the use of GPS, remote sensing, and data analytics to monitor and manage farm operations with high precision. Technologies like drones and satellite imagery provide real-time data on soil health, moisture levels, and crop growth, enabling farmers to make informed decisions. This results in optimal use of inputs such as water, fertilizers, and pesticides, enhancing crop yield and minimizing environmental impact.
- Modern Irrigation Techniques; water scarcity is a significant challenge in Kharif farming, particularly in regions with erratic monsoon patterns. Modern irrigation methods, such as drip and sprinkler systems, have emerged as effective solutions. These techniques ensure efficient water usage by delivering water directly to the plant roots, reducing wastage and improving water use efficiency.
- Mechanization; the adoption of farm machinery, including tractors, harvesters, and seed drills, has increased labour efficiency and productivity. Mechanization reduces the reliance on manual labour, which is particularly beneficial in the context of rural-to-urban migration and labour shortages in the agricultural sector.

Innovative Farming Practices

Alongside technological advancements, innovative farming practices are reshaping Kharif cultivation. These practices aim to enhance sustainability, productivity, and resilience against climatic and economic uncertainties.

- Conservation Agriculture practices, such as zero tillage, crop rotation, and cover cropping, are gaining popularity among farmers. Zero tillage involves minimal soil disturbance, which helps in maintaining soil structure, reducing erosion, and conserving moisture. Crop rotation and cover cropping improve soil fertility and break pest and disease cycles, leading to healthier and more productive crops.
- Integrated Pest Management (IPM) combines biological, cultural, mechanical, and chemical methods to manage pests in an environmentally and economically sustainable manner. By reducing the reliance on chemical pesticides, IPM helps in maintaining ecological balance and reducing the risk of pest resistance.
- Organic Farming; with increasing consumer demand for organic products, many farmers are adopting organic farming practices. Organic farming involves the use of natural inputs and practices to enhance soil fertility and manage pests. This method promotes biodiversity, improves soil health, and reduces environmental pollution.
- Agroforestry integrates trees and shrubs into crop and livestock farming systems. This practice provides multiple benefits, including improved soil health, enhanced biodiversity, and additional income sources from timber, fruits, and other tree products. Agroforestry also contributes to carbon sequestration, mitigating the impacts of climate change.

Policy interventions have also contributed to the shift in Kharif cultivation. Government initiatives like the Pradhan Mantri Fasal Bima Yojana (PMFBY) provide crop insurance, helping farmers manage financial risks associated with crop failures. Subsidies on fertilizers, seeds, and farm machinery, along with minimum support prices (MSPs) for key crops, have influenced farmers' choices and encouraged the adoption of improved agricultural practices. Additionally, programs like PM-KISAN, which offers direct income support to farmers, have bolstered economic stability and incentivized investments in better farming techniques.

Socio-economic factors, including labour migration and improved market access, have further influenced Kharif farming dynamics. The migration of rural labour to urban areas has led to labour shortages in the agricultural sector, prompting farmers to adopt more mechanized farming methods. Enhanced connectivity and digital platforms have improved farmers' access to markets, enabling them to secure better prices for their produce and reducing dependency on intermediaries.

Crop Diversification And Sustainable Agricultural Practices

Furthermore, there has been a noticeable trend towards crop diversification and sustainable agricultural practices. Faced with the uncertainties of climate change and market volatility, farmers are increasingly diversifying their crops to include high-value crops such as fruits, vegetables, and pulses. This not only helps in risk mitigation but also improves income stability. Sustainable practices, including organic farming, zero tillage, and IPM, are gaining attention, driven by the dual objectives of environmental conservation and long-term soil health improvement.

The Road Ahead

The changing dynamics of Kharif farming in India reflect a multifaceted evolution driven by technological advancements, innovative practices, shifts in crop patterns, policy support, and socio-economic factors. These transformations present both challenges and opportunities for the agricultural sector. To ensure sustainable growth and resilience, it is crucial to continue investing in technology, promoting sustainable practices, and supporting farmers through favourable policies and infrastructure development. By adapting to these changing dynamics, Kharif farming can contribute significantly to India's food security, economic stability, and environmental sustainability.

Climate-Smart Agriculture for

Basmati Rice Production

> **The path to sustainable Basmati rice cultivation is a stunning symphony of creation, adaptation, and change**

ABOUT THE AUTHOR

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Global food security is an important concern, due to inefficiencies in agricultural practices, over-exploitation of agricultural inputs, and the impacts of climate change, which contribute to the degradation of natural resources and it exacerbates crop failures due to recurrent extreme weather events such as droughts, floods and high temperatures. Furthermore, floods lasting 10 to 18 days exacerbate these challenges.

Climate-Smart agriculture acknowledges the gravity of the problem; therefore, it offers a ray of hope. It also provides a multifaceted strategy to improve food and nutrition security, with an emphasis on boosting farm income and productivity, building community adaptability, and lowering greenhouse gas emissions. India has already been implementing several encouraging strategies to increase basmati rice production in an environmentally friendly way:

- Nitrogen Management helps farmers manage nitrogen effectively, lessening its environmental impact and maintaining the balance of plant nutrients.
- Using Neem-Coated Urea reduces greenhouse gas emissions, delays the release of nitrogen, and provides rice plants with effective nutrition.
- Adapting fertilizer applications to appropriate soil conditions improves soil health and nutrient uptake while increasing yields.
- Efficient irrigation techniques reduce water waste and promote water efficiency, which is especially significant in water-scarce areas.
- Practices such as minimal soil disturbance and crop residue management improve soil structure, conserve water, and enhance overall ecosystem health.
- Direct Seeded Rice minimizes water usage and labor while increasing crop establishment efficiency, offering a sustainable alternative to traditional transplanting methods.

In Bangladesh and India, farmers lose 4 million tonnes of rice annually due to floods alone. However, there is hope ahead. Rice strains developed by CGIAR carrying the SUB1 gene have shown remarkable adaptability to being fully submerged in water. These varieties have demonstrated an average increase in yield of 1-3 tons compared to the original varieties. By increasing the adoption of these strategies, research, and continuous innovation, Indian farmers can overcome the challenges posed by climate change, ensuring a resilient and sustainable future for Basmati rice. As stewards of the land, we have a responsibility to implement these solutions to ensure that future generations are fed.

Developing And Promoting High-Yielding Basmati Varieties

Speaking from experience, we at KRBL Limited have always maintained a close working relationship with the PUSA Institute, investing in developing and promoting high-yielding Basmati varieties to maximize output given the resources available in today's climatic conditions. Some of the new seeds, like 1847, 1885, and 1886, are evolved varieties that are high-yielding and MRL compliant. We ensure the dissemination of these seeds through our seed extension programs, working closely with farmers to promote these varieties in Basmati growing areas, ensuring that these developments reach those who need them most.

Kharif paddy production trends are highly variable due to multidimensional impacts of climate change. Agriculture is particularly sensitive to global warming and faces challenges and opportunities that are changing traditional practices. Rising temperatures and changing rainfall patterns are changing agricultural areas, increasing drought stress especially in semi-arid regions These climate changes affect water resources distribution, growing season, and ultimately the yield of crops. While kharif crops like basmati rice are grown during the rainy season, variations in the amount and duration of rainfall pose severe challenges extreme climatic conditions such as increased frequency of drought and floods further increases the risks associated with rice production, necessitating adaptive policies to ensure its sustainability

In response to these challenges, modern trends in kharif rice cultivation have increasingly focused on climate-smart practices. A combination of drought-resistant rice varieties, water management techniques and pest management is needed. Research suggests that the direct impact of climate change on kharif crops may be limited but it makes kharif agriculture more vulnerable to increased weather extremes. In addition, intervention programs supporting research and development, farmer education and infrastructure development are needed to make kharif rice production more resilient to ongoing climate challenges. By integrating these strategies, farmers can better manage the complexities of climate change, and ensure the sustainability and productivity of kharif paddy crops.

Balanced, Environment-Friendly Farming

The path to sustainable Basmati rice cultivation is a stunning symphony of creation, adaptation, and change. Farmers who have accepted the responsibility of balanced farming with the environment have not only restored their position as representatives of the planet but have also emerged as champions for the next generation of environmentalists. Through their unwavering efforts and dedication to climate-friendly practices, they are sowing the seeds of change, ensuring that Basmati rice will continue to support our plates and our world for many years to come.

Monsoon Bounty

A better kharif season is always brings better prospects to rabi cropping, animal husbandry and fishing

The kharif season is significant and unique as it contributes about 50% of fine cereals and over 70% of nutri-cereals, 40% pulses and 70% of edible oilseeds and almost entire cotton, jute, mesta, and sugarcane.

Beyond the production of kharif crops, a better kharif season is always brings better prospects to rabi cropping, animal husbandry and fishing by virtue of more residual soil moisture and water in reservoirs for irrigation, better fodder and grasses availability for livestock and water-filled ponds and seasonal rivers for fisheries.

Changes In The Kharif Cropping Season

The kharif cropping has seen a sea change over period of time post-Green Revolution. While the green revolution technologies especially dwarf varieties of rice and later hybrid rice in 60s, 70s and 80s and basmati variety Pusa-1121 during first decade of 20th century onwards revolutionised the whole rice cropping, the hybrids of maize, jowar and bajra helped augmenting productivity of these stressed crops despite sizeable area shifting to oilseeds, pulses, cotton and maize.

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Another milestone in technological development adding to kharif was introduction of Bt cotton in 2002 which enhanced area by 5.62 m ha and production by 4.53 million tons of cotton by 2021/22. The growth in productivity of cotton was almost 1.5 times than the growth in area during 2002/03 to 2020/21. The foodgrain landscape during kharif and rabi changed markedly over time. While during 60s to early 80s, the kharif foodgrains accounted about 50% of the gross cropped area of India, the same declined to 34.5% in 2020-21. The share of rabi cropping increased from 23.6% to 27.2% during this period (Figure 1). This is obviously due to area expansion under non-foodgrain crops.

Of the total cropped area of about 211.01 million ha, about 50% (105.28 m ha) is occupied by the kharif crops which together produces 534.33 million tons of agricultural produce (Table 1). Rice is the major staple foodgrains produced in kharif followed by millets and pulses. Soybean and groundnut are major edible oilseeds and cotton and sugarcane are the leading commercial crops.

Table 1: Normal (average of 2016/17 to 2020/21) area, production and yield of major kharif crops (2016-2021)

Crops	Area (m ha)	Production (m tons)	Yield (kg/ha)
Rice	39.54	99.44	2515
Jowar	1.91	1.92	1005
Bajra	7.40	9.49	1283
Maize	7.54	19.47	2582
Small millets	1.54	1.99	1292
Tur	4.71	4.09	868
Other Kharif Pulses	9.46	4.64	490
Total Kharif Foodgrains	72.10	141.03	1956
Groundnut	4.95	8.35	1688
Soyabean	11.21	12.15	1084
Sugarcane	4.71	365.47	77609
Cotton @	12.38	5.51	445
Jute & Mesta$	0.72	1.83	2540
Total	105.28	534.33	--

Source: Authors calculation based on Agricultural Statistics at a Glance, 2022, MoAFW

Rainfall And Kharif Cropping

The success of a large proportion of kharif area under different crops depends solely on the intensity and distribution of S-W monsoon. However, this scenario is also changing due to expansion of irrigation and development of new varieties and improved management technologies which are able to offset some of the adverse effect of water stress.

During 2005 to 2021, the severe drought was experienced in 2009 in all the broad meteorological divisions except south peninsula which hit production by 14 million tons as compared to 2008. However, in subsequent years of 2012, 2014 and 2020 the production was not affected much. It establishes that up to 18-20% deficit in rainfall in N-W India can be offset by irrigation but with an enhanced cost to farmers.

Since the introduction of green revolution technologies, the dynamics of kharif season changed entirely. The productivity grew impressively despite the limitations of climate and weather, soil and water resources, and virulent pests and pathogens. While production was less than area under kharif foodgrains till 1987/88, it surpassed area in 1988/89 and continued progressing well with productivity rising steadily. In 2020-21, the production of kharif foodgrains is more than twice the area (Figure 3). Similar changes have been experienced in other sectors as well due to better varieties, management of diseases and pests and adoption of better management practices in all sub-sectors of agriculture.

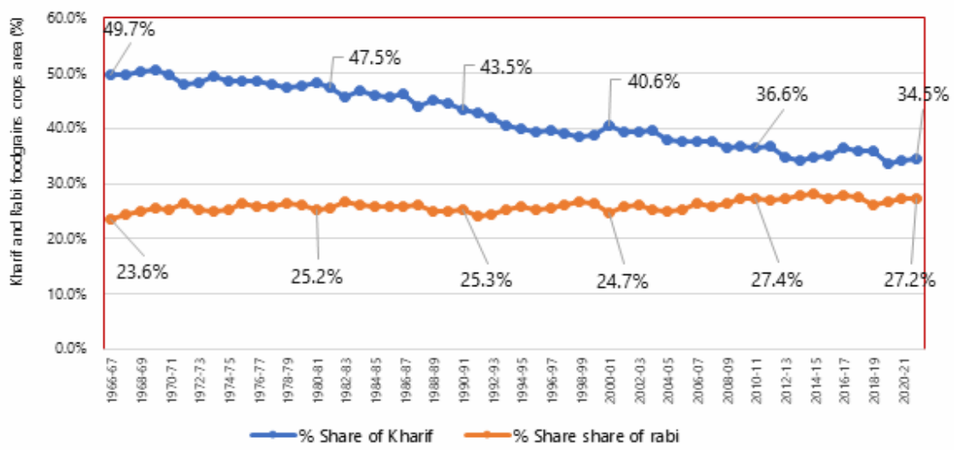
Technologies In Agriculture

The technologies in agriculture are changing fast with the infusion of precision tools and techniques. The breeding protocols, good agricultural and management practices and digital technologies have made inroads to farmers' fields and households and are expanding with strong handholding of ICAR, KVKs, SAUs, Industries and young entrepreneurs-startups.

The recent developments in the fields of herbicide tolerance in basmati rice and private bred hybrids of rice are likely to make a positive change in the vertical diversification of rice technologies like direct seeded rice in those ecologies which have been struggling for the want of high yielding but water-positive and cost-effective rice production in kharif season. The new varieties and systems in maize, nutri-cereals, oilseeds, pulses and commercial crops and allied sectors of livestock and fishing are poised to make a paradigm change in kharif.

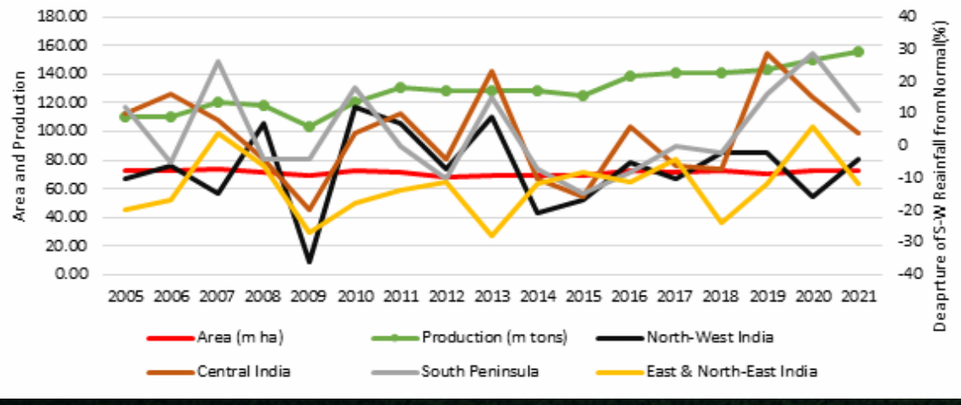
Our endeavour under National Innovations for Climate Resilient Agriculture (NICRA) has been received well and appreciated worldwide including the G-20 Group of Nations. The new varieties and practices in kharif crops, breed, health and nutrition management in livestock, avians and fish with the central role of KVKs have been able to bring additional production in the past. The outstanding impact has been reflected in more than doubling of production with almost static area for last three decades under kharif cropping which establishes the absolute merits of proactive disseminations of technologies.

Figure 1: Changing landscape of foodgrains cropping over time in kharif and rabi seasons



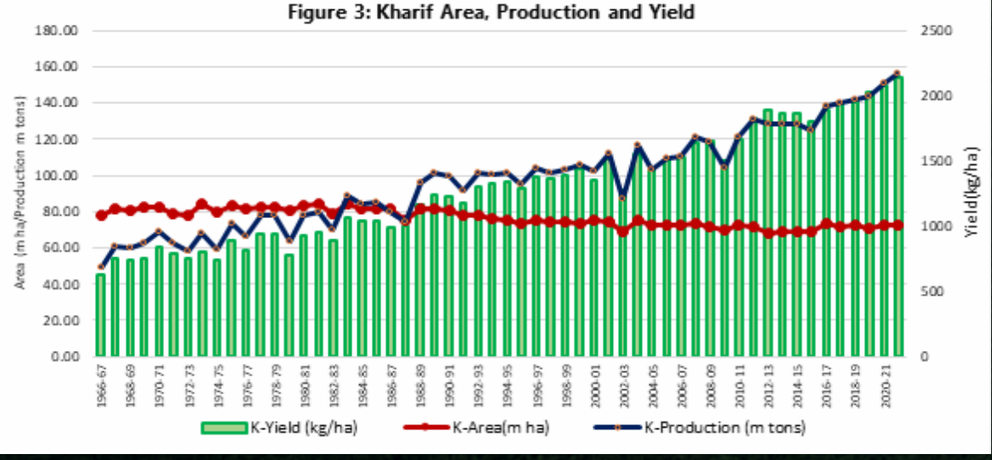
Source: Authors calculation based of different volumes of Agricultural Statistics at a Glance, MoAFW

Figure 2: Perfromance of S-W Rainfall and Kharif Cropping



Source: M/o Agriculture & Farmers Welfare, Agricultural Statistics at a Glance, 2022

Figure 3: Kharif Area, Production and Yield



Source: Agricultural Statistics at a Glance, 2022

COW BASED NATURAL FARMING

A reward of 1 crore rupees has been announced to the farmers if they suffer a loss of 20/- rupees in this experiment.

I have been promoting cow-based agriculture for the last 20 years.IN which Jivamrut,Ghanjivamrut, Cow Milk, Jaggery, Gomutra (Cow Urine) and Cow dung water.

JIVAMRUT

After pouring 200 liter Water in 200 liter of barrel water add 20 kg Cow Dung,5 to 10 liters Cow urine (Gomutra),2 kg jaggery,2 liters Cow butter Milk Mix it for 3 to 4 days then irrigated this liquid with well or bore water every 15 days in 1 acre of land.

GHANJIVAMRUT

250 kg of Cow dung 15 to 20 liters of Cow urine (Gomutra) 5 kg of jaggery 5 liters of Cow buttermilk all these mix it and it dry and multiply it how many acre of land these material is for 1 acre of land.

Veljibhai Bhudia kutch promoting this milk jaggery cow urine and cow dung water in kutch district of gujarat Since last 15 years.I am very happy with it got success in promoting these formula Worldwide.

FOR FLOWERING

Veljibhai Bhudia when flowering comes in wheatgrass groundnut chickpea jira cotton all types of vegetable and fruits spray 250 mili cow milk 100 gram of jaggery for more result add 250 mili cow urine(Gomutra) 250 mili cow dung liquid every 15 days 2 to 3 times.

1000 litres of tank mix 15 liters of cow milk,10 kg jaggery,10 liter cow urine (Gomutra) spray it in big trees pomegranate,mango,chiku,guava etc at the time of flowering for 3 to 4 times ever 15 days.

FOR PESTICIDE AND GERMS

Take 1 kg piece of Asafoetida (hing) and soak it in 5 liters of water for 24 hours. Take 100ml of Asafoetida (hing) water it with 250 ml milk,100gm jaggery.spray it every 15 days till germs destroy.

These production will increase by 25% and expenditure will reduce by 25% or PRIME MINISTER NARENDRABHAI MODI honoured me with shawl when he was chief minister of gujarat in 2010 this experiment was conducted in America and baroda laboratory.

VELJIBHAI BHUDIA

THANKS

BHARAT PARSANA

Rajkot, Gujarat (INDIA)

Mo.: 97263 99699

BHARAT PARSANA

Crop Dynamics and Practices in Western India

Climate Change Impact

> This increasing risk from climate change is likely to impact crop production of major crops grown in the state of Maharashtra and Gujarat

ABOUT THE AUTHOR

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Agriculture in Maharashtra is primarily rainfed, with only 18.2% of crop area irrigated. The net sown area for agriculture is about 168.15 lakh hectares. Kharif being the major cropping season, most of the major crops of the west like soybean (41 lakh ha) and cotton (45 lakh ha) are raised in this period depending on monsoon rain in Maharashtra. Rainfall has impacted soybean crops for several years. High incidence of fungal diseases (spodoptera) and insect pests (soybean semi looper) are common in soybean in kharif season. Late onset of monsoon, prolonged dry spell during growth, rain at maturity damage to the crop. Heat at the time of harvesting leads to heat strain for the labourers. Among the climatic factors it is rainfall which affects most to the soybean crop not the temperature. Historical data and projected analysis indicated that the temperature does not have major role in soybean.

Climate Resilient Technology

Broad bed and farrow system (BBF} technique - one of the most important climate resilient technologies for soybean which helps to maintain optimum moisture in the field by draining excess water in the deep furrow. BBF techniques reduce runoff (10.6%), plant mortality (14-19%), enhanced yield (16-18 %) and saves 40 to 50% of water in comparison to traditional crop establishment practices in soybean crops.

Rainfall is the most important challenge faced by cotton. A large amount of intense rainfall causes a lot of damage to the cotton crop. Soil degradation also led to reduction in moisture holding capacity and when moisture brought by rainfall exceeds soil and water holding capacity it causes a water logging situation. Roots get stressed for oxygen and fall victim to fungal diseases due to damp conditions. Rainfall in the months of July and August not held by soil and extreme deficit in moisture supply is seen in the month of September. These can be changed if the water holding capacity of the soil is improved through soil management practices. In Maharashtra, Vidarbha, Marathwada and Khandesh are the most cotton growing regions where climatic variation is prominent. In cotton mostly Bt cotton is grown in Maharashtra. The water requirement of this crop is about 100-150 cm annually.

Major kharif crops in Gujarat are groundnut, pearl millet, cotton sesame and castor. All these crops depend on monsoon rain for growth. About 80 lakh ha (78 percent area) of cultivated land is rainfed in Gujarat which depend on rain, Surat, Valsad, Navsari, Dang receive sufficient rainfall, other districts rainfall is not only less but also erratic.

Combating Climatic Issues

To combat the climatic issues, timely sowing of kharif crop with the onset of monsoon is necessary. Main crop of groundnut should be sown immediately after the onset of monsoon and proper crop stand is necessary for making use of limited water available for this crop. There is also a need to change cropping practices to minimize the risk of climatic variations. Intercropping practices of bunch groundnut with pigeon pea (1:1) and sesame (1:1) is advocated to minimize climatic risk. In cotton, hybrid cotton GCH 9,5,7,8 are advised to be sown with a spacing of 12 cm X 60 cm with intercropping of green gram , black gram and cowpea in 1: 1 ratio. The technique minimizes the risk of climate changes and helps to get economic return from the system. Bt cotton hybrids G cot. Hy 8 and Hy 6 should be sown in closer spacing of 60cm x 40 cm.

A varietal management is necessary in case of delay in monsoon in kharif season in Gujarat. The following varieties are recommended for major kharif crops in Gujarat.

Groundnut - GJG-32, TG 37 A , GG 2, 7, 35 and 38, J 11 JL 24 GJG -9

Castor- GCH-4,5,7,8 , GAUCH 1

Sesame - Gujarat Til 1, 2,3, 5, 6

Pearl Millet - GHB 538, GHB 717,719, 757

Hybrid pearl millet GHB 558 and 557 save the crop in situations of long duration dry spell after sufficient rain.

This increasing risk from climate change is likely to impact crop production of major crops grown in the state of Maharashtra and Gujarat. Mapping of India's climatic vulnerability showed Maharashtra is in third position in climatic risk parameters after Assam and Andhra Pradesh while Gujarat is in 16th position in this ranking. Thus, western zone needs much attention for climate change issues and crop planning in kharif, as agriculture in kharif season entirely depends on monsoon rains.

Pre-Budget Analysis

Who Is Responsible for 85% of India's Infertile Farmland?

> The current crisis in rural India is a result of short-term agricultural techniques with no regard for long-term social and environmental impacts

ABOUT THE AUTHOR

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Key Facts

- 85% of India's farmland (120 million hectares out of 142 million hectares) is suffering from declining productivity : National Soil Survey and Land Use Planning Bureau
- Is "technical fatigue" in agriculture a reality or an excuse?
- Only 0.01% of toxic pesticides reach the target pests, of which 99.99% contaminate the environment : David Pimentel, Cornell University
- High-cost solutions like polyhouses, hydroponics, and drones are burdening farmers instead of increasing their income :Dr. Rajaram (AIFA)
- Over 20 million farmers have quit farming in the last two years, driven by toxic fertilizers, pesticides, and GM seeds : Dr. Rajaram Tripathi (AIFA)

A new government has taken charge, but in the past five years, farmers have been persistently agitating for various reasons. However, this article will neither discuss these agitations nor blame any government. Instead, it aims to provide an unbiased and comprehensive assessment of the current state and direction of Indian agriculture.

Beyond the fluctuating statistics of food grain production, the harsh reality is that farming has become a loss-making venture. Farmers are increasingly distressed due to rising agricultural costs, uncertainty in yield quantity and quality, and the inability to obtain fair and remunerative prices for their produce. This distress has led to over 20 million farmers abandoning farming in the last two years.

The rampant use of chemical fertilizers, toxic pesticides, and GM seeds has pitted agriculture against the environment, soil, and humanity itself. These toxic chemicals have not only polluted the environment but have also posed severe health risks to humans. Pesticides are introducing new forms of devastation for farmers, which some agricultural scientists label as "technical fatigue" — a term perhaps coined to mask technical failures.

Are Imported Agricultural Technologies a Boon or Burden for Indian Farmers?

Recently, the government has been promoting high-tech farming methods like drones, polyhouses, greenhouses, and hydroponics, offering substantial subsidies for these technologies. However, these subsidies often entrap naive farmers with promises of high returns, leading them into the web of subsidies and bank loans. Poor-quality materials provided at exorbitant prices further exacerbate the farmers' woes. Many farmers, unable to understand the technical specifications and quality standards, fall prey to this trap, leading to increased debt and eventual ruin.

For instance, polyhouses are touted as a profitable venture, but many farmers end up with substandard structures that collapse during the first or second monsoon. The agents, manufacturers, and subsidy officers profit immensely, leaving the farmers to bear the losses. This blind imitation of foreign high-tech farming methods without considering local conditions is causing significant harm to both the government and farmers.

Ill Effects of the Green Revolution or Just The "Technical Fatigue" Excuse?

The link between food grain production and population is direct. To feed the burgeoning population, India launched the Green Revolution in 1966-67, advocating for increased use of chemical fertilizers, pesticides, and herbicides. Initially, this led to higher yields, but over the decades, it has caused significant environmental degradation and soil infertility.

Despite the apparent short-term success, the long-term consequences are dire. The excessive use of groundwater has led to critical depletion levels, especially in states like Punjab, where groundwater exploitation has reached alarming levels. In Uttar Pradesh, several blocks have been identified as over-exploited due to intensive irrigation practices. The National Soil Survey and Land Use Planning Bureau estimates that 120 million hectares of India's agricultural land are suffering from productivity loss due to various factors.

> Blindly importing foreign technologies has proven detrimental to Indian farmers, leading to increased debt and financial instability

Agriculture and Water: A Tragic Tale

India has not learned from its continuous mistakes regarding water management. Groundwater levels in many states are critically low, and the situation is worsening. In Punjab, for example, 108 out of 138 blocks are in the dark zone concerning groundwater levels. Similar distress is observed in Uttar Pradesh, where excessive water extraction for crops like sugarcane is making the land infertile.

Agriculture and Chemical Fertilizers

For years, the narrative was that chemical fertilizers are essential for increasing crop yields. Initially, they did boost productivity, but over time, they have rendered the soil diseased and infertile. The environmental destruction is evident, but the continued push for chemical fertilizers has exacerbated the problem. Studies now show that areas with lower fertilizer consumption have higher yields, contradicting the long-held belief in their necessity.

Pesticide application has become an integral part of modern farming, driven by the development of pest-attracting dwarf varieties. Despite evidence from Cornell University's David Pimentel that only a minuscule fraction of pesticides reach the target pests, their use has continued unabated, causing widespread environmental contamination.

Need for a Paradigm Shift

The current crisis in rural India is a result of short-term agricultural techniques with no regard for long-term social and environmental impacts. It is imperative to review these techniques and consider sustainable alternatives. Blindly importing foreign technologies has proven detrimental to Indian farmers, leading to increased debt and financial instability.

Indian agriculture is at a critical juncture, but it also presents an opportunity. By identifying the root causes of the current crisis and developing sustainable, cost-effective, and environmentally friendly farming techniques, we can secure a prosperous future for India's farmers. This requires collective efforts to promote indigenous innovations and support farmers in adopting these sustainable practices.

AI Powered Agriculture

ABOUT THE AUTHOR

Mr Agam Khare is Founder and CEO of Absolute®, a ground-breaking bioscience company reimagining possibilities in biomaterials, healthcare, and agriculture

> Precision farming involves integrating advanced technologies to automate and optimize various farming processes

Paul Ehrlich, an American biologist famously painted a grim & alarming image of the future in his book The Population Bomb (1968). “India couldn’t possibly feed 200 million more people by 1980.” Ehrlich wrote. Thankfully, Ehrlich’s prediction didn’t turn out to be true. In fact, by 1980, India’s yield was so bountiful that government schools had to be converted into granaries for storage.

So what went wrong with Ehrlich’s prediction? For one, it doesn’t account for the power of innovation. For example, the reason behind India’s growing yield was Norman Borlaug, a brilliant plant scientist whose innovation in wheat & grain production saved over a billion lives from starvation. In fact, his innovation sparked the green revolution. So if Borlaug’s method can feed a billion people, do we need another revolution?

Here’s the catch - Borlaug’s crop varieties used synthetic fertilizers for improved growth, and in a world fighting climate change, the older approaches are now unsustainable. Today, we face a twofold challenge in agriculture - on one hand, we need to address growth in food production to feed 10 billion people in 2050 and on the other hand, we need to reduce agriculture’s environmental footprint.

Agricultural Innovations

With India turning a hotbed of agricultural innovations, one key technology is accelerating her pursuits faster than ever - Artificial Intelligence (AI). Unlike the Green Revolution, which treated crops as mechanical systems that needed external inputs like synthetic fertilizers to thrive, AI allows us to view agriculture through a different lens. It enables us to analyze vast amounts of data across multiple parameters, providing a deeper understanding of natural processes. AI-driven outcomes, therefore, are more likely to offer sustainable solutions to challenges in agriculture & food security.

Key Areas Where AI Is Living Up To Its Promise

Research & Development (R&D)

1. AI-Based Agri Input Discovery

Artificial intelligence is revolutionizing the development of next-generation agricultural biologicals by screening a vast array of biomolecules and microbes. Advanced AI algorithms analyze extensive datasets to identify microbes and biomolecules with the potential to enhance crop growth, resilience, and yield. This high-throughput screening process accelerates the discovery of effective biological inputs that can replace traditional chemical fertilizers and pesticides.

At Xenesis, we have deployed state-of-the-art AI algorithms to identify the most promising microbes for our Inera line of breakthrough ag biologicals. These algorithms sift through genetic and phenotypic data to pinpoint “winning” microbes that can improve soil health, boost nutrient uptake, and protect crops from diseases and pests. By leveraging AI, we ensure that our products are not only effective but also sustainable, aligning with the growing demand for eco-friendly agricultural solutions.

2. AI-Based Agri Inputs Testing

The testing of agricultural inputs using AI involves simulating various environmental conditions and cloning crop interactions to predict their effectiveness and safety. Machine learning models can create virtual environments that mimic real-world conditions, allowing researchers to assess how new inputs will perform under different scenarios. This approach can identify potential issues with new inputs before they are used in the field, reducing the risk of crop failure and environmental harm. By using these advanced simulations, we ensure that only the most effective and sustainable inputs are deployed in agriculture.

Cultivation

3. Preparing Dynamic Crop Recipes

India is geographically diverse with multiple agro-climatic conditions across the country. When it comes to deciding the optimal way of growing a crop, there is no “one size fits all” approach. To achieve this, we need to analyze a huge database of individual geographic locations for many parameters. This is where AI comes in. At Absolute, we used AI algorithms with Machine Learning to develop dynamic crop recipes for over 63 crops. These recipes adjust automatically in context to the plantation type and geographical location.

4. Remote Farm Monitoring and Analysis

Remote farm monitoring employs various technologies such as satellite imagery, drones, and ground sensors to collect and analyze data on crop health, soil conditions, and weather patterns. This approach allows farmers to make informed decisions about irrigation, fertigation, and pest control, ultimately improving crop yields and reducing resource use. AI-powered analytics further enhance the precision and efficiency of remote monitoring systems.

5. End-to-End Farm Automation

Precision farming involves integrating advanced technologies to automate and optimize various farming processes. This includes using IoT devices for real-time monitoring of soil moisture and nutrient levels, automated irrigation systems that adjust water delivery based on plant needs, and drones for crop surveillance and pesticide application. These technologies enable farmers to manage their fields with greater accuracy, resulting in increased productivity and sustainability.

Risk Mitigation

6. Crop Protection Based on Weather and Disease Prediction

AI-driven weather forecasting and disease prediction models play a crucial role in crop protection. These models use historical weather data, real-time sensor inputs, and disease outbreak patterns to predict adverse conditions and potential pest infestations. Farmers receive timely alerts and actionable insights, enabling them to implement preventative measures such as adjusting irrigation schedules or applying targeted treatments to vulnerable crops.

7. AI for Financial Institutions

AI can significantly aid financial institutions in offering credit and processing insurance claims. By analyzing vast amounts of data, including crop health, soil conditions, weather patterns, and historical yield data, AI can assess the risk profiles of farmers more accurately. This enables financial institutions to offer customized credit solutions based on the specific needs and risk factors of each

farmer. AI can streamline the insurance claims process by quickly analyzing damage reports, verifying claims against satellite and drone imagery, and automating the approval process, ensuring timely compensation for farmers.

Market Linkage

8. Crop Recommendations Based on Market Prediction

AI can also be used to analyze market trends and predict the demand for different crops. By integrating market data with crop performance metrics, AI systems can recommend which crops farmers should plant to maximize profitability. These recommendations consider factors such as historical price trends, consumer preferences, and potential market disruptions, helping farmers align their production with market needs.

Current Challenges in AI-Driven Agriculture

Accessibility and Affordability

Many smallholder farmers struggle with the high costs associated with AI technologies. Equipment, maintenance, and subscription services can be prohibitively expensive. Additionally, the digital divide in rural areas, with limited internet access and smart devices, hampers the adoption of these technologies.

Data Quality and Availability

In agriculture, data collection is often inconsistent and fragmented, especially in developing regions. Integrating various data sources like weather, soil, and market prices into a cohesive AI system remains a significant challenge.

Farmer Education and Training

Many farmers lack the technical knowledge to effectively use AI tools. Comprehensive training programs are insufficient, and interpreting AI-generated insights can be challenging. Additionally, traditional farming practices are deeply ingrained, making farmers hesitant to adopt new technologies without clear, demonstrated benefits.

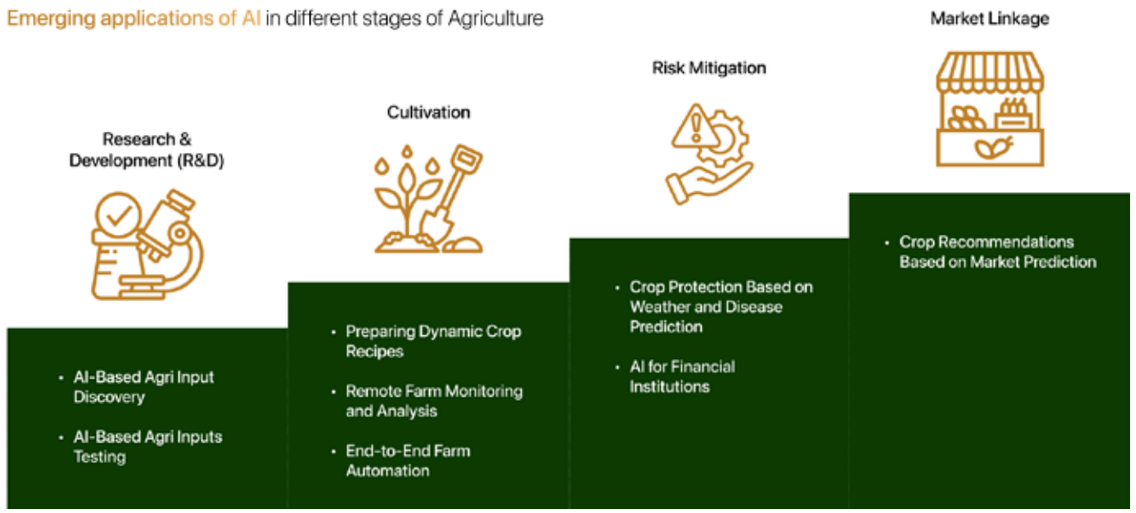
Scalability and Customization

One-size-fits-all AI solutions are often ineffective as they are not tailored to the specific needs of different regions, crops, or farming practices. Scaling successful pilot projects to larger areas or different regions with varying conditions remains a significant hurdle.

Solving Challenges

Integrating new technology into agriculture presents scaling challenges, but organizations and governments are actively addressing these. For instance, the “Saagu Baagu” project in Telangana has improved yields and incomes for 7,000 chili farmers and plans to expand to 500,000 farmers across five value chains. AI4AI workshops have empowered farmers with AI tools, significantly boosting efficiency and earnings. Similarly, pilot programs by Microsoft and ICRISAT have increased yields by up to 30% through AI-driven sowing advisories and pest risk predictions.

Addressing key challenges in AI-driven agriculture starts with making these technologies accessible and affordable for smallholder farmers. Absolute’s Upaj offers a free precision advisory and community platform that supports over 5 million farmers. This helps them make informed decisions without financial burden and bridges the digital divide. We also introduced India’s first DIY insurance model, where farmers can customize premiums, which scaled crop insurance services, benefiting 6.5 million farmers. Here, we use AI for automatic claims disbursal to help farmers in their time of need. Through the same ag value chain, we, at Absolute, emphasize ethical data collection and analysis, integrating sources like weather patterns, soil health, and market trends to provide actionable insights and reliable information for better farming practices.



PROTECT THE NATIVE BEES OF THE HIMALAYAS

> The neglected conservation of native bees needs to get renewed focus

ABOUT THE AUTHORS

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Honeybees are an important component of mountain farming in the Himalayas. For mountain communities, they provide a source of money, food, and medicine. Traditionally, farmers keep the indigenous honeybee, A. cerana, primarily in log and wall hives just next to the farmhouse. This bee has a long foraging period and a higher pollination rate, which uplift crop yield and sustain the local biodiversity. Introduction of managed pollinators, particularly western honey bee, A. mellifera is a common practise in order to meet the demand for pollination services in crops (Garibaldi et al., 2017).

Relative to A. cerana, these bees can make three times more honey and majority of beekeepers in Himachal Pradesh switched to this species. Even though the state's honey production climbed, other challenges started to appear. According to recent research, the introduction of numerous managed colonies into areas that are protected may have a negative impact on the populations of native/wild bees (Danner et al., 2016; Norfolk et al., 2018). Moreover, A. mellifera is susceptible to assaults of local bee enemies such as predators, pests, and parasites. Antibiotics must be administered to them in order to manage Varroa.

On the other hand, A. cerana does not need any therapy as it is a natural host of Varroa. The Italian bees can only live if the beekeeper provides constant care and protection. Beekeeping with A. mellifera is migratory and aids in boosting honey production by utilising various bee flora, giving opportunity to overcome unfavourable climatic conditions. The indigenous bees, which are crucial to our ecosystem, are in danger of going extinct. In a scenario of floral resource limitation, there is proof of competition between introduced managed honey bees and native wild bee pollinators (Wojcik et al., 2018). Pollinator health is decreased by pathogen spillover from controlled to native/ wild bee pollinators (Manley et al., 2015).

The number of A. cerana population has been declining in Himalayan region over the past few decades because of deforestation, urbanisation, climate change, greater pesticide use and competition from exotic A. mellifera. Its extinction is a direct threat to crop production and long-term biodiversity in Himlayan region. All of these factors have led to an abrupt decline in the overall population and health of A. cerana. A. cerana produces less honey per colony than A. mellifera, but because of its inherent strength, resistance to disease, and docile nature, it is very simple to maintain, particularly in places where it may be challenging to find the equipment and supplies needed to maintain European honeybees.

Most colonies of A. cerana are still around in their natural habitat and in harmony with the environment. A. cerana has tremendous potential for profit for both small- and large-scale beekeeping, in addition to offering priceless pollination services to both natural and cultivated environments. In fact, maintaining and improving gardening with A. cerana is essential for the survival of the species in Himalayan region. There is urgent need for integrated conservation planning for all endangered bees, including the native/wild pollinators populations. Although the negative effects of managed honey bees on other wild bee populations should be taken into account in conservation planning, the role of natural areas for the conservation of wild populations.

Benefits of indigenous bee and its economic impact for small and marginal farmers of Himalayan region

Apis cerana is a vital bee for Asian beekeepers, particularly in impoverished areas. Dr. YS Parmar UHF has started initiatives to educate beekeeping as a long-term employment opportunity in these communities. Beekeepers keep A. cerana in a variety of mountainous areas that can be challenging to access. However, this species can flourish in these environments because it is adapted to them. Indigenous beekeeping techniques in log and wall hives are still practised in many areas of Himachal Pradesh. The vast majority of A. cerana colonies continue to exist in the wild and naturally in balance with a variety of predators, pests, and parasites without the need for beekeeper assistance and produce organic honey (not exposed to chemical residues). To maintain the health of the hive, A. cerana also exhibits remarkable hygiene.

Apis cerana is well-known for its ability to pollinate a wide range of products, including spice crops, fruits, nuts, oilseeds, cauliflower, okra, and onion. In some cases, it is thought to be a more effective pollinator than A. mellifera due to several factors, the first of which is its limited foraging area. With a smaller range, workers are more devoted to their individual plants and exhibit greater floral fidelity than A. mellifera. Apis cerana's smaller colony size is also advantageous, as it makes them easier to transport and handle. Apis cerana also has a longer daily foraging time than A. mellifera. Compared to A. mellifera, A. cerana begins foraging earlier in the morning and finishes later in the evening. Furthermore, A. cerana bees are well-acclimated to the climate and can continue to forage under more extreme conditions than A. mellifera. A. mellifera needs big foraging areas, standardised equipment, and supplementary feeding in order to produce the huge quantities of honey that it is admired for. The foraging activity of A. mellifera can be reduced by tropical and wet circumstances, increasing the need for supplements (Koetz, 2013).

Because each unit needs routine maintenance, it is important to keep in mind that the profitability of a single, high-performing colony is still greater than that of two or more combined, less productive colonies. This is crucial in circumstances where the resources (such as honey sources) available close to apiaries are limited.

Beekeepers receive training on different aspect of beekeeping for conservation of native bee Apis cerana

Honey bee conservation, protection: An emerging perspective

An essential part of a sustainable pollination plan is provided by native bees. Natural areas are necessary for the preservation of native and wild bee populations. Native bee populations are generally present in agricultural environments, albeit their numbers may be low due to intense farming practises that reduce the availability of suitable nesting and feeding locations. It is crucial that older trees with cavities are accessible in sizable, forested regions with little to no management (or heavy management) for colony nesting. To make their fields more suitable for these significant beneficial insects, farmers can implement certain rather easy practises in and around their fields. Various actions are necessary for native bee conservation.

- Thorough bee monitoring in protected forest zones, evaluation of surviving natural areas in terms of their capacity to meet the needs of wild honey bee habitat.
- Strategies for managing colonies to reduce the possibility of human-mediated hybridization and pest transmission.
- Reduce the use of insecticides; abstain from using them during bloom, and switch to chemicals that are more bee-friendly.
- Use of bee-friendly practises to reduce direct threats from pesticides and mass-flowering disturbances.
- Establish a nesting environment and supply materials for making nests, like as mud and plants with waxy leaves.
- Promote the planting of flowering plants to ensure blooms throughout the growing season.
- Raising awareness of the dangers posed by dwindling wild honey bee populations.

Aside from that, educational programmes for local hobby beekeepers ought to cover beekeeping techniques that promote local bee utilisation. An effort has been made by the College of Horticulture and Forestry Thunag Mandi under Dr YSP UHF Nauni, Solan H.P. to raise awareness about the value of indigenous bees; native bees demonstrate or promote mud hive technology among farmers through the organisation of a training course.

Inspired pioneer Mr David Verma (progressive Apis cerana beekeeper and conservator) a local resident of Seraj Valley, Mandi has recently (2022) started A. cerana beekeeping with 50 colonies, breaking new ground in beekeeping in the State. He used to capture swarms and place hives in conventional homes, but he was unable to capture the full benefits due to a lack of technical expertise and understanding. He received training in 2022, and currently he owns 100 A. cerana colonies, 12 of which are in log hives and are managed and well maintained on the orchard area near his residence. He chose beekeeping as a way to supplement his family's income. He has received financial assistance from the Himachal Pradesh Horticulture Department in the past year. He extracts honey from the bees on a commercial basis, and rents colonies for pollination purpose, which fetches him a profit of INR150,000-200,000 annually. His profits rose to INR70, 000 INR in 2022 from the sale of honey alone in a single honey flow season from 50 colonies only. He was selected as master trainer for further advance training at main campus UHF Nauni. He now inspires the locals, assisting them in realising the entire potential of Apis cerana.

Need For Protection

The neglected conservation of native bees needs to get renewed focus. Due to widespread habitat destruction, A. cerana and other wild bee species are under risk in their natural habitats. The human-mediated hybridization linked to manage colonies, disease transmission, and resource competitions are additional threats to the wild populations of A. cerana. All vulnerable wild bee species, including A. cerana colonies, require proactive planning for their conservation. Highlighting their shared interests, this would help alleviate friction between environmentalists and beekeepers and would lend credence to the notion that inclusive solutions for sustainable environmental management may be developed.

About the Author

As the Managing Director at Crystal Crop Protection Ltd., **Mr Ankur Aggarwal** brings over two decades of experience in the agriculture and crop protection sector.

Thoughts expressed are personal

AGRItech the Road Ahead

AGRICULTURE WORLD

> Farmers should focus on cultivation of 4Ms – maize, moong, mustard and millets – which can in turn help the country in attaining self-sufficiency

Our journey begins amidst the complexities of climate change, where erratic rainfall patterns, intensified droughts, and soaring temperatures threaten the very fabric of global food security.

The shift in the Indian monsoon patterns, largely due to El-Nino effect in the recent years have not only caused drought like conditions but have altered the sowing pattern in many states.

Around 30 per cent land area in India was under different degrees of drought in the first week of September 2023. At least 11.5 per cent area was under 'severe', 'extreme' and 'exceptional' dry conditions, while 18.9 per cent was under 'abnormal' to 'moderate' dry conditions.

This has increased troubles for farmers, who first delay sowing in June and July because of low rainfall and later have to face crop failures and a decrease in crop output, especially as evapotranspiration rates increase due to excessive heat at the time of harvest.

For instance, in Maharashtra alone, the area under kharif crop has marginally declined by 2.72 lakh hectares. Sowing for 2023-24 was completed on 137.50 lakh hectares as against 140.22 lakh hectares last year for the same period.

Apart from production, the productivity of food grains is deteriorating casing a direct loss in the overall realised income for the farmers. There is an increase in frequency of drought from 1986 onwards in the deccan zone and a monsoon rainfall deficit by about 21.25% during June–September which coincided with tillering and grand growth stage of sugarcane. The imposed drought during the growth and elongation phase is emerging as a major constraint in realizing high cane productivity in sugarcane growing states.

How Tech Can Help

Amidst this uncertainty, the active adoption of technology in agriculture can help maintain the production, ensuring food security and resilient agricultural production.

For instance, the micro irrigation economy in India can be the next big change, mitigating the adverse effect of erratic Indian monsoons. Out of total 140.13 million hectares of sown area, the net irrigated area is 68.38 million hectares while 71.74 million hectares are unirrigated. The average penetration of micro irrigation in India is 19% (as on February 3, 2021), which is much lesser than many countries.

Currently only Sikkim, Andhra Pradesh, Karnataka and Maharashtra have more than half of their net cultivable area under micro irrigation whereas 27 states in India have less than 30% micro irrigation system out of which 23 have less than 15%.

Uttar Pradesh being largest producer of Sugarcane, which is a water intensive crop but has only 1.5% area under micro irrigation and Punjab has only 1.2 %.

Even if the technology exists, our focus should be on adoption and execution of these novel techniques. Government schemes like Pradhan Mantri Kisan Sinchai Yojana aim at water conservation and increasing water use efficiency. The Indian government, at all levels, must tackle erratic monsoons and 'climate-proof' the economy by incentivizing the participation of private players to increase the rate of adoption of these technologies.

Maize, Moong, Mustard And Millets

Apart from traditional cropping patterns, farmers should focus on cultivation of 4Ms – maize, moong, mustard and millets – which can in turn help the country in attaining self-sufficiency and at the same time help in enhancing the income of the farmers.

Choosing climate resilient seeds, with correct agronomic practices to maximize yield and correct application of agrochemicals, farmers can mitigate the adverse effects of climate change on the crops.

Global climate change is a reality, a continuous process and needs to be taken seriously even though there are large uncertainties in its spatial and temporal dimensions. Analysis of recent weather data indeed indicates a warming trend at many places in India. Simulation studies indicate that the direct effects of climate change on Indian agriculture would be small in short run provided pests could be controlled. In the long run, however, the production of different crops may be seriously affected depending upon the season, level of management and the magnitude of climate change.

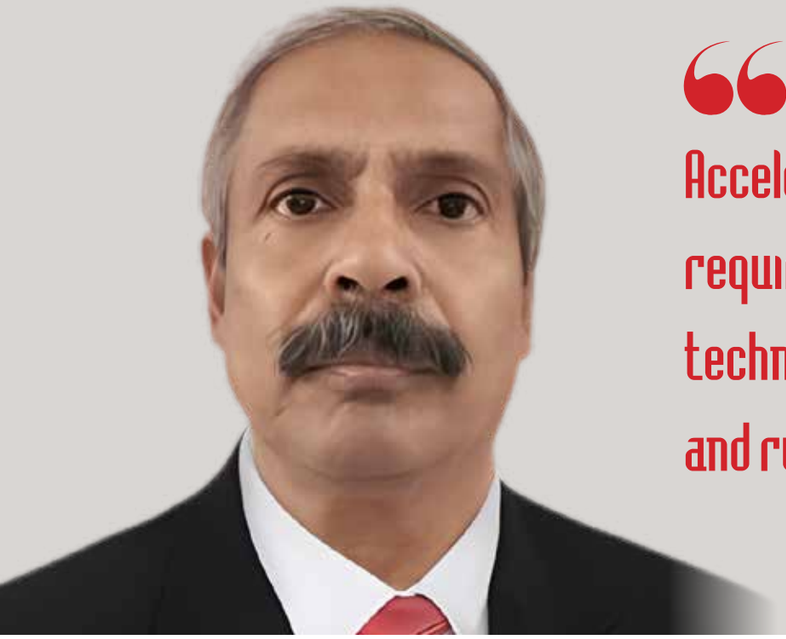
The indirect effects of climate change through projected increased incidence of uncertainties of rainfall onset, duration and frequencies of drought and floods, availability of irrigation, soil transformations, crop-pests competition, and submergence of some coastal land due to sea level rise may be more serious than the direct effects on crop growth.

Long-term scenarios of global climate change may take 50 to 100 years to materialize whereas there are many more drivers of agriculture such as changing demands, markets and agricultural technologies that are expected to significantly transform Indian agriculture in near future.

The pace of these changes is expected to increase rapidly in the coming years and the whole agricultural scenario may become quite different in the next ten to twenty years. Thus, it is important to move towards enhanced practices and techniques along with maintaining the production and food security goals of the country.

Changing Dynamics of Kharif Cultivation

Challenges and Pathways to Resilience



> Accelerating diversification requires policies on technological development and rural investment

ABOUT THE AUTHOR

Dr Pradip Dey is Director, ICAR-ATARI, Kolkata

The nation's diverse agroclimatic conditions historically shaped regional crop specializations. Over time, market forces and technological advances enabled higher yields and shifted crop areas without reducing output. Kharif, a cornerstone of India's agricultural calendar, is undergoing significant transformations due to evolving climatic patterns.

Recent data paints a stark picture: out of 650 districts surveyed, a concerning 310 are categorized as high to very high-risk zones, indicating an urgent need for adaptive strategies. The alarming shift in temperature dynamics, where minimum temperatures rise faster than maximum temperatures, disrupts the delicate balance required for optimal crop growth, posing a direct threat to crop health and productivity.

Extreme Weather Events

The intensity and variability of rainfall patterns further complicate the scenario. Erratic rainfall distribution affects sowing and harvesting schedules, leading to waterlogging or drought conditions, exacerbating crop losses. Additionally, the reduction in the duration and number of days suitable for kharif cultivation narrows the window of opportunity for farmers, heightening the pressure to maximize yields within a limited timeframe. The increasing occurrences of extreme weather events, such as cyclones, floods, and droughts, cause immediate damage to crops and leave lasting impacts on soil health and agricultural infrastructure.

Diminishing Crop Diversity

A notable trend in kharif cultivation is the diminishing crop diversity including inter-varietal diversity. In fruit production, the strategic use of inter-varietal diversity, by combining early and late maturing varieties, is an essential practice for effectively managing climate risks. In general, the cultivation of rice and wheat is increasing, often at the expense of pulses and oilseeds.

While rice and wheat are staple crops crucial for food availability, overemphasis on their cultivation can lead to monoculture practices, increasing vulnerability to pests, diseases, and adverse weather conditions. Conversely, the decline in pulses and oilseeds cultivation is concerning due to their nutritional value and contribution to soil fertility. Pulses are rich in protein and essential nutrients, while oilseeds provide valuable edible oils and maintain soil health through nitrogen fixation.

Analysis of the broader canvas of resilience and the COVID-19 pandemic exposed both the strengths and vulnerabilities of India's agri-food systems, underscoring the need for robust safety nets and resilient agricultural frameworks. Supply chain disruptions, labor shortages, and market access issues highlighted the fragility of current systems. Yet, the farming community's resilience and adaptability shone through, with digital platforms becoming new avenues for trading and knowledge exchange.

Strategies

Strategies for navigating the evolving challenges of kharif landscape are given below:

Climate-Resilient Crop Varieties: Developing crops that can withstand drought, heat, and flooding ensures productivity despite climatic disruptions.

Innovative Water Management: Techniques like rainwater harvesting and drip irrigation are vital for conserving water and ensuring its efficient use.

Sustainable Farming Practices: Practices like cover cropping and conservation agriculture enhance soil carbon sequestration, improving soil health, water retention, and crop yields, thus contributing to long-term agricultural sustainability.

Agroforestry and Mixed Cropping: Integrating trees and diverse crops creates a harmonious ecosystem, improving soil health and reducing erosion.

Enhancing Crop Diversity for Resilience: Promoting crop diversity is crucial for improving food and nutritional security and enhancing resilience against climate change. Encouraging the cultivation of a diverse range of crops through crop rotation systems, providing incentives for pulses and oilseeds cultivation, and disseminating knowledge on the benefits of diversified cropping are essential steps towards enhancing crop diversity in kharif agriculture.

Precision Farming: In the heartlands of India, farmers are embracing the future with open arms, adopting technologies that promise to harmonize the discordant notes of climate change. Precision farming, with its arsenal of GPS, drones, IoT, sensors, and data analytics, offers a symphony of solutions. These advanced tools allow farmers to monitor soil moisture, predict weather patterns, and manage irrigation with finesse, mitigating the adverse effects of climate upheaval.

Enhanced Extension Services: Providing farmers with timely information through digital channel and training on climate-smart practices empowers them to adapt and thrive.

Policy and Investment Support: Governments must invest in research, infrastructure, and insurance schemes, providing a robust backdrop for farmers against climate-induced adversities.

Accelerating diversification requires policies on technological development and rural investment, ensuring benefits for small and marginal farmers. By prioritizing climate-resilient crop varieties, innovative water management techniques, and enhanced extension services, we can significantly improve the resilience and sustainability of kharif agriculture. Policymakers need to prioritize investment in research, infrastructure, and insurance schemes to support farmers in mitigating the risks associated with climate change. Embracing a proactive and adaptive approach will allow us to navigate the changing dynamics of kharif while safeguarding the livelihoods of millions dependent on agriculture.

Biostimulants

For Climate Smart Agriculture

Biostimulants are going to stay and will play a very important role in furthering the global food production with superior quality of yield to ensure food and nutritional security to mankind.

ABOUT THE AUTHOR

Mr S. Narayanan, WTD of Greenstar Fertilizers Ltd, heads the marketing team that offers sustainable solutions for betterment of farm income

The past decades witnessed a boost in the agricultural production with the introduction of high yielding varieties, advanced nutrient management solutions and ever advancing pest management tools.

In spite of the adoption of all the above, the global food production system is witnessing the widening of yield gap, stagnation of yield levels and frequent crop failures.

The main reason attributed to this is the gradual reduction of crop resilience caused by physiological stress on the crops; triggered by unpredicted change in weather patterns. A small variation in weather like extremes in temperature, frost, rain, flood, drought, wind velocity, soil limitations etc., during critical growth phases adversely impacts the Global Food Security Schemes.

The research community across the Globe as offered a proven solution to mitigate the ill effects of climate change in Agricultural production systems; through timely intervention in the physiology of the crops by ensuring "Hormonal and Enzymatic Sufficiency". Beyond genetic improvement, balanced nutrition and effective pest control; Hormonal Sufficiency takes importance in protecting the corps from Climate Changes.

Biostimulants:

European Biostimulants Industry Council {EBIC} has defined Biostimulants as a material which contains substance(s) and/or microorganisms whose function, when applied to plants or the rhizosphere, is to stimulate natural processes to enhance/benefit nutrient uptake, nutrient efficiency, tolerance to abiotic stress, and crop quality, independent of its nutrient content.

Government of India has identified and notified formulations containing the following active ingredients as Biostimulants:

- Botanical extracts including seaweed extracts
- Bio-chemicals
- Protein hydrolysates and amino acids
- Vitamins
- Cell free microbial products
- Antioxidants
- Anti-transpirants
- Humic & fulvic substances and their derivatives.

Mode of action and benefits of Biostimulants:

The above-mentioned active ingredients work synergistically with cell metabolism and triggers specific metabolic pathways to bring about natural defence mechanisms on the corps.

Some of the known activities of Biostimulants on the crops are:

- Improved rhizosphere environment.
- Improved uptake, translocation and assimilation of water and nutrients.
- Improved metabolic efficiency of the crops through enhanced photosynthesis and carbon assimilation.
- Effective scavenging of free radicals released during a stress situation for quick bounce back to normalcy.
- Effective translocation of nutrients to growth parts as well as on the yield.
- Triggering the physiology for activated metabolism to enable the crops to reach its genetic potential.
- Improved yield quality in terms of nutritional factor, appearance, colour, aroma, shelf life, etc.

Biostimulants have become an essential agro input complimenting the modern-day agriculture technology to protect the crops and yield in this unpredictable weather conditions. Since different formulations addresses specific physiological condition in the crops, it is very important to select the right type of formulation to suit crop, season of cultivation and geography of cropping.

Some of the known roles of Biostimulants on the crops is given below as a guidance.

Active ingredient	Crop limiting factors
Seaweed extracts	Soil limitations – Alkaline,
Protein hydrolysates and amino acids	Extremes in temperature, frost, flood and drought.
Humic substances	Soil limitation – heavy metal, calcareous soil, drought,
Anti transpirants	High wind velocity

The timely application of Biostimulants to overcome the ill effects of climate changes will ensure a predictable yield with superior quality yields.

Market Opportunities

It is estimated that the Biostimulant as an Industry will grow rapidly across the globe. Indian manufacturers can play an important role in the production and exporting of Biostimulants of global standards. The industry is estimated to growth to 7 ~ 8 billion USD by 2030 from today estimated market value of 4.00 billion USD.

Legalisation

The Government of India has taken initiative to legalise the production and marketing of Biostimulants. This process will encourage organisation that is committed to the supply of products of global standards and deter small time players.

Mankind's Need

Given the situation of today's global agricultural production system, Biostimulants are going to stay and will play a very important role in furthering the global food production with superior quality of yield to ensure food and nutritional security to mankind.

ABOUT THE AUTHOR
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"Continued innovation, government support, and collaboration between various stakeholders will be essential in addressing future challenges and ensuring the long-term sustainability of Indian agriculture

Since independence India has made significant strides in various sectors, with agriculture being a pivotal one. Agricultural engineering has played a crucial role in transforming India's agricultural landscape, enhancing productivity, sustainability, and efficiency.

Green Revolution - Mechanization of Agriculture

Introduction of Tractors and Farm Machinery: The Green Revolution in the 1960s and 1970s saw the widespread introduction of tractors, power tillers, and other mechanized farm equipment. This mechanization reduced the dependency on manual labor, increased efficiency, and enabled farmers to cultivate larger areas of land.

Harvesting Equipment: The use of Tractors, combine harvesters, threshers etc. during the Green Revolution period significantly improved the efficiency of harvesting processes, reducing time and labor costs.

High-Yielding Varieties (HYVs)

Development and Adoption: Agricultural engineers and scientists developed and promoted high-yielding varieties of crops such as wheat and rice. These varieties, along with the use of chemical fertilizers and irrigation, led to a substantial increase in crop production.

Irrigation Infrastructure

Canal Systems and Tube Wells: The development of extensive irrigation infrastructure, including canal systems and tube wells, played a vital role in ensuring a reliable water supply for agriculture. This infrastructure enabled the cultivation of multiple crops in a year, contributing to increased agricultural productivity.

Advances in Irrigation and Water Management

Micro-Irrigation Systems

Drip and Sprinkler Irrigation: Agricultural engineers introduced micro-irrigation systems such as drip and sprinkler irrigation, which have significantly improved water use efficiency. These systems deliver water directly to the plant roots, reducing wastage and promoting better crop growth.

Water Conservation Techniques

Rainwater Harvesting: Engineers have designed rainwater harvesting systems to capture and store rainwater for agricultural use, especially in arid and semi-arid regions. This technique helps in supplementing irrigation needs and conserving groundwater resources.

Integrated Water Resource Management (IWRM)

Holistic Approach: IWRM initiatives involve the coordinated development and management of water, land, and related resources. Agricultural engineers contribute to these initiatives by designing efficient water distribution systems and promoting sustainable water use practices.

Post-Harvest Technology and Food Processing

Storage Solutions

Cold Storage and Warehousing: The development of modern cold storage facilities and warehouses has been instrumental in reducing post-harvest losses. These facilities help in preserving the quality of perishable goods, extending their shelf life, and stabilizing market prices.

Food Processing and Packaging

Value Addition: Agricultural engineers have developed advanced food processing and packaging technologies that add value to raw agricultural products. This value addition has created new market opportunities, improved farmer incomes, and enhanced the availability of processed foods.

Future too looks promising.

Precision Agriculture and Digital Technologies

Precision Farming Techniques

GPS and GIS Technologies: The use of GPS and GIS technologies has enabled precision farming, where farmers can optimize field-level management based on detailed spatial information. This approach leads to better resource utilization and higher crop yields.

Variable Rate Technology (VRT): VRT allows for the precise application of inputs like fertilizers and pesticides, based on the specific needs of different areas within a field. This reduces input costs and minimizes environmental impact.

ICT and Digital Platforms

Mobile Apps and E-Agriculture Platforms: The advent of information and communication technology (ICT) has revolutionized Indian agriculture. Mobile applications and e-agriculture platforms provide farmers with real-time information on weather forecasts, soil health, pest management, and market prices.

IoT and Smart Farming: Internet of Things (IoT) devices and sensors are increasingly being used to monitor various parameters such as soil moisture, nutrient levels, and crop health. These smart farming technologies enable data-driven decision-making and improve farm management practices.

Sustainable Agriculture Practices

Conservation Agriculture

No-Till Farming, Direct Seeded Rice, Crop Rotation: Agricultural engineers have promoted conservation agriculture practices such as no-till farming, Direct Seeded Rice, crop rotation. These practices help in maintaining soil health, reducing erosion, and better water management.

Integrated Pest Management (IPM): IPM strategies involve the use of biological, mechanical, and chemical controls to manage pest populations sustainably. These strategies reduce the reliance on chemical pesticides and minimize their environmental impact.

Renewable Energy in Agriculture

Solar-Powered Equipment: The use of solar-powered pumps and machinery has gained traction in Indian agriculture. These renewable energy solutions reduce dependency on fossil fuels, lower greenhouse gas emissions, and decrease operational costs.

Bioenergy Production: Agricultural engineers are also involved in the production of bioenergy from agricultural waste. This sustainable energy source provides additional income to farmers and reduces waste disposal issues.

Government Initiatives and Support

Subsidies and Financial Assistance

Support for Modern Equipment: The Indian government provides subsidies and financial assistance for the purchase of modern agricultural equipment and machinery. These initiatives make advanced technologies accessible to small and marginal farmers.

Incentives for Sustainable Practices: Incentives and support programs are available for farmers adopting sustainable agricultural practices, such as organic farming, Bio mass management, micro-irrigation systems etc.

Research and Development

Public and Private Sector Collaboration: Government research institutions and universities, in collaboration with the private sector, conduct research and development to create innovative and locally adapted agricultural technologies.

Extension Services: Extension services play a crucial role in disseminating knowledge and training farmers in the use of new technologies and practices.

Since independence, agricultural engineering has made substantial contributions to the Indian agricultural sector, driving significant improvements in productivity, efficiency, and sustainability. From the mechanization of farming during the Green Revolution to the adoption of precision agriculture and digital technologies, the role of agricultural engineers has been pivotal in transforming Indian agriculture. Continued innovation, government support, and collaboration between various stakeholders will be essential in addressing future challenges and ensuring the long-term sustainability of Indian agriculture.

Building Trust

Combating Misinformation and Fake News in Agri Domain with Focus on Food Safety

Agriculture and Livestock extension and research services are known for their credibility to help produce safe food, which are important for our health. Earlier these services were face to face and in group-based approach. With the increase in digital media and online like Facebook, Twitter, You Tube etc the process of engagement has become one on one.

Safe food is everyone's right and there is no food security without food being safe.

On the other hand, food security is the state of having reliable access to a sufficient quantity of affordable, nutritious food. The availability of food for people of any class, gender or religion is another important element of food security. Both food security and safety are equally important. Food sector as any other

Misinformation and Disinformation

Let us quickly dwell on two important terms, Misinformation and Disinformation.

Misinformation is defined as fake or misleading information when shared without the intention to cause harm, but it does cause harm, though unintentionally.

In contrast, disinformation is false information that is designed to harm people. In today's interconnected digital world, it is easier than ever for mis- and disinformation to spread. False claims shared on social media tend to rapidly become viral, especially if they trigger negative emotions such as fear or anger.

Consequences Of Agri-Food Misinformation

Agri-food misinformation can lead to anxiety, uncertainties and confusion among farmers and consumers alike. It reduces the ability of the consumer to make science-based decisions on issues related to food and health which may lead to economic and health losses. Some common examples related to genetically modified crops, organic farming and animal welfare, are commonly surrounded by misinformation.

While there are legitimate scientific debates on these topics, both sides use information that they believe to be true to promote their own personal, financial or political interests. However, this information may be false. Misinformation can affect everyone, from farmers who are sold poor quality seeds and fertilisers or farmers who are blamed for adulterated milk, to consumers who are led to buy unhealthy or unsustainable foods.

Separating Fact From Fiction

With so much information available online, it is indeed difficult to separate fact from fiction. The most important thing is to develop a critical mind when consuming information online. Thus, it become very important to critically evaluate the credibility of the information shared online.

- Author of the information/video

Research the author. The anonymous articles may be untrustworthy.

- Objective of writing

Evaluate the author's motives for sharing the information.

- Examine your own feelings

Disinformation often deliberately generates strong emotions and divisive opinions. Therefore, one must look for more information before believing the story.

- Genuineness of the information

Genuine stories should be reported by multiple sources. One must research the website where you found the information. Read multiple sources to get different points of view on the topic. Do not just read articles that agree with your opinion.

Fake News In The Agrifood System

The agriculture and livestock sector can have significant repercussions, influencing public perception, policy-making, and industry practices.

Health Risks: Exaggerated or false claims about the dangers of consuming certain foods or products (genetically modified organisms (GMOs), meat, dairy products).

Environmental Impact: Misinformation about the environmental impact of farming practices (e.g., methane emissions from cattle). Excessive use of fertilizers impacting soil quality ia another debatable issue.

Animal Welfare: Exaggerated or false stories about animal cruelty in livestock farming.

Economic Impact: False information about the economic consequences of certain agricultural practices or policies.

Impact of Fake News

Public Perception: Shaping consumer opinions and behaviour, often leading to unnecessary fear or avoidance of certain products. One such example is that during COVID 19 people stopped eating chicken

Policy and Regulation: Influencing policy decisions, sometimes resulting in regulations that are not based on scientific evidence. The example may pertain to import of GM Soya meal or maize for use in poultry feed.

Industry Practices: Forcing farmers and producers to change practices based on public pressure rather than scientific or economic rationale.

Market Dynamics: Affecting the market demand and pricing of agricultural products.

Combating Fake News

Education and Awareness: Increasing public awareness about how to identify reliable sources of information.

Fact-Checking: Promoting and supporting fact-checking organizations that can debunk false claims.

Scientific Communication: Encouraging scientists and experts to engage more actively with the public and media.

Regulation of social media: Implementing policies that require social media platforms to monitor and manage the spread of fake news.

Conclusion

Addressing mis or disinformation in the agrifood system and livestock sector requires a multifaceted approach that may range from education, regulation, and active engagement from both industry and scientific communities. By fostering a well-informed public and encouraging responsible communication practices, the negative impacts of fake news can be mitigated effectively.

> *Agri-food misinformation can lead to anxiety, uncertainties and confusion among farmers and consumers alike*

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Kharif

Navigating the Changing Landscape

The Kharif season in India is dependent on the monsoon and has always been susceptible to weather fluctuations. Unpredictable rainfall patterns disrupt sowing schedules and expose crops to moisture stress during crucial growth stages. Rising temperatures accelerate pest life cycles and disease outbreaks, threatening yields. These combined factors threaten the economic viability of Kharif farming (which includes cultivation of rice, bajra, jowar, maize, millets, cotton, etc) jeopardizing not only food security but also the livelihoods of millions of farmers who depend on this crucial season.

Climate Dynamics in 2024

The central and western peninsular regions are anticipated to experience the most severe impact of extreme heat between April and June this year. According to the IMD, Gujarat, central Maharashtra, and northern Karnataka are predicted to be the most susceptible to heat waves, followed by Rajasthan, Madhya Pradesh, northern Chhattisgarh, Odisha, and Andhra Pradesh. However, the Monsoon Mission Climate Forecast System (MMCFS) predicts that the El Niño conditions will likely weaken in the upcoming season and become neutral. There are also signs that La Niña conditions may develop during the monsoon season. If La Niña forms after June, it could be good news for India, since it usually leads to increased rainfall, benefiting agricultural production, particularly for rain-reliant crops.

Contemporary Practices for Efficient Agriculture

With changing climatic conditions, adopting modern farming techniques has become crucial. The Kharif season in India is one of the most important periods for farmers in terms of production and earnings. This season significantly contributes to India's GDP, making it essential to adopt contemporary methods to increase yield and minimize losses.

Soil testing is a critical method for determining the capabilities of the soil and identifying ways to improve it. This process helps farmers assess soil health and identify nutritional deficiencies. DeHaat offers comprehensive soil testing services, providing personalized advice to ensure optimal harvest results for farmers.

Geo-tagging is an emerging technology in precision farming that leverages advanced GPS technology to provide precise mapping and monitoring of agricultural fields. This service enables farmers to accurately track crop health, soil conditions, and irrigation needs. By utilizing geo-tagging, DeHaat helps optimize resource usage, improve crop management, and increase overall field productivity. The service also facilitates better planning and decision-making for farmers through data-driven insights.

With growing awareness of environmental sustainability, many farmers are adopting practices that promote soil health and reduce carbon footprints. Techniques such as crop rotation, organic farming, and the use of biofertilizers are becoming increasingly popular. Bio-fertilizers, bio-stimulants, and bio-pesticides help reduce dependency on chemical inputs. DeHaat offers such organic inputs for farmers to achieve better environmental outcomes and contribute to sustainable farming practices.

One of the significant challenges for Kharif farmers is accessing markets to sell their produce at fair prices. Agritech platforms are bridging this gap by connecting farmers directly with buyers and ensuring better profitability. These platforms provide real-time market prices, demand forecasts, and logistical support.

Direct Seeded Rice (DSR) is an innovative agricultural practice where rice seeds are directly sown into the field, eliminating the need for traditional transplanting of seedlings. This method reduces labor costs, water usage, and other initial costs. DSR promotes timely sowing and better crop establishment, leading to potentially higher yields.

Tackling the Climate Change

Mitigating climate change has become a vital factor as it can impact agriculture considerably. Additionally, investing in resilient crop varieties, climate-smart practices, and efficient inputs can aid in enhancing adaptability to changing climate conditions.

Climate-smart agriculture is a holistic approach that integrates practices that enhance productivity, improve adaptation to climate change, and reduce greenhouse gas emissions. DeHaat has enhanced access to advanced weather monitoring systems to promote climate-smart farming. By delivering regular weather updates and forecasts for the upcoming weeks, DeHaat assists farmers in more effectively planning their crop sowing and harvesting, aiding their adaptation to weather-related changes.

Cultivation of millets is essential in the face of climate change, as these resilient grains thrive in arid conditions and require minimal water. Millets can withstand extreme weather, making them a sustainable choice for ensuring food security. Their cultivation supports biodiversity and enhances soil health, reducing the carbon footprint of agricultural practices. Embracing millets can transform our food systems, aligning with climate resilience and sustainable development goals.

With rising global temperatures, adopting climate-resilient seeds is crucial. These seeds are genetically engineered or selectively bred to withstand extreme temperatures, ensuring stable crop production even during heat waves and extreme cold.

Crop insurance is vital for mitigating the financial risks associated with agriculture. They provide a safety net for farmers against losses due to natural disasters, pests, and diseases. This financial protection encourages investment in modern farming techniques and technologies, fostering a more resilient agricultural sector. DeHaat offers bundled insurance with inputs, involving a paperless and hassle-free process. Furthermore, in case of claims, the compensation is directly credited to the farmer's account, making it a quick endeavor.

Practices such as soil testing, geo-tagging, and the use of climate-resilient seeds offer pathways to more sustainable and efficient agriculture in extreme climatic conditions. Agritech platforms like DeHaat are at the forefront of this agricultural transformation, offering a comprehensive suite of services that empower farmers with the tools and knowledge necessary to thrive. Currently operating across 12 Indian states, DeHaat has been on a mission since 2011 to empower farmers to enhance both the quality and quantity of their crop yields. Through personalized crop advisory and digital farmer services, DeHaat supports over 2.5 million farmers across the country.

> **Embracing millets can transform our food systems, aligning with climate resilience and sustainable development goals**

ABOUT THE AUTHOR

Mr Shyam Sundar Singh is the Co-founder & Director of DeHaat, India's largest full-stack Business to Farmer (B2F) platform

Tell it RIGHT

Combating misinformation and Fake News

ABOUT THE AUTHOR

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“Empowering women with economic opportunities creates a ripple effect that benefits their families and entire communities

Fake news and misinformation, the most prevalent viruses in our society, have infiltrated agriculture, causing widespread financial losses for farmers, the industry, and the nation at large. These viruses spread through word of mouth, social media, messaging apps, and attractive advertisements. This is a pressing issue that demands our immediate attention. Fake news and misinformation in agriculture are not new. They have been problems in the sector for a long time. However, in the past, due to a lack of awareness, corrective measures were not taken.

Agriculture includes various branches such as horticulture, agronomy, soil science, crop physiology, and entomology, among others. Misinformation and fake news are not confined to any specific branch; they affect all areas of agriculture to varying degrees. While misinformation in fertilizers and pesticides is very common, there are also significant instances of local seed producers selling low-quality seeds to farmers. These producers often use attractive offers and sell their seeds at below-market prices, promising excellent harvests. Without access to authentic information, farmers are easily deceived. Consequently, by trusting these fake seed dealers, the farmers suffer from poor production outcomes.

Impact Of Misinformation

This widespread misinformation affects farmers in multiple ways. It leads to the use of substandard inputs, incorrect farming practices, and misallocation of essential resources like water and soil. Agriculture is season-bound, and the spread of misinformation ahead of any season can cause farmers to fall into debt for the entire year. Hence, the pervasive nature of this problem underscores the urgent need for effective measures to combat misinformation and ensure that farmers have access to accurate and reliable information across all branches of agriculture.

Countering Miss Information and Fake News in Agriculture

Combating misinformation and fake news in the agricultural domain requires a multi-faceted approach involving education, technology, policy, and community engagement. Here are several strategies that can be employed:

Educational Initiatives:

- Organising Workshops and Training Programs for farmers and Agricultural Workers: Conduct workshops to educate them about identifying reliable sources, critical thinking, and fact-checking techniques.
- Sensitising consumers and general public: Promote awareness campaigns to educate consumers about food production processes and the sources of agricultural news.
- Integrate media literacy into agricultural education programs at universities and agricultural colleges.
- Organize conferences where experts discuss the latest trends in agricultural misinformation and share strategies to combat it.

Technology Solutions:

- Developing and promoting fact-checking tools, that automatically check the credibility of agricultural news, such as browser extensions or mobile apps specifically designed for agricultural information.
- Use AI to monitor and flag potentially false information on social media and other platforms.

Policy and Regulation:

- Advocate for stronger regulations against the spread of false information, including penalties for those who deliberately spread misinformation.
- Establish and promote standards for verifying agricultural news and information. This can include a certification process for reliable sources.

Collaboration and Partnerships:

- Collaborate with agricultural organizations, universities, and research institutions to promote accurate information and debunk myths.
- Work with reputable media outlets to ensure that they have access to accurate agricultural information and provide them with experts for commentary and fact-checking.
- Partner with influencers in the agricultural sector who can reach large audiences and convey accurate information in a relatable manner.
- Use social media to spread accurate information and counter misinformation. Create engaging content that is easy to share.

Research and Development:

- Invest in research to understand the sources and spread of misinformation in agriculture. Use this research to develop more effective countermeasures.
- Publish case studies showing the impact of misinformation on agriculture and how it has been effectively countered in specific instances.

Monitoring and Reporting:

- Establish hotlines or online platforms where misinformation can be reported. Ensure these reports are investigated and acted upon swiftly.
- Utilize services that monitor the spread of agricultural news and provide real-time alerts on emerging misinformation trends.

About Grameen Foundation for Social Impact (GFSI)

Grameen Foundation for Social Impact (GFSI) is a not-for-profit organization, registered under section 25 of Companies Act, 1956 (now known as section 8 of the Indian Companies Act 2013). GFSI was acquired by Grameen Foundation India in 2017 to undertake activities and services that impact the lives of the poor, especially women.

At Grameen, we believe that empowering women with economic opportunities creates a ripple effect that benefits not only their families but also their entire communities. Our organization is renowned for pioneering innovative and scalable models that have positively impacted millions of low-income people. At Grameen, we believe that when poor rural women are empowered with knowledge and commensurate resources, they are able to transform their lives and the lives of their larger communities. Our projects have already impacted over 1 million women. We are working to impact a billion more. Our Mission is to Enabling the poor, especially women, to create a world without poverty and hunger. In an effort to prevent the spread of misinformation and fake news in agriculture, GFSI is supporting smallholder farmers, particularly women, to expand and improve their agricultural production. This is being done through the ALPs vertical, which utilizes digital technology and data to connect farmers with extension services, markets, and financial resources.

ABOUT THE AUTHOR

Mr Anil Jauhri is former CEO of National Accreditation Board for Certification Bodies, a constituent Board of the Quality Council of India. He has earlier worked in the Bureau of Indian Standards and the Export Inspection Council in his 44 plus year career in standards, conformity assessment, accreditation and technical regulations

World of Fake Unauthnetic Certifications

> Certificates issued by government bodies are generally authentic although cases of fake BIS certification mark have also grown

The awesome advancement in technology in recent years has, as should be expected, its fair share of pluses and minuses. One big minus is how easy it has become to create hard-to-distinguish fakes – news, products, claims et al.

From the world of standards and quality, we can add another – fake and unauthentic certifications which are rampant in the market including in agrifood sector.

How many times have you seen GMP or HACCP certificates? Without even looking at them, one can safely say they are unauthentic!

Surprised?

Let us understand why!

Certification System

Any certification – be it product (any food item) or process (like organic or good agricultural practices), systems (like food safety management systems) or person (such as food safety supervisor) – first requires a standard or criteria – what is called a normative document - which contains requirements. One easy way of identifying such a standard would be that it uses 'shall' in the text – use of 'should' implies these are recommendations and not obligatory to fulfil.

There are standards which provide guidance – these normally use term 'should' and therefore are neither auditable nor certifiable.

Now if someone presents a GMP or HACCP certificate to you, you should expect that there is a mention of a standard against which such certification is granted.

Oh yes! There is – Codex GMP/GHP/HACCP!!!

The problem is that Codex GMP/GHP/HACP standard, mother standard though it is, is titled *"GENERAL PRINCIPLES OF FOOD HYGIENE - CXC 1-1969 - Adopted in 1969. Amended in 1999. Revised in 1997, 2003, 2020. Editorial corrections in 2011"*

It contains principles for safe food production NOT requirements.

To be clearer – here is what is stated in its beginning as Objectives:

The General Principles of Food Hygiene: Good Hygiene Practices (GHPs) and the Hazard Analysis and Critical Control Point (HACCP) System aim to:

- provide principles and guidance on the application of GHPs applicable throughout the food chain to provide food that is safe and suitable for consumption;
- provide guidance on the application of HACCP principles;
- clarify the relationship between GHPs and HACCP; and
- provide the basis on which sector and product-specific codes of practice can be established.

Note the use of word 'guidance'.

To sum up, Codex standard is not certifiable and therefore any certificate to it is unauthentic.

IndiaGHP and IndiaHACCP Standards And Certification Schemes

In order to help Indian agrifood industry secure a proper GMP or HACCP certification, Quality Council of India (QCI), supported by the Food Safety and Standards Authority of India (FSSAI), developed IndiaGHP and IndiaHACCP standards and certification schemes which are available at https://padd.qci.org.in/indiaghp-indiahaccp-schemes/

What you find in the market are GMP or HACCP certificates which either do not mention any standard or mention Codex standard – neither is appropriate and you can be sure such certifications are liable to be rejected by the market.

Larger Question Of What Is A Genuine Authentic Certification

There are countless certifying agencies, formally called certification bodies (CBs), in the private sector in India literally hawking ISO and other kind of certifications. Large majority of stakeholders do not understand the system of certifications and therefore are regularly fooled by beautifully designed certificates carrying for added effect many times addresses in Europe or USA!!! And yet many of them are fake or fraudulent or unauthentic.

The problem is that there is no law in India or for that matter in most countries which requires such private agencies to be registered or licensed – like many services do need – say hotels or hospitals or financial services.

Any one can set up a certifying agency and start issuing certifications whether to ISO or Codex or even USFDA standards or any other standard.

Many times, industry which is seeking these certificates is ignorant of what would be an authentic certificate – equally many times businesses are complicit in this activity – they just need a certificate to show to their buyers or submit as part of a tender – quality and systems be damned!!!

How To Distinguish A Genuine Certificate From Fake, Unauthentic Ones

If the certificate is from a government agency like the Bureau of Indian Standards (BIS) or Textiles Committee, it should be accepted unhesitatingly – usually list of those granted such certifications would be on their website where it can be cross checked.

Caution is to be exercises when private agencies issue a certificate – howsoever big their name may be – many of them are issuing certificates for GMP/HACCP or Risk management as per ISO 31000 or even complaints handling as per ISO 10002 which are all guidance standards and as already explained not certifiable.

Globally there is a system of what is called accreditation of such certifying agencies – which also covers inspection agencies and testing or calibration labs. This is a voluntary system operated under the aegis of the International Accreditation Forum (IAF – iaf.nu) which is an association of accreditation bodies. The National Accreditation Borad for Certification Bodies (NABCB - https://nabcb.qci.org.in/) is a member of IAF from India. A similar system operates for labs and inspection agencies under the International Laboratory Accreditation Cooperation (ILAC - https://ilac.org/) where NABCB is a member for inspection; for labs there are three Indian accreditation bodies now who are full members namely:

- National Accreditation Board for Testing and Calibration Laboratories (NABL - https://nabl-india.org/)
- Quality and Accreditation Institute Pvt. Ltd (QAI - https://qai.org.in/)
- *Federation for Development of Accreditation Services* (FDAS - https://www.fdasindia.org/)

Incidentally, IAF and ILAC are slated to merge into a single body in 2025. In addition, there are regional bodies and India is under the jurisdiction of the Asia Pacific Accreditation Cooperation (APAC - https://www.apac-accreditation.org/). All the ABs in India named above are members of APA as well. Some more are in the offing!

IAF and ILAC have set requirements for reginal bodies and actually evaluate regional bodies every 4 years. The regional bodies in turn evaluate the individual accreditation bodies every 4 years based on which these ABs sign the mutual recognition arrangement of IAF called MLA and ILAC called MRA.

The safest approach is to rely on certificates (or test reports or inspection reports) of bodies which are accredited under the IAF/ILAC system signified by presence fo AB logo on the certificates (and many times IAF or ILAC logo too).

IAF has gone one step further and for some of the management systems certifications like ISO 9001 or ISO 14001 or ISO 22000, it has created a global directory which is available at https://www.iafcertsearch.org/

Anyone can go to this site and verify the certificate he is holding or has been provided with.

However, there are some systems globally which operate outside IAF/ILAC framework – for example some of the sustainability certifications like Forest Stewardship Council (FSC) for forestry or Marine Stewardship Council (MSC) or Aquaculture Stewardship Council (ASC) or Round Table for Sustainable Palm Oli (RSPO) have designated an exclusive accreditation body Assurance Services International (ASI) or SA 8000 has its own accreditation system known as Social Accountability Accreditation Service (SAAS).

Therefore, it is necessary to find out if the certificate has been issued under some known certification scheme and is genuine by checking on the website of the scheme owner.

To Sum Up

- Certificates issued by government bodies are generally authentic although cases of fake BIS certification mark have also grown and therefore it is necessary to check on the website of the government body if a particular organization is certified.
- In case regulators specify certification e.g. organic certification, the list of CBs and certified clients invariably would be available on their website
- Generally certificates issued under the IAF system (and ILAC system for inspection and testing) should be trustworthy – you can check names of accreditation bodies on their websites and the names of accredited certification bodies (and labs or inspection agencies) on the AB website. The certificates should carry logo of the AB and often it may have IAF (or ILASC) lgo also.
- Many management systems certificates can be verified on iafcertsearch.org website. In case of those not covered in the global directory, one can check with the concerned accreditation body some of who have a similar certificate check facility on their website.
- In case of known schemes, like GlobalGAP or FSSC 22000 or BRCGS, the website of scheme owner would provide list of authorized certification bodies and certified organizations.

With the above guidance, hopefully one can avoid being duped by fake or unauthentic certificates.

Future Wise

The Climate-Smart Approach

Tackling Land Degradation, Desertification, and Drought Resilience in Indian Agriculture

Addressing land degradation, desertification, and drought resilience in Indian agriculture requires a multifaceted and collaborative approach

ABOUT THE AUTHOR

Mr Ashish Dobhal is the CEO of UPL SAS

Extreme weather events are becoming increasingly common.

Floods, erratic rainfall, and extreme heatwaves — these consequences of climate change are becoming familiar to all of us.

For those not engaged in agriculture, these effects are disruptive and inconvenient. However, for the farming sector, they pose an existential threat, primarily due to land degradation.

According to the United Nations Convention to Combat Desertification (UNCCD) report, as of 2019, India had 30.51 million hectares of degraded land, which accounts for 9.45% of the country's total land area.

Additionally, over 120 million hectares, more than a third of India's land area, were reported as being under drought conditions in 2019.

Statistics also reveal that over 18 percent of India's population was exposed to land degradation, and a staggering 83.85 percent were exposed to drought.

Frequent Extreme Weather Events

The situation is indeed dire, with increasingly frequent extreme weather events being a major contributing factor.

For example, heavy rains wash away the topsoil. In India, more than half of the farmlands are rainfed rather than irrigated, leaving the topsoil vulnerable to erosion during heavy rains.

Water erosion is responsible for 80 percent of the degradation occurring on unirrigated, rainfed farmland.

Similarly, heatwaves deplete soil moisture, creating drought-like conditions and destroying soil biodiversity. This loss of fertility-boosting organisms and microorganisms further diminishes soil and crop health.

In simple terms, climate change severely impacts farmlands and their productivity.

With food demand soaring and expected to rise further, we cannot afford this toll

Fortunately, there are measures to conserve soil health and reverse land degradation.

Precision Agriculture

What is required is a climate-smart approach that prolongs soil fertility while building resilience to withstand extreme weather events and droughts. This encompasses crop nutrition and protection, precision agriculture, crop rotation, and intercropping.

Precision agriculture uses data on weather conditions, soil health, and crop growth to determine the exact inputs needed.

By accurately gauging the amount of water, nutrients, fertilizers, and pesticides required, farmers can use resources like water more responsibly and efficiently, reducing the strain on the soil. Combined with practices like crop rotation and intercropping, this approach preserves soil health and extends its fertility.

Fertile soil has immense potential, which can be harnessed through agroforestry. Agroforestry exemplifies how farmland and forests can coexist symbiotically. Forest trees enrich the soil and protect crops from extreme weather.

However, for climate-smart practices to be most effective, a collaborative approach involving farmers, the government, and the private sector is necessary. While the government should create an enabling policy environment, the private sector can drive innovative solutions.

Innovation

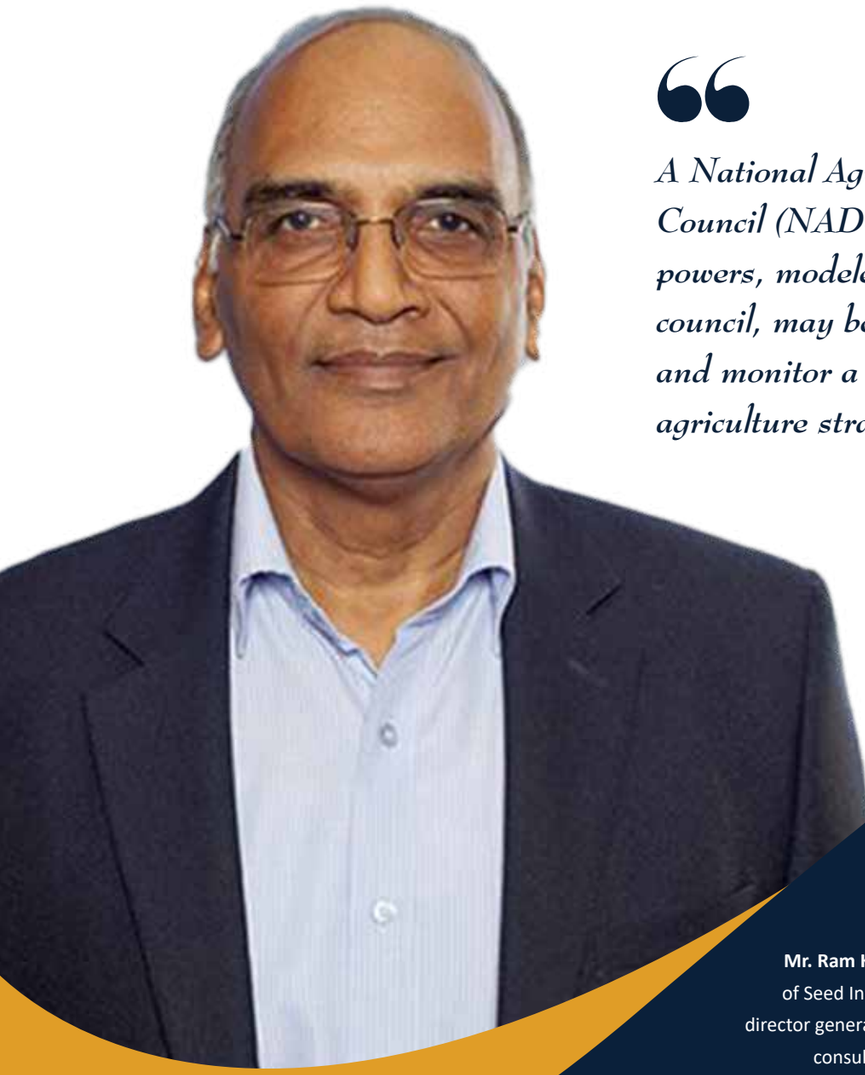
Innovation is already in motion. UPL, for instance, has developed a wide range of climate-smart products, for crop protection and soil health to plant stimulation and post-harvest solutions. One notable success is the Zeba technology, a patented sustainable superabsorbent product that is biodegradable.

Zeba increases the soil's water-holding capacity, improves nutrient use efficiency in the crop's root zone, and positively affects the soil microbiome, thereby maintaining soil health. Adoption of Zeba can lead to a 15-20% increase in water efficiency compared to traditional irrigation methods, benefiting crops like sugarcane and groundnuts. Similarly, subsurface irrigation systems have demonstrated their efficacy in delivering water directly to the root zone, thereby reducing water wastage and maximizing crop yields.

Zeba was used across 1.2 lakh acres of farmland in India in 2023 and saved 72 billion litres of water. Moreover, the use of Zeba led to a 25% reduction in fertilizer use while delivering savings of Rs. 1,500 per acre on electricity and Rs. 1,000 per acre on labor. In total, Zeba has helped farmers earn an additional income of Rs. 22,000+ per hectare on an additional spend of less than Rs. 5,000.

The company is also contributing to reforestation efforts by promoting Social Forestry, where communities work together to restore barren and deforested lands, driving environmental, social, and rural development.

In conclusion, addressing land degradation, desertification, and drought resilience in Indian agriculture requires a multifaceted and collaborative approach. By adopting innovative climate-smart practices and fostering cooperation between farmers, the government, and the private sector, we can build a sustainable and resilient agricultural future for India.



A National Agricultural Development Council (NADC) with statutory powers, modeled after the GST council, may be established to create and monitor a comprehensive national agriculture strategy

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HEALTH HIGHWAY

A Roadmap for Revitalizing Indian Agriculture

Agenda for the First 100 Days

Indian agriculture faces numerous challenges such as stagnant yields, climate change, dwindling resources, rising costs, and inadequate innovation. The new government has a crucial role to play in steering the sector towards self-reliance, farmers' prosperity, sustainability and robust innovation through research and development (R&D). Towards this end the government may focus on certain key points in the first 100 days.

Focal Areas

Deployment of modern technologies in seeds, crop protection chemicals, crop nutrition products, and biological products is crucial. These technologies can boost yields and reduce environmental impact. A detailed technology deployment plan for critical crops such as cotton, oilseeds, maize, fruits, and vegetables is to be prepared and implemented.

To spur innovation, it is vital to increase agricultural research investment from the current 0.61% of Agri GDP to 1%. Identifying and funding high-priority research projects over the next 3-5 years with active participation from public and private sectors can yield significant advancements. Emphasis should be placed on crop improvement through superior seeds and planting material, supported by a policy framework that recognizes and incentivizes research-based seed companies and protects their intellectual property.

Sustainable Practices

Agricultural subsidies should be redirected to promote sustainable practices including crop diversification based on agro-ecological zones, water and soil conservation programs and the cultivation of climate-resilient crop varieties. Introducing Carbon Credits and Green Credits systems through digital platforms for easy access can incentivize farmers to adopt sustainable practices profitably.

Building capacity of governance, compliance, commercial market dealing skills and primary processing facilities among Farmer Producer Organizations (FPOs) through a national program will strengthen their role in agricultural development and farmers prosperity. Special lending guidelines by RBI for FPOs is essential. Encouraging market-aligned crop production requires multi-stakeholder dialogue with end-user industries, private sector, farmers and policy guidance from an inter-ministerial committee. Providing end-to-end solutions for key crops will boost farmers' profitability.

Enhancing Digital Infrastructure

Enhancing digital infrastructure is crucial for operational efficiency, reducing drudgery, and enabling digital business operations in agriculture. Standardizing parameters of crop lots and processes is the key. Financial services like credit and insurance, delivered digitally, benefit farmers. Digital management of agricultural output is vital for profitability, inflation control, and minimizing post-harvest losses. Establishing digitally enabled micro-warehouses and supporting public-private partnerships for digital products and services will be beneficial.

A special team may engage with all stakeholders and develop a mutually acceptable model for farm market liberalization. This team addresses crop production planning, price guidance, and market oversight. Establishing a regulator to monitor market functionality, data privacy, interoperability and quality will ensure fair and efficient market operations and their digitization.

National Agricultural Development Council

A National Agricultural Development Council (NADC) with statutory powers, modeled after the GST council, may be established to create and monitor a comprehensive national agriculture strategy. This council would include representatives from central and state agriculture ministries, NITI Aayog, political parties, researchers, farmers' bodies, industry, academicians, and economists. By encouraging collaboration among these stakeholders, the NADC can ensure cohesive and inclusive policy-making and implementation.

We must enhance Indian farmers' global competitiveness. Mapping cost and quality parameters against competing countries will help address higher costs and lower quality issues through technology deployment, improved agronomic practices, better input management and labor cost reduction. Promoting private funding for export-oriented crop clusters, value chain development, and quality management, supported by regulatory frameworks is critical.

Budget Focus

Increasing the budget threefold for drip irrigation, sprinklers, and hose reel systems is crucial. Programs like free power and water that harm the environment should be phased out. Farmers who adopt water-conserving practices, such as Direct Seeded Rice and growing less water-intensive crops, need incentivization for sustainable water use through direct benefit transfers.

A Bhavantar program for selected priority crops will encourage farmers to go for them without anxiety about low prices.

Implementing these points with a fresh, mission-driven approach can significantly enhance the competitiveness and profitability of Indian agriculture. The new government must embrace creativity and urgency to address these pressing needs, laying the foundation for a prosperous and sustainable future for agriculture.

Miraculous Millets

Unveiling the Trendy Resurgence of Ancient Grains

> A radical change in the government policies from food security to nutritional security is likely to have a positive impact on the future of millets

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In a world where dietary patterns are changing periodically, one ancient grain family has made an impressive resurgence – the 'millets'. These small powerhouses of nutrients have been cultivated for thousands of years and are now drawing the interest of health-conscious consumers, food enthusiasts, academicians, and researchers globally. Besides being a dietary staple, millets are becoming a symbol of a healthy lifestyle, culinary innovation, and sustainable climate-resilient farming.

The United Nations has declared 2023 as the International Year of Millets (IYoM 2023) to maintain its momentum. India is the largest producer and consumer of millets in the world. But interestingly, the per capita consumption of millets dropped drastically from 30.94 kg/annum in the year 1960 to 3.87 kg/annum in 2022 in India. APEDA& YES Bank Analysis (Yes Bank and APEDA, 2022) showed that reduction in consumption factor included increase in population and increase in utilization of millets into seed and industry under FSI (Food, Seed & Industry) segment consumption. Therefore, on one hand, millets have earned the status of super-food, while, on the other hand, till 2022 the percapita consumption of millets as cereals showed declining trend.

The Delhi Survey

Is it, that, millets are being consumed in some other form? Or did the resurgence get a push after 2023 IYoM declaration? To find out answers to these questions, the authors of this study conducted a survey in Delhi NCR in year 2024 to get an idea of the consumption pattern of millets amongst urban Indians.

Analyzing the Production and Consumption Balance of Millets in India: the Global Leader of Millets

India is the largest producer of millet in the world with around 19% of global share in production (2022). In the year 2022, India produced 17.60 million metric tons (Mn MT) of millets (Yes Bank and APEDA, 2022). Even the yield of millets over the years have increased in manifolds, from nearly 400kg/ha in 1961 to 1400kg/ha in 2021 (Fig.2). Currently, in India, there are approximately 180 registered Farmer Producer Organizations (FPOs) focusing on millets (APEDA, 2024). This shows a growing trend towards organized agricultural efforts within the millet sector.

In 2022, global millet consumption was 90.43 Mn MT. India led with 17.75 Mn MT, followed by China (13.70 Mn MT) and Nigeria (8.80 Mn MT). Of the total consumption, 25.66 Mn MT were used as feed, and 64.76 Mn MT for food, seed, and industrial (FSI) purposes. This shift in use contributed to a significant drop in India's per capita millet consumption from 30.94 kg/year in 1960 to 3.87 kg/year in 2022. According to Indexmundi and YES Bank Analysis, factors for this decline include population growth and increased use of millets in the FSI sector.

On the other hand, millets are gaining recognition as a superfood in India and globally due to their nutritional benefits, becoming popular among dieticians, doctors, and health-conscious urban populations. Despite increased marketing after the International Year of Millets (IYoM) 2023, consumption has declined from 1960 to 2022. While Yes Bank and APEDA (2022) attribute this to population growth and increased FSI usage, questions remain about whether Indians simply prefer other foods. To explore this, the authors conducted a survey in Delhi NCR in 2024 to understand urban millet consumption patterns.

Consumption Pattern and Dietary Preferences of Millets in Delhi NCR

To enhance data triangulation, a survey was conducted in the Delhi NCR region. Findings indicate that 76 per cent of urban respondents are aware of millets and regularly purchase and consume them (Fig. 3). However, 24 per cent are aware of their nutritional benefits but refrain from consumption due to factors like high prices and unfamiliar taste. Notably, a majority of consumers began preferring millets since 2023, possibly influenced by awareness programs tied to the UN International Year of Millets and the G20 initiative "MAHARISHI."

The survey found most respondents consumed millets for their health benefits, especially as a gluten-free option. Elderly respondents highlighted benefits for diabetes and weight loss. Some were influenced by the trendiness and taste of millets. Social learning significantly impacted urban consumers' choices. Additionally, Fig. 4 shows a preference for value-added millet products like cookies and biscuits over raw millets.

Striking Balance for Prosperity: Strategizing Millet Value Chain and Exports

As evident from the above study that millet consumption is undoubtedly increasing amongst urban Indians especially after 2023. Millet production is already increasing as per statistics. Hence, the statistics that show consumption had decreased of millets from 1960 to 2022, it can be inferred that urban consumers prefer millet based value added products over millets as cereals which was also a reason of increased divergence of millets towards FSI as already discussed earlier. Hence millet based food products can emerge as a potential industry in coming years coupled with the demand for gluten-free products in recent decades. Millet offers consumers a gluten-free alternative from millet biscuits to kichdi, laddu, noodles etc. (Fig. 5).

From production point of view, the resurgence of millets is not only benefiting our health and the environment but also revitalizing local economies as they have comparatively less input requirement and climate resilience (G20 AWG, 2023).

Along with providing nutritional security in a global platform, millets contribute largely in boosting India's agricultural export. During 2022-23, the export of millets and millets related products from the country has been shipped worth of 169049.11 MT valued Rs. 608.12 crore (75.45 million US$) (APEDA, 2024).

The way forward for promoting millets and millet value chain and export is boosting productivity, intensive R&D efforts focusing on increasing access to improved varieties, efficient processing technology, increasing product shelf-life, export promotion, marketing. Partnering with both government and non-government organizations is essential for achieving success. Key initiatives include establishing millet-centric Farmer Producer Organizations (FPOs), startups, incubation centers, and Nutri-Hubs, which are vital for reaching this objective.

Need For Greater Awareness

As the world becomes more conscious of sustainable living and the importance of healthy eating, millets are occupying the spaces as the magical grains that check all the boxes. A radical change in the government policies from food security to nutritional security is likely to have a positive impact on the future of millets. Still the major focus should be on escalating the productivity of millets in India as well as other developing countries in order to provide consumers with cost effective millet products and maintain a sustainable value chain.

Spice it Right

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“ The problems with Indian spices are part of a larger issue of food safety in India

Urgent Reforms Needed to Tackle Indian Spice Contamination Crisis

India, a formidable force in the global spice market, recorded exports worth an impressive $4.4 billion in the 2023-2024 fiscal year, marking a remarkable 12.3% increase from the previous year, according to The Spices Board of India. From fiery chillies to aromatic cardamom, India’s diverse spice offerings captivate palates worldwide, from China to the United States. However, beneath this vibrant success lies a troubling reality: a growing concern over contamination within India’s spice industry.

On April 5, 2024, the Hong Kong Food Safety Centre revealed a disconcerting discovery. Three MDH spices - Madras Curry Powder, Curry Powder, and Sambhar Masala - along with Everest’s Fish Curry Masala, were found to contain toxic levels of ethylene oxide, a carcinogenic chemical banned in many countries. This revelation casts a shadow over India’s spice empire, raising questions about the extent of contamination. Is India’s spice paradise becoming a perilous minefield for unsuspecting consumers? Amidst the turmoil, can India restore trust in its cherished culinary treasures?

In response to the detection of ethylene oxide, several countries quickly banned the contaminated spices. By May 4, 2024, Singapore, Hong Kong, and the Maldives had already prohibited these products. Nepal followed, banning the sale and import of specific spice-mix products from Indian brands due to quality concerns. The banned items included MDH’s Madras Curry Powder, Sambhar Mixed Masala Powder, Mixed Masala Curry Powder, and Everest’s Fish Curry Masala. Nepal’s Department of Food Technology and Quality Control, citing Article 19 of the Food Regulation 2027 B.S., emphasized the health hazards these products posed and instructed importers and traders to recall them from the market. This action echoed similar measures in Singapore and Hong Kong, where food safety agencies had already raised concerns about high levels of ethylene oxide in these products.

Following these bans, Singapore ordered a recall of an Everest mix, and authorities in New Zealand, Australia, and the United States began investigating complaints about the two brands. In early June, Britain’s Food Standards Agency (FSA) imposed additional control measures on all spice imports from India. The contamination scare has had ripple effects in Nepal, where consumers are increasingly turning to locally manufactured and packaged spices. The ancient market of Ason in Kathmandu has seen a surge in demand for traditional, locally produced spices, following the ban on Indian spices, including MDH and Everest brands.

Action By Spices Board of India

The Spices Board of India has initiated measures to inspect the plants of major spice brands MDH and Everest to ensure they meet quality standards for exports, as reported by The Indian Express. Efforts are underway to improve compliance and prevent future rejections of Indian spices in global markets. A senior official from the Commerce and Industry Ministry highlighted a drastic decline in alerts on Indian food commodity exports to the European Union regarding ethylene oxide, noting that only 0.2% of all consignments were non-compliant in 2023-24. However, compliance issues persist. Inspections revealed several problems at the MDH and Everest plants, including the use of non-approved sterilization methods, poor hygiene practices, inadequate storage facilities, and non-compliance with labeling regulations. Ensuring strict adherence to food safety standards is crucial for maintaining the safety and quality of spices, which are widely consumed and exported.

The contamination issue in India’s spice industry extends far beyond just a few products. Over the past four years, the Food Safety Authorities of the European Union have banned or recalled more than 500 Indian products due to ethylene oxide contamination. These products include not only spices but also nuts, seeds, herbs, cereals, fruits, vegetables, and various other food items. The situation is further aggravated by the presence of Salmonella in several shipments of MDH spices sent to the United States, with 31% of these shipments being returned due to contamination. Despite these serious issues, the response from Indian authorities has been notably lacking.

Regulatory Failures and Measures Taken by Indian Authorities

The Food Safety and Standards Authority of India (FSSAI) has faced widespread criticism for its handling of recent contamination revelations. According to The Wire, the FSSAI recently increased the maximum residue limit (MRL) for pesticides on spices and herbs. This adjustment permits a higher retention of chemical agents on these food items post-pesticide treatment. The MRL has been significantly raised from 0.01 milligrams per kilogram (mg/kg) to 0.1 mg/kg, allowing spices and herbs to contain ten times more pesticide residue than previously permissible. This decision has sparked serious concerns regarding the government's commitment to food safety and public health.

The FSSAI has defended this increase, claiming it is based on proper field trials. However, the Pesticide Action Network of India has disputed this justification, noting that the field trials rely on data provided by pesticide manufacturers rather than independent sources. This decision has drawn widespread criticism, with many accusing the FSSAI of prioritizing industry interests over public health. The situation is further exacerbated by the significant influence of large Fast-Moving Consumer Goods (FMCG) and pesticide companies on government policies.

In response to recent recalls, the Spices Board of India has intensified inspections at the processing and manufacturing plants of major brands like MDH and Everest. The Board has established detailed protocols to prevent ethylene oxide (ETO) contamination and mandated ETO testing for consignments destined for Singapore and Hong Kong. Additionally, the FSSAI has directed state food commissioners to collect samples from major spice brands for ETO testing.

On April 22, the FSSAI launched a nationwide campaign involving commissioners of food safety from states and union territories, along with regional directors of FSSAI. According to sources reported by PTI, the regulator conducted extensive investigations of spice manufacturing units, including sampling and testing of spice products intended for domestic sale and distribution.

As reported, samples of Everest spices were collected from two manufacturing facilities, while 25 samples of MDH spices were obtained from 11 manufacturing units by FSSAI. These samples were analyzed for compliance with various safety and quality parameters, including residues and ethylene oxide, in NABL-accredited laboratories. Additionally, over 300 samples of spices from other brands were examined, and none showed the presence of ethylene oxide. The Spices Board has also issued guidelines to spice exporters on using ethylene oxide as a fumigant for sterilizing spices to address microbial contamination in accordance with the standards of importing countries.

International Standards and Comparisons

Different countries have varying standards for EO residues. Europe maintains a near-zero tolerance policy, allowing a maximum residual limit of 0.1 mg per kg, while Singapore allows up to 50 mg per kg. Despite these more lenient standards, Singapore still found excessive EO levels in Everest's Fish Curry Masala. In Hong Kong, EO is considered a pesticide, and its use for fumigation is entirely banned. Violations of food safety regulations in Hong Kong can result in hefty fines and imprisonment.

The European Union (EU) favors steaming over EO for sterilizing spices. While EO is cost-effective at ₹5 per kilogram, steaming costs range from ₹20 to ₹25 per kilogram. The EU's stringent standards for EO and pesticide residue levels contrast with the more lenient regulations in the United States, where EO use is permitted. Despite the controversies, the American Spice Trade Association (ASTA) recently issued a statement reassuring that the consumption of EO-treated spices is safe. The US Food and Drug Administration (FDA) and the US Environmental Protection Agency (EPA) support the use of EO for sterilization. ASTA's letter to the Spices Board of India emphasized that prohibiting EO could lead to compliance issues with US food safety regulations.

The Broader Issue of Food Safety in India: A Call for Action

The problems with Indian spices are part of a larger issue of food safety in India. Various harmful substances, including Salmonella, aflatoxins, mercury, and lead, have been detected in Indian food exports. The rejection rates for Indian food products by countries like the United States and the European Union are significantly higher than those for products from other countries, indicating systemic issues in food safety and quality control.

Despite these alarming trends, there has been minimal public awareness or media coverage in India. Critics accuse the Indian government of failing to adequately address these issues, attributing this inaction to the influence of powerful industry lobbies.

The excessive use of pesticides in Indian agriculture is a pressing concern. Numerous pesticides employed in India are banned in other countries due to their detrimental effects on human health and the environment. The widespread use of these pesticides is frequently influenced by pressure from chemical companies, which market their products as vital for achieving high crop yields. This has resulted in substantial health risks for both farmers and consumers.

The contamination of Indian spices with ethylene oxide and other harmful substances is a serious public health issue that demands immediate attention. The government must take decisive action to ensure food safety, including stricter enforcement of regulations, improved inspection processes, and greater transparency in addressing food safety concerns. The following policy recommendations aim to address the root causes of this crisis and enhance the safety and quality of Indian food exports.

AGRICULTURE WORLD

> The excessive use of pesticides in Indian agriculture is a pressing concern

Policy Recommendations

Establish Stricter Limits for Contaminants: The Food Safety and Standards Authority of India (FSSAI) should revise and enforce stricter limits for ethylene oxide and other harmful contaminants in food products. This includes aligning with international standards set by the European Union and other stringent regulatory bodies.

Regular and Comprehensive Inspections: Conduct frequent and thorough inspections of food processing plants, focusing on sterilization methods, hygiene practices, and compliance with labeling regulations. These inspections should be unannounced and include both random sampling and targeted checks based on risk assessments.

Mandatory Reporting and Public Disclosure: Implement mandatory reporting requirements for contamination incidents and recall actions. All test results and compliance reports should be publicly accessible to ensure transparency and build consumer trust.

Independent Testing: Establish independent laboratories for testing food products, reducing reliance on data provided by manufacturers. This ensures unbiased results and helps identify contamination issues more effectively.

Training and Education Programs: Launch training programs for food manufacturers on best practices for hygiene, storage, and sterilization. Emphasize the importance of complying with international safety standards to maintain export quality.

Certified Quality Assurance: Introduce a certification program for spice producers who meet high safety and quality standards. Certified producers would receive a quality mark, boosting consumer confidence and potentially opening up new export markets.

Ban Harmful Pesticides: Expedite the banning of pesticides that are known to be harmful and are banned in other countries. This includes revisiting and potentially reversing recent decisions to increase permissible pesticide limits.

Promote Integrated Pest Management (IPM): Encourage farmers to adopt IPM practices, which reduce the reliance on chemical pesticides by integrating biological, cultural, and mechanical control methods. Provide financial incentives and technical support to facilitate this transition.

Align with Global Standards: Work closely with international food safety authorities to align Indian regulations with global standards. This includes adopting best practices from countries with stringent food safety regulations and participating in international food safety initiatives.

Technical Assistance and Knowledge Exchange: Seek technical assistance and engage in knowledge exchange programs with countries that have advanced food safety systems. This can help India upgrade its regulatory framework and enforcement mechanisms.

Public Awareness Campaigns: Launch awareness campaigns to educate consumers about food safety issues and the importance of checking the source and safety certifications of the spices they purchase. Encourage consumers to report any suspected contamination.

Support Consumer Advocacy Groups: Strengthen and support consumer advocacy groups that can act as watchdogs, ensuring that food safety regulations are followed and holding manufacturers accountable.

Research on Safe Sterilization Methods: Fund research into safer and more effective sterilization methods that do not involve harmful chemicals like ethylene oxide. Encourage innovation in food processing technologies to enhance safety without compromising quality.

Food Safety Research Institutes: Establish dedicated research institutes focused on food safety and quality. These institutes can conduct studies on contamination sources, develop new testing methodologies, and provide scientific support to regulatory bodies.

A Call for Harmonised Standards

The Spices Board is advocating for harmonised international standards on ethylene oxide (ETO) usage, addressing the discrepancies in regulations across different countries. This harmonisation would facilitate smoother trade and ensure the safety of Indian spices on the global market. Additionally, there is a push for the Indian government to negotiate with the European Union (EU) to relax stringent norms, thereby enhancing Indian spice exports to European markets. The contamination of Indian spices with ETO is a wake-up call for stricter regulatory oversight and improved industry practices. While the economic impact of the recent recalls may be temporary, the long-term implications for public health and the reputation of Indian spices are significant. The health of 1.4 billion people is at stake, and it is imperative that the government and regulatory bodies take swift and decisive action to address these issues.

AI & Farming
It's Here & Now

> It can be difficult to water crops using conventional methods. However, cutting-edge irrigation technology found in Agriculture 4.0 is revolutionizing the field.

AI-based technologies have revolutionized the field of agriculture. Algorithms utilizing artificial intelligence possess the ability to analyze intricate databases collected from various sources, including but not limited to drones, VRT, RTK, and soil sensors. AI is currently being utilized to improve irrigation patterns, forecast crop yields, and spot possible pest and disease outbreaks. Precision agriculture techniques lead to more efficient use of fertilizer, irrigation, and pesticides. These solutions encourage sustainable agricultural methods while reducing the harmful impact of pesticides on the environment. It also assists farmers in lowering their financial risks through prudent pricing, distribution, and storage choices.

Agriculture 4.0 Concept

This next generation of farming uses IoT, AI, and data analytics among other technologies to improve workflows, boost productivity, and ensure agriculture's sustainability. By 2050, food demand is expected to rise sharply by 70% in tandem with the country's rapid population expansion. Because environmental changes are unpredictable, the newest farming trend is utilizing IoT, AI, and data analytics to improve workflows, boost productivity, and ensure agricultural sustainability. We have to look to agricultural technological innovation.

IoT's Effect on Agriculture

Examining Internet of Things (IoT) Applications in Farming Smart sensors that track soil moisture content and drones that assess crop health are just two examples of the technologies that are becoming commonplace in fields. By collecting data in real-time, these networked gadgets enable farmers to maximize yield and make well-informed decisions.

Advantages of IoT Integration in Farming

Farmers may implement precision farming and do away with guesswork thanks to IoT. Farmers can increase productivity and sustainability by using IoT data to observe weather patterns, monitor livestock, and adjust irrigation.

Using Artificial Intelligence in Agriculture

AI-Powered Agriculture Revolution With the use of AI, farmers can anticipate crop illnesses, analyse enormous volumes of data, and even automate repetitive jobs. Farmers may achieve unprecedented levels of productivity and efficiency when AI is on their side.

Variable Rate Technology, or VRT, enables farmers to apply varying amounts of nutrients, insecticides, fertilizers, and other materials to different areas of the field based on the conditions there. By gathering data from the field, AI will automatically apply variable rates and optimize the VRT. This method is primarily applied in the agricultural sector.

Using remote sensing

Without making physical contact with the surface, data is gathered via remote sensing technology. Using satellites and drones, remote sensing gathers information about disease outbreaks, weather patterns, and soil mapping. The data will be automatically interpreted by AI.

Global Positioning System, or GPS

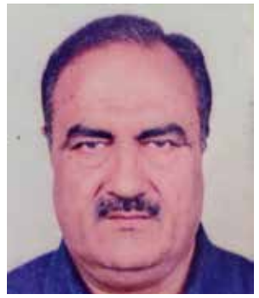
Farmers can create field maps by using GPS, a satellite-based navigation system, to pinpoint the precise location of farm equipment. GPS is equipped with VRT and GIS (geographical indication system) to maximize input rates and agricultural output. Farm equipment will supply the precise input since AI will understand data related to GPS.

Real-time kinetics, or RTK, is a clever gadget that transfers messages to different farm equipment by receiving signals from satellites.

Monitors of yield

Following harvest, these tools are used to monitor crop yield. This gadget gives us useful information about the productivity of various field segments, allowing AI to adjust farm inputs appropriately. Additionally, it offers crop tracking during transit and storage. Throughout, the yield losses are measured.



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Astute watering

There have been a lot of commercial advancements in precision irrigation in recent years. Sensors can be used to regulate drip and sprinkler irrigation systems based on the flow and volume of water required by plants. Sensor technologies regulate flow, minimizing water loss and reducing soil erosion.

Drone

Drone methods will be used to apply pesticides and fertilizers from the air. Materials are transported using drones as well.

Ideas for Entrepreneurship

AI-Powered Online Marketplaces

By using artificial intelligence algorithms and contemporary agricultural technologies to assess customer demand and deliver desired products to purchasers, food spoiling will be reduced and consumers will receive fresh food, both of which are good for the environment. By eliminating the middleman, these markets will enable farmers to receive real selling prices. In addition, a transparency model is developed so that consumers may learn about the chemicals used in food, the nutrients it contains, and any processing that has been done. It will increase consumers' faith in farmers. Digital tools enable sellers to personalize their offerings and receive real-time feedback from purchasers. Customers can place orders straight from their homes using the home delivery approach. The potential market for online sales is substantial, notwithstanding several obstacles to infrastructure, consumer acquisition, and technology accessibility. A website or smartphone application can be used to access this online market.

Management of livestock

An application based on artificial intelligence will be developed in compliance with husbandry and dairy management. Several sensors are used by this system to monitor the feeding patterns, overall health, and alertness to sickness in husbandry animals. It will evaluate the milk's quality and create data based on the nutrients found in it. This will assist farmers in increasing the productivity and efficiency of their dairy facilities.

AI for Decision-Making and Crop Monitoring

Drones and cameras with AI capabilities are now able to survey crops with unparalleled accuracy, enabling farmers to make data-driven decisions instantly.

Transforming Crop Watering Methods

It can be difficult to water crops using conventional methods. However, cutting-edge irrigation technology found in Agriculture 4.0 is revolutionizing the field.

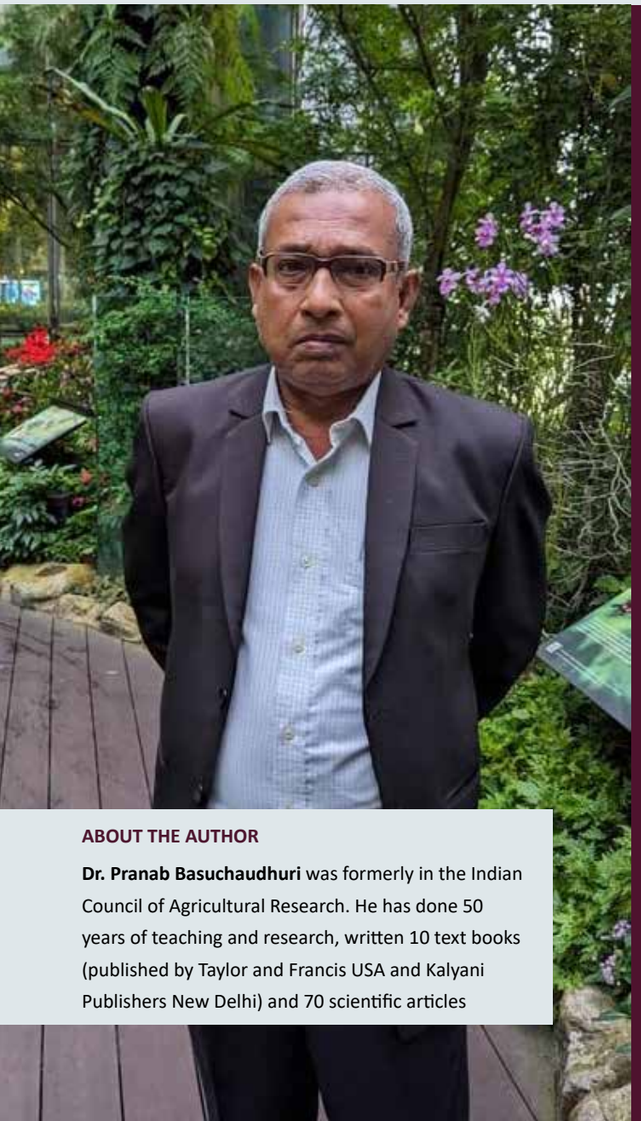
Agriculture 4.0: Innovative Irrigation Technologies

Put into practice IoT and AI-powered smart irrigation systems. To provide the ideal amount of water at the ideal time, these technologies evaluate crop water requirements, soil moisture levels, and weather forecasts. Farmers can save water, increase crop yields, and guarantee a plentiful harvest by regulating irrigation.

Developments in Spraying Systems Automation

These days, automated spraying systems are all the rage. They use drones, GPS, and sensors to deliver fertilizer or pesticides precisely where they need to go. Higher yields and healthier crops are the result of these systems' accurate and consistent coverage, which also lessens human error. This important market, valued at approximately USD 457.26 billion in 2023, is expected to grow at a phenomenal Compound Annual Growth Rate (CAGR) of roughly 4.9% between 2024 and 2032. It is a growing market. According to the forecast, the Indian agriculture market will grow rapidly to over USD 703.30 billion by 2032. Justifying the growing impact of Agriculture 4.0, the convergence of technologies such as robotics, AI and IOT is reshaping the agricultural environment in several ways.

STRATEGIES FOR INCREASED RICE PRODUCTION IN INDIA



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Dr. Pranab Basuchaudhuri was formerly in the Indian Council of Agricultural Research. He has done 50 years of teaching and research, written 10 text books (published by Taylor and Francis USA and Kalyani Publishers New Delhi) and 70 scientific articles

Rice is an important crop that serves as a staple food for over 3.5 billion of the world's population and also serves as food security for many countries in Africa and Asia. It is widely grown in varied environmental conditions, ranging from sea-coasts to high altitudes.

Rice was grown on 162 million hectares and its global production was 755 million tons in 2019 (http://www.fao.org/t/en). The world population may rise anywhere from 9.7 to 11 billion in 2050 (https://population.un.org/wpp/).Thus, a significant increase in rice yield will be required to feed the growing population. The global demand for rice is estimated to increase by 50% by 2050. However, climate change is a major limiting factor in crop production and increases in temperature are leading to more frequent and severe drought spells and soil salinization.

Wetland rice systems

Wetland rice systems in Asia make a major contribution to global rice supply. The system is also able to maintain soil fertility on a sustainable basis. The essential components of wetland rice culture comprise cultivation of land in the wet or flooded state (puddling), transplanting of rice seedlings into puddled rice paddies, and growing the rice crop under flooding.

The land is dry or flood-fallowed during the turnaround period between two crops. Following these cultural practices, two or three crops of rice or rice with upland crops in sequence are grown.

However, in the present context of increasing freshwater scarcity, there is a case to shift from the traditional method of growing rice to ways that are water-wise. In this context, it is crucial that the benefits of the wetland rice system on soil fertility and productivity are considered.

The plant height varies according to variety and environmental conditions, ranging from 0.4 m in dwarf varieties to 5 m in some deep-water floating rice. Generally taller varieties have a greater penetration of roots than shorter varieties. Similarly varieties with good tillering habit have a well-developed root system. The direct seeded crop develops deeper but has a poorly developed root system, whereas the transplanted crop has a shallow but well-developed root system. The plant height varies according to variety and environmental conditions, ranging from 0.4 m in dwarf varieties to 5 m in some deep-water floating rice.

Similarly varieties with good tillering habit have a well-developed root system. The direct seeded crop develops deeper but has a poorly developed root system, whereas the transplanted crop has a shallow but well-developed. The stem above the ground level consists of solid nodes and hollow internodes and is commonly called a 'culm'. Based upon the habitat and species, the elongation of internodes varies. Rapid elongation is observed mostly after the emergence of panicle from the flag leaf.

The lowermost buds on the crowded nodes, just at the ground level or below that, develop into tillers. The tillering habit depends on varieties, spacing, fertilizers, and cultural operations.

Elite lines and cultivars

A number of elite lines and cultivars characterized with resistance to biotic and abiotic stresses and quality characters were developed through conventional breeding, using the available genetic variability in the germplasm of O. sativa to the maximum extent. However, genetic variability for different traits, like resistance to stem borer, sheath blight, tungro virus, etc., is limited in the cultivated germplasm.

Therefore, for further improvement, the cultivated rice gene pool has been widened by introgression of genes from wild species for tolerance/resistance to major biotic and abiotic stresses as well as for quality characters using different newly-developed techniques.

Increased water use efficiency (WUE) must reduce water use in rice production through decreasing losses due to seepage, percolation, and evaporation, laser land leveling, crack ploughing to reduce bypass flow and bund maintenance. Water stress at vegetative and reproductive stage, can affect flower initiation, reduce spikelet fertility and hamper grain filling, which leads to lower grain weight and ultimately poor paddy yield. Reduced grain size, grain weight, and seed setting rate are typical features of rice under water stress.

Some challenges

In South and South-east Asia, rice have always been a highly flood-threatened crop in farmer's field. Identification of the Sub 1 gene that confers tolerance against submergence had a great impact in this context and introgression of the said gene into different high-yielding varieties through crossing has been successful till date. Now it is necessary to find other QTLs (Quantitative Trait Loci) imparting tolerance against inundation in addition to Sub1 gene. In this aspect, a new gene i.e., LGF 1 gene might be utilized to enhance submergence tolerance in rice plants by facilitating oxygen and carbon-di-oxide exchange underwater. Erratic rainfall pattern makes the rice crop vulnerable to excess water stress. If it happens during germination stage in direct seeded rice, it leads to germination stage oxygen deficiency (GSOD) stress thus poor germination.

> *In the present context of increasing freshwater scarcity, there is a case to shift from the traditional method of growing rice to ways that are water-wise*

Among the two predominant ecotypes of cultivated Asian rice, indica ecotype found to possess greater salt-tolerance ability than japonica. Tolerant indica cultivars are reported to be better Na+ excluders with high K+ uptake and tissue K+-retention ability for which they can maintain a low Na+/K+ ratio in the upper plant parts. Interestingly, rice is more vulnerable to salinity stress at early seedling and reproductive stages, while it was reported to be relatively tolerant during germination, active tillering and maturity stages. Exposure to salt stress at the reproductive stage, reduces grain yield significantly more than seedling stage. Besides, salt stress affects P, K+, Ca2+, Fe, Zn and Mn uptake but has interactive effects on N and Mg. Boron (B),silicon (Si), zinc (Zn) availability decreased under high salinity.

Heat stress and other issues

Heat stress results in poor anther dehiscence, causing reduced pollen dispersal and hampered pollination. reduced pollen viability and pollen tube growth, increased spikelet sterility, delayed heading and increased chalkiness. At a mean day temperature of more than 33°C at the heading stage reduced rice yield by 24-27% . Cold stress, it also increases floret sterility, grain abortion, and lowers yield. A temperature below 13°C for 15 days has been reported to cause 19-29% yield loss in rice.

Various studies indicate a decrease of up to ~12% in rice yield with time. The climate suitability for rainfed rice is projected to decline in the range of 15-40% by the year 2050. Burning of residues in field results in the loss of approximately 8 Mt C equivalent to a CO2 load of approximately 29 Mt per year and depletion of beneficial soil microflora. Burning rice straw is harmful to the atmosphere as it leads to (1) The release of soot particles and smoke,causing asthma or other respiratory problems; (2) release of GHGs, which cause global warming; and (3) loss of N, P, K, and S and other plant nutrients.

Increasing rice yield potential requires immediate attention. Identification of traits, donors, QTLs, and genes from diverse germplasm and related species will be necessary to enable yield to increase. Designing a plant type with appropriate combinations of genes for different yield-enhancing traits through a long-term strategy will be necessary to achieve the next quantum jump in increasing rice yield potential. To enable rice to better adapt to varying climatic conditions, as well as to enable resistance to and tolerance of new pathotypes and biotypes of diseases and insects, superior alleles for different genes must be identified and appropriately combined with the traits required in different ecosystems and conditions. For sustainable rice cultivation under reduced water-labor situations, breeding programs will need to invent a new rice plant type combining traits that provide better adaptability to mechanized water-saving cultivation systems.

Crop varieties such as CR-Dhan 801 and CR-Dhan 802 for rice and several for other crops, which are tolerant to multiple stresses, i.e.,submergence, salinity, drought, heat and pest and diseases have been developed. Rice is the most water demanding crop; technology has been developed to minimize the use of water and mitigate gas emissions, for example, alternative weathering and drying and dry direct sowing of seeds (DSR).

Adaptation strategies

Adaptation strategies for climate change include developing cultivars tolerant to different stresses, amending crop management practices, improving water management, adopting new techniques such as conservation agriculture (CA), improved pest management, better weather predictions and crop insurance. For rice-based systems, these approaches include: the direct seeded rice production on permanent no-till permanent 'narrow' beds, or direct seeded rice production in no-till leveled paddies, or direct seeded rice in no-till soils with sub-surface micro-irrigation. use of CA equipment and machinery; maintenance of soil mulch cover; management of competition for crop residues, effective integrated weed management; and economically and ecologically sustainable cropping systems, including more productive integration of livestock into CA systems. Advanced solutions to reduce methane emissions could be utilizing a changed water system (mid-season runoff, alternative flooding), modified residue management (straw sequestration), additive use (phosphor-gypsum, nitrification inhibitors) and modified land management (modified land management) (direct seeding, reduced tillage and site-specific nutrient management). Similarly, novel approaches of demand-driven N supply using leaf colour charts and site-specific N management minimize the excessive nitrogen pool in the soil and thus reduce nitrous oxide emissions.

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