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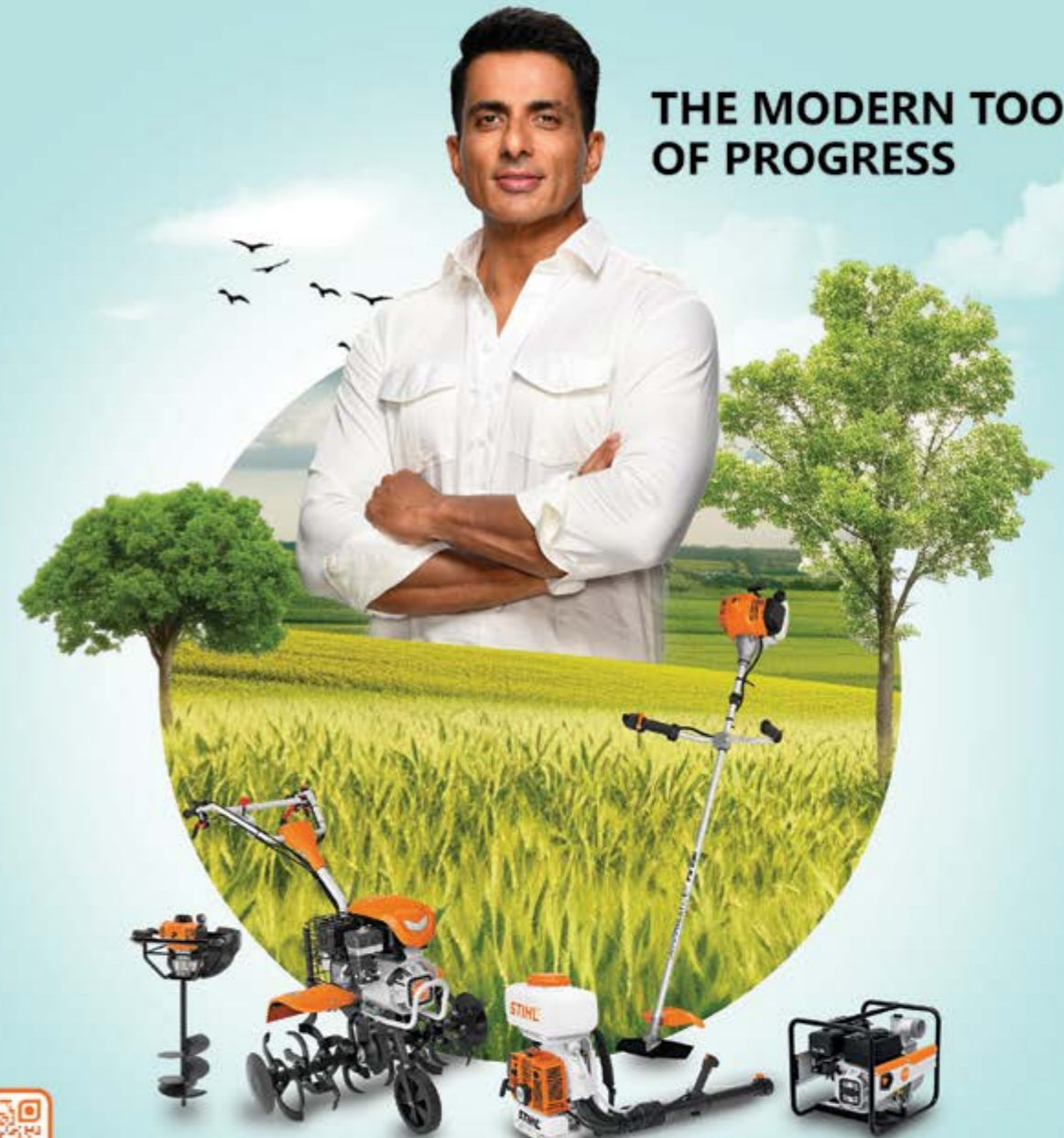


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CONTENT

10. True Value Addition
12. Industry Powerhouse
14. Promise Of Prosperity
18. Reassessing India's Post-Harvest Landscape
20. Food Express
22. Postharvest & Supply Chain Management for Food Security
24. Farm to Fork
26. Agri Distress in India
28. Women's Advancement In Agriculture
32. Food Security in Poultry Supply Chain
34. Block Chain
36. Turning Waste into Wealth
38. Sweet Solutions
40. Milk Plaanel
44. Water Pricing Reforms in India
46. Infra Boost
48. Tech Push
52. Dairy Does It!
54. Food Highway
56. Post-Harvest Management
58. Zero Tillage in Wheat
60. Urban Agriculture
62. Integrating IPM into Agri Inputs Supply Chains
64. Panacea to Future Food security

THE VISION



M C Dominic
Founder & Editor-in-Chief

Post-Harvest Management in India for Food Security

Post-harvest management (PHM) plays a crucial role in ensuring food security in India, a nation characterized by its vast agricultural output yet plagued by significant food wastage. Effective PHM encompasses all the steps taken after harvesting to preserve, store, process, and distribute agricultural produce, aiming to minimize losses and enhance food availability.

Some reports indicate that in India, approximately 30-40% of food produced is lost post-harvest due to inadequate infrastructure, poor handling practices, and insufficient storage facilities. If the loss of food produce is so high, it is indeed alarming. Wastage not only impacts the economy but also exacerbates food insecurity, particularly among vulnerable populations. Thus, improving PHM is vital for enhancing food security.

Key strategies for effective PHM include better storage solutions, such as modern silos and cold storage facilities, which can significantly reduce spoilage. Investment in technology is also essential. For instance, the use of hermetic storage bags can help prevent pest infestations without the use of harmful chemicals. Additionally, training farmers in best practices for harvesting, handling, and transportation can lead to substantial reductions in post-harvest losses.

With the optimum use of technology, integrating processing facilities can add value to raw produce, transforming perishable items into shelf-stable products. This not only extends the product's market life but also boosts farmers' incomes. Encouraging cooperative models can facilitate collective storage and processing, thereby optimizing resources and improving bargaining power.

Government initiatives, such as the Pradhan Mantri Krishi Sinchai Yojana and the Agricultural Marketing Infrastructure scheme, aim to enhance PHM infrastructure. Raising awareness about the importance of PHM among farmers and stakeholders is critical for the successful implementation of these strategies.

Strengthening post-harvest management in India is essential for mitigating food loss, enhancing food security, and ensuring that the benefits of agricultural production reach all segments of society. By addressing these challenges, India can move towards a more sustainable and secure food system.

Prosperous Farmers: Testimony to India's Growth Story

THE SUPPLY CHAIN – Farm to Fork



The narrative of India's economic growth is closely intertwined with the success of its farmers. Agriculture remains a cornerstone of the Indian economy, employing nearly half of the workforce and contributing significantly to the GDP. The rise of India's prosperous farmers symbolizes a transformative journey that reflects broader advancements

in technology, policy, and rural infrastructure.

In recent years, the Indian government has implemented various initiatives aimed at enhancing agricultural productivity and farmer welfare. Programs like the Pradhan Mantri Kisan Samman Nidhi provide direct income support, while investments in irrigation, soil health management, and crop diversification have empowered farmers to optimize yields. These efforts have resulted in a shift from subsistence farming to more profitable practices, enabling farmers to invest in education, healthcare, and improved living standards.

The adoption of modern agricultural technologies, such as precision farming and biotechnology, has further bolstered productivity. Access to information through mobile technology allows farmers to make informed decisions regarding crop management, weather patterns, and market prices, reducing risks and enhancing profitability.

The rise of farmer cooperatives and producer organizations has

enabled smallholders to band together, improving their bargaining power and access to markets. This collective approach fosters a sense of community and resilience, ensuring that benefits are distributed more equitably.

The success of prosperous farmers also has a multiplier effect on rural economies. Increased income leads to greater local demand for goods and services, stimulating growth in other sectors. This interconnectedness highlights the importance of agriculture in driving overall economic progress.

Prosperous farmers are not just beneficiaries of India's growth story. In fact, they are pivotal players in shaping it. Their success reflects the potential of a robust agricultural sector to uplift communities, drive economic development, and contribute to national prosperity. As India continues to evolve, the resilience and innovation of its farmers will remain key to sustaining growth and achieving food security.

India's hard working and prosperous farmers symbolize our nation's remarkable growth story, showcasing the resilience and innovation within the agricultural sector. Their success reflects advancements in technology, sustainable practices, and government support, contributing to food security and rural development. This transformation boosts the economy and empowers communities, driving India towards a more prosperous future.

Shiny Dominic
Managing Director



As we are aware, the journey of farm produce from harvest to the consumer's table is a multifaceted and complex one. The supply chain network must be seamlessly connected to ensure that no time is lost in the process because it leads to wastage of perishables. Another way to overcome the challenge of wastage is value addition and farm-to-fork traceability which will ensure an efficient supply chain management. It also enables 100% transparency for consumers, paving way to loyalty.

Postharvest and supply chain management are critical components in enhancing food security, particularly in developing regions where approximately one-third of food produced is lost or wasted, according to the Food and Agriculture Organization (FAO). Effective postharvest practices encompass all activities that occur after harvest, including handling, storage, processing, and distribution. By implementing improved techniques such as better packaging, temperature control, and sanitation measures, food loss can be significantly reduced.

Moreover, a well-structured supply chain plays an essential role in ensuring that food reaches markets efficiently and safely. This involves coordination among various stakeholders, including farmers, suppliers, distributors, and retailers. Innovations in supply chain

logistics, such as the use of digital platforms and data analytics, can enhance transparency and traceability, enabling stakeholders to make informed decisions.

Furthermore, integrating local food systems into broader supply chains can promote resilience against external shocks, such as climate change or global supply disruptions. Localized supply chains can adapt more swiftly to changes in demand and supply, ensuring that communities have access to essential food resources. Collaborative efforts between governments, private sectors, and non-governmental organizations can facilitate training programs aimed at empowering farmers with postharvest techniques and supply chain knowledge.

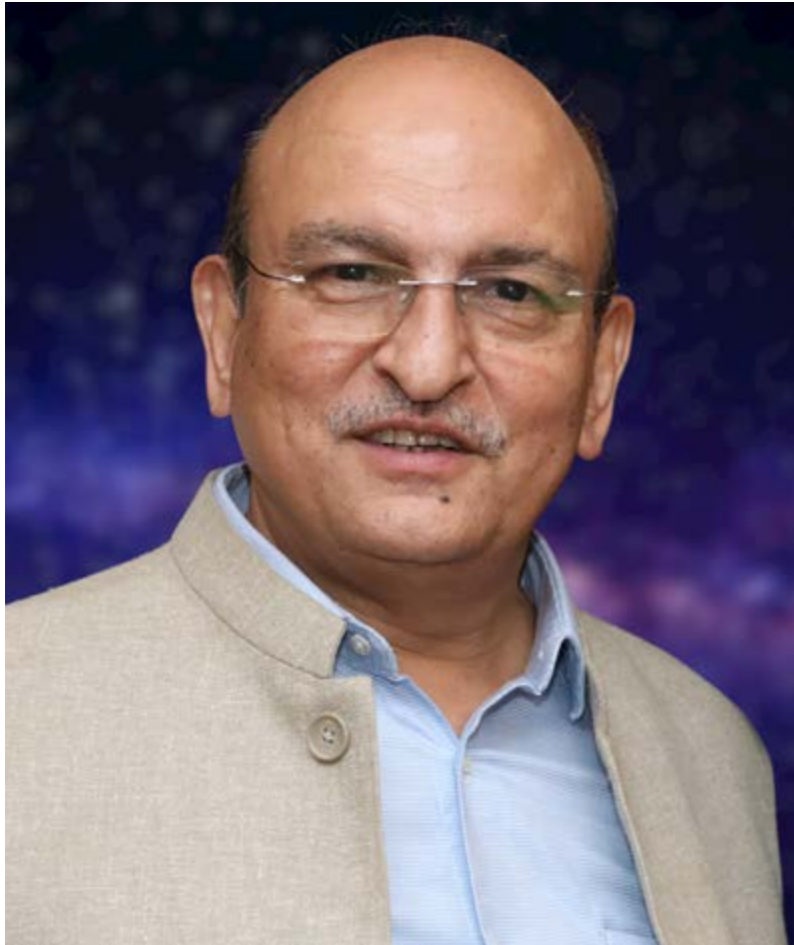
In conclusion, enhancing postharvest and supply chain management is vital for achieving food security. By reducing food loss, improving logistics, and strengthening local supply chains, stakeholders can ensure a more stable food supply, ultimately contributing to better nutrition and economic stability for vulnerable populations. Addressing these challenges requires a multifaceted approach, leveraging technology and collaboration to build a sustainable food system that can withstand future challenges.

This edition of Agriculture World attempts to explore **Postharvest & Supply Chain Management for Food Security**.

Mamta Jain
Group Editor & CEO

True Value Addition

Food to Feed, Not to Fritter Away



Mr Tarun Shridhar
is former Secretary, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India

world wasted 1.05 billion tonnes of food, i.e. 19 percent of food available to consumers. In addition, 13 percent of the world's food got lost in the post-harvest supply chain. Most of the world's food waste comes from households. Out of the total food wasted in 2022, households were responsible for 631 million tonnes equivalent to 60 percent, the food service sector for 290 and the retail sector for 131 tonnes respectively. Reducing food waste provides compounding benefits. Food loss and waste generate 8 to 10 percent of global greenhouse gas (GHG) emissions, almost five times the total emissions from the aviation sector. Households waste a staggering one billion meals a day. On average, each person wastes 79 kg of food annually. This is the equivalent of 1.3 meals every day for everyone in the world impacted by hunger.

Dealing With Food Waste
Food waste is not just a 'rich country' problem, according to the Food Waste Index Report; high-income, upper-middle income, and lower-middle income countries differ in observed average levels of household food waste by just 7 kg/capita/year. However, the report

recognises the temperature and waste correlation; hotter countries appear to have more food waste per capita in households, potentially due to increased consumption of fresh foods and lack of robust cold chain. Higher seasonal temperatures, extreme heat events, and droughts make it more challenging to store, process, transport, and sell food safely, often leading to a significant volume of food being wasted or lost. To sum up the report, food loss and waste is a failure of the value and supply chains resulting in the throwing away of more than US\$1 trillion worth of food every year. It is also an environmental failure as it generates 8-10 percent global greenhouse gas emissions; this is a footprint equivalent to that of a nation, third only to China and the US. Further, it takes up the equivalent of nearly 30 percent of the world's agricultural land. The conversion of natural ecosystems for agriculture has been one of the leading causes of habitat loss. Food waste is failing people, and this failure assumes criminal dimensions because even as food is being thrown away at an abnormal scale, up to 783 million people are affected by hunger each year, a third of humanity faces

Stop Food Loss and Waste. For the People. For the Planet", is the slogan of the fifth observance of the International Day of Awareness of Food Loss and Waste to be observed on 29th September. It would aim to highlight the critical need for committing adequate resources to bolster efforts to reduce food loss and waste as a measure to advancing the Global Development Agenda 2030. Sustainable Development Goal (SDG) 12, of Agenda 2030, seeks to "ensure sustainable consumption and production patterns." Target 12.3 of the goal aims to "by 2030, halve the per capita global food waste at the retail and consumer level, and reduce food losses along production and supply chains including post-harvest losses." Addressing food loss and waste throughout the supply chain, from production to consumption, would improve the overall efficiency of the food system, helping to ensure that more food reaches those in need. After all, the broader context of sustainable development is elimination of poverty and promotion of prosperity while protecting the planet. According to the United Nations Environment Programme (UNEP) Food Waste Index Report 2024 titled "Think Eat Save", in 2022, the

food insecurity and 150 million children under the age of five suffer stunted growth and development due to a chronic lack of essential nutrients in their diets.

Strategies To Reduce Food Loss And Waste
The report is a stark indication of the inefficiency of current food systems. Food losses and waste also translate into economic losses for farmers and other stakeholders within the food value chain, and higher prices for consumers, both of which affect food insecurity by making food less accessible for vulnerable groups. Reducing food losses and waste would, obviously, increase the supply of available food and strengthen global food security. When food is lost or wasted, all the resources that went into producing it are also wasted. Strategies to reduce food loss and waste, as suggested by the Food and Agriculture Organisation (FAO), include adjustments in production; technological enhancements in post-harvest handling, treatment, storage and distribution; targeted interventions; information dissemination; and behavioural reminders to optimise food consumption, reduce food waste, and foster circular economy practices. In a nutshell, a reinvention of the entire food value/supply chain.

Loss and waste are commonly used interchangeably in the context of food, but there is a difference, and it is subtle, beyond the semantics. The distinction between food loss and food waste is important, because it underscores their different underlying causes. Policies and strategies need to take these into account when seeking solutions to the problem. Food loss is the decrease in the quantity or quality of food as an outcome of inadequacies or mismanagement in the supply chain, however, excluding retailers, food service providers and consumers.

Empirically, the term refers to any food that is discarded, incinerated or otherwise disposed of along the food supply chain, which starts with harvest/slaughter/catch up to but excluding the retail level, and the food does not re-enter the supply chain for any other productive use, such as for feed or seed. Food waste, on the other hand, refers to the decrease in the quantity or quality of food through discarding by retailers, food service providers and consumers. Obviously, besides positively impacting the availability of food, less food loss and waste would lead to more efficient land use and better management of natural resources, including water, which would address concerns of climate change and livelihoods. Briefly stated, food losses and waste are both a decrease in quantity or quality of food, i.e. a reduction in the availability of food, a decline in its nutritional and/or economic value, and/or a deterioration in food safety. Food waste discards safe and nutritious food or puts it to use other than human consumption.

Degree Of Loss And Waste
Quantifying and measuring food loss and waste is not easy, in part because food production and supply chains are long and involve many actors, including small farmers, transporters, processors, retailers and households.

The degree of loss and waste varies by geography and stage of the value chain. For example, it is reported by the World Resources Institute (WRI) that whereas 17% of all calories produced in North America and Oceania are lost in production, a staggering 61% are wasted at the consumer level. This contrasts starkly with South and Southeast Asia, where 33% are lost and wasted in production and supply chain, and 13% at the consumer end.

Overall, on a per-capita basis, much more food is wasted in the industrialised world than in developing countries. It is estimated that the per capita food waste by consumers in Europe and North America is in the range of 95 to 115 kilograms per year, while this figure in sub-Saharan Africa and South/Southeast Asia is only 6 to 11 kilograms per year.

Causes Of Food Losses And Waste
The causes of food losses and waste in low-income countries are mainly connected to financial, managerial and technical limitations in harvesting techniques, storage and cooling facilities in difficult climatic conditions coupled with infrastructure gaps, and absence of efficient packaging and marketing systems. Given that many smallholder farmers in developing countries live on the margins of food insecurity, a reduction in food losses could have an immediate and significant impact on their livelihoods. On the other hand, the causes of food losses and waste in medium/high-income countries mainly relate to consumer behaviour influenced by the "problem of plenty" syndrome. A good part of the problem surely lies with consumers, particularly in some parts of the world; and to reiterate, in South and Southeast Asia, only 13% of food is wasted by consumers; in the developed economies of North America and Oceania, this rises to a huge 61%.

The causes of food losses and waste vary greatly by region, hence accurate estimates of losses and waste in the food system are unavailable. However, evidence to date indicates that, every year, about 670 million tonnes of food is lost or wasted in high-income countries, and 630 million tonnes in low and middle-income countries; a one-third of the food originally intended for human consumption. When food is squandered, so too are the water, soil, biodiversity and other natural resources and inputs that were used to produce it and move it through the supply chain. So food losses and waste are increasingly becoming an environmental issue. Various studies have estimated that the agrifood sector currently accounts for around 30 percent of the world's total energy consumption, and that the energy embedded in global food losses is 38 percent of the total final energy consumed by the whole food supply chain. This translates to more than 10 percent of the world's total energy consumption for food that is lost and wasted. These concerns are now expressed as 'food loss and waste footprint' on the environment.

Let us recall the words of Carlo Petrini, the Italian food activist, "There is food for everyone on this planet, but not everyone eats" and not let food not be frittered away.

Food losses and waste also translate into economic losses for farmers and other stakeholders within the food value chain, and higher prices for consumers

INDUSTRY POWERHOUSE

Realizing India's Viksit Bharat 2047 Vision

As India sets its sights on becoming a developed nation by 2047, the role of industry in realizing this ambitious vision cannot be overstated. The Viksit Bharat 2047 initiative aims to transform India into a global economic powerhouse while ensuring sustainable and inclusive growth. To achieve this, industries across sectors must step up and play a pivotal role in driving innovation, fostering sustainable practices, developing a skilled workforce, and promoting inclusive growth. This article explores eight key areas where industry can make significant contributions to realizing India's vision for 2047.

1. Innovation Ecosystem and R&D Investment

At the heart of any developed nation lies a robust innovation ecosystem. Indian industries must significantly ramp up their research and development (R&D) investments to foster such an ecosystem. This involves not just increasing financial allocations but also creating an environment that nurtures creativity and breakthrough thinking.

One approach is to establish innovation hubs and incubators in partnership with academic institutions. These collaborative spaces can bring together researchers, entrepreneurs, and industry experts to work on cutting-edge technologies and solutions. For instance, the Indian IT industry could partner with leading engineering colleges to create AI and machine learning labs, fostering the next generation of tech innovators. Funding cutting-edge research in emerging technologies like artificial intelligence, quantum computing, and biotechnology is another crucial step. By investing in these future-focused areas, industries can position India at the forefront of technological advancements. This could involve setting up dedicated research centers or funding academic research projects aligned with industry needs.

Creating industry-specific innovation challenges to solve critical national problems can also drive focused innovation. For example, the automotive industry could launch a challenge to develop affordable and efficient electric vehicles suited for Indian roads and climate conditions. Such initiatives not only spur innovation but also address pressing national issues.

2. Sustainable Manufacturing and Circular Economy

As the world grapples with climate change and resource depletion, industries must lead the charge in adopting sustainable practices. This is not just an environmental imperative but also a key factor in ensuring long-term economic sustainability.

Adopting green manufacturing processes and technologies should be a priority. This could involve investing in energy-efficient machinery, implementing waste reduction strategies, and using renewable energy sources. For instance, the textile industry, known for its high water and energy consumption, could invest in waterless dyeing technologies and solar-powered factories.

Implementing circular economy principles is another crucial step. This involves designing products for longevity, repairability, and recyclability, thus minimizing waste and maximizing resource efficiency. The electronics industry, for example, could design modular smartphones that allow for easy upgrades and repairs, reducing electronic waste.

Investing in developing biodegradable alternatives to traditional materials is also essential. The packaging industry, in particular, can play a significant role by developing and adopting biodegradable plastics and other eco-friendly materials.

Pioneering carbon capture and utilization technologies in heavy industries is another area where Indian industry can make a global impact. Steel and cement industries, which are significant carbon emitters, could invest in developing and implementing technologies that capture CO2 emissions and convert them into useful products.

3. Skill Development and Future-Ready Workforce

As technology evolves rapidly, ensuring a skilled and adaptable workforce is crucial for India's development. Industries must take a proactive role in shaping the workforce of the future. Collaborating with educational institutions to design curricula that match future industry needs is essential. This could involve regular industry-academia interactions, guest lectures by industry experts, and co-

designed courses that blend theoretical knowledge with practical skills.

Implementing large-scale reskilling and upskilling programs for existing workers is equally important. As automation and AI transform job roles, industries must ensure their workforce can adapt to these changes. This could involve creating in-house training academies or partnering with online learning platforms to offer continuous learning opportunities.

Creating apprenticeship programs that provide hands-on experience in emerging technologies can bridge the gap between education and industry requirements. For instance, the manufacturing sector could offer apprenticeships in advanced manufacturing technologies, preparing workers for Industry 4.0.

Focusing on developing soft skills like critical thinking, adaptability, and problem-solving alongside technical skills is crucial. In an ever-changing work environment, these skills will be as important as technical expertise. Industries could incorporate soft skills training into their employee development programs and recruitment processes.

4. Rural Industrialization and Inclusive Growth

To ensure balanced development and stem rural-urban migration, industries must play a role in rural industrialization and inclusive growth.

Establishing manufacturing units in rural areas can create local employment opportunities and spur economic development. This could involve setting up food processing units near agricultural areas or textile manufacturing units in handloom clusters. Developing rural-urban industrial corridors can improve connectivity and logistics, making it easier for rural industries to access markets. This requires collaboration between industries and government to invest in infrastructure development. Investing in agri-tech and food processing industries can significantly boost rural economies. This could involve developing cold storage facilities, implementing precision farming technologies, and creating value-added food products from local produce.

Creating mentorship programs for rural entrepreneurs and small businesses can foster a culture of entrepreneurship in rural areas. Large industries could partner with rural startups, providing guidance, market access, and sometimes, funding.

5. Digital Transformation and Industry 4.0

Digital transformation is key to driving economic growth and improving productivity across sectors. Industries must lead this transformation by embracing Industry 4.0 technologies. Accelerating the adoption of Industry 4.0 technologies like IoT, AI, and robotics is crucial. This could involve implementing smart manufacturing systems, using AI for predictive maintenance, or deploying collaborative robots in factories.

Developing India-specific solutions for digital transformation challenges is equally important. Given India's unique context, off-the-shelf global solutions may not always be suitable. Industries should invest in developing solutions that address India-specific challenges, such as language diversity or infrastructure limitations. Creating platforms for sharing best practices and case studies on digital adoption can accelerate the overall digital transformation of Indian industry. This knowledge sharing can help smaller industries learn from the experiences of larger ones and avoid common pitfalls.

Investing in cybersecurity infrastructure to protect critical industrial assets is crucial as industries become more digitally connected. This involves not just implementing security technologies but also training employees in cybersecurity best practices.

6. Global Competitiveness and Export Orientation

For India to become a global economic powerhouse, its industries must be globally competitive and export oriented. Focusing on developing world-class quality standards and certification processes

is crucial. This involves not just adhering to global standards but also developing India-specific standards that can become global benchmarks in certain sectors.

Investing in advanced manufacturing technologies to improve productivity and reduce costs is essential for global competitiveness. This could involve adopting automation, additive manufacturing, or other advanced production technologies. Collaborating with global partners to integrate into international supply chains can open up new markets for Indian industries. This could involve strategic partnerships, joint ventures, or participation in global industry consortiums.

Developing expertise in emerging sectors like green hydrogen, electric vehicles, and space technology can position India as a leader in future industries. This requires significant investment in R&D and close collaboration between industry, academia, and government.

7. Public-Private Partnerships for Infrastructure Development

Infrastructure development is crucial for economic growth, and industries can play a significant role through public-private partnerships (PPPs). Partnering with the government on large-scale infrastructure projects can bring in much-needed private sector investment and expertise. This could involve projects in transportation, energy, or urban development.

Bringing in private sector efficiency and project management expertise to public initiatives can improve the execution of infrastructure projects. Industries can contribute their management skills, technological know-how, and operational efficiency to public projects.

Developing innovative financing models for infrastructure development is another area where industries can contribute. This could involve structures like build-operate-transfer (BOT) models or infrastructure investment trusts (InvITs).

Collaborating on smart city projects and urban planning initiatives can help create sustainable and livable urban spaces. Industries can contribute technologies and solutions for smart transportation, waste management, or energy-efficient buildings.

8. Corporate Social Responsibility (CSR) and Community Development

While pursuing economic goals, industries must also ensure they contribute to holistic social progress through their CSR initiatives.

Aligning CSR initiatives with national development goals can ensure that corporate efforts complement government initiatives. This could involve focusing on areas like education, healthcare, or skill development. Focusing on long-term, sustainable community development projects rather than one-off charitable activities can create lasting impact. This might involve multi-year projects that address systemic issues in communities. Collaborating with NGOs and social enterprises can help industries maximize the impact of their CSR activities.

These partnerships can bring in specialized expertise and on-ground knowledge. Measuring and reporting the social return on investment of CSR activities is crucial for transparency and continuous improvement. This involves developing robust metrics to assess the impact of CSR initiatives and using this data to refine future efforts.

Pivotal Role Of Industry

The journey towards Viksit Bharat 2047 is a collective endeavor, and industries have a pivotal role to play. By fostering innovation, embracing sustainability, developing skills, promoting inclusive growth, driving digital transformation, enhancing global competitiveness, partnering in infrastructure development, and contributing to community development, industries can be the engines that propel India towards its vision of becoming a developed nation.

This requires not just financial investment but also a shift in mindset towards long-term, sustainable, and inclusive growth. As India stands at the cusp of a transformative period, the proactive involvement and leadership of industries will be crucial in shaping the nation's future and realizing the dream of a developed India by 2047.



MR SATISH LAKKARAJU
New Chief Executive Officer. Lakkaraju, who brings over 30 years of industry experience, previously worked at Wiz Freight, Agility Logistics, and Dachser India.

“Proactive involvement and leadership of industries will be crucial in shaping the nation's future”

Promise Of Prosperity

Post-harvest management for sustainable food security



Dr. Nachiket Kotwaliwale

Director at ICAR-Central Institute of Post-Harvest Engineering and Technology, Ludhiana.



“By reducing losses, preserving nutritional quality, and ensuring the safety of food, effective post-harvest practices can contribute to a more stable and secure food systems

Post-harvest management plays a critical role in food security by minimizing the food waste and losses and by preserving food quality and safety for consumption. It also adds value by meeting the contemporary consumer's demand, thereby augment the earnings of the farmers and food-processors. The recent developments in the post-harvest mechanization and automation tools including the use of sensors, artificial intelligence (AI) and Machine learning (ML) based sorter, graders and the real time quality monitoring devices could be the game-changer in the coming years. However, various challenges involved in actual implementation of the advanced tools include the cost, feasibility, lack of adequately trained and skilled manpower, infrastructures, etc. Therefore, there is a need to develop

the affordable indigenous technologies based on advanced scientific methods, easy operating strategies and economical infrastructure to address the above challenges and achieve a sustained food-security in India.

Ensuring Sustainable Agriculture

Post-harvest management basically refers to the various techniques, strategies and unit operations carried out after harvesting the crop till its utilization by consumers. These operations generally include handling, storage, processing, packaging, transportation and marketing. The effective strategies employing the advanced technological tools for post-harvest management are crucial for maintaining the quality, safety and nutritional value of food, along with minimum losses and waste.

This brings a sustainable approach towards ensuring food security on the planet, particularly in nations like India, where most of the populace rely on agricultural practices for economy and livelihood. In the scenario of rising population, diminishing per capita land and water, climate change, ever changing food preferences and growing food demand, it is imperative to develop post-harvest management protocols and technologies to tackle the impending challenges.

As per NITI Ayog (2024), in 2021-22, India produced 330 million tonnes (MT) of food grains, 221 MT of milk, 317 MT of fruits and vegetables, and 16 MT of fish, whereas overall food demand is expected to grow at 2.44% annually. The projected demand by 2047-48 will be of 402 MT food grains, 417 MT fruits and vegetables, 527-606 MT milk and milk products, 41-48 MT fish. Along with increasing productivity and best farming practices, it is highly recommended to minimize the post-harvest losses. As per NABCONS (2022), the post-harvest losses (%) have been in Cereals: 3.89-5.92; Pulses: 5.65-6.74; Oil Seeds: 2.87-7.51; Fruits: 6.02-15.05; Vegetables: 4.87-11.61; Plantation Crops & Spices: 1.29-7.33; Milk: 0.87; Fisheries (Inland): 4.86; Fisheries (Marine): 8.76; Meat: 2.34; Poultry: 5.63; Egg: 6.03. Accordingly, the qualitative losses were 12.49 MT in cereals, 1.37 MT in pulses, 2.11 MT in oilseeds, 7.36 MT in fruits, 11.97 MT in vegetables, 30.59 MT in plantation crops (including sugarcane and spices), 3.01 MT in livestock excluding eggs and 7363 million eggs. The estimated monetary loss due to these losses in tune of ₹ 1,52,790.42 crores (equivalent to 2.35 percent of national GDP (at current prices for Q1 of 2022-23), clearly establish the urgent need of the effective post-harvest management tools for food-security. These tools could be the new age technological interventions, management practices, training and capacity building of the stockholders, policies reforms, infrastructure development and so on. Thus, in this article, an attempt was made to briefly discuss these approaches for the best management of foods in the post-harvest value chain to achieve the food-security.

Key elements of Post-Harvest Management

Technological interventions

Technological inventions for the best post-harvest practices are looked-for at different stages of handling, harvesting, storage, processing, packaging, transportation, marketing and distribution. The gentle handling and adequate pre-treatments are needed for avoiding the initial damage due to mechanical shock and rupture, minimizing spoilage and removing the field heats. Variety of machines operating at different capacities are available for cleaning, grading and sorting of agricultural commodities. Similarly for other on-farm unit operations like handling, bagging and drying, there are different types of equipment available. For handling, there are mechanical handlers, and there are handling equipment based on pneumatic or hydrodynamic properties.

In case of bagging, there are machines available for automatic as well as semi-automatic bagging or there are tools available for making these operations easy for the human labourers. For the drying, so many types of technologies have been developed and there are very good equipment available commercially. The research and development efforts are now targeted towards increasing efficiency of these machines, reducing the power requirement, making them more environment friendly, using appropriate material for construction of these machines, and making them ergonomically better.

One of the prominent examples of automation in the area of primary processing of grains is use of colours sorters for rice and some other grains; such machines are now made available in grain mandis as well.

Another major area of post-harvest management is transportation and storage. Both are liable to cause huge loss to the commodity being handled. India has a total storage capacity of 870.39 Lakh T (as on 01.11.2023) for food grains, comprising of the capacity available with FCI is 366.69 Lakh T (147.49 LT (owned) + 219.20 LT (Hired)), State agencies (395.80 Lakh T) and with Central Warehousing Corporation (CWC) is 107.9 Lakh T. Currently, there are 8653 cold storages installed in the country with the capacity of 394.17 lakh T (DFPD, (2023); PIB (2023)). It has been proven that by using appropriate storage protocols and well-calibrated and accurate instruments a huge loss in storage can be prevented. Monitoring of the commodity during transportation and storage is a challenge that is being addressed by use of appropriate sensors, IoT, Blockchain technology and good communication network. These technologies also ensure traceability of the commodities and help in a transparent marketing. Hitech devices like robots, electronic nose, electronic tongue, multi sensor data fusion, machine vision, artificial intelligence, etc. are now being explored by the scientist to apply in the area of post-harvest management.

Agro Processing Center (APC)

Multi-machinery based multi-commodity processing under a single roof has been found to be a sustainable solution for post-harvest management, especially for the value addition through primary, secondary and tertiary processing. Such centers can be established in or near the production catchment to reduce the food-miles and also to provide year-round employment opportunity to the farming or rural community.

Indian Council of Agricultural Research (ICAR) through various programmes has supported in establishment of around 300 such APCs and yields annual turnover of each APC nearly 6.0 lakhs employing at least 3-6 people as direct employment and nearly 10 indirect employment, thereby extends a saving of INR 20438.63 crores due to value added products (Kotwaliwale et al., 2023). Some of such centers are successfully operating in full or partial custom-hiring mode as well. It has been estimated that if every block of the country has one APC then the rural economy would attract around Rs. 26,000 crore.

Organized marketing through systematic channels, such as farmer producer organization (FPO) or farmers producer companies (FPC) or co-operatives is being promoted, which is helping in better price realization to the farmers. Apart from mandi and other conventional market place, the e-commerce platforms are also promoted for eased, extended reach and transparency in transactions.

Certification and testing of foods through institutional framework is imperative for establishment of credibility of the product(s) in the niche market. As of July 2022, the Food Safety and Standards Authority of India (FSSAI) has recognized/notified 224 food testing laboratories (including 53 state government laboratories, 145 private laboratories and 26 other government laboratories for primary testing and 20 laboratories for testing referral food samples). Further government support for establishing such laboratories and providing them accreditation is required.

Crucial Component

Post-harvest management is a crucial component of the agricultural value chain that directly impacts food security. By reducing losses, preserving nutritional quality, and ensuring the safety of food, effective post-harvest practices can contribute to more stable and secure food systems, particularly in regions vulnerable to food insecurity. Addressing the challenges like Inadequate Infrastructure, Knowledge and Skills Gap, Financial Constraints, Climate Change and strong and reliable market linkage, etc. through appropriate infrastructure development, education, financial support, climate adaptation and developing indigenous technologies is essential for maximizing the benefits of post-harvest management for food security and also to reduce reliance of India on imported resources.



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Policy Support

The Government of India supports efficient post-harvest management through various of its schemes such as Sub-mission of Agricultural Mechanization (SMAM), Pradhan Mantri Formalisation of Micro food processing Enterprises (PMFME), Agri Infrastructure Fund, Mission for Integrated Development of Horticulture (MIDH), National Beekeeping and Honey Mission, support for Integrated Post Harvest Management under Rashtriya Krishi Vikas Yojna (RKVY), Operation Greens Scheme for 22 perishable crops, etc. besides many schemes individually launched by different state governments to reduce post-harvest losses, add value to the farm produce and in general welfare of the farming community.

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Reassessing India's Post-Harvest Landscape



“It is important to invest in technologies that enhance supply chain transparency, supporting financial mechanisms that empower farmers

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networks were underdeveloped, and access to financial resources was limited. Today, India's agricultural landscape has evolved, and it is essential to reassess the situation with a more accurate understanding of the current context.

The portrayal of India as a nation struggling with massive post-harvest losses overlooks the significant strides made in recent years. These improvements have been driven by advancements in technology, better infrastructure, and enhanced access to financial services. The narrative of severe post-harvest losses does a disservice to the progress that has been achieved and underestimates the resilience and adaptability of India's agricultural sector.

Evolving Infrastructure and Financial Support

In recent years, India's agricultural output has grown, and with it, the infrastructure for managing post-harvest produce has significantly improved. A major factor in this improvement has been the increased access to finance, enabling farmers to invest in better storage facilities. For example, since around 2004-2005, financial institutions on large scale have started using commodities stored in warehouses as collateral, which has given farmers greater financial flexibility. One of the key developments has been the growth of storage solutions near farms, which allow farmers to securely store their

produce until market conditions are more favourable. This approach not only reduces the risk of spoilage but also gives farmers more control over when and how they sell their crops. By providing access to storage facilities close to the point of production, these solutions help mitigate the risks associated with fluctuating market prices and enable farmers to take advantage of higher prices when they increase during the off season.

Additionally, the financial sector's willingness to use stored commodities as collateral has opened new avenues for farmers to access credit. This access to finance has been crucial in enabling the ecosystem to invest in modern storage facilities and/or adopt scientific stock management processes, which in turn has helped reduce post-harvest losses. The ability to secure loans against stored commodities (to meet their consumption needs) has also provided farmers with the financial stability needed to make informed decisions about when to sell their produce, further enhancing their income potential.

Technology Bridging Market Gaps

The past five to six years have seen a surge in agritech innovations, particularly in connecting buyers and sellers more effectively. Digital platforms have emerged as a vital tool in streamlining the agricultural supply chain, making it easier for farmers to access markets and receive fair prices for their produce. These platforms facilitate direct transactions between farmers and consumers, reducing the need for intermediaries and ensuring that farmers retain a larger share of the profits.

For example, in Varanasi, Arya.ag's targeted interventions have shown that when farmers are able to store their produce and connect directly with buyers, they can achieve significantly better prices. In this case, women producer groups cultivating the 'Katarni' variety of paddy were able to store their produce in nearby facilities and then sell it directly to buyers, resulting in a 20% increase in price compared to what they would have received in the open market. This example highlights the potential for technology and targeted storage solutions to create tangible benefits for smallholder farmers, especially when coupled with strong market linkages.

The role of technology extends beyond just facilitating transactions. It also plays a crucial role in enhancing transparency and trust within the supply chain. By providing real-time data on market prices, storage conditions, and buyer requirements, these platforms empower farmers to make more informed decisions. This increased transparency not only benefits farmers but also helps build stronger relationships between producers and buyers, leading to more efficient and reliable supply chains.

Maintaining Efficiency Without Disruption

India's supply chains are more efficient than they are often credited for, especially when considering the fragmented land holdings and the need to cater to a large population and price conscious one too. Despite these challenges, the existing supply chains have adapted well, balancing the need to keep prices low for consumers while ensuring fair compensation for farmers.

Small-scale storage solutions near the farm gate, for example, have played a significant role in reducing the cost and time associated with transporting produce to distant markets. By keeping the produce closer to where it is grown, these solutions help minimise the risks of spoilage and ensure that farmers can sell their crops in a timely manner. Additionally, these local storage options open up rural markets to larger buyers, increasing competition and driving better price realisation for farmers.

The key to continued success in this area is to enhance existing systems without causing unnecessary disruption. Overhauling supply chains could lead to increased costs, ultimately affecting those who depend on affordable produce. Instead, working with current participants to further improve efficiency will ensure that India's agricultural sector continues to thrive.

A Balanced Approach to Future Challenges

As India continues to advance its agricultural capabilities, it is essential to approach future challenges with a balanced perspective. The focus should be on building upon the progress already made, rather than attempting to completely overhaul systems that have proven to be effective. This means continuing to invest in technologies that enhance supply chain transparency, supporting financial mechanisms that empower farmers, and fostering collaborations that bridge the gap between traditional practices and modern innovations.

At the same time, it is important to recognise the unique context in which India's agricultural sector operates. The country's vast and diverse landscape, coupled with its large population, presents both opportunities and challenges that require tailored solutions. By taking a measured approach that values both technological advancement and the wisdom of experience, India can continue to strengthen its agricultural sector in a way that is sustainable, resilient, and equitable.

Looking Ahead: A Sustainable Future for Indian Agriculture

As we look to the future, the focus should be on continuing to refine and improve the systems already in place. The goal is to ensure that India's agricultural sector remains resilient, capable of adapting to changing conditions, and efficient in its use of resources. This means investing in technologies that enhance supply chain transparency, supporting financial mechanisms that empower farmers, and fostering collaborations that bridge the gap between traditional practices and modern innovations.

The future of India's post-harvest landscape depends on a balanced approach that values both technological advancement and the wisdom of experience. By maintaining this balance, India can ensure that its agricultural sector continues to thrive, feeding not just its own population but contributing to global food security in a sustainable and equitable manner. As India continues to innovate and improve its agricultural practices, the nation stands at the cusp of a new era where food security, farmer prosperity, and environmental sustainability are not just goals, but achievable realities.

Food Express

Post-harvest and Supply Chain Management in India



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Post-harvest food loss, referring to the qualitative and quantitative reduction of food along the supply chain from harvest to consumption, is a critical global issue. Annually, about 1.3 billion tonnes of food intended for human consumption is wasted worldwide. In industrialised countries, significant waste occurs at the consumer level, whereas in low-income countries, losses predominantly occur during the early and middle stages of the supply chain.

India, being the second-largest food producer globally, holds immense potential for both domestic and export markets, with a comparative advantage in production volumes and crop diversity. Despite this, the sector faces several challenges, including a lack of awareness, limited access to innovative agricultural practices, inadequate cold supply chain infrastructure, and market volatility.

A study by NABCONS estimated the economic impact of post-harvest losses to be around ₹1.5 trillion, equivalent to 2.35% of the national GDP, almost surpassing the budget allocation for the Ministry of Agriculture and Farmers Welfare. Livestock products, including milk, meat, eggs, and fish, significantly contribute to these losses, closely followed by fruits and vegetables.

Production to Harvest Scenario

Many traditional farming methods remain inefficient, resulting in labour-intensive, time-consuming processes, imbalanced fertiliser use, and poor yields and quality. The variability in agro-climatic conditions complicates the selection of appropriate crop varieties and technologies. The agricultural sector still relies on manual harvesting, especially in many parts, and labour shortages are increasingly problematic. Despite the introduction of precision farming technologies, their adoption remains limited due to a lack of awareness of the potential benefits in optimising outputs with low inputs. In today's era of Artificial Intelligence (AI), there is a need for extensive research and application of AI technologies in agriculture to enhance precision and efficiency in farming and management practices, thereby boosting agricultural productivity and sustainability across the country.

Climate change, driven by global warming, poses significant challenges for producers as temperature extremes adversely affect crop growth and development, leading to premature maturation and reduced yields. Simultaneously, Inadequate pollination often cause floral abortions and premature flower and fruit drop. Crops such as citrus, grapes, melons, and mangoes may mature about two weeks earlier with higher temperatures, while photosensitive crops like onions develop smaller bulbs. Similarly, strawberries produce more runners at the expense of fruit, inducing ripening in later growth stages. Increased evaporation rates due to hot air also lead to water vapour buildup, resulting in unreliable rainfall distribution, complicating cultivation by dampening mature crops before harvest, promoting mould growth, and reducing grain quality.

Transportation and Storage strategy

The post-harvest phase, including pre-cooling, transportation, and storage, is essential for maintaining the quality and extending the shelf life of horticultural and agricultural commodities. Inadequate infrastructure and processing affect the preservation of perishable produce, leading to substantial post-harvest losses and decreased product quality. Logistical mismanagement is also a major challenge in the post-harvest phase.

Scientific Processing and Packaging

Proper process management is essential for ensuring efficient and effective processing and packaging to reduce waste, enhance shelf life, and maintain high standards. However, many processing facilities lack robust management systems, leading to inefficiencies and errors. Inconsistent processing times and temperatures can lead to uneven cooking or drying, impacting the texture and taste of the final product. Without proper process management, maintaining the high standards required for fresh produce becomes challenging.

Government Policies and Initiatives

- Pradhan Mantri Kisan Sampada Yojana (PMKSY) to support the food processing industry by developing Mega Food Parks, Integrated Cold Chain and Value Addition Infrastructure.
- Agriculture Infrastructure Fund (AIF) to provide financial support for post-harvest management infrastructure, including cold storages, warehouses, and processing units which aims to improve supply chain efficiency and reduce losses.
- National Agriculture Market (e-NAM) creates a unified national market for agricultural commodities.
- Negotiable Warehouse Receipts (NWRs) allows farmers to store produce in accredited warehouses.
- Research and Development Initiatives Led by institutions like the Indian Council of Agricultural Research (ICAR), focus on developing post-harvest technologies and practices, better storage methods, and efficient transportation solutions.
- Farmer Producer Organisations (FPOs) Improve market access, play a crucial role in creating post-harvest management infrastructure.

Emerging Trends and Technologies

- Use of advanced packaging materials that enhance storage conditions and extend shelf life.
- Smart Sensors and IoT Devices to monitor temperature, humidity, and other environmental parameters in real-time, provide data for predictive analytics and proactive management.
- Blockchain Technology to enhance transparency and traceability in the supply chain and track movement of produce from farm to fork, ensuring quality and reducing fraud
- Artificial Intelligence (AI) and Machine Learning (ML) for analyzing data from weather forecasts, market trends, and supply chain logistics.
- Drones and Satellite Imagery for monitoring crop health and predicting yields and better planning and management of the supply chain.
- Biodegradable and Compostable Packaging Materials to provide sustainable alternatives to conventional packaging and reduce environmental impact.
- Hydroponics and Vertical Farming - Innovative farming methods that produce high-quality crops with minimal post-harvest losses.
- Renewable Energy Sources - Use of solar-powered cold storage units and other sustainable energy solutions to Provide cost-effective and reliable storage in remote areas.
- Collaborative Platforms and Digital Marketplaces - Connect farmers directly with consumers, reducing intermediaries and ensure better prices for farmers.

Focus on developing post-harvest technologies and practices, better storage methods, and efficient transportation solutions will significantly help farmers

Postharvest & Supply Chain Management for Food Security

Addressing Food Wastage in India

India's agricultural sector is a marvel of diversity and scale, producing a broad array of crops, from staples like rice and wheat to a rich variety of fruits, vegetables, and dairy products. Despite this bounty, India faces a significant paradox: substantial food wastage coexists with widespread food insecurity. Estimates suggest that approximately 30-40% of food produced in India is lost or wasted annually. This wastage not only represents a loss of economic value but also squanders critical resources such as water, land, and energy. As agriculture consumes a significant portion of India's water resources, reducing food wastage can also contribute to better water management. Addressing this issue through improved postharvest and supply chain management is crucial for enhancing food security and promoting resource sustainability.

Stages of Food Wastage in India

Food wastage in India occurs at various stages of the supply chain, from production to consumption. Each stage presents unique challenges and opportunities for reducing losses:

Harvesting and Handling

Inefficient harvesting techniques and inadequate handling often lead to significant losses. Fruits and vegetables are particularly vulnerable to bruising and spoilage during harvesting and initial handling.

Storage

The lack of proper storage infrastructure, especially cold storage, results in the spoilage of perishable items such as fruits, vegetables, and dairy products. Without equipped storage facilities, maintaining the quality and safety of these products becomes challenging.

Harvesting and Handling

Inefficient harvesting techniques and inadequate handling often lead to significant losses. Fruits and vegetables are particularly vulnerable to bruising and spoilage during harvesting and initial handling.

ABOUT THE AUTHOR

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Transportation:

Inefficiencies in transportation infrastructure exacerbate food losses. Issues such as delays, inadequate refrigerated transport, and rough handling during transit contribute to the deterioration of food quality.

Processing and Packaging:

Food processing and packaging inefficiencies also contribute to wastage. Outdated technologies and inadequate processing facilities can cause spoilage and contamination.

Distribution and Retail:

At the distribution and retail levels, significant food losses occur due to poor inventory management, lack of cold chain facilities, and mishandling. Inefficient practices in these stages lead to a considerable amount of food going to waste before reaching consumers.

How Significant are Post-Harvest Losses?
Post-harvest losses in India are particularly severe in specific sectors:

Perishable Commodities:

Major losses are observed in perishable items, including eggs (22%), fruits (19%), and vegetables (18%). These commodities are highly susceptible to spoilage due to their short shelf life and require effective management to minimize losses.

Export Stage Losses:

Approximately 19% of food is lost during the export process, particularly at the trade partner stage. These losses impact the profitability of exports and reduce the availability of food resources domestically.

Impact on Farmers:

Small and marginal farmers, who make up 86% of the farming population, suffer income losses due to inefficiencies in the supply chain. These losses undermine their financial stability and discourage investment in better practices.

Postharvest Management: Reducing Food Losses

Effective postharvest management is crucial for minimizing food wastage. Key areas of focus include:

Improved Harvesting Techniques:

Training farmers in proper harvesting techniques can reduce initial losses. Using the right tools and timing harvests to optimal periods can prevent damage and spoilage.

Advanced Storage Solutions:

Investing in modern storage facilities, particularly cold storage, can significantly reduce postharvest losses. Controlled atmosphere storage and the use of preservatives can extend the shelf life of perishable items.

Efficient Transportation:

Enhancing transportation infrastructure and logistics is essential. Developing a cold chain network, optimizing transportation routes,

and using better packaging materials can ensure that food reaches its destination in good condition.

Modern Processing Technologies:

Upgrading processing facilities with modern technologies can improve efficiency and reduce wastage. Innovations in packaging that extend shelf life and protect against contamination are also critical.

Effective Distribution and Retail Practices:

Implementing better inventory management systems and promoting hygienic handling practices at the retail level can minimize food losses. Encouraging supermarkets and retailers to adopt best practices in storage and display can also help.

Corporate Involvement: Building Better Structures

Corporate participation is vital in addressing food wastage in India. Corporations can contribute in several ways:

Investment in Infrastructure:

Corporates can invest in building and maintaining storage and transportation infrastructure. Public-private partnerships can facilitate the development of cold chains and modern logistics systems.

Adoption of Technology:

Corporates can drive the adoption of advanced technologies in processing, packaging, and inventory management. Innovations in these areas can enhance supply chain efficiency and reduce losses.

Capacity Building:

Corporates can play a role in training farmers and supply chain workers. Providing technical support and resources can help improve postharvest practices and reduce losses.

Sustainable Practices:

Adopting and promoting sustainable practices within the supply chain can reduce wastage. Corporates can set examples by implementing zero-waste policies and sustainable sourcing practices.

Addressing food wastage through effective postharvest and supply chain management is essential for enhancing food security in India. By focusing on critical stages where wastage occurs and involving corporate participation, India can significantly reduce food losses, conserve resources, and ensure a stable food supply for its population. Collaborative efforts between the government, private sector, and other stakeholders are necessary to build resilient and efficient food systems that can sustainably meet the needs of a growing population. Reducing postharvest losses, especially in perishable commodities and during export stages, and supporting small farmers are crucial steps toward achieving a more secure and sustainable food future for India.

Collaborative efforts between the government, private sector, and other stakeholders are necessary to build resilient and efficient food systems

Farm to Fork

POSTHARVEST AND SUPPLY CHAIN MANAGEMENT

Food security remains a critical issue globally, with millions of people lacking access to sufficient, safe, and nutritious food. The intricacies of postharvest management and supply chain logistics play a pivotal role in addressing food security challenges. Effective management of these stages can significantly reduce food loss, enhance food availability, and improve the livelihoods of millions.

Postharvest and supply chain management are critical components of the broader efforts to achieve food security. By implementing best practices, leveraging technology, and addressing infrastructure and policy challenges, it is possible to significantly reduce food losses, enhance food availability, and improve the overall efficiency of the food system. Ensuring that food is safely and efficiently delivered from farm to table will not only help in addressing hunger and malnutrition but also contribute to the economic well-being of farmers and other stakeholders in the food supply chain.

Postharvest management encompasses all the stages from the moment crops are harvested until they reach the consumer. This period is crucial for maintaining food quality and safety, minimizing losses, and ensuring that the food remains nutritious and edible.

Krishi Udan Scheme

The Krishi Udan Scheme was introduced by the Airports Authority of India (AAI) to promote the marketing of agricultural and farm products from the northeastern states outside their region. The Krishi Udan scheme's primary goal is to assist farmers with the transportation of agricultural products, allowing them to realize the value of their

products. The scheme is a step towards the needed paradigm shift in agriculture that can help double the income of the farmers. The scheme will aid in doubling the income of the farmers by providing them with value realizations for their products. The scheme will pave the way for the growth of the agriculture sector and help achieve the goal of doubling farmers' income by eliminating barriers in the supply chain, logistics, and transportation of farm produce. The scheme aims to address the problem of wastage of agricultural food products.

Despite the advancements in technology and management practices, several challenges remain in postharvest and supply chain management for food security.

Infrastructure and Investment

Many regions, particularly in developing countries, lack the necessary infrastructure for effective postharvest management and supply chain logistics. Investments in cold storage facilities, transportation networks, and processing plants are crucial for reducing losses and improving food security.

Capacity Building and Training

Capacity building and training for farmers and supply chain stakeholders are essential. Educating them on best practices in harvesting, handling, storage, and logistics can significantly reduce postharvest losses and improve food quality.

Policy and Regulation

Supportive policies and regulations are needed to create an

enabling environment for efficient postharvest and supply chain management. This includes providing incentives for investments in infrastructure, promoting research and development, and ensuring that food safety standards are met.

The supply chain for food products involves multiple stages, from farm to table, each with its own set of challenges and opportunities. Efficient supply chain management ensures that food reaches consumers in a timely and cost-effective manner while maintaining quality and reducing losses.

Transportation and Logistics

Transportation is a critical component of the supply chain. Efficient logistics solutions, such as refrigerated transport for perishable goods, are essential to prevent spoilage and maintain food quality. Advanced tracking and monitoring systems can help in optimizing routes, reducing transit times, and ensuring that food arrives at its destination in the best possible condition.

Distribution Channels

Choosing the right distribution channels is essential for minimizing delays and ensuring that food reaches consumers quickly. Traditional markets, supermarkets, and online platforms each have their own advantages and challenges. For instance, direct-to-consumer models can reduce the time food spends in the supply chain, while centralized distribution centers can help in better managing inventory and reducing waste.

Supply Chain Coordination

Coordination among all stakeholders in the supply chain is crucial for ensuring efficiency and minimizing losses. This includes farmers, processors, distributors, retailers, and consumers.

Collaborative efforts, such as sharing information on demand forecasts, production schedules, and inventory levels, can help in aligning supply with demand and reducing excess production.

Role of Technology

Technology plays a transformative role in both postharvest management and supply chain logistics. Innovations such as the Internet of Things (IoT), blockchain, and artificial intelligence (AI) are revolutionizing the way food is managed and distributed.

IoT and Sensor Technologies

IoT and sensor technologies enable real-time monitoring of various parameters, such as temperature, humidity, and location, throughout the supply chain. This helps in identifying and addressing issues promptly, reducing losses, and ensuring food safety.

Blockchain for Transparency

Blockchain technology provides a transparent and immutable record of transactions, enhancing traceability and accountability in the supply chain. Consumers can trace the origin of their food, ensuring that it meets quality and safety standards. This also helps in quickly identifying and addressing food safety issues, such as contamination or recalls.

AI and Data Analytics

AI and data analytics can be used to optimize various aspects of the supply chain. Predictive analytics can help in forecasting demand, optimizing inventory levels, and reducing waste. AI algorithms can also assist in route optimization for transportation, ensuring that food reaches its destination faster and more efficiently.

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Technology plays a transformative role in postharvest management and supply chain logistics

AGRI DISTRESS IN INDIA

Unheard Cries of Farmers

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The recent 'Economic Survey' and the annual budget for 2024 were presented consecutively in the nation's largest forum, the 'Parliament'. On this occasion, the honorable Prime Minister referred to agriculture as the engine of the country's development. Theoretically, his statement is not incorrect, as approximately 70% of the population relies on agriculture and allied sectors for employment, and 100% of the population depends on it for food. However, when it comes to budget allocation for agriculture, it remains confined to a mere 3 to 4 percent. Ironically, while the government was boasting about its achievements in the agricultural sector, news broke that 145 farmers in Amravati district had committed suicide in the past 152 days. It was also revealed in Parliament that 31 farmers commit suicide daily in the country. For a nation that prides itself on being agrarian, this is a matter of immense sorrow and shame.

Boasting about being the world's fifth-largest economy is fine, but don't turn a blind eye to reality. Statistics show that while an American farmer earns an annual income of ₹6.5 million (approximately ₹18,000 daily), an Indian farmer earns just ₹27 per day. In such a scenario, how will millions of farmer families survive? When will our country's policymakers understand their plight?

Is it not necessary to find answers to questions like: In a country where "Agriculture is the foundation of the world" and "Agriculture is the most excellent profession", how did farming and farmers reach such a dire state?

Our Strong Roots In Agriculture

Agriculture in India has a history of thousands of years. The Vedas contain ample verses related to agriculture. The Rigveda mentions that the farmer works in the fields to produce food for society and brings prosperity. During the Mughal era, Indian agriculture also saw significant development. Under Akbar's rule, agricultural attention was highlighted in texts like Tota-Nama and Ain-i-Akbari. However, over time, farmers faced heavy taxation and their situation worsened

during natural calamities like droughts or floods.

During the colonial period, the policies of the British East India Company and the British government significantly impacted the farmers' situation. Heavy taxation, forced shift to cash crops, and land dispossession caused great suffering to Indian farmers. Under colonial rule, a significant portion of Indian agriculture shifted to cash crops for export, leading to food shortages and increased farmer distress. The European colonial industrial revolution also gradually ruined India's agrarian-based cottage industries.

Post-Independence Agricultural Policies and Inconsistencies

After independence, agriculture was always a priority in discussions, but agricultural policies gradually got overshadowed by other planned developmental priorities. The Green- Revolution in the 1960s significantly increased agricultural production, but it also led to several complex issues. Subsidies were provided for fertilizers, seeds, and irrigation facilities. However, intermediaries and powerful alliances reaped most of these benefits. This plundering continues even today.

On the other hand, indiscriminate use of chemical fertilizers has brought about 85% of the country's land to the brink of becoming barren. The Agricultural Produce Price Commission was established to ensure fair prices for farmers' produce, but it has never truly been a supporter of farmers. The minimum support prices (MSP) it sets are often lower than the actual cost of farming, causing losses for farmers. Agricultural produce markets, Kisan Mandis were also created, but here too, politicians, intermediaries, and brokers dominate, continuing the exploitation of farmers.

“ At Kisan Mandis, politicians, intermediaries and brokers dominate, continuing the exploitation of farmers

You Must Learn To Struggle

Currently, there seems to be a new awakening among farmers. In such times, the lines of the renowned Russian poet Yelena Yerekh's poem seem to show the path regarding the problems and solutions of the farmers:

Like elephants passing through the wilderness,
Trampling the bushes,
Clearing the trees from their path,
You too must walk the path of great penance.
Thus, you must learn to struggle

Burning Issues of Indian Agriculture

Climate Change: A recent report highlighted that rising temperatures during wheat ripening led to shrunken grains, reducing the country's total wheat production by about 12 to 16%. For a country with a population of approx. 1.5 billion, this is highly alarming. The Vedic quote "Rain is for the happiness of the farmer" emphasizes the importance of weather in agriculture. Farmers are helpless against irregular rains, floods, and droughts caused by global climate change. As crop cycles change, farmers must adapt their farming methods accordingly.

Rising Farming Costs and Unfair Prices for Produce: Farmers' biggest problem is that they don't get even the Minimum Support Price (MSP) for their produce. According to a report by the Organisation for Economic Co-operation and Development (OECD) and the Indian Council of Agricultural Research (ICAR), farmers suffered a loss of ₹45 trillion between 2000 and 2017 due to not getting the right price for their produce.

The Shanta Kumar Committee's report mentioned that only 6% of farmers benefit from MSP, meaning 94% of farmers do not receive even the minimum support price. Due to not getting fair prices, farmers face an annual loss of approx. ₹5-7 trillion. Despite the government's claims of prioritizing agriculture, only ₹1.52 trillion has been allocated for agriculture in the 2024 budget, meaning farmers will still face a loss of around ₹5 trillion this year. The situation is bound to worsen.

Debt Burden on Farmers: Due to not getting fair prices for their produce, farmers often face losses, resulting in very low incomes. The burden of debt and high interest rates further deteriorate their financial condition. According to the National Sample Survey Office (NSSO), about 47% of farmers in the country are, on average, in debt. **Farmer Suicides a National Shame:** A shocking report from Amravati Division in Maharashtra revealed that 557 farmers committed suicide in six months. Farmer organizations claim that daily suicides are occurring in Vidarbha. According to the National Crime Records Bureau (NCRB), 10,677 farmers and agricultural laborers committed suicide in 2020. This statistic highlights the severe economic and mental pressures faced by farmers.

Inconsistent Policies: Ancient belief states that the protection of agriculture is essential for the prosperity of any nation. However, government policies often seem to work against farmers' interests. The recent land acquisition laws, controversial farm laws, and the latest electricity bill law are examples. Farmers fear that these policies will ultimately work against their interests and force them to succumb to big corporates.

Who is Responsible?

Now, the million-dollar question is, who is responsible for these anti-farmer policies? The answers are multi-faceted:

Government Policies: The petty politics for votes and the unethical alliance between corporates and the government often result in policies and their implementation processes being against farmers' interests. Despite various agricultural laws and reforms, proper implementation is often lacking.

Corporate Interests: Political parties depend on corporate donations for election expenses. Hence, the interests of large corporate houses heavily influence agricultural policies. The influence of corporates is evident in land acquisition, the push for cash crops, and investment policies in agriculture. In 2020-21, corporate investments in agriculture increased to ₹78 billion. Currently, every major corporate is trying to acquire farmers' land by any means to increase their 'land-bank,' which is extremely concerning for the country's small farmers, who make up about 84%.

Social Structure: The feudal and caste-based structure of Indian society also promotes inequality in agriculture. Small and marginal farmers often remain under the pressure of large landlords and wealthy farmers. Although there have been some changes in this situation, much more needs to be done to improve their condition.

Vote Politics and Fragmented Farmer Leadership:

In our democratic system, every community and group strives to claim their rights according to their social status. In this race, farmers are at the bottom of the ladder. Despite being the largest segment of the population, farmers have never been able to form a cohesive vote bank. Their issues and problems are similar, but they never fully unite on their issues or vote en bloc. When farmers reach the polling booth, they cease to be farmers; instead, they divide into countless categories like Hindu, Muslim, upper caste, lower caste, forward, backward, etc.

Politicians have understood this fact well that farmers can never unite as a single vote bank and will not stand together for their issues, so they exploit this situation. The selfish, impotent, arrogant, and incompetent leadership of farmers is also largely responsible for this situation. Most of the narrow-minded farmer leaders are self-centered and are ready to compromise even with farmer interests for petty political gains.

Therefore, they do not unite strongly on common issues. Most farmer leaders are satellites of some political party or leader. At crucial moments of major movements, such leaders do not hesitate to sell the movement for their petty interests. Despite being 70% of the population, farmers have been waiting for 75 years for governments that win with 40% of the total votes.

Women's Advancement In Agriculture

Strategic Imperative For India's Economic Progress



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Women's leadership and development in agriculture and allied sectors is not just a matter of equity but a critical driver of economic growth and sustainability in India

the integration of women into the mainstream of agricultural and rural development will be crucial for building a resilient and inclusive economy

Indian women farmers in agriculture and allied sectors participate in multifaceted roles despite the constraints stemming from structural inequality, access to resources, and socio-cultural norms. Currently, Women constitute ~33% of the agricultural workforce in India, which translates to ~80 million women involved in varied agricultural activities. Similarly, in horticulture and dairy farming, they account for ~50% & 70-80% of workforce, respectively. Women manage between 40%-50% of dairy farms in the country, although ownership rates are low. They are also involved in both marine and inland fisheries, contributing around 15-20% of labour in fishing. Women are increasingly taking roles within aquaculture and their participation is estimated to be 20-30% in many regions.

Key Challenges Faced by Indian Women Farmers

The challenges faced by women in Indian agriculture and allied sectors are multifaceted, often rooted in socio-economic barriers, limited access to resources, and inadequate recognition of their contributions:

- **Resource Access:** 13% of women's total agricultural landholders were recognized legally, while they manage about 30% of the total farmland. Women holds only about 2% land holdings in India. This limited land ownership restricts their access to credit and the decision-making power. Also, only 6% of rural women access credit from formal sources, making them reliant on informal channels that often have high-interest rates. The World Bank estimates that about 60% of women-owned agricultural enterprises lack access to formal financial services.
- **Education and Skill Development:** The female literacy rates in rural areas was 57.93% hindering women's access to knowledge and information about modern practices as they receive only about 15% of the training provided by extension services.
- **Health and Safety:** Women in agriculture face significant health & safety risks from the work environment without adequate protective measures, leading to long-term health issues. The maternal health services are inadequate, with only 50% of rural women receiving no childbirth assistance.
- **Social and Cultural Barriers:** Only 20% of women in rural households have a say in major decisions, affecting their ability to make choices about farm management and resource use. A survey conducted by Oxfam India indicated that only 33% of women in rural areas have a say in decisions related to loans or investments.

- **Mobility Restrictions:** Women often experience significant mobility constraints, limiting their potential for entrepreneurship. Also, cultural norms prevent women from accessing markets or networking opportunities. A report by IFPRI revealed that 50% of women reported not being able to travel freely outside their home, limiting their access to agricultural markets and training.
- **Climate Change and Environment:** Women are more vulnerable to the impacts of climate change i.e., affected by changes in rainfall patterns and extreme weather events due to reliance on agriculture for their livelihood. A study from UN Women indicates that women farmers are disproportionately affected by climate change impacts, with 80% of rural women indicating that they have encountered difficulties due to changes in rainfall and temperature affecting crop yields. Women's adoption rates of new agricultural technologies are significantly lower due to limited access to information related to climate-resistant farming practices.

GOI Initiatives for Women Advancement

Women's upliftment & development in Indian agriculture and allied sectors has been an important focus in recent years which is reflected by the policies, schemes and budgets allocated by various ministries. GOI has introduced several policies and schemes targeting women in agriculture & allied sectors and here's brief overview including fund allocations and expected impact:

- **Mahila Kisan Sashaktikaran Pariyojana (MKSP):** Enhances skills of women] farmers, promotes sustainable agricultural practices, and improves household nutrition security. The fund allocation has been between INR 800-900 crores per year during the past 3 years.
- **Rashtriya Krishi Vikas Yojana (RKVY):** Increases women's access to agricultural resources, improves productivity, and supports diversification. The fund allocation has been between INR 10500-12500 crores per year during the past 3 years for broader agriculture initiatives including women.
- **Paramparagat Krishi Vikas Yojana (PKVY):** Promotes organic farming among women, enhancing soil fertility and product marketability while improving women farmers' income. The fund allocation has been between INR 500-650 crores per year during the past 3 years.
- **National Livestock Mission (NLM):** Empowers women by improving livestock production, enhances livelihoods, and promotes entrepreneurship among women in rural areas. The fund allocation has been between INR 2200-3500 crores per year during the past 3 years for broader livestock management initiatives including women.
- **Dairy Entrepreneurship Development Scheme:** Supports small dairy farms, enhances women's income in dairy production, and promotes gender equality in dairy enterprises. The fund allocation has been between INR 320-360 crores per year during the past 3 years.
- **Pradhan Mantri Matsya Sampada Yojana (PMMSY):** Enhances women's participation in fisheries and aquaculture, improves productivity, and supports sustainable practices. The fund allocation

has been between INR 2800-3200 crores per year during the past 3 years for broader livestock fisheries development initiatives including women.

- **Deendayal Antyodaya Yojana: National Rural Livelihoods Mission (DAY-NRLM):** Lakhpati Didi scheme strengthens women's self-help groups and cooperatives, promotes financial inclusion, and empowers women economically. The fund allocation has been between INR 10000-12500 crores per year during the past 3 years. These schemes and financial allocations reflect a concerted effort by GOI to empower women across various agricultural sectors, fostering inclusivity and enhancing productivity aiming at:
- **Economic Empowerment:** Through these schemes, women gain direct access to resources, training, and technologies critical for agricultural sustainability. Enhanced earning opportunities improve household incomes and economic independence for women.
- **Skill Enhancement & Sustainability:** Women receive training in advanced agricultural practices, leading to improved yield and productivity. Adoption of sustainable agricultural and animal husbandry practices leads to long-term environmental and economic benefits.
- **Gender Equality:** By increasing women's participation across these sectors, the schemes promote gender equality and reduce socio-economic disparities.
- **Community Development:** Empowered women will contribute significantly to the socio-economic growth of their communities.

Strategic Interventions for Women Advancement in Agriculture & Allied Sectors

Strategic interventions aimed at women enablement in these sectors have the potential to not only uplift women but also contribute significantly to economic growth. Targeted interventions and policies are essential to overcome the barriers, ensuring women's participation, enablement, and recognition of the contribution they make in agricultural and allied sectors. Addressing these issues comprehensively through improved access to land, credit, training, and decision-making power is crucial for enhancing women's roles in agriculture. Here are some impactful interventions:

- **Legal and Policy Reforms:** Legal reforms aimed at ensuring land rights for women have been crucial in empowering them in agriculture. Policies that promote joint ownership of land and provide incentives for women-led agricultural enterprises are also important. **Impact:** Secure land rights have improved women's ability to invest in and manage agricultural resources, leading to better productivity and economic outcomes.
- **Access of Financial Resources to Women Self-Help Groups (SHGs) and Women Led Cooperatives:** SHGs and Cooperatives have been instrumental in empowering women by providing them access to credit, skills training, and a platform for collective action.
- **Gender-Sensitive Agricultural Policies:** Convergence of all gender sensitive agricultural policies of Government of India under single window will lead to empowering women farmers through capacity

building and market linkages.

Impact: Single window system of all policies will lead to better recognition of women's contributions in agriculture, increased their access to resources, and enhanced their decision-making power within households and communities.

Impact: Enhanced access to financial resources will lead to increased income levels and economic stability for women.

- **Training and Skill Development:** Focus on providing technical training to women in agriculture & allied sectors to enhance women's knowledge of modern practices and value addition.

Impact: Improved skills have enabled women to adopt better farming techniques, increase productivity, and engage in entrepreneurial activities.

- **Credit and Financial Access:** Conceptualizing and Implementing schemes for women entrepreneurs in agribusiness sector, providing them with access to credit for starting or expanding their enterprises.

Impact: Financial independence and the ability to invest in productive assets have significantly improved women's economic status and contributed to overall rural development.

- **Women-Led Farmer Producer Organizations (FPOs) & Cooperatives:** Promoting women-led FPOs & Cooperatives to ensure that women farmers have better access to markets, inputs, and extension services. These CBOs provide a collective platform for women to negotiate better prices and access larger markets.

Impact: Women-led FPOs & Cooperatives will improve the market reach and profitability of women farmers, leading to higher incomes and better livelihoods.

- **Technology and Digital Inclusion:** Digital literacy programs & Initiatives aimed to include women in the digital economy, providing them with access to market information, weather forecasts, and agricultural best practices through mobile technology should be introduced and implemented.

Impact: Digital inclusion has empowered women with knowledge, reduced information asymmetry, and increased their participation in agricultural value chains.

- **Market Linkages and Value Chain Development:** Programs focusing on creating market linkages for women in agriculture and allied sectors will help them gain better access to local and international markets. Initiatives to provide easy access to financial resources to support women-led enterprises in agriculture should be constructed and implemented.

Impact: Women's increased participation in value chains has led to higher income generation and economic empowerment, contributing to overall economic growth.

- **Promotion of Organic and Natural Farming:** Training and capacity building in sustainable practices for promoting organic and natural farming should be implemented to ensure long-term environmental and economic benefits.

Impact: Women engaged in organic farming have been able to access niche markets and command higher prices for their produce, leading to increased household incomes and sustainable livelihoods.

- **Education and Awareness Campaigns:** Awareness campaigns that focus on gender equality and the economic benefits of empowering

women in agriculture have been conducted by various stakeholders, including government, NGOs, and the private sector.

Impact: These campaigns have helped shift societal norms, encouraging more families to support women's participation in agriculture and allied sectors, thus boosting overall economic growth.

The above strategic interventions targeting women in agriculture and allied sectors will enable exploit significant potential in enhancing their economic empowerment. By improving access to resources, skills, markets, and legal rights, these initiatives not only uplift women but also contribute substantially to the broader economic development of India.

Contribution to Indian Economy

Women's participation in Indian agriculture and allied sectors contributes to economic growth and social development.

- **Increased GDP Contribution:** Women's participation in agriculture can contribute an additional 1-2% to the national GDP, translating into billions of rupees in economic output.

- **Poverty Reduction:** Women Inclusion in agricultural development could lead to a significant decrease in rural poverty rates, estimated at 10-15% in targeted regions.

- **Contribution to Food Security:** Women are often the backbone of household food security; their involvement can improve food production by 15-25%, leading to enhanced food security for families and communities.

- **Adoption of Sustainable Practices:** A shift towards sustainable agricultural practices, resulting in improved environmental health and sustainability, ethically conscious farming, and biodiversity preservation.

Women's leadership & development in agriculture and allied sectors is not just a matter of equity but a critical driver of economic growth and sustainability in India. As the backbone of rural economies, women farmers, entrepreneurs, and laborers play an indispensable role in the food production system. Strategic interventions, ranging from the formation of Self-Help Groups (SHGs) to the promotion of women-led Farmer Producer Organizations (FPOs), have demonstrated the transformative impact that targeted policies and programs can have.

By enhancing women's access to resources, credit, training, and markets, these initiatives have significantly improved productivity, income levels, and economic stability among rural women. Moreover, these efforts contribute to broader goals such as poverty reduction, food security, and sustainable development. However, the journey towards full autonomy is ongoing, requiring continued investment in gender-sensitive policies, legal reforms, and education.

In conclusion, women's advancement in agriculture is not only a pathway to achieving gender equality but also a strategic imperative for India's economic progress. As we look to the future, the integration of women into the mainstream of agricultural and rural development will be crucial for building a resilient and inclusive economy.

Dhanuka Agritech Unveils Heartfelt Film Celebrating India's Next Generation of Farmers

New Delhi, 5th September 2024 – Dhanuka Agritech, a leading name in Indian agri-input, has released a touching new mini-feature film as part of its acclaimed 'India ka Pranam, Har Kisaan ke Naam' campaign. The film delivers a powerful message about the future of farming in India through the eyes of a young boy who dreams of becoming a farmer—a profession that nurtures the nation.

Building on the momentum of the 2022 campaign, this second instalment has already garnered widespread attention. Teasers and social media buzz have created excitement, and today's release has been met with overwhelming appreciation. The film's simple yet profound message—the future of India lies in the hands of its farmers—is resonating deeply with audiences across the country.

Behind this impactful campaign is Dhanuka Agritech, which has been a trusted partner in Indian agriculture for 44 years. "We are thrilled to unveil this film," said Ratnesh Kumar Pathak, Senior Deputy General Manager at Dhanuka Agritech. "This initiative

is a continuation of our mission to uplift and honor the farming community. Through this film, we challenge the outdated belief that brilliant young minds cannot pursue farming—a profession that is the backbone of our country. Farming is not just a livelihood; it's a legacy, and we want to celebrate it. This film is our way of expressing deep gratitude to every farmer for their unwavering dedication and invaluable contributions."

For decades, Dhanuka Agritech has stood alongside Indian farmers, understanding their struggles, successes, and the tireless effort behind each harvest. The film serves as a tribute to those efforts, and a call to inspire the next generation to embrace farming with pride. It plants seeds of hope for a future that is rooted in the enduring values of agriculture, which remain integral to the fabric of India.

As the film reaches homes across the nation, it reinforces Dhanuka's ongoing commitment to supporting the people who feed the country. This campaign celebrates not just today's farmers, but also the future ones, reminding us that farming is more than a profession—it's a legacy worth cherishing and nurturing.



Food Security in Poultry Supply Chain

Post Harvest and Supply Chain Management



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Food security relies on effective post-harvest management and Supply Chain Management (SCM) practices that ensure food quality and safety from farm to table. This review focuses on the critical roles of post-harvest management, food loss, surplus food and SCM in ensuring food security, particularly in the poultry sector and staple crop production (soya and corn) which is essential in poultry value chain.

Food waste is a pressing global issue that affects both human well-being and the environment. According to the Food and Agriculture Organization (FAO), approximately one-third of all food produced for human consumption is wasted each year. This wastage occurs at various stages of the supply chain, from production and distribution to consumption. There is another area where surplus food is also an issue. Surplus food is the food which is edible food that remains unsold or unused. Supermarkets, restaurants, and households often discard surplus food due to aesthetic imperfections, overstocking, or expiration dates. However, this surplus can be a valuable resource if managed effectively.

Multiple Benefits

There are multiple benefits if we manage the food wastage and surplus food for Food Security. The access to nutritious food through recovered surplus food provides essential nutrients to vulnerable populations. It ensures that nutritious meals reach those who might otherwise go hungry. The initiatives such as redistributing surplus food, we bridge the gap between abundance and scarcity. Families facing economic challenges can access fresh produce, dairy, and grains. The recovery programs foster community involvement. Volunteers participate in collecting, sorting, and distributing food, creating a sense of shared responsibility. We can also reduce environmental implications such as reducing Greenhouse Gas Emissions by preventing methane—a potent greenhouse gas after decomposition and by diverting surplus food, we decrease methane emissions and mitigate climate change.

These initiatives can also help to conserve resource by reducing the need for additional agricultural production. It saves water, energy, and other resources associated with growing, processing, and transporting

food. Less food waste means less pressure on ecosystems and by using surplus food efficiently, we protect natural habitats and biodiversity. There is need for collaboration of Government policies, private sector participation and educating the consumers as well as food businesses to raise the awareness about responsible consumption, implement better inventory management practices.

Technological Advancements

Post-harvest management through effective handling, storage, processing, packaging, transportation, and marketing for agriculture produce. The post-harvest loss accounts roughly 15-20% for agriculture produce. The effective practices minimize food losses and maintain quality and safety which applies to across various sectors.

In the poultry sector, post-harvest management includes hygienic slaughtering, evisceration, chilling/freezing, and packaging to prevent contamination. Efficient SCM ensures a seamless flow of food products from producers to consumers, maintaining efficiency and safety. Technological advancements like blockchain technology enhance transparency and ensure food safety standards.

Animal protein, including poultry, provides essential nutrients. Improved post-harvest and supply chain practices address challenges like limited shelf life and food wastage, enhancing food security and achieving Sustainable Development Goals (SDGs) like Zero Hunger, Responsible Consumption and Production, and Good Health and Well-Being. Some of the initiatives such as recovery and redistribution play a crucial role in addressing food insecurity while promoting environmental sustainability. By valuing surplus food and redirecting it to those in need, we create a win-win situation for people and the planet.

Utilization Of Waste

The poultry waste which accounts for 30% in unorganized sector such as roadside slaughter goes waste, which is valuable source of protein. The waste also creates issues such as transfer of zoonotic disease. The benefits of utilization of waste and converting it to valuable protein through rendering will help to prevent loss of good protein, environmental pollution issues, zoonotic disease transmission and many startups can also work on this initiative. The biosecurity to prevent zoonotic disease has significant impact and can be of a significant help to prevent disease outbreaks and remain competitive through preventing losses.

The approach of best practices sharing can help countries to reduce the food loss and wastage wherein education awareness is crucial step. The other areas which include the community's engagement which has significant role to play. They can take the lead in community initiatives against food waste and loss. Recognizing that both loss and waste have moral implications beyond their economic and environmental impact. Food loss and wastage undermine food security, with significant wastage in high-value animal proteins like poultry.

Adopting advanced technologies, improving cold chain infrastructure, promoting animal welfare, and enhancing collaboration between industry and regulatory bodies can reduce food loss and wastage, ensuring the availability of safe and nutritious food. Effective post-harvest and SCM practices are vital for maintaining food security and achieving a secure and nutritious food for future which is the need of the day globally.



Effective post-harvest and SCM practices are vital for maintaining food security

Block Chain

Boosting Transparency and Traceability in Fresh Food Supply Chain

“Blockchain technology can serve as a foundational technology for collaborative supply chains”



ABOUT THE AUTHOR

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Blockchain is a distributed, immutable, and decentralized ledger at its core that consists of a chain of blocks and each block contains a set of data. The blocks are linked together using cryptographic techniques and form a chronological chain of information. It allows transparent information sharing within a business network.

It is designed to store information in a way that makes it virtually impossible to add, remove or change data without being detected by other user/ Admin. It's based on principles of cryptography, decentralization, and consensus, which ensure trust in transactions.

The fresh food supply chain refers to the network of entities, activities, and resources involved in the production, processing, transportation, storage, and distribution of fresh perishable food products, such as:

1. Fruits and vegetables
2. Meat, poultry, and seafood
3. Dairy products
4. Bakery and pastry products
5. Prepared foods

The fresh food supply chain typically involves:

1. Farmers and growers
2. Packers and processors
3. Distributors and wholesalers
4. Logistics and transportation providers
5. Retailers and food service providers
6. Consumers

The goal of the fresh food supply chain is to deliver high-quality, safe, and fresh food products to consumers while minimizing waste, reducing costs, and ensuring food safety and traceability.

The Benefits

Blockchain technology has gained significant attention in the food supply chain due to its potential to enhance traceability, transparency, and accountability, & BT can play a crucial role in enhancing the efficiency of the fresh food supply chain, making it possible to track the origin, movement, and ownership of food products throughout the supply chain.

Here are some strategies and technologies that help prevent damage and ensure the integrity of the cold chain:

1. Real-Time Monitoring and IoT Sensors

Temperature Sensors: IoT-enabled temperature sensors can be placed on containers or pallets to continuously monitor the temperature of products throughout the supply chain.

Humidity and Pressure Sensors: These sensors help ensure that environmental conditions remain within specified ranges, providing additional data points for maintaining product integrity.

Real-Time Alerts: Automated alerts can be sent to relevant personnel if temperature, humidity, or pressure deviates from acceptable ranges, allowing for immediate corrective actions.

2. Data Logging and Blockchain Integration

Continuous Data Logging: Data loggers record temperature and environmental conditions at regular intervals, providing a detailed record of the conditions experienced by the products.

Blockchain for Transparency: Integrating blockchain technology ensures that data from IoT sensors and data loggers is stored in an immutable ledger. This provides a transparent and tamper-proof record of the cold chain conditions, which can be accessed by all stakeholders.

3. Packaging Solutions

Insulated Packaging: Use of insulated containers and packaging materials to maintain internal temperatures, reducing the impact of external temperature fluctuations.

Phase Change Materials (PCMs): These materials absorb or release heat at specific temperatures, helping to maintain a stable temperature within the packaging.

Active vs. Passive Cooling: Active cooling systems (such as

refrigerated containers) provide continuous cooling, while passive cooling systems (such as gel packs) rely on pre-conditioned materials to maintain temperature.

4. Efficient Transportation and Handling

Refrigerated Transport: Use refrigerated trucks, ships, and aircraft specifically designed for temperature-sensitive products to ensure a consistent temperature is maintained during transit.

Minimize Handling Time: Reduce the time products spend outside of controlled environments by streamlining loading, unloading, and transfer processes.

Route Optimization: Plan transportation routes to minimize delays and exposure to varying temperatures, ensuring the fastest and most efficient delivery path.

5. Facility Management

Cold Storage Facilities: Maintain cold storage facilities that are properly equipped and monitored to keep products at required temperatures.

Regular Maintenance: Ensure that refrigeration equipment is regularly maintained and inspected to prevent breakdowns and temperature deviations.

Backup Systems: Implement backup power systems and contingency plans to handle power outages or equipment failures.

6. Compliance and Training

Regulatory Compliance: Adhere to industry standards and regulations for cold chain management, such as GDP (Good Distribution Practice) guidelines for pharmaceuticals.

Employee Training: Train staff on best practices for handling temperature-sensitive products, including the importance of maintaining cold chain integrity and how to respond to temperature excursions.

Blockchain technology can enhance transparency and traceability in the fresh food supply chain in the following ways:

Enhanced Traceability and Accountability

- **Real-Time Monitoring:** IoT-enabled sensors and data loggers provide real-time monitoring of environmental conditions, ensuring that any deviations are immediately detected and corrected. This traceability allows for accountability at every stage of the supply chain.

- **Blockchain Integration:** Using blockchain for recording data provides an immutable and transparent record of the product's journey. This transparency ensures that any issues can be traced back to their source, facilitating quick resolution and maintaining product integrity.

- **Ensuring compliance with established sustainability standards:** Blockchain technology can help ensure that food producers and suppliers comply with sustainability standards by accurately documenting sustainability information

- **Strengthening transparent sustainability reporting practices:** Blockchain technology offers the potential to enhance transparency in sustainability reporting by accurately recording what international initiatives and standards are applied to guide sustainability reporting

- **Facilitating sustainability certification and label verification:** Blockchain technology can facilitate verifiable information about sustainability attributes, thereby validating adherence to sustainability standards.

- **Engaging consumers in sustainable food consumption:** Blockchain technology can empower consumers by providing them with access to more detailed sustainability information about the food they purchase beyond simplistic sustainability labels

- **Fostering multi-stakeholder collaboration throughout the supply chain:** Blockchain technology can serve as a foundational technology for collaborative supply chains, facilitating active participation of diverse stakeholders in governance and decision-making processes.

Turning Waste into Wealth

Educating Cattle Farmers on By-Product Utilization

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By transforming waste into wealth, farmers can ensure the prosperity of future generations, fulfilling the dual goals of economic profitability and environmental health

ABOUT THE AUTHOR

Mr Kumar Ranjan is CEO, eFeed, a precision animal management & nutrition company focused on revolutionizing animal feed practices and empowering farmers across the country with better milk yields and reduced methane emissions. eFeed has raised more than 1.5 million USD in venture capital from prominent investors like Omnivore, Huddle, Better Capital, Faad & Venture Catalyst

India, predominantly an agrarian nation, relies heavily on agriculture and allied sectors, supporting nearly 65% of its population. This encompasses not only crop cultivation but also animal husbandry and livestock farming. However, these activities generate a substantial amount of waste. Annually, India produces approximately 1500 lakh tons of agricultural waste, including crop residues and livestock by-products such as dung and urine. If managed efficiently, this "neglected" waste could significantly boost farmers' incomes, thereby contributing to the nation's wealth.

The Potential of Livestock Waste

The livestock sector alone, which forms a significant part of agricultural GDP, produces vast amounts of waste that could be harnessed. Livestock by-products like dung and urine are valuable resources that contribute approximately 7% to the total livestock Gross Value Added (GVA), showcasing their potential beyond conventional disposal methods. Adopting sustainable practices to manage agricultural waste is crucial. This method not only conserves resources but also adds directly to the farmers' income.

From Waste to Resource: Various Utilization Methods

Cattle farming in India, a cornerstone of the agricultural sector, supports the livelihoods of millions of families. In recent years, innovative approaches have emerged for cattle farmers to earn additional income, particularly through the utilization of cattle waste. This waste, traditionally seen as a by-product, holds significant economic potential if processed and used effectively.

One of the most promising methods for monetizing cattle waste is through the production of biogas. Biogas technology allows farmers to convert animal manure into a clean, renewable energy source. According to a report by the Indian Biogas Association, there are over 12 million family-type biogas digesters in India, which can collectively manage about 15 million metric tonnes of biowaste annually. The biogas produced can be used for cooking, heating, and generating electricity, not only reducing household energy expenses but also providing an additional revenue stream through the sale of surplus energy to local grids under government-supported schemes.

The slurry by-product from biogas production is a highly effective organic fertilizer. This nutrient-rich fertilizer can improve soil fertility and yield, reducing the need for chemical fertilizers and enhancing crop production. The Indian government's emphasis on organic farming has increased demand for such natural fertilizers, providing an economic incentive for farmers to market this by-product. Research indicates that using biogas slurry can increase crop yields by up to 25%, demonstrating its value in enhancing agricultural productivity.

Vermicomposting

Another avenue for generating income from cattle waste is through vermicomposting. This process involves using earthworms to break down organic waste, turning it into high-quality compost. This method is particularly suited to India's agrarian-based economy, where sustainable and eco-friendly farming practices are becoming increasingly important. According to the National Centre of Organic Farming, vermicompost sells at a premium in the market, often fetching twice the price of chemical fertilizers. Additionally, vermicomposting can process large quantities of organic waste, with a single hectare of land yielding up to 50 tonnes of vermicompost annually.

In recent years, the government has launched various initiatives to support these practices. For example, the Gobar-Dhan (Galvanizing Organic Bio-Agro Resources) scheme aims to promote the management of cattle waste for additional revenue,

emphasizing the benefits of turning waste into wealth. This scheme not only supports the setup and maintenance of biogas plants but also aids in connecting farmers with markets to sell their organic fertilizers and surplus energy.

Maximizing Income from Cow Dung and Urine

Cow Dung: Innovative uses of cow dung include biogas production for electricity and fertilizer. It's also used to make eco-friendly products like paper, paint, and disinfectants. For example, handmade paper from cow dung has increased farmer incomes in Rajasthan. Bio-enhancers and biopesticides made from cow dung reduce the need for chemical fertilizers. Vedic Plaster, made from cow dung, sandy soil, and gypsum, provides thermal insulation and generates extra income.

Cow Urine: Cow urine can be sold for Rs 15-30 per liter for use as organic pesticides, medicinal, and ritualistic purposes. High-breed cow urine is in demand in Rajasthan. It is also used to produce eco-friendly sanitizers and disinfectants, boosting its market value.

The economic potential of cattle waste in India is vast and multifaceted. By adopting these waste-to-wealth strategies, cattle farmers can enhance their income, contribute to the energy needs of the country, and promote sustainable agricultural practices. These initiatives not only bolster the farmers' financial stability but also align with the national goals of energy self-sufficiency and reduced environmental impact.

Enhancing Farmer Education and Outreach

To realize the full potential of agricultural waste, it is imperative to educate and train farmers on the benefits and methods of waste utilization. Workshops, training programs, and on-site demonstrations can play a pivotal role in changing perceptions and practices regarding agricultural waste.

Cattle farming in India is supported through various government initiatives aimed at promoting sustainable practices and enhancing productivity. In addition to the traditional support programs, companies like eFeed play a significant role in transforming cattle farming towards sustainability and efficiency.

eFeed, an AI-powered precision animal management and nutrition company, focuses on enhancing the livelihoods of dairy farmers through innovative solutions. They offer technology that helps in measuring and reducing enteric methane emissions in dairy farming, aligning with sustainable practices. Their platform, Vetvantage, aids farmers in managing and reducing methane emissions effectively, which not only helps in complying with environmental standards but also in monetizing sustainability goals through carbon credits. By integrating eFeed's technology, farmers can improve their cattle's health and productivity, leading to increased milk yields and income, all while contributing to the global effort against climate change. This marks a significant shift towards high-tech, eco-friendly farming practices that can coexist with traditional methods to enhance the overall efficiency and sustainability of dairy operations in India.

By leveraging these resources and support systems, cattle farmers in India can improve the sustainability of their operations and increase their income, contributing positively to the overall growth of the dairy sector in the country.

Increasing Farmers' Income

Effectively utilizing cattle farming by-product waste can lead to a substantial increase in farmers' incomes and contribute to the sustainability of agricultural practices. By transforming waste into wealth, farmers can ensure the prosperity of future generations, fulfilling the dual goals of economic profitability and environmental health. This holistic approach not only supports farmers but also contributes to the national economy, making cattle farming a more sustainable and profitable venture.

DEPARTMENT OF AGRICULTURAL ENGINEERING



AGRI BUSINESS INCUBATOR
KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF AGRICULTURE, VELLANIKKARA



Advancing research, development, and industrial collaboration can make sugarcane bagasse a cornerstone of sustainable packaging, promoting a greener future



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Sweet Solutions

Harnessing Sugarcane Bagasse for Packaging

In today's environmentally conscious world, the materials used in packaging are increasingly important due to their significant role in household waste. Plastic packaging, in particular, poses severe environmental challenges due to its persistence and potential harm. In India, packaging materials account for 59% of all plastic usage, often ending up in landfills and contributing to pollution and environmental degradation. To address this issue, eco-friendly packaging solutions are essential. One promising option is sugarcane bagasse, a natural

by-product of sugar production, offering a sustainable alternative to traditional packaging materials.

Sugarcane as a sugar source

Sugarcane, with a sugar content ranging from 10% to 20%, is one of the most efficient plants for sugar production, making it a key player in the global sugar industry. It fulfills the worldwide demand for sugar and its derivatives. In India, sugarcane production is immense, with around 419.25 million metric tons produced in the 2022-23 season. Over 500 sugar mills in the country produce approximately 91 million tons of sugarcane bagasse annually. Bagasse, the fibrous residue left after sugarcane is crushed and its juice extracted, contains cellulose (40-50%), hemicellulose (25-35%), lignin (25-28%), ash, and wax. This composition makes it an excellent reinforcement fiber for composite

materials. From 1 kilogram of sugarcane, roughly 140 grams of sugar and 250-280 grams of bagasse are obtained.

Bagasse as packaging material

The bagasse extraction process begins with collecting sugarcane stalks after sugar extraction (Figure 1). The dried bagasse (pulp) is used as a raw material for packaging materials. Sugarcane bagasse requires several tailored treatments and pulping processes for package making. Figure 2 illustrates the production process of molded packages and tableware from sugarcane bagasse pulp.

- **Pulping:** Bagasse is mechanically or chemically pulped to break down its fibrous structure, with chemical pulping producing longer, more durable fibers.
- **Cooking:** The pulp undergoes heat, pressure, and chemical treatment to further break down lignin, using continuous

cooking equipment due to bagasse's low bulk density and high compressibility.

- **Washing:** A vacuum drum washer efficiently removes black liquor, offering cost-effective and easy operation.
- **Screening:** The pulp is refined with centrifugal sieves and low-concentration decanters, considering water consumption and wastewater discharge, with significant water use and sewage output impacting production costs.
- **Bleaching:** The CEH (chlorine-extraction-hypochlorite) three-stage bleaching process enhances the pulp's brightness and purity.
- **Molding:** The bagasse mixture is molded into specific shapes and sizes through compression or injection molding techniques.
- **Curing or drying:** The material undergoes curing or drying to reinforce the structure and remove excess moisture for optimal performance.
- **Finishing:** Trimming, surface smoothing, or eco-friendly printing enhances the packaging's aesthetic appeal and functionality.

Bagasse Packaging: Trends And Challenges

Sugarcane bagasse is gaining recognition as a versatile and eco-friendly packaging material in the food market. Bagasse-based products, including takeaway containers, plates, bowls, cups, and cutlery, are valued for their durability, heat resistance, and insulating properties. These materials typically biodegrade within 30-90 days without leaving toxic residues, supporting a circular economy.

However, achieving the mechanical properties, particularly strength, to match traditional plastics remains a challenge. Consistency in the quality of bagasse fibers depends on the type of sugarcane and the machinery used in the crushing process. Reinforcement of bagasse-based materials is often necessary, and incorporating nanocellulose or nano-clay can enhance moisture and oxygen resistance.

Economically, offering bagasse packaging at a competitive price with conventional plastics depends on large-scale production and cost-reduction technologies. Technological interventions, such as coatings, can complicate biodegradability predictions from a commercial perspective. Additionally, being degradable, bagasse is susceptible to infections and infestations, necessitating safety assurances for food contact surfaces.

Future Research Directions

Future advancements in packaging will heavily rely on the development of active and intelligent, or smart packaging systems tailored to product quality and use. Coordinated efforts in research, development, and industrial collaboration are crucial in bagasse-based and similar plant-derived packaging solutions.

MILK PLANET

Overcoming Challenges, Embracing Technology for a Sustainable Future

The journey of dairy produce from harvest to the consumer's table is a multifaceted and complex process, particularly in the livestock and dairy sector. This journey encompasses numerous stages, including production, processing, transportation, and retail. Ensuring that this supply chain operates seamlessly is crucial to minimize wastage of perishables and maintain product quality. The integration of value addition and farm-to-fork traceability can significantly enhance supply chain efficiency and transparency, fostering consumer loyalty and contributing to the achievement of Sustainable Development Goals (SDGs).

Current Challenges and Existing Situation

The livestock and dairy supply chain faces several challenges:

1. **Perishability:** Dairy products and fresh meat are highly perishable, requiring swift processing and delivery to prevent spoilage.
2. **Fragmented Supply Chain:** The supply chain often involves multiple intermediaries, leading to delays and inefficiencies.
3. **Lack of Traceability:** Consumers are increasingly demanding information about the origin and journey of their food, which many existing systems struggle to provide.
4. **Inadequate Infrastructure:** In many regions, particularly in developing countries, the infrastructure for cold storage and transportation is insufficient, exacerbating wastage.
5. **Regulatory Compliance:** Meeting food safety and quality standards involves complex regulatory requirements that can vary significantly across regions.

Future Trends

Several trends are shaping the future of the livestock and dairy supply chain:

1. **Digitalization:** The adoption of digital technologies is transforming supply chain management, enabling real-time monitoring and decision-making.
2. **Sustainability:** There is a growing emphasis on sustainable practices, from reducing carbon footprints to ensuring ethical treatment of animals.
3. **Consumer Awareness:** Increased consumer awareness about food quality, safety, and origin is driving demand for greater transparency.
4. **Automation:** Automation in production and processing is enhancing efficiency and reducing human error.
5. **Smart Packaging:** Innovations in packaging, such as biodegradable materials and smart labels, are helping to extend shelf life and provide valuable information to consumers.

Ways to Improve

To address the current challenges and leverage future trends, several strategies can be employed:

1. **Enhanced Infrastructure:** Investing in cold storage facilities and efficient transportation networks can significantly reduce wastage.

2. **Integrated Supply Chain Management:** Developing integrated systems that connect all stakeholders can streamline operations and reduce delays.

3. **Education and Training:** Providing farmers and supply chain workers with training on best practices can improve overall efficiency and product quality.

4. **Value Addition:** Transforming raw produce into value-added products, such as cheese or yogurt, can extend shelf life and open new market opportunities.

5. **Farm-to-Fork Traceability:** Implementing systems that provide end-to-end traceability can enhance transparency and consumer trust.

Use of Technologies like AI, IoT, GenAI, and Blockchain

The integration of advanced technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), Generative AI (GenAI), and Blockchain can revolutionize the livestock and dairy supply chain.

Artificial Intelligence (AI)

Predictive Analytics and Spoilage Prevention: AI can analyze vast amounts of data from various stages of the supply chain to predict when products might spoil. By considering factors such as temperature, humidity, and time in transit, AI algorithms can forecast the remaining shelf life of dairy and meat products. This predictive capability allows stakeholders to take proactive measures, such as rerouting shipments or adjusting storage conditions, to prevent spoilage and reduce waste.

Demand Forecasting: AI-driven demand forecasting models can predict consumer demand more accurately by analyzing historical sales data, market trends, seasonal variations, and other external factors like economic conditions. This helps producers and retailers manage inventory more effectively, ensuring that supply meets demand without overproduction or stockouts, which can lead to waste.

Optimizing Supply Chain Operations: AI can optimize various aspects of the supply chain, from production planning to logistics. For instance, AI can identify the most efficient routes for transportation, considering factors such as traffic, weather conditions, and fuel consumption. This not only speeds up delivery but also reduces costs and environmental impact. Additionally, AI can streamline warehouse operations by automating tasks such as sorting, packing, and inventory management.

Internet of Things (IoT)

Real-Time Monitoring: IoT devices, such as sensors and RFID tags, can monitor the condition of produce in real-time during storage and transportation. These devices track critical parameters like temperature, humidity, and light exposure, providing continuous data streams that can be analyzed to ensure optimal conditions are maintained. For example, if the temperature inside a refrigerated truck exceeds a certain threshold, an alert can be triggered to take corrective action immediately.

MR ASHISH SONKUSARE

CEO & Founder of eVerse. AI. He has more than 25 years of experience in cutting edge technologies like Artificial Intelligence and Machine Learning

Current challenges such as perishability, fragmented supply chains, and inadequate infrastructure must be addressed to minimize wastage and maintain product quality





Enhanced Traceability: IoT technology enables detailed tracking of products from the farm to the consumer's table. Each product can be assigned a unique identifier that records every stage of its journey. This data can be accessed by all stakeholders, including farmers, processors, distributors, and consumers, ensuring full transparency and traceability. Consumers can scan QR codes on packaging to learn about the product's origin, processing, and transportation history.

Generative AI (GenAI)

Efficient Farm Management Systems: GenAI can develop sophisticated farm management systems that optimize various aspects of livestock farming. These systems can analyze data from multiple sources, such as weather forecasts, soil conditions, and crop health, to provide actionable insights. Farmers can use these insights to make informed decisions about planting, irrigation, and harvesting, ultimately improving productivity and sustainability.

Optimized Feeding Regimes: GenAI can design personalized feeding regimes for livestock based on their specific nutritional needs and health conditions. By analyzing data from sensors and other monitoring devices, GenAI can create feeding plans that maximize growth, milk production, and overall health, while minimizing feed waste and costs.

Improving Animal Health: Predictive modeling with GenAI can help identify potential health issues in livestock before they become severe. By analyzing data from health records, sensors, and environmental conditions, GenAI can predict outbreaks of diseases or health problems, enabling early intervention and reducing the risk of widespread issues. This leads to healthier animals and more consistent product quality.

Blockchain Technology

Immutable Record-Keeping: Blockchain technology provides a secure and tamper-proof way to record every transaction and movement within the supply chain. Each block of data is linked to the previous one, creating a permanent and unalterable record. This ensures that all information is accurate and trustworthy, reducing the risk of fraud and errors.

Enhanced Traceability and Accountability: With blockchain, every participant in the supply chain, from farmers to retailers, can access a shared ledger that records all activities related to a product. This transparency allows for easy tracing of products back to their source, which is crucial in case of recalls or quality issues. Consumers also benefit from this transparency, as they can access detailed information about the products they purchase, fostering trust and loyalty.

Smart Contracts: Blockchain can enable the use of smart contracts, which are self-executing contracts with the terms of the agreement directly written into code. These contracts automatically enforce and execute agreements when predefined conditions are met. For example, a smart contract could automatically release payment to a supplier once a shipment is verified to meet quality standards, reducing delays and administrative overhead.

Desired Outcomes

The application of these technologies and strategies aims to achieve several desired outcomes:

1. **Reduced Wastage:** By optimizing the supply chain and improving infrastructure, the wastage of perishable products can be minimized.
2. **Enhanced Quality:** Real-time monitoring and predictive analytics can ensure that produce remains within optimal conditions, maintaining high quality.
3. **Increased Transparency:** Blockchain and traceability systems can provide consumers with detailed information about the origin and journey of their food, fostering trust and loyalty.
4. **Improved Efficiency:** Automation and AI can streamline operations, reducing delays and costs.
5. **Sustainability:** Sustainable practices can be more easily implemented and monitored, contributing to environmental conservation and ethical production standards.

Impact on SDGs

Improving the livestock and dairy supply chain aligns with several Sustainable Development Goals:

1. **Zero Hunger (SDG 2):** Reducing wastage and improving efficiency can enhance food security and ensure a stable supply of nutritious products.
2. **Industry, Innovation, and Infrastructure (SDG 9):** Investing in infrastructure and adopting innovative technologies supports economic growth and sustainable industrialization.
3. **Responsible Consumption and Production (SDG 12):** Enhancing traceability and reducing wastage promote sustainable consumption and production patterns.
4. **Climate Action (SDG 13):** Sustainable practices and improved efficiency can reduce the environmental impact of livestock and dairy production, contributing to climate change mitigation.

Solutions For Growth

The journey of farm produce from harvest to the consumer's table is a complex process that requires a seamless and efficient supply chain. Current challenges such as perishability, fragmented supply chains, and inadequate infrastructure must be addressed to minimize wastage and maintain product quality. Future trends, including digitalization, sustainability, and increased consumer awareness, present opportunities for improvement.

By leveraging advanced technologies such as AI, IoT, GenAI, and Blockchain, the livestock and dairy supply chain can achieve reduced wastage, enhanced quality, increased transparency, improved efficiency, and sustainability. These improvements not only benefit the industry and consumers but also contribute to the achievement of several Sustainable Development Goals, paving the way for a more sustainable and equitable food system.

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Water Pricing Reforms in India

A Way to Water Management

Due to economic and demographic changes in India, water demands in all sectors are increasing. According to the projections by the National Commission on Integrated Water Resources Development, the irrigation sector alone is going to need an additional 71 BCM by 2025 and 250 BCM of water by 2050 compared to the demands of 2010. The water availability has reduced per person and more polluted water and climate change have worsened this further.

India's projected water availability per capita was 1486 m³ in 2021 and is slated to decline to 1367 m³ by 2031. Due to the implementation of effective water policies and regulatory mechanisms, the industrial sector across the globe has reduced water withdrawal by 18% during 2016-2018. This is encouraging and even the domestic water supply is being metered and monitored.

Impending Water Stress

However, the agricultural sector, which uses most of the water, needs to focus and intensify its efforts to increase water use efficiency. Overall water consumption needs to be reduced and therefore, focusing only on enhancing the efficiency of water use will help in attaining SDG Target 6.4: "By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity".

By combining sustainable water supply for agricultural irrigation along with adequate water policies, increasing efficiencies, adoption of deficit irrigation and necessary investments in the infrastructure, water availability and sustainable food production can be ensured.

Water Resources Management

Water resources management incorporates policies, latest technologies, water demand and supply strategies, and water governance systems to address societal needs and ecosystem requirements sustainably. Appropriate water policy and law with proper regulatory mechanisms can prove to be of vital importance in the demand-side management of water and enhance agricultural water use efficiency. Many countries continue to reform their water policy to safeguard the appropriate water resource management strategy.

The first Indian National Water Policy (1987) advocates charging the water pricing to convey the scarcity value of the water. The policy

also sets the goal to pay for the annual O&M charges and a portion of the capital costs associated with irrigation projects. Even this was recommended by the Vaidyanathan Committee Report in 1992, which was constituted by the Government of India to review the prevalent water pricing rate and structure and the provision of subsidies in government-funded irrigation projects.

The implementation of an irrigation water pricing mechanism was expected to encourage efficient water use, water conservation and ensure equitable distribution of resources. Though quantitative water pricing was recommended in the National Water Policy, 2012, this is not practised due to the poor on-field implementation of water metering infrastructure. Because of simplicity in assessment, irrigation water charges are determined on the area coverage and crops grown.

In India, there has been an important change in the policy formulation. The National Water Framework Bill in 2016 reiterates the recovery of the full financial cost of the water used, with a special focus on commercial agriculture and industry. The bill further suggests implementing a variable pricing system for domestic water supply.

The Ministry of Water Resources drafted a Groundwater Model in 2016 that only reflected the concern of the government for bringing out regulation of groundwater by all the state governments. The bill emphasised the State's role as a public trustee of groundwater resources which should be treated as a community resource for protection, conservation, regulation and management.

Irrigation Efficiency

India's irrigation water supply infrastructural projects are generally government-funded with almost no consideration for managing water demand but recently, the government has focused on increasing irrigation efficiency to mitigate water scarcity and reduce irrigation water demand. As irrigation water is used by small and marginal farmers largely engaged in agriculture just to sustain their livelihood, price fixation of irrigation water becomes a critical issue and therefore, considering the social, economic, and political dimensions play a key role in the formulation of such pricing policy.

Water rates vary both inter-state and among different crops. In a few states, revenue generation is very near to O&M cost. The collection of revenue of irrigation water as part of the O&M cost has gradually declined due to low canal irrigation water charges and lack of revision of water pricing by some states at regular intervals.



Improving water policy and governance is key to ensuring water security

During 1975-76, about 96% of the O&M cost could be met by irrigation water charges and other receipts; a meagre 5.8% could only be met in 1997-98. In 2013-14, this share increased to about 20%. There is an independent water regulatory authority in a few states and the price-fixing mechanism for irrigation water is temporary and excludes consultation. Further, the revenue collection mechanism is also a major issue and needs to be strengthened.

The low percentage recovery of the irrigation water charges is strongly connected with appalling groundwater depletion because water pricing is fixed only for surface water sources. In the case of groundwater usage, only electricity charges are levied.

Water Pricing Dynamics

India can have varying pricing methods and fix higher prices in water scarcity regions and may relax in the water-abundant region. In water-scarce regions, higher prices tend to discourage water-intensive crops. Water can also be transported from regions having alluvium formation to scarce regions if the economy goes well. This will avoid unnecessary drilling in water-scarce regions and may allow the groundwater to be recharged naturally. The creation of more water storage structures to capture falling rainfall must be prioritised and planned in India. A model river basin should be developed where the volumetric pricing method is adopted and monitored for a long time so that the outcomes can be followed by other river basin authorities or the states.

Currently, farmers pay a fixed amount, regardless of how much they consume. The permit system for the abstraction of water and the formation of effective and working river basin commissions are important measures which can be modified and implemented in India to strengthen water resources management. Improving water policy and governance is key to ensuring water security in growing economies. Economic principles may lean towards the privatization of such natural resources to overcome scarcity.

However, privatization does not necessarily result in improved

efficiency - it all depends on the effectiveness of the regulatory system of a country. The future of water security in India is also in the hands of future leaders in water management and collaboration is the key to developing relationships among the nations to tackle the pressing water challenges of the countries.



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INFRA BOOST

Navigating Food Security via Post Harvest & Supply Chain Management

In a world grappling with the dual challenge of a growing population and the need to ensure food security, post-harvest and supply chain (PHSC) management stand as critical areas of focus. The Food and Agriculture Organization (FAO) estimates that nearly one-third of food produced for human consumption is lost or wasted globally, amounting to approximately 1.3 billion tons per year. Efficient PHSC are essential to mitigate these losses, enhance food security, and ensure sustainable agricultural practices.

The journey of farm produce from harvest to the consumer's table is a multifaceted and complex one, where the supply chain network needs to be seamlessly connected to ensure that no time is lost in the process because it leads to wastage of perishables. This short article explores emerging prospects towards smarter versions of PHSC management, emphasizing efficiency, value addition, and traceability as key factors in securing food supply. Key elements and related optimizations are pinpointed along with ways to harness benefits of smart tools and technologies to overcome the challenge of wastes & wastage of food encompassing its qualitative as well as quantitative portraits at global scale.

Importance Of Post Harvest Management (PHM)

PHM involves processes that maintain the quality and extend the shelf life of agricultural products after harvest. Effective postharvest handling can significantly reduce food losses, a crucial factor in food security. The Food and Agriculture Organization (FAO) reports that

about one-third of the food produced for human consumption is lost or wasted globally.

In countries like India, these losses are mainly due to poor postharvest practices. Proper PHM includes timely and efficient harvesting, cooling, storage, processing, packaging, and transportation. For example, cooling harvested fruits and vegetables immediately can slow respiration rates and delay spoilage. Modern storage facilities with controlled atmospheres can further extend the shelf life of perishables, reducing waste and ensuring food reaches consumers in optimal condition.

Enhancing the Supply Chain for Efficiency

Unlike other segments, the supply chain in the farming sector happens to be highly complex network involving multiple stakeholders, including farmers, processors, distributors, retailers, consumers; and all under highly uncertain and uneven situations. An efficient supply chain always ensures that produce moves swiftly from farms to consumers, reducing transit time and minimizing losses. Advanced technologies such as the Internet of Things (IoT), block chain, and artificial intelligence (AI) can revolutionize the supply chain, by monitoring/managing produce conditions during transportation & storage, providing real-time data, and offering a transparent & immutable ledger for tracking the journey of produce from farm to fork, building trust and accountability among stakeholders.



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Value-added products open new markets for farmers and boost their incomes

Value Addition

It remains a giant intrusion beyond mere "Basic Produce" to transform raw farming products into more valuable goods, increasing their shelf life, reducing waste, and enhancing marketability. Activities such as canning, freezing, drying, and packaging can significantly reduce wastage and provide consumers with convenient, long-lasting products. Value-added products open new markets for farmers and boost their incomes. By investing in small-scale processing units and training farmers in value addition techniques, rural communities can create sustainable livelihoods while contributing to food security.

Traceability: Ensuring Precision And Building Trust

Traceability in the agricultural supply chain is emerging as another innovative interference, which indeed means tracking the movement of produce from farm to consumer. It provides many advantages like; (1) Consumer confidence via necessary information to assure their food's safety and quality, even the origin of food from and how it has been handled; (2) Traceability systems hold all stakeholders in the supply chain accountable for their actions, to deal and trace back the issues like contamination/spoilage allowing for prompt corrective actions; and (3) It facilitates compliance to regulatory bodies with food safety standards. Modern traceability solutions leverage technologies like block chain, providing a tamper-proof record of every transaction & movement in the supply chain, which in turn builds a better level of consumer loyalty and trust.

Harnessing Robotics For Enhanced PHSC

In recent times, integration of robotics in PHSC presents another transformative opportunity to enhance quality, safety, and efficiency. The demands on the food system necessitate innovative solutions to optimize processes, reduce waste, manage labor shortages, and ensure food safety. Smart technologies (materials science, artificial intelligence, sensors) are revolutionizing the sphere of opportunities in food sector, where robotic advancements are most recent options. It offers a range of standard applications, from efficient storage and retrieval to automated inventory management and safety improvements.

To attain smarter PHSC, robotics can enhance variety of its key stages like quality control, sorting after harvest, storage, picking & packing, grading, sorting, packaging, palletizing, and managing storage & material flow through mobile robots. These robots may also facilitate real-time monitoring of product quality & storage conditions, automate inventory management, optimize space utilization etc., ensuring the integrity of fresh produce from farm to fork. For NextGen PHSC experts below given viewpoints have their own significance,

Quality Management and Loss Reduction

Fresh farming produce is often highly perishable, and significant food loss occurs at various stages of the supply chain (even >30% before reaching retail). Effective realizations of its 5 key elements (Fig-1 A&B) via standard operating procedures, grading, sorting, and optimized transport and storage conditions, is emerging as need of hour. Robotics may play a vital role by providing precise, consistent

handling and monitoring throughout such a supply chain.

Robotic Grasping & Manipulation

Though smarter robots are increasingly becoming essential in fresh food handling/processing, still the traditional industrial robots perform repetitive tasks (picking, moving, stacking, palletizing) quite effectively at lesser costs. In recent times the concept of collaborative robots (cobots), is also flourishing where robots work alongside humans in shared workspaces. Cobots are often equipped with sensors and safety features, making them flexible & safe for various tasks. The primary challenge in handling fresh produce is managing their complex, varied characteristics without causing damage or spreading pathogens. Downscaled indexes on food waste and food loss and also a globally adopted architecture of key food loss pyramid could be better understood with such grasping & manipulations.

Innovations in Grasping Solutions

Robotic handling of fresh products involves both contact-based (electric, pneumatic, hydraulic, multi-body grippers) and air-based mechanisms (suction cups, levitation grippers). Soft end-effectors, made from advanced materials, are becoming commercially viable, providing flexible, hygienic solutions for delicate fresh produce. These innovations ensure minimal damage and contamination, preserving quality at both individual and batch levels.

Robotic Navigation and Autonomous Mobile Robots (AMRs)

AMRs offers enhanced post-harvest logistics by optimizing transportation and material flows. These robots can autonomously navigate warehouses, manage inventory, and perform tasks such as storage and retrieval, monitoring, and quality checks. They react to their surroundings, follow designated paths, navigate around obstacles, and handle varying payloads.

Quality-Sensitive Warehouse Automation

Managing perishable products in warehouses requires complex inventory systems, considering factors like product perishability, quality-driven demand forecasting, and sustainability. Their transportation capabilities allow them to move products based on quality assessments, ensuring optimal storage and handling conditions

Mitigating Global Food Waste and Loss

In conclusion, effectively navigating food security through robust post-harvest and supply chain management is crucial to mitigating global food waste and loss, as underscored by international food waste and food loss indexes reflected herein. By implementing strategic practices from field to fork, we can enhance food availability, sustainability, and resilience, ensuring a more secure future for global agriculture. The journey of farm produce from harvest to the consumer's table is fraught with challenges that require concerted efforts to overcome the newer issues by prioritizing postharvest management & enhancing supply chain efficiency to ensure farm-to-fork traceability, and thus reduce food losses and improve food security.

TECH PUSH

Commercial Testing of Post-harvest Machinery at ICAR-CIAE, Bhopal - A Success Story



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ICAR-Central Institute of Agricultural Engineering (CIAE), Bhopal, is a premier agricultural engineering institute in India and is devoted to promoting agricultural mechanization leading to enhancing agricultural productivity, reducing drudgery of agricultural workers, generating and managing energy in agriculture, resource conservation, minimizing post-harvest losses, producing value added quality products and creating employment opportunities in the rural sector. Along with a major mandate as research, the institute is also carrying out activities such as training, teaching, extension of technologies and commercial testing of farm and post-harvest equipment.

The Agro Produce Processing Division is one of major divisions of ICAR-CIAE, Bhopal and is working on development of cutting-edge technologies on primary, secondary and tertiary processing of horticultural produce as well as food grains. Various technologies developed by the division have been transferred to the stakeholders. Training, teaching and extension and commercial testing of post-harvest machines are also the key activities of the division.

Machines and Equipment

The Post-Harvest Equipment and Machinery (PHEM) Testing Centre has been established in April 2019 at ICAR-Central Institute of Agricultural Engineering, Bhopal and is authorized by the Department of Agriculture, Co-operation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare (Govt. of India). The testing of machines and equipment contributes to ensuring their quality, efficiency and compliance with relevant standards, thereby

“
Mini rice mill is a portable machine provided with de-husking unit, polishing unit and a husk collection chamber

facilitating their adoption and use in various agricultural and food processing applications.

Testing facility of PHEM testing center of ICAR-CIAE, Bhopal is well equipped with trained experts and a wide range of instruments which ensures precision measurement capabilities and exemplary report preparations. The center is authorized for testing 19 different categories of post-harvest machinery which includes Cleaning/grading machines, Milling/Dehulling machines, oil expellers, flour mill, dryers etc.

Objectives of the PHEM Testing Centre:

- Testing of post-harvest equipment and machinery to assess

their working performance, suitability and certification.

- To establish standardization in parts, components, assembly, systems etc. to bring quality and to reduce repair and replacement cost.

Testing protocol

The ICAR-CIAE has an online portal for every information regarding the testing procedure, testing fee and relevant information. Testing of post-harvest machinery/equipment is being carried out as per the Bureau of Indian Standards (BIS) Test Codes. The overall process of testing of post-harvest machines is depicted in the following flow chart (Fig. 1).

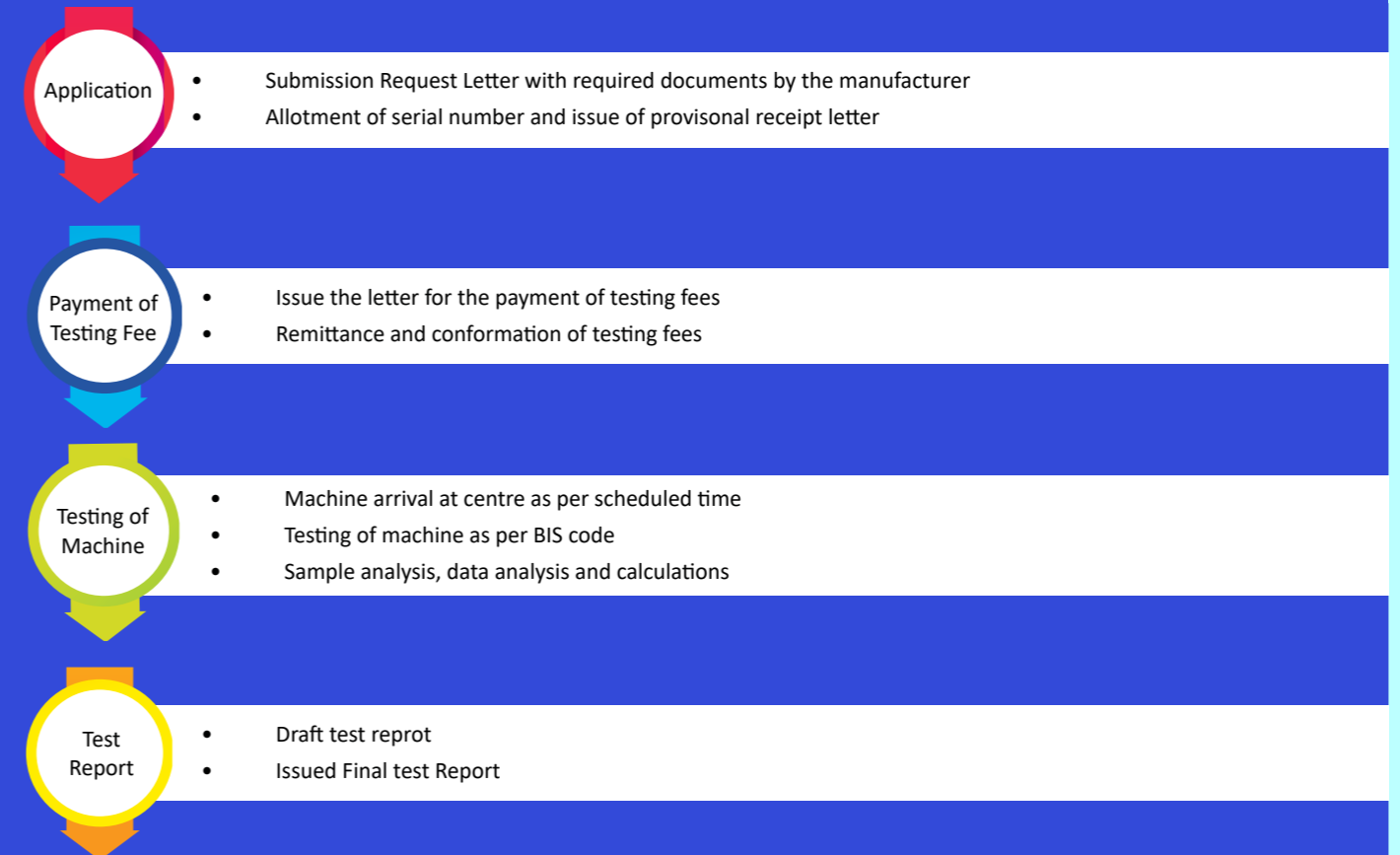
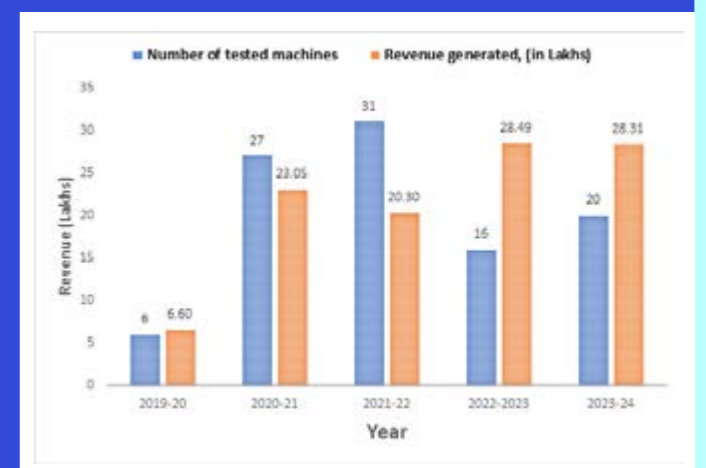


Fig. 1 Flow chart for testing procedure of machines at PHEM Testing Centre

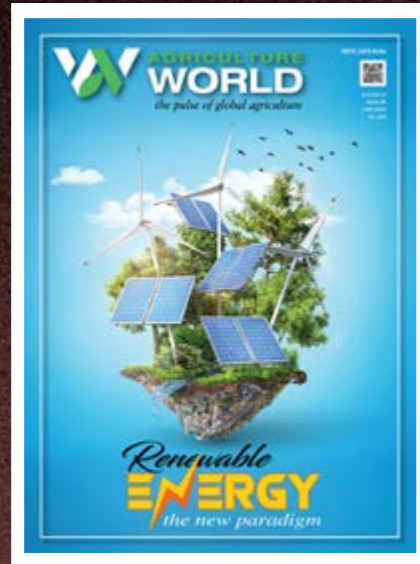
Status of Post-Harvest Machine Testing at ICAR-CIAE, Bhopal

The PHEM testing Centre, ICAR- Central Institute of Agricultural Engineering, Bhopal has so far tested 105 machines/equipment under different categories and generated a revenue of ₹ 106.75 Lakhs during the period of April, 2019 to March, 2024. The year wise details of machine tested and revenue generation is depicted in Fig. 2. The number of machines tested per year are varied from minimum of 16 (year 2022-23) to a maximum of 31 (year 2021-22).

Except the lowest testing in 2019-20 (6 Nos.). The testing of machines depends upon various factors like location of the firm, climatic conditions, types of crops grown etc. The government schemes also determines the commercial testing of machines.



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Dairy Does It!

Road to Global Leadership

India is the largest milk producing nation accounting for 24% of the global milk production. Dairy is the largest agriculture commodity in India, contributing 5% to the national GDP and employing more than 8 crore farmers.

In FY 22-23, milk production in India rose to 230 million Tones,

worth about \$110bn. 52% of the milk produced in India comes to market for sales of which, 40% is organized sector. Though there is a rapid shift happening from unorganized sector to organized sector, postproduction supply chain management remains a big challenge with such a perishable product in both markets.



There are numerous stakeholders within the milk procurement supply chain starting from the farmer who is a milk producer, then comes the Sahayak who runs a village level milk collection center, the transporter who enables movement of milk from village level collection center to milk chilling plant where the milk is chilled and in the end another transporter to shift the milk from chilling center to the plant where production happens.



MR UTKARSH KAPOOR

CEO and founder of ORIGHT. Combining the latest in AI and ML tech with the traditional supply chain infrastructure, ORIGHT builds upon the existing framework to digitize and improve operational efficiency across the supply chain.

India's Dairy Map

About 70 million rural households are engaged in dairy. It contributes to about 26% of total income in case of poorest household and 12% in case of overall rural income. Share of milk expenditure to total food expenditure is 20% in Urban and 19% in Rural population. Currently average producer pours 2.8 litres of milk per day and earns a gross income of Rs 85/-. Farmer earns only 20-30% of the total sale price as net income.

As per NDDB 2023 Annual Report, dairy cooperatives have the below percentage of cold chain infrastructure across India:

East India has about 59% of the cold chain capacity, followed by North India, which has 68% cold chain infrastructure. The leader in cold chain infrastructure is South India which has 88% of the infrastructure build up followed by West India which has 83% infrastructure setup.

India still needs a big push in cold chain infrastructure as 3% of total produce i.e. 7 million tonnes of milk gets soiled / wasted due to cold chain issues.

Challenges Faced By Dairy Sector

Certain challenges faced by dairy companies without efficient supply chain and lack of technology are:

- 1) Lack of real time data: lack of real time data causes delays and pilferage within the supply chain and is a hurdle to transparent communication. It delays decision making causing breakage within the supply chain.
- 2) Quality control issues: timely monitoring of milk quality is difficult, leading to potential adulteration.
- 3) Difficulty in tracking sourcing: lack in transparency of milk sourcing makes it challenging to ensure authenticity and quality
- 4) Reduced efficiency: manual data collection causes human errors,

“ Big efforts are required to ensure proper handling of milk with the help of technology to provide data ensuring good quality milk is being collected across the supply chain enabling India to export its surplus

reduced efficiency and increased cost of procurement

5) Transportation challenges: delays in transportation and storage leads to milk wastage and reduced shelf life.

Addressing the above challenges requires dairy companies to implement technologies like IOT, data analytics and real time milk procurement monitoring. This will enable them to take timely and data driven decisions and reduce cost.

Our Startup Ecosystem

A lot of Agri-tech startups are working in post-harvest area and ORIGHT is one of them working to streamline the dairy milk procurement supply chain with implementation of IoT devices and milk procurement software. With over 6500 villages digitized, ORIGHT has crafted state of the art eco-system to measure the quality of milk throughout the supply chain and record real time data on the cloud.

ORIGHT has provided various stakeholders with state-of-the-art technology covering every node in the supply chain to capture Composite, Actual and Dispatch milk quality right from the village level collection centre to the plant.



With data being captured with or without internet, ORIGHT enable dairies to view pilferage within the supply chain and take correct actions at the point of entry to stop pooling of soiled milk with good quality milk.

Clients have recorded that real time data has helped them to reduce adulteration and reduce cost of milk procurement. More milk is being collected from village level collection centers which helps in better utilization of capital expenditure.

The quality of milk has also improved and more FAT and SNF

percentages are being collected at chilling centers. This enables a dairy to produce more value-added products, thus improving their EBITA.

Navigating Challenges

India is world's largest producer of milk, but it cannot export its surplus as it does not fulfill international standards and cold chain infrastructure is a key issue that remains to be addressed. Big efforts are required to ensure proper handling of milk with the help of technology to provide data ensuring good quality milk is being collected across the supply chain enabling India to export its surplus.

Food Highway

Post-Harvest Management: Embracing New Technologies to Bridge the Gap in Food Security

In the vibrant landscape of India, agriculture forms the bedrock of the economy, engaging a substantial workforce and significantly contributing to the nation's GDP. Despite this, post-harvest losses loom large, posing a threat to food security and economic resilience. As a pioneering Indian Agri Input company, we spearhead the innovation and application of cutting-edge solutions to curtail these losses, ensuring that our agricultural bounty is delivered to consumers in prime condition. This article delves into the avant-garde technologies in post-harvest management, illuminates opportunities, and deliberates on strategies to narrow the food security chasm.

The Scope of Post-Harvest Losses in India

India grapples with considerable post-harvest losses, with figures suggesting that as much as 16% of fruits and vegetables, along with 10% of cereals, succumb to wastage post-harvest. This translates to a staggering financial loss of roughly ₹92,651 crore annually. On a global scale, about 14% of food produced is forfeited between harvest and retail, amounting to a \$400 billion loss each year. This percentage escalates to 17% when factoring in waste at retail and consumer levels. In sub-Saharan Africa, over 30% of food produced is lost after harvest, equating to an economic loss of up to \$4 billion annually. Nigeria alone witnesses post-harvest losses reaching N3.5 trillion each year. Tackling these losses is imperative for bolstering food security, augmenting farmers' earnings, and mitigating environmental detriments.

Emerging technologies in post-harvest management are revolutionizing the agricultural landscape, offering innovative solutions to enhance food preservation and reduce waste. Cold chain solutions like refrigerated transport and solar-powered cold storage are critical in ensuring the safe movement and storage of perishables across diverse climatic zones, especially in regions with limited access to electricity. Smart packaging innovations, such as active packaging with oxygen scavengers and biodegradable materials, extend the shelf life of fresh produce while minimizing environmental impact. Precision agriculture leverages IoT, sensors, and drones to optimize harvest timings and monitor crop health, significantly reducing losses from premature harvesting. Additionally, the development of biopesticides and biofungicides provides sustainable methods to protect post-harvest goods from pests and diseases, ensuring food safety and quality without harmful chemical residues. These technologies collectively contribute to a more resilient and sustainable post-harvest management system, crucial for meeting the growing demands of global food security.

Role Of Indian Agrochemical Companies

Indian agrochemical companies are uniquely positioned to drive significant advancements in post-harvest management, offering a range of opportunities to enhance the quality and longevity of agricultural produce. A major avenue lies in research and development (R&D), where companies can innovate new products tailored to address specific post-harvest challenges. For instance, developing coatings that delay ripening and reduce spoilage can drastically extend the shelf life of fruits and vegetables, reducing losses and ensuring



MR GIRISH AHUJA

Head of Corporate Affairs at Crystal Crop Protection Limited, with over 17 years of experience in government affairs, policy advocacy, communication, and branding

that produce reaches consumers in optimal condition.

Additionally, there is a substantial opportunity in farmer training and education. By conducting workshops and training programs, agrochemical companies can equip farmers with the knowledge and skills to implement best practices in post-harvest handling, storage, and transportation. This education can lead to more efficient and effective management of crops after harvest, reducing waste and enhancing the overall value of the produce.

Public-private partnerships offer another promising opportunity. By collaborating with government bodies and international organizations, Indian agrochemical companies can contribute to large-scale projects aimed at reducing post-harvest losses across the country. These partnerships can lead to the implementation of advanced technologies and methodologies on a broader scale, benefiting both farmers and consumers.

Finally, expanding market reach to remote and underserved regions presents a significant growth opportunity. By providing post-harvest solutions to these areas, companies can not only enhance food security but also support the economic development of rural communities. This expansion can lead to increased adoption of advanced post-harvest technologies, further reducing losses and improving the quality of produce available in the market.

Addressing Food Security Gaps

Effective post-harvest management is pivotal in addressing the food security gap in India, where significant portions of agricultural produce are lost due to inadequate infrastructure and inefficient practices. As global hunger persists, with over 820 million people affected and more than 2 billion lacking essential nutrients, ensuring that food reaches those who need it is more crucial than ever. With the world's population expected to rise significantly, requiring 70% more food by 2070, enhancing post-harvest management is vital.

One of the primary strategies for bridging this gap is through infrastructure development. Investing in modern storage facilities, efficient transportation networks, and robust market linkages can drastically reduce post-harvest losses. By ensuring that produce is stored safely and transported quickly to markets, these investments help maintain the quality of food, making it more accessible to consumers, particularly in regions where food scarcity is a pressing issue.

Policy advocacy also plays a critical role in supporting food security. By pushing for policies that encourage investment in post-harvest technologies and offer incentives for farmers to adopt innovative practices, stakeholders can create an environment conducive to reducing food waste. These policies can include subsidies for advanced storage systems, tax breaks for companies developing post-harvest technologies, and programs that facilitate access to markets for smallholder farmers.

Sustainable practices are another key component in closing the

“ We are educating farmers on safe and judicious use of agrochemicals to help them to increase farm productivity and reduce post-harvest losses

food security gap. Promoting agricultural methods that reduce environmental impact while boosting food production ensures that resources are used efficiently and responsibly. This approach not only contributes to the long-term viability of agriculture but also minimizes waste, ensuring that more food reaches the end consumer.

Ensuring Capacity Building

Capacity building among smallholder farmers is essential to this effort. By providing access to resources and training in effective post-harvest management techniques, farmers can significantly reduce losses and increase the quantity of produce that makes it to market. Strengthening the skills and knowledge of farmers ensures that they are equipped to handle the challenges of post-harvest management, ultimately contributing to a more resilient food system.

We at Crystal Crop Protection Limited took this very seriously and in collaboration with the various sectorial associations and trade bodies, we are educating the farmers on safe and judicious use of agrochemicals that will help them to increase their farm productivity and reduces the post-harvest losses. Further, we are giving the training to the Indian farmers on the use of new technology in the farmland under the stewardship programs. We are sure that through the support of Government of India and the trade bodies along with the stakeholders we can have a bright and a safe future with regards to the food security and nutrient food.

In conclusion, bridging the gap in food security requires a comprehensive approach that includes infrastructure development, policy advocacy, sustainable practices, and capacity building. Indian agrochemical companies, along with other stakeholders, have a crucial role to play by leveraging new technologies, fostering collaboration, and exploring emerging opportunities. Through innovation, education, market expansion, and using available state of the art technologies these entities can significantly reduce food losses, enhance food security, and promote sustainable agriculture, ensuring a secure and resilient food system for India's as well as global future.



POST-HARVEST MANAGEMENT

Technologies, Opportunities, and Bridging the Gaps for Food Security

The agricultural value chain's post-harvest management is a vital link that keeps food safe and of high quality from the time of harvest until it is consumed by consumers. Numerous tasks are involved in this phase, such as processing, sorting, cleaning, packing, storing, and shipping. Post-harvest management done well can boost food security, lower food loss rates, and increase farmers' profits. We will examine the several technologies utilized in post-harvest management, the opportunities they offer, and the methods employed to close the gaps and guarantee food security in this comprehensive presentation.

Technologies in Post-Harvest Management

Storage Solutions

1. Controlled Atmosphere Storage: In order to prolong the shelf life of fruits and vegetables, controlled atmosphere (CA) storage slows down the respiration rates of the produce by altering the composition of gases inside storage facilities. This method modifies nitrogen, carbon dioxide, and oxygen concentrations to provide the ideal climate for particular crops. For example, CA storage greatly increases the marketability of apples and pears and can keep them fresh for several months.

2. Cold Storage: One of the most popular methods for keeping perishable goods fresh is cold storage. Cold storage facilities reduce the rate of microbiological activity and enzymatic reactions that cause spoiling by keeping temperatures low. The preservation of the quality of meats, fruits, vegetables, and dairy products depends on this technology. Modern cold storage systems frequently have humidity controls.

3. Modified Atmosphere Packaging (MAP): MAP is a packaging technology that alters the atmospheric composition inside a package to extend the shelf life of food products. This can involve reducing oxygen levels and increasing carbon dioxide levels to slow down the growth of spoilage organisms. MAP is commonly used for packaged fruits, vegetables, and meat products.



Modified Atmosphere Packaging



ABOUT THE AUTHOR

DR VIJAYA TRIPATHI

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Processing Technologies

1. Drying and Dehydration: Drying is one of the oldest and most effective methods of preserving food. By removing moisture, drying inhibits the growth of microorganisms and enzymatic reactions. Technologies like solar drying, hot air drying, and freeze-drying are used for various products, including grains, fruits, vegetables, and herbs. Freeze-drying, in particular, is known for preserving the nutritional quality and flavor of the food.

2. Canning and Bottling: Food is sealed in airtight containers and heated to eliminate hazardous bacteria during the canning and bottling processes. Fruits, vegetables, meats, and shellfish are all frequently treated using this technology. It provides long-term preservation without requiring freezing. The quality and safety of canned goods have increased because to advancements in canning technologies, which have also improved packaging materials and procedures.

3. Freezing: Freezing is a highly effective method of preserving food by reducing its temperature to levels that inhibit microbial growth and slow down enzymatic reactions. Quick-freezing technologies, such as blast freezing and individual quick freezing (IQF), preserve the texture, flavor, and nutritional value of food. Freezing is commonly used for fruits, vegetables, meats, and prepared meals.

Quality Control and Safety

1. Hazard Analysis Critical Control Points: HACCP, is a methodical methodology of detecting, assessing, and managing risks to food safety. It entails dissecting every stage of the manufacturing process to pinpoint crucial control points where risks could materialize. From

harvest to consumption, HACCP guarantees the safety and quality of food items by keeping an eye on these aspects and putting control mechanisms in place.

2. Smart Packaging: Technologies for smart packaging include sensors and indicators to track and share information about the state of the food within the container. These systems offer real-time information regarding the safety and freshness of the food by detecting changes in temperature, gas levels, and rotting markers. Smart packaging makes sure that only wholesome, safe items get to consumers, which improves traceability and lowers food waste.

Processing Technologies

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Opportunities in Post-Harvest Management

1. Market Expansion: Efficient post-harvest management can open new markets by extending the shelf life and maintaining the quality of produce. This makes it possible for farmers to reach distant consumers and export markets. For instance, proper post-harvest handling and storage can allow tropical fruits to be shipped to temperate regions, increasing market opportunities for producers.

2. Value Addition: Value addition involves transforming raw agricultural products into processed goods with higher market value. Examples include converting fruits into juices, jams, or dried snacks, and processing grains into flour or ready-to-eat products. Value addition not only enhances the economic returns for farmers but also provides consumers with a wider range of convenient and nutritious food options.

3. Employment Generation: The development and operation of post-harvest facilities create job opportunities in rural and urban areas. Activities such as sorting, grading, packaging, processing, and transportation require skilled and semi-skilled labor. Additionally, the establishment of agro-processing industries can stimulate economic growth and provide employment in related sectors.

4. Technology Adoption: Introducing advanced technologies in rural areas can boost productivity and efficiency in post-harvest management. Technologies such as mechanized sorting, automated packaging, and precision storage systems can reduce labor costs, minimize losses, and improve the overall quality of produce. Training

programs and extension services are essential to promote the adoption of these technologies among smallholder farmers.

Bridging the Gaps for Food Security

1. Infrastructure Development: Investing in infrastructure is crucial for effective post-harvest management. This includes building storage facilities, processing units, and transportation networks. Adequate infrastructure reduces post-harvest losses by ensuring that produce is handled, stored, and transported under optimal conditions. Governments and private sector players must collaborate to develop and maintain this infrastructure.

2. Training and Education: Providing farmers and stakeholders with knowledge about best practices in post-harvest management is essential for reducing losses and improving food quality. Training programs should cover areas such as harvesting techniques, storage methods, processing technologies, and quality control measures. Extension services can play a vital role in disseminating this information to farmers.

3. Policy Support: Implementing policies that support post-harvest management initiatives is vital for achieving food security. This includes providing subsidies for technology adoption, offering financial incentives for infrastructure development, and creating regulatory frameworks that ensure food safety and quality. Policies should also promote research and development in post-harvest technologies and practices.

4. Research and Development: Encouraging research and development (R&D) to develop innovative solutions for post-harvest challenges is essential for advancing the field. R&D can lead to the creation of new storage technologies, processing methods, and packaging materials that enhance the quality and shelf life of food products. Collaboration between research institutions, universities, and the private sector can drive innovation in post-harvest management.

5. Public-Private Partnerships: Collaborating with private sector players to bring in investment, technology, and expertise can enhance post-harvest management practices. Public-private partnerships (PPPs) can facilitate the development of infrastructure, the adoption of advanced technologies, and the implementation of training programs. PPPs can also help bridge the gap between research and practical application, ensuring that innovative solutions reach farmers and processors.

Effective post-harvest management is vital for enhancing food security, improving the livelihoods of farmers, and ensuring that consumers have access to safe, high-quality food. By leveraging modern technologies, exploring new opportunities, and bridging existing gaps, we can create a more resilient and efficient agricultural sector. Investments in infrastructure, training, policy support, and research are essential for achieving these goals. Public-private partnerships can play a significant role in driving innovation and ensuring that post-harvest management practices are adopted widely. With concerted efforts from all stakeholders, we can minimize post-harvest losses, enhance food security, and build a sustainable agricultural system for the future.

Zero Tillage in Wheat

A Cost-Effective Practice that Enhances Soil Health



Ms Chaithra.P.M,
is Assistant manager (Partnerships & Fundraising) at S M Sehgal Foundation



Mr Praveen Tiwari
is Project coordinator

“ The project, Bolstering Farmer Producer Organizations (FPOs), supported by Walmart Foundation and implemented by S M Sehgal Foundation in Uttar Pradesh and Karnataka

In the heartlands of India, where wheat cultivation is not just a tradition but a lifeline for many, new methods of wheat cultivation are making silent inroads. The Mau Aima block of Prayagraj district in Uttar Pradesh witnessed the introduction of new practices as farmers learned about wheat sowing with zero tillage. The project, Bolstering Farmer Producer Organizations (FPOs), supported by Walmart Foundation and implemented by S M Sehgal Foundation in Uttar Pradesh and Karnataka, spearheads the introduction of new agricultural practices in FPOs for increased profits and climate resilience for small and marginal farmers.

In the traditional method of wheat cultivation, the land preparation involves multiple tilling operations. The land is initially ploughed once using a rotavator which loosens the soil structure, then the wheat is broadcast manually; and finally, an additional plowing is done to ensure good seed to soil contact that is essential for germination. The drawbacks of this intensive ploughing or tilling method include negative effects on soil health, reduced ability of soil to hold moisture, increased cost of cultivation, and lower crop yields. Thus, this is not a sustainable practice.

Allahabad Bovine Farmer Producer Company (FPC), UP
Allahabad Bovine Farmer Producer Company (FPC) in Uttar Pradesh, located in Phaphamau town, Prayagraj, and registered at Registrar of Companies, Kanpur, is one of the FPCs selected by the project for enhancement and further development. This FPC has 90 percent women shareholders. Allahabad Bovine FPC was formed in November 2021 and has a total of 304 shareholders. After the project's association with the FPC, fifty-six new women farmers have joined the organization. Sameem Fatima, a woman member of the FPC, became the first farmer in Mau Aima block to sow wheat without ploughing.

The journey toward adoption of zero tillage was not without its challenges as the traditional farming practices were ingrained deeply in the community's ethos. However, through systematic efforts by the project team such as farmer meetings and door-to-door outreach, awareness about the benefits of the zero-tillage technique and the use of machines began to permeate the collective consciousness of the farming community.

In the zero-tillage method of cultivation, seeds are directly sown into the unploughed soil, often with the crop residue from the previous harvest left on the surface. For this, zero tillage machines or their adapted versions are used.

To help small and marginal farmers in mechanization, the FPC was provided with select farm machines, including the zero-tillage machine, at the Custom Hiring Centre. Despite initial scepticism among farmers, Sameem Fatima took a leap of faith, and in no time her conviction and the results that followed paved the way for others. The advantages of zero tillage are manifold, ensuring sustainability and profitability. By eliminating the need for ploughing, farmers reduce the cost of cultivation. Seed and fertilizer savings, coupled with water conservation, result in additional economic and environmental benefits. Zero tillage promotes the accumulation of dry and organic

matter in the soil, increasing soil health and fertility and improving crop yield and the absorption of nutrients. The technique prevents loss of topsoil by reducing erosion. With timely sowing and multiple benefits, farmers are assured good yields.



Sameem Fatima in field where zero tillage method was used



Sameem used the zero-tillage technique on 0.62 acres, and the reduced cost of ploughing, seeds, fertilizers, and irrigation led to a savings of INR 3,000 4,000. Studies establish that the use of zero tillage in wheat reduces the production cost by 20 percent and saves 15–20 percent of water for irrigation.

After implementing zero tillage, Sameem achieved a yield of 1,105 kg compared to the 875 kg harvested before its adoption, inspiring fellow farmers. Through collaborative efforts and knowledge-sharing initiatives, 60 percent of the members of Allahabad Bovine FPC have adopted the zero-tillage method for wheat cultivation, a practice that will stay with the farmers. A total of 381.65 acres by 184 farmers have been covered under zero tillage.



Wheat crop in the field

Urban Agriculture

Cornerstone of Food Security in India



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In an era of rapid urbanization and growing concerns about food security, urban agriculture has emerged as a promising solution to nourish our cities and reconnect urban dwellers with their food sources. This innovative approach to food production within urban and peri-urban areas is gaining traction worldwide, offering a multitude of benefits beyond just putting food on the table. As India grapples with the challenges of feeding its burgeoning urban population, urban agriculture presents an opportunity to transform cityscapes into productive, sustainable, and resilient food systems.

Urban agriculture, which encompasses farming practices in urban and peri-urban regions, focuses on cultivating a variety of food and non-food items. These practices involve activities like livestock rearing, aquaculture, beekeeping, and commercial floriculture. However, urban agriculture typically limits staple food cultivation due to the

“Innovative technologies and efficient practices allow urban farms to feed a substantial number of people, especially in densely populated areas”

intricate processes involved, including soil management, irrigation, transplantation, mechanization, and harvesting, as well as the substantial land requirements. Instead, urban agriculture prioritizes the cultivation of micronutrient-rich food items like fruits, vegetables, dark leafy greens, and fish, legumes are essential for human growth, development, and maintenance.

Types of Urban Agriculture Practices

Although cities worldwide constitute only about 3 percent of the total geographical area, urban agriculture appears to have considerable potential to produce food. Some innovative practices for urban agriculture are as follows:

1. Urban beautification through the design and maintenance of public green spaces along streets (street landscaping)

Street landscaping involves deliberately designing and maintaining green spaces along roadways, sidewalks, and urban streets to enhance their visual appeal, utility, and ecological health. This intentional landscaping not only increases the aesthetic appeal of streets but also contributes to providing nourishment to the local community or neighbourhood.

2. Tactical gardens

Tactical gardens are versatile and adaptable green spaces designed with ingenuity to address various urban challenges. We cleverly craft these ephemeral or impermanent gardens to quickly appear in underutilized or neglected urban areas, such as vacant lots, roofs, or abandoned structures. Tactical gardens transform urban landscapes by repurposing these spaces, creating vibrant, productive, and environmentally sustainable locations.



3. Agroforestry

Forest gardening, often known as food forest or agroforestry, is an environmentally friendly method of managing land. It replicates the organization and operations of natural forests, promoting the growth of diverse and complex ecosystems. These ecosystems provide a wide range of resources, such as food, fuel, and fiber, in a balanced and efficient way.

4. Greenhouses are structures used for cultivating plants in a controlled environment, typically made of glass or plastic, allowing sunlight to enter and trap heat inside.

Greenhouses play a crucial role in agriculture in commercial, residential, and communal urban areas. Depending on the specific crops grown, their establishment necessitates large parcels of land. These buildings, on the other hand, facilitate year-round farming by customizing controlled conditions to meet the precise crop-growing needs.

5. Building rooftops are home to green spaces

Rooftop gardens are a novel method of using normally unoccupied roof areas for gardening, allowing fruits, vegetables, and herbs to grow. Rooftop gardens offer more than just horticultural advantages; they also help improve air quality, reduce the impact of urban heat islands, and support successful rooftop agricultural projects in India. Moreover, these gardens provide chances for improving leisure activities and enhancing visual appeal. We can use various rooftop farming methods, such as green roofs, urban hydroponics, air-dynamics systems, and container gardens, to boost production and sustainability in these elevated urban



6. Green walls

Green walls are vertical constructions that support the growth of many types of plants or other vegetation. Additionally, cultivating plants on a substrate of dirt, water, and stones is a common practice. Alternatively, the green wall surrounds the cultivated plants both inside and outside of the wall. This system's technique effectively provides water to the food without requiring a large amount of space. Additionally, the system makes use of the existing dirt on the walls. Furthermore, urban gardening serves as an effective means to mitigate stormwater runoff.

Integrating IPM into Agri Inputs Supply Chains

Game-Changer for Farmer Profitability



In the dynamic landscape of agriculture, the balance between maintaining crop health and ensuring economic sustainability for farmers is more critical than ever. In the last Triennium the profitability across crops has declined steadily, eg: as per research statistics cotton profits has come down by 53.70%. The Agri supply chain, which involves everything from production to distribution, faces significant challenges, particularly when it comes to pest management. Traditional methods of pest control, heavily reliant on chemical pesticides, resulted in lead to increased costs, environmental concerns, higher pest resistance and diminishing returns for farmers. However, Integrated Pest Management (IPM) has emerged as a powerful alternative, offering a sustainable solution that enhances both supply chain efficiency and farmer profitability.

Understanding IPM and Its Importance

Integrated Pest Management is a holistic approach that provides with Process, Protocols and Products that is a combination of biological, physical, chemical, and Mechanical tools to manage pests in a balanced way that minimizes risks to both the environment and human health. Unlike conventional methods that focus on eradicating pests through chemical means, IPM emphasizes understanding pest life cycles and their interaction with the environment. This allows for Improved Diagnostics (A part that is nearly a completely missing aspect in agri Pest management at the moment), preventive controls and that too at the Moth Level which helps in reducing the long term population growth of the Pests.

The importance of IPM in the agricultural supply chain cannot be overstated. By adopting IPM practices, farmers can significantly reduce their reliance on chemical pesticides, leading to lower input costs and improved crop quality. This not only benefits farmers but also enhances the overall resilience and sustainability of the agricultural supply chain.

Enhancing Supply Chain Efficiency through IPM

The integration of IPM into agricultural supply chains offers numerous advantages. One of the key benefits is the reduction in chemical use in the agri inputs, which directly translates into cost savings for farmers. By employing a combination of biological controls, such as natural predators and parasites, along with cultural practices like crop rotation and the use of pest-resistant varieties, farmers can achieve effective pest management without the heavy financial burden of chemical inputs and deploying Mechanical Trapping systems to Diagnose the Pest Attack, its economic threshold levels and proactive pest management at Moth level to completely eradicate pest population propagation.

Additionally, IPM helps in maintaining the quality of produce, which is increasingly important in today's markets where consumers demand Low-Residue/ residue-free products. By directly minimizing pesticide residues, IPM aligns with global food safety standards, opening up opportunities for farmers to access premium markets. This not only increases their profitability but also strengthens the entire supply chain by ensuring that high-quality produce reaches the end consumer. Which not only is a Market Demand however a global need for Population health management.

Moreover, the adoption of IPM practices contributes to environmental sustainability by reducing the negative impacts of chemical pesticides on soil health, water quality, and non-target organisms. This, in turn, enhances the long-term viability of agricultural production systems, making them more resilient to the challenges posed by climate change and other environmental stressors.

Impact on Farmer Profitability

The economic benefits of IPM for farmers are clear. By reducing input costs and improving crop yields and quality, IPM directly boosts farmer profitability. Furthermore, the adoption of IPM can lead to greater market access and higher price premiums for produce that meets stringent quality and safety standards. The indirect impacts are absolutely clear on Soil Health and the Farmer Health. Both of which over years has been deteriorating because of higher chemical

exposure. While IPM doesn't bring it zero, it does help in bringing it to a logical demanded level.

In India, where smallholder farmers dominate the agricultural landscape, the cost-effectiveness of IPM is particularly appealing. Many farmers have reported significant savings in pesticide costs after switching to IPM, allowing them to invest more in other areas of their farming operations. Additionally, the reduction in chemical use has led to healthier crops and soils, further contributing to increased yields and long-term farm sustainability.

Case studies from various regions highlight the positive impact of IPM on farmer livelihoods. For example, farmers who have integrated IPM & Mechanical Traps into their operations have seen up to a 30% increase in net profits, thanks to reduced input costs and improved crop quality. This not only enhances their financial stability but also encourages the wider adoption of IPM practices within their communities.

The Future of IPM in Agriculture

IPM is undoubtedly the future of Agriculture practices, it will be leading the way, It has been a scient knowns to humanity for a long time however the real impact & need is seen in today's agri ecosystem as we evolve towards the next agri revolution of sustainable and Low-Residue farming. IPM is now expanding its wings further with remote sensing, IOT driven tech and deep data analytics, which is expected to further enhance its effectiveness, making it easier for farmers to monitor pest populations and implement timely interventions and only in needful volumes.

The future of IPM also lies in its ability to adapt to the evolving challenges of agriculture, including the emergence of new pests and diseases, climate change, and the need for increased food production to meet the demands of a growing population. By continuously refining IPM practices and integrating them into broader supply chain strategies, the agricultural industry can ensure that farming remains both profitable and sustainable.

Driving Agricultural Sustainability through IPM Integration

Integrated Pest Management represents a significant advancement in agricultural practices, offering a sustainable and cost-effective approach to pest control. By integrating IPM into supply chains, farmers can achieve greater profitability, while also contributing to the overall sustainability of the agricultural sector. As IPM continues to evolve, it will undoubtedly play a crucial role in shaping the future of farming, ensuring that both the environment and farmers' livelihoods are protected. Financial well-being and profitable growth of the Farmer and resulting in a High grade commodity being consumed by the populations is the sign of true progress of the nation.

By integrating IPM into supply chains, farmers can achieve greater profitability while contributing to the overall sustainability of the agricultural sector

ABOUT THE AUTHOR

Mr. Sanjay Shirodkar & Mr. Joy C are Co-Founders, Wavar

Panacea to Future Food security

Horticulture Value Addition

“Value addition enterprises aim to transform raw horticultural commodities and waste into multiple products”



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During the period from 1995 to 2050, the world population is projected to increase from 5.7 billion to 9.8 billion people, and then begin to stabilize. This population growth necessitates a 78% increase in food production. However, future food needs depend on population size, age, level of activity, and the availability of natural resources, especially cultivable land and water. The world population has been rising at a rate of 1.9% per year since 1960, while food production has grown at a rate of 2.8% per year since the Green Revolution.

These statistical measures indicate that enormous effort is required to achieve the necessary growth in food production to feed the future and improve food and nutritional security. To move towards a sustainable food future, the minimum arable land required to sustainably support one person is 0.07 hectares. Since arable land is less than 0.1 hectares per person, it could be difficult to maintain a minimal level of nutrition. It is clear that a large fraction of suitable land is not available for crop production to meet the needs of feeding the world.

Dealing With Water Stress

During the cultivation of agricultural crops, water is considered an important renewable resource; globally, 70% of freshwater is used in agriculture. By

2050, feeding a planet of 9.8 billion people will require an estimated 15% increase in water withdrawals. When water withdrawals exceed 40%, water is considered scarce.

The available freshwater consumption is assumed to be 30% for domestic use and 10% for industrial use. Thus, this measure of the vulnerability of land and water represents a significant constraint to producing sufficient, safe, and healthy food for everyone. However, in addressing the interconnected problem of global food and nutrition security, horticulture is essential. Horticultural crops provide sustainable ways to increase food production under dwindling natural resources of land and water, contributing to a climate-resilient food system.

Nutrition Security

Horticulture, especially the growing of fruits and vegetables, provides critical nutrients for a balanced diet. Farmers who grow high-value crops such as fruits, vegetables, flowers, spices, plantation crops, medicinal, and aromatic plants consistently earn more compared to those growing other agricultural crops. Horticulture can be an engine for agricultural and economic diversification as well as for improving livelihoods. By encouraging a varied and nutrient-rich diet in light of the world's expanding population and mounting demand on agricultural resources, horticulture also offers the potential for turning commodities into value-added goods, which increases their year-round accessibility and shelf life.

Post-harvest food loss is a leading cause of food insecurity for millions of families across the world. Over 15% of food is lost before it leaves the farm, and 40% of fruits and vegetables are never consumed, either on the farm or after harvest. Additionally, 58% of global post-harvest losses of fruits and vegetables occur in high-income, middle-income, and low-income countries.

One-third of all food produced for human consumption is lost, which is equivalent to 1.3 billion tons. If this waste were converted into calories, it would equate to 24% of the world's food supply going uneaten, while one in ten people globally remains malnourished. Wasted food takes a major financial toll, costing the global economy more than 1 trillion dollars every year. It also fuels climate change, accounting for approximately 8-10% of global greenhouse gas emissions. It is simply not possible to achieve the Paris Agreement's goal of staying within 1.5-2 degrees Celsius of warming without addressing the issue of post-harvest loss in horticultural crops. Hence, the waste occurring after harvest significantly underestimates the magnitude of the problem.

Preventing Post-Harvest Losses

Achieving zero hunger by 2050 will require that no more food is lost or wasted to meet the needs of a growing population. By preventing post-harvest losses in the food system, adding value, and implementing strategic supply chains, we can increase the availability of food worldwide without requiring additional resources or placing further burdens on the environment. From production to processing

to distribution, each phase of the supply chain carries risks of overproduction, delays, spoilage, waste, and resulting financial losses.

Moreover, the supply chain for horticultural commodities is complex and involves numerous stakeholders: farmers, processors, distributors, retailers, and logistics providers. Any breakdown in communication or inefficiencies among these parties can lead to significant losses for everyone involved in the entire supply chain of horticultural crops. Therefore, improving the post-harvest supply chain, processing, and adding value to the waste will help the world feed more people without expanding cultivated areas.

Feeding The Future

Alleviating land use pressure through efforts such as reducing the need to produce more food to compensate for loss and waste is a key strategy for feeding the future and addressing the global land squeeze. NITI Aayog estimates annual post-harvest losses at more than 40% of horticultural production, resulting in monetary losses close to Rs 90,000 crores per annum.

Value addition is an effective method for reducing post-harvest losses, increasing food security, and providing income to smallholder farmers and other actors along the value chain. Reducing food loss and waste by 25% through value addition by 2050 would close the food gap by 12%, the land gap by 27%, and the greenhouse gas mitigation gap by 15%.

Adding value to the original crop not only helps farmers overcome spoilage and losses but also yields higher returns due to the newly added technology.

Value addition enterprises aim to transform raw horticultural commodities and waste into multiple products, such as fruit candies, dehydrated products, and semi-processed foods, which benefit both farmers through remunerative prices and consumers through convenient and safe food options. This approach also promotes the diversification and commercialization of horticulture by providing an effective linkage between consumers and farmers, and it enhances the exportability of farm produce.

However, the development and commercialization of technology on a small scale are critically important for growth and diversification. Hence, we at the Post-Harvest Technology Lab, College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, India, have developed several products using low-cost techniques and marketed them online.

These include value-added products such as pomegranate scrubbers from fruit peel, pomegranate ubtan, mouth fresheners from dried aril, soaps and face creams from fruits and vegetables, dragon fruit-based face gels, lip balms, capsules from moringa leaves mixed with Garcinia, inulin formulations, dried banana fig, dried red banana with honey, halwa from overripe watermelon, car air fresheners from aromatic oils, and incense sticks from horticultural waste.

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STIHL Water Pump: Powerful and Efficient Solution to Water Requirements in the Agricultural Sector

A water pump is a device designed to move water from one place to another. It is typically used to lift water to a height or remove water from a specific location. Water pumps are most commonly used in the agricultural sector. If you are a farmer seeking a powerful water pump, consider purchasing one from STIHL.

STIHL water pumps make it easy to move water from rivers, lakes, wells, and other water sources. The WP 300, WP 600, and WP 900 models are specifically designed for users seeking high pumping capacity and excellent water discharge performance. Additionally, all these water pumps come with a 2-year warranty and run on petrol fuel.

Key Features and Technology of STIHL Water Pumps:

1. **High Power and Head:** This water pump features a high head capability, which provides a high pumping capacity and high LPM (water discharge capacity). This makes it ideal for irrigating and supplying water to large areas.

2. **Euro V Engine:** The pump is equipped with a Euro V engine, which conserves fuel while offering excellent power and durability with minimal fuel consumption.

3. **Easy to Use:** Its design makes it extremely easy to carry and operate, ensuring no interruptions

to your work.

4. **Inbuilt Low-Oil Safety Protection:** The pump has an inbuilt low-oil safety feature, which automatically shuts down the engine when the oil level is low, preventing engine damage.

5. **Anti-Vibration System:** It comes with an impressive anti-vibration system, ensuring minimal vibration even at high engine speeds, thereby maintaining stability during use.

6. **Longer Product Life:** The pump is equipped with a durable cast iron impeller, making it long-lasting and suitable for long-term use.

7. **Strong Frame:** Provide stability during various applications and protect the engine.

8. **Compact Design:** Allows for easy, space-saving storage.

Technical Specifications of STIHL Water Pump

STIHL water pumps come in different pump sizes and capacities so they are suitable for different uses. Depending on their design and functionality, they can be used for small household tasks to agricultural purposes-



Water Pump - WP 300

- Engine cc- 212 cm³
- Power output: 4.4 kW / 6 horsepower
- Pump size/hose connection: 2 inches
- Maximum flow capacity: 37 cubic metres per hour
- Maximum water output: 616 litres per minute
- Maximum pumping height: 33 metres
- Maximum suction height: 7 metres
- Maximum pumping pressure: 3 bar
- Weight: 26 kg
- Fuel tank capacity: 3.61 litres



Water Pump - WP 600

- Engine cc: 212 cm³
- Power output: 4.4 kW / 6 horsepower
- Pump size/hose connection: 3 inches
- Maximum flow capacity: 63 cubic metres per hour
- Maximum water output: 1,050 litres per minute
- Maximum pumping height: 31 metres
- Maximum suction height: 7 metres

- Maximum pumping pressure: 3 bar
- Weight: 29 kg
- Fuel tank capacity: 3.61 litres

Water Pump - WP 900

- Engine cc: 252 cm³
- Power output: 5.2 kW / 7 horsepower
- Pump size/hose connection: 4 inches
- Maximum flow capacity: 94 cubic metres per hour
- Maximum water output: 1,567 litres per minute
- Maximum pumping height: 34 metres
- Maximum suction height: 6.5 metres
- Maximum pumping pressure: 3 bar
- Weight: 38 kg
- Fuel tank capacity: 4.01 litres



With a STIHL water pump, you get a high-quality device capable of meeting all your water transportation needs. If you are thinking of buying a STIHL water pump or want to get more information, you can visit the official website of STIHL at www.stihl.in, or call or WhatsApp on mobile number 9028411222.

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Bharat Certis AgriScience Ltd.

Pioneering Innovation in Agriculture

Established in 1977, Bharat Certis AgriScience Ltd. has emerged as a cornerstone in India's agriculture sector, dedicated to delivering innovative crop protection solutions. In September 2020, a transformative partnership with Mitsui & Co., Ltd. and Nippon Soda Co., Ltd. through a special purpose company marked a significant milestone. This collaboration has propelled the company, now a group entity of Mitsui & Co., Ltd., to enhance its capabilities in developing sustainable agricultural practices and pioneering new technologies in crop protection.

Bharat Certis AgriScience Ltd. places utmost importance on the safety, health, and welfare of its **700-strong workforce**. With a robust domestic network encompassing **26 warehouses**, over **4,000 distributors**, and **22,000 dealers**, Bharat Certis AgriScience Ltd. provides extensive support to farmers nationwide. Recognized as a Star Export House by the Government of India, the company exports its products to **28 countries**, exemplifying its global footprint and commitment to international quality standards. The company continues to innovate, launching **12 new products** in the Indian market last year, with **13 more products** set to debut in the coming year.

At the helm is Mr. Kimihide Kondo, Managing Director since December 2022, who brings over three decades of expertise from Mitsui & Co., Ltd. His leadership has been instrumental in steering Bharat Certis AgriScience Ltd. towards sustainable growth and fostering strategic collaborations to advance agricultural practices in India.

Under its **Corporate Social Responsibility (CSR)** initiatives, Bharat Certis AgriScience Ltd. actively engages in improving the livelihoods of farmers across India. Initiatives include setting up **40 Soil Testing minilabs**, conducting Safe Use of Pesticides (SUP) Days to educate farmers, and distributing safety kits, benefitting over 85,000 farmers to date.

Bharat Certis AgriScience Ltd. remains committed to its vision of bringing "**Smiles with AgriScience**" by continuing to innovate, collaborate, and lead in sustainable agricultural solutions. The company's dedication to excellence, sustainability, and social responsibility underscores its deserving candidacy for the Corporate Leadership Award.



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Purpose

- Credit needs for scientific/progressive method of farming



Eligibility

- Credit score: 650 and above*
- Land holding: ≥ 4 acres or farmer is engaged in scientific farming
- For companies & corporates: Profit earning in last/next 2 years



Interest Rate

- Below ₹50 lakhs: 1 year MCLR+1.80%[^]
- \geq ₹50 lakhs: Based on Credit Risk Assessment



Security

- Primary: Crop/asset created out of bank finance
- Collateral: Mortgage of immovable property/ Agriculture land and/or SARFAESI compliant security and/or liquid securities.

* Deviation in CIC score upto 600 may be allowed.

[^] Maybe reduced

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