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# Times of Agriculture

A Resonance in Agriculture  
Monthly Agriculture E-Magazine

November-2024

## WHITE REVOLUTION

### INDIA'S JOURNEY TO MILK SELF-SUFFICIENCY



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# Times of Agriculture

A Resonance in Agriculture

## From the Editor's Desk

Dear Readers,

We are delighted to present a new edition of **Times of Agriculture Magazine**. On the occasion of **National Milk Day**, our cover story delves into an extensive and significant topic: **The White Revolution in India**. This revolution emerged as a transformative movement, not only for dairy development but also for enhancing the lives of milk producers. It quickly gained recognition as the largest revolution in the field of dairy and milk development worldwide, with the noble aim of making India self-sufficient in milk production.

Under the visionary leadership of **Dr. Verghese Kurien**, widely known as the **Father of the White Revolution**, the National Dairy Development Board (NDDB) was established. Through this institution, a groundbreaking project was implemented to streamline the revolution on a national scale. As a result, it brought about significant improvements in the lives of milk producers and the dairy sector as a whole.

In this issue, **Times of Agriculture Magazine** takes pride in honoring Dr. Kurien's invaluable contributions on this special occasion of **National Milk Day**. Such initiatives, though focused at a national level, bring about global changes in the lives of farmers, significantly transforming the social and economic fabric of any nation or society.

So, as always, let us explore some fascinating insights through Times of Agriculture Magazine in this edition and learn something new from it!

Thank you very much, and enjoy reading!

**Editor-In-Chief**

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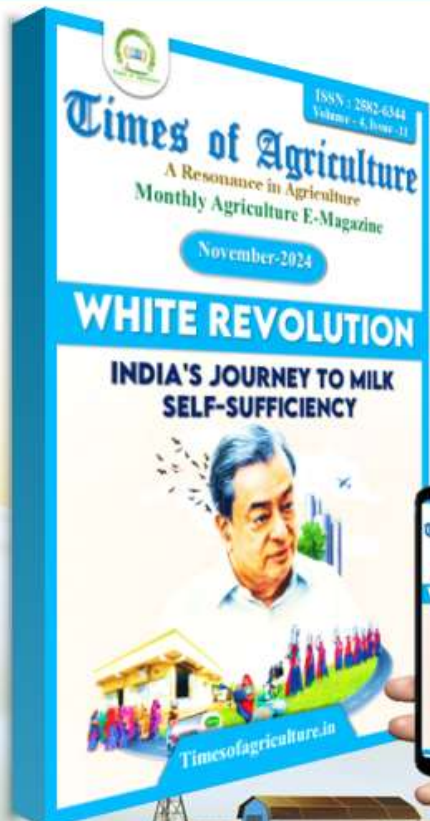
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INDIA'S JOURNEY TO MILK SELF-SUFFICIENCY



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# AGRICULTURE UPDATES



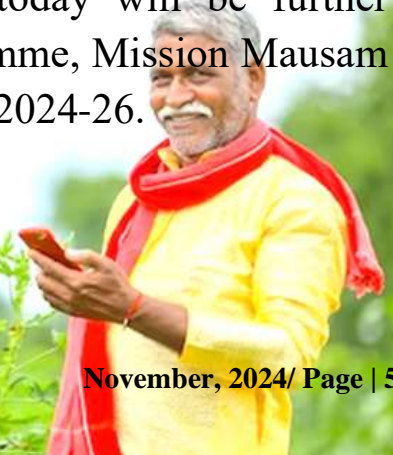
## Govt. Launched Gram Panchayat Level Weather Forecasting

India Meteorological Department (IMD), Ministry of Earth Sciences (MoES), in collaboration with Ministry of Panchayati Raj (MoPR) has launched Gram Panchayat-Level Weather Forecast on 24<sup>th</sup> October 2024 at Vigyan Bhawan, New Delhi.

With this initiative, daily gram panchayat-level forecasts will be available for nearly all 2.6 lakh panchayats across India, covering crucial weather parameters such as temperature, rainfall, relative humidity, wind and cloud cover. The forecasts will be disseminated through the Ministry's digital platforms: like Mausamgram of IMD and e-GramSwaraj and Meri Panchayat app of Ministry of Panchayati Raj.

The Mausamgram is a noble initiative aiming at ***"HAR HAR MAUSAM HAR GHAR MAUSAM"*** (weather information at each house hold at any time). It is a path breaking initiative developed indigenously by IMD to provide location specific forecast at Gram Panchayat level. It will provide weather forecast hourly up to 36 hours, 3-hourly from 36 hrs to next five days and every 6-hourly from next 5 days to 10 days. These timely updates will empower the common man including farmers for utilising weather information in their daily life and hence improve socio economic condition and ease of living.

The farmers can utilize this information to take decisions about agricultural processes like sowing, harvesting, irrigation, fertilizer/ pesticide applications etc. It will also reduce the loss of life and property from the meteorological disasters. The application launched today will be further augmented with the implementation of flagship programme, Mission Mausam approved by Union Cabinet for implementation during 2024-26.



## **“Bhu-Neer” Portal Launched by Jal Shakti Ministry for Water Sustainability**

The Ministry of Jal Shakti launched the "Bhu-Neer" portal during the 8th India Water Week-2024, marking a significant step forward in groundwater regulation in India. Developed by the Central Ground Water Authority (CGWA) in collaboration with the National Informatics Centre (NIC), the portal aims to improve transparency, efficiency, and sustainability in groundwater management. It provides a centralized database containing comprehensive details on groundwater compliance, regulations, and sustainable practices, making it a vital tool for stakeholders involved in water resource management.

The portal simplifies processes by integrating a Permanent Account Number-based single ID system, ensuring ease of access and efficient handling of data. It also streamlines the issuance of No Objection Certificates (NOCs) with QR code integration, promoting the Ease of Doing Business in the sector. Its user-friendly interface allows stakeholders to access critical information about the legal framework governing groundwater extraction and policies at both state and national levels, ensuring better adherence to regulations and fostering sustainable water use.

The initiative reflects the collaborative efforts of CGWA, constituted under the Environment (Protection) Act of 1986, and NIC, a pioneer in e-Governance since 1976 under the Ministry of Electronics and Information Technology. Together, these organizations are leveraging technology to address critical groundwater challenges in India. The "Bhu-Neer" portal is set to play a transformative role in sustainable water management, supporting agricultural growth and environmental conservation efforts nationwide.



## Govt launches Namu Drone Didi Scheme to provide drones to women self help groups

The Department of Agriculture & Farmers' Welfare has released the Operational Guidelines this scheme and all the stakeholders have been requested to make meaningful use of these operational guidelines to ensure prompt roll out and implementation of the 'Namu Drone Didi' Scheme.

The Government has approved the Central Sector Scheme 'Namu Drone Didi' for providing Drones to the Women Self Help Groups (SHGs) under DAY-NRLM, with an outlay of Rs. 1261 Crores. The scheme aims to provide drones to 14500 selected Women SHGs during the period from 2024-25 to 2025-2026 for providing rental services to farmers for agriculture purpose (application of liquid fertilizers and pesticides for the present).

The Namu Drone Didi Scheme will be governed at the Central level by the Empowered Committee of the Secretaries of Department of Agriculture and Farmers' Welfare, Department of Rural Development and Fertilizers. Eighty per cent of the cost of drone and accessories charges up to a maximum of eight lakhs will be provided to the women Self Help Groups for purchase of drones. The Cluster Level Federations of Self Help Groups will raise the balance amount as loan under National Agriculture Infra Financing Facility. One of the members of the women Self Help Groups will be selected for 15 day training comprising mandatory drone pilot training and additional training for agriculture purpose for nutrient and pesticide application. The Lead Fertilizer Companies will be responsible for the States.

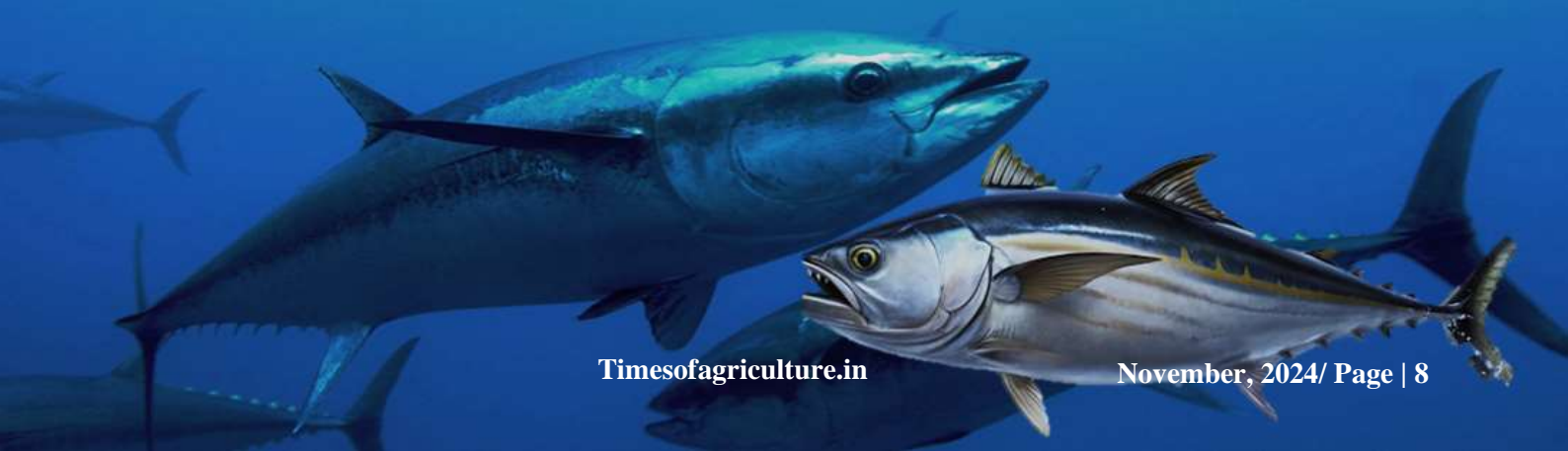


## **India Eyes Andaman Islands to Strengthen Tuna Export Industry**

India's tuna fish exports experienced a remarkable surge of 31.83% during the 2023-24 period, prompting the government to explore new areas for sourcing. The Andaman and Nicobar Islands are emerging as a potential hub for tuna exports due to their rich marine resources. The global tuna market, valued at \$41.94 billion, presents significant opportunities, with the Indian Ocean contributing 21% of the global supply. The Exclusive Economic Zone around the islands hosts a variety of tuna species, with an estimated annual yield of 64,500 tonnes, including yellowfin, skipjack, bigeye, and neritic tuna.

In 2023-24, India exported 51,626 tonnes of tuna worth \$87.96 million, as reported by the Marine Products Export Development Authority. While the islands primarily harvest neritic tuna, they also land small quantities of yellowfin, skipjack, and bigeye species. Despite the growing demand, the region's tuna fishery remains underdeveloped, constrained by inadequate infrastructure, outdated fishing technology, and a lack of processing and storage facilities. These challenges limit the efficiency of tuna catch rates and hinder the region's export potential, underscoring the need for significant investment and modernization.

To address these issues, the government is fostering collaboration among fisheries and aquaculture stakeholders. An investors' meet was organized to encourage partnerships and drive growth. Skill development in advanced tuna fishing techniques and sustainable management plans are crucial to ensure the long-term viability of tuna stocks. By addressing these challenges and leveraging the untapped potential of the Andaman and Nicobar Islands, India can strengthen its position in the global tuna market.





## Odisha Launches ‘Compendium of Regenerative Agriculture’

A ‘Compendium of Regenerative Agriculture’ developed by ICRISAT in partnership with the Government of Odisha was launched on 10<sup>th</sup> November 2024 during the “International Symposium on Shree Anna and Forgotten Foods” held in Bhubaneswar. This high-level event was graced by prominent dignitaries, including the Chief Minister of Odisha Mohan Charan Majhi.

The compendium outlines five essential principles. These are, minimising soil disturbance, maximising crop diversity, maintaining soil cover, keeping living roots year-round, and integrating livestock. These principles aim to enhance soil health and promote sustainability in farming practices. Arabinda K Padhee, Principal Secretary of Agriculture, emphasized the compendium’s role. It will serve as a vital resource for scaling regenerative agriculture, especially for millets, pulses, and oilseeds. The focus is on holistic farming techniques that improve carbon sequestration and climate resilience.

The symposium attracted over 400 attendees, including international representatives. Presentations focused on research priorities for millets in Odisha. The event told the growing momentum for regenerative agriculture in India.

A delegation from the Confederation of Indian Industry (CII) Telangana engaged with ICRISAT. They discussed collaboration opportunities in agriculture and food processing. M Raghunandan Rao brought into light the importance of mechanisation. He noted that it could enhance efficiency and sustainability in farming.



## Google Empowers Indian Farmers with AI-Powered Agricultural Insights

Google announced new partnerships to bring its AI research and models to support India's healthcare, sustainability and agriculture sectors. The company shared it will work with partners to help scale screening for diabetic retinopathy, strengthen India's circular economy, and open its Agricultural Landscape Understanding (ALU) Research API to developers to support India's agriculture sector. This innovative tool combines AI with satellite imagery to provide detailed insights at the farm level. By identifying field boundaries, water bodies, vegetation, and acreage, the API helps farmers optimize resources and make data-driven decisions. This technology marks a step forward in precision agriculture, enabling better management and sustainability.

The ALU Research API supports India's agricultural ecosystem by fostering efficiency and informed decision-making. It aids in developing tools for precision agriculture, optimizing inputs like water and fertilizers, and improving overall farm productivity. By providing granular data, the API equips farmers to adopt advanced practices, enhancing yields and reducing waste.

This initiative reflects Google's commitment to addressing pressing challenges in agriculture while aligning with sustainability goals. Alongside its efforts in healthcare and recycling, the agricultural push demonstrates the transformative potential of AI in improving lives and livelihoods in India.





# WHITE REVOLUTION

## INDIA'S JOURNEY TO MILK SELF-SUFFICIENCY



About the Author

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Since the dawn of civilization, agriculture and livestock have been inherently connected. Evidence from ancient civilizations reveals that livestock management in our country was highly advanced. Historical records of animal husbandry can be found in regions such as Mesopotamia, India, and Egypt. In India, the Vedas (5000-3000 BC), Puranas (2000-1000 BC), and Arthashastra (400-300 BC) provide detailed insights into livestock management.

The Rigveda mentions milk and ghee-based products as offerings, while numerous literary sources highlight the divine cow, Kamdhenu. Sculptures and rock paintings of the bull Nandi can be seen in Shiva temples. The significance of cows is underscored in the Vedas through the following statements:

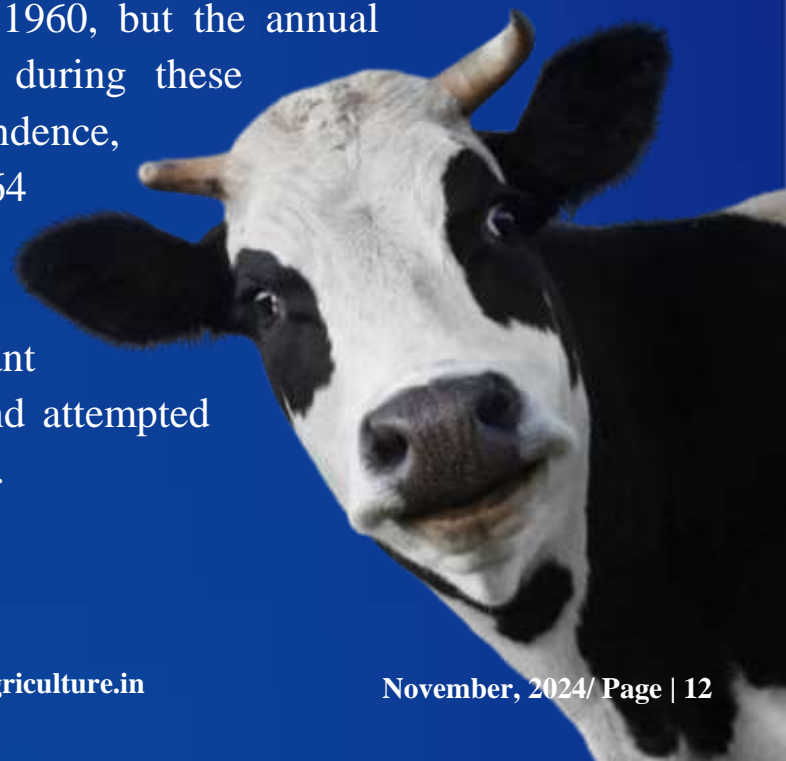
## **धेनु सदनंरयीणाम (Atharvaveda)**

### ***“Cow is the treasure house of wealth”***

The cow is also recognized as one of the 14 treasures obtained during the churning of the ocean (Samudra Manthan). Guru Vashishta is credited with expanding cow breeds, identifying types like Kamdhenu, Kapila, Devani, Nandini, and Bhauma.

### **Need for the White Revolution**

After independence, the development of rural areas in the country became very important, as not only crop production was a problem but the country was also lagging in the field of milk production. The import of milk and dairy products from abroad was increasing the economic burden on the country. Milk production had increased in 1950 and 1960, but the annual production growth rate was negative during these years. In the first decade after the independence, the annual combined growth rate was 1.64 percent, which dropped to 1.15 percent by the end of 1960. As a result, the Government of India made significant changes in the dairy sector's policies and attempted to become self-reliant in milk production.



## The Foundation of the White Revolution

Prime Minister **Lal Bahadur Shastri** inaugurated the Amul Cattle Feed Factory in Kanjari on **October 31, 1946**. Understanding its significance, he spent time in villages, interacting with farmers and discussing their challenges with **Dr. Verghese Kurien**, which eventually led to the establishment of the National Dairy Development Board (NDDB).

In **July 1970**, Operation Flood was launched with technical assistance from the United Nations Development Programme (UNDP) and the Food and Agriculture Organization (FAO). Dr. Verghese Kurien, known as the **Father of the White Revolution**, played a pivotal role in its success. He also founded Amul, which became India's largest milk-producing company. Alongside H.M. Dalaya, Kurien developed techniques to produce milk powder and condensed milk from buffalo milk.

## Phases of the White Revolution

The White Revolution, or Operation Flood, was implemented in three phases:

### Phase 1 (1970-1980):

Operation Flood established 18 milk sheds in 10 states, connecting them to major cities. By 1981, 13,000 villages had dairy cooperatives benefiting 15,000 farmers, with financial support from the European Economic Community (EEC).

### Phase 2 (1981-1985):

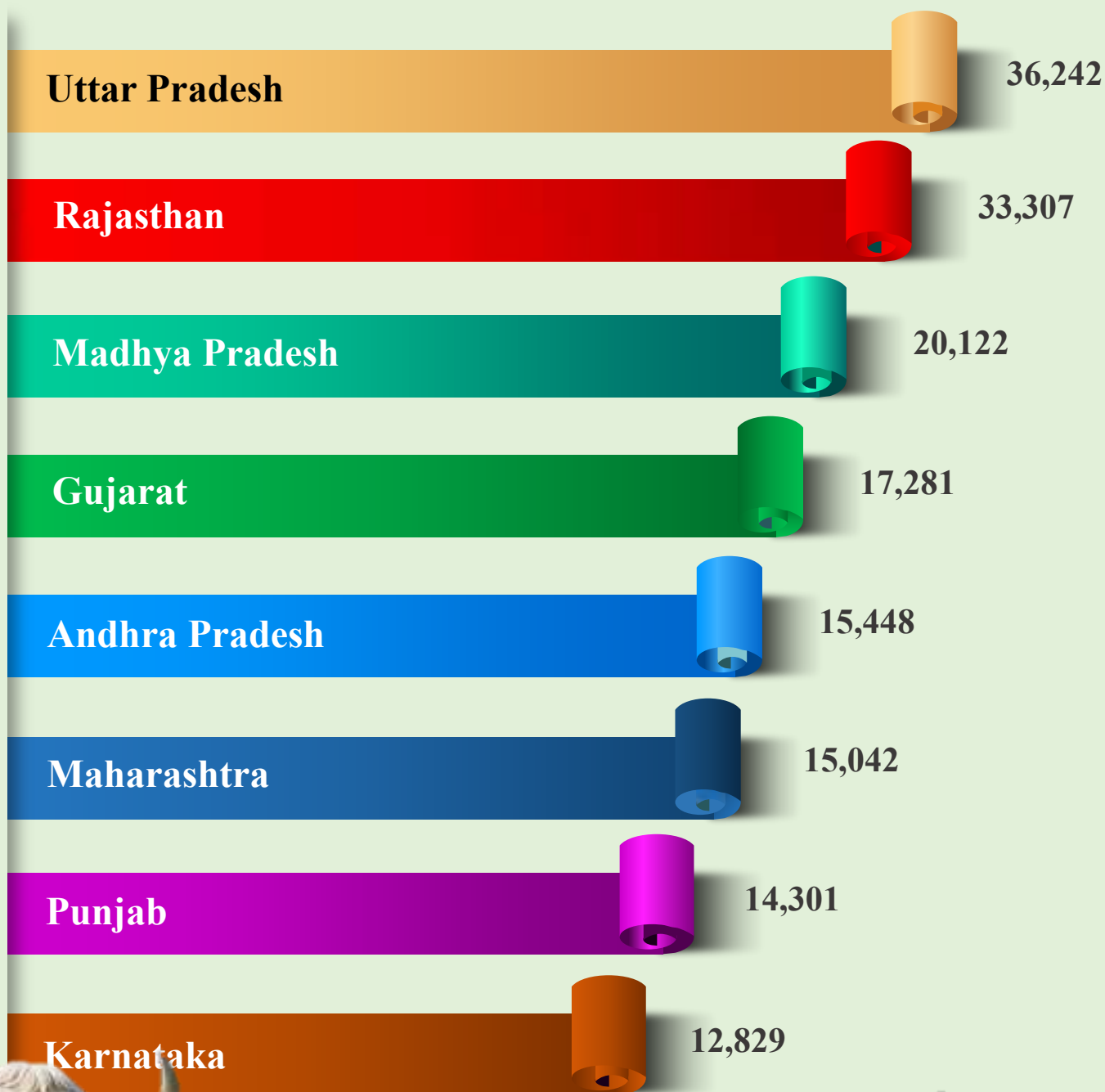
The program expanded to Karnataka, Rajasthan, and Madhya Pradesh, with 136 milk sheds producing 4.25 million liters of milk daily by 1985. Financial and technical support came from the World Bank, EEC, and NDDB.

### Phase 3 (1985-1996):

This phase strengthened dairy infrastructure, introducing veterinary and artificial insemination services. By 1989, there were 73,300 cooperatives involving 9.4 million farmers, and women's participation grew through initiatives like the Women Dairy Cooperative Leadership Program (WDCLP) in 1995.



# Leading Milk Producing States ('000 Tonnes )



## **Dr. Verghese Kurien: The Man Behind the White Revolution**

Dr. Verghese Kurien, often referred to as the "Father of the White Revolution" and also known as "Milkman of India". Born on November 26, 1921, in Calicut (now Kozhikode), Kerala, he pursued a B.Sc. in physics and later a degree in mechanical engineering from the University of Madras. In 1948, he earned a master's degree in mechanical engineering from Michigan State University, USA. Dr. Kurien passed away at the age of 91 in 2012, leaving behind an unparalleled legacy.

### **Career and Foundational Work**

In 1949, Verghese Kurien was posted to Anand, Gujarat, under a government scholarship agreement, as an officer in the Dairy division. Witnessing the exploitation of farmers by milk distributors, he was inspired by Tribhuvandas Patel's cooperative movement. This led him to establish the Kaira District Cooperative Milk Producers Union Ltd. (KDCMPUL) in 1950, later branded as "Amul." He also founded the National Dairy Development Board (NDDB) in 1965, serving as its chairman until 1998.

### **Contribution to the White Revolution**

Dr. Kurien turned the country into the world's largest milk producer. His innovative "Anand cooperative model" empowered farmers to manage procurement, processing, and marketing. The model's success prompted Prime Minister Lal Bahadur Shastri to replicate it nationwide, resulting in the creation of the NDDB. Kurien's leadership in "Operation Flood," the world's largest dairy development program initiated in 1970, solidified India's self-sufficiency in milk production.



## Awards and Honors

Dr. Verghese Kurien received numerous accolades for his remarkable contributions. November 26 is celebrated annually as National Milk Day in his honor. His international awards include the Ramon Magsaysay Award for Community Leadership, the Wateler Peace Prize, and the World Food Prize. Nationally, he was conferred the Padma Shri, Padma Bhushan, Padma Vibhushan, and Krishi Ratna Award. These honors reflect his unparalleled impact on India's dairy sector and social welfare initiatives

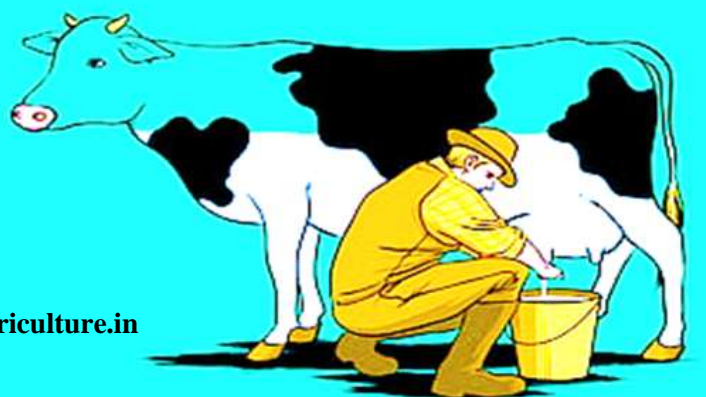
## Impact of the White Revolution

The revolution significantly increased milk production and improved rural livelihoods, Milk powder production grew from 22,000 tons to 140,000 tons by 1989. Dependency on milk imports ended, making India self-sufficient in dairy production. Rural farmers were empowered economically, and dairy cooperatives became a global model for agricultural development The World Bank's 1998 report highlighted the transformative impact of Operation Flood, noting that an investment of ₹200 crore yielded an economic growth of ₹24,000 crore over a decade.

## Government Initiatives for Dairy Sector

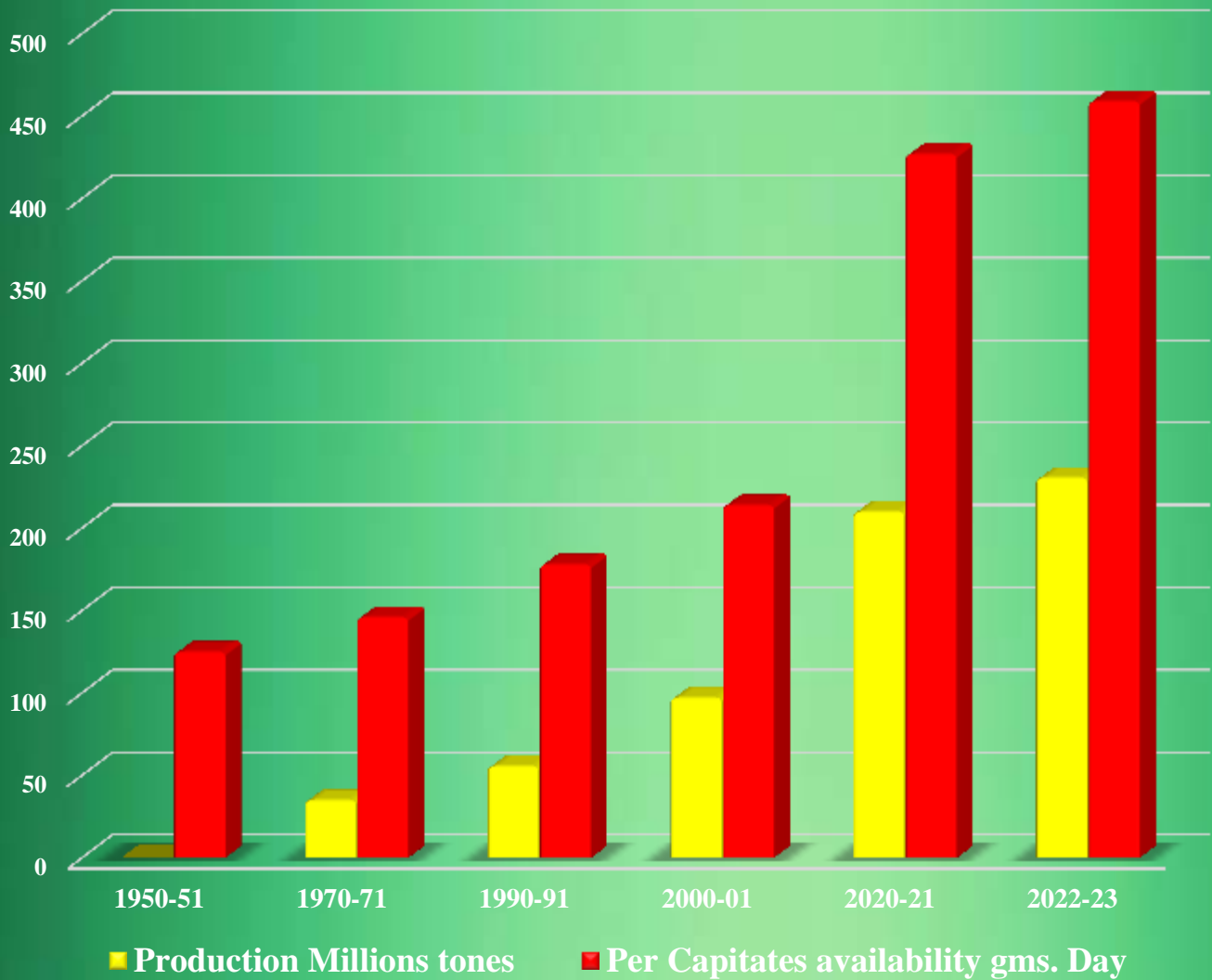
India has launched several national initiatives to improve the dairy sector, with a focus on milk production, quality enhancement, and infrastructure development.

- **National Programme for Dairy Development (NPDD)**
- **Dairy Processing and Infrastructure Development Fund (DIDF)**
- **Rashtriya Gokul Mission (RGM),**
- **White Revolution 2.0**





# Milk production and per capita of milk in India



**National Programme for Dairy Development (NPDD)**, which was launched in February 2014 by merging three existing schemes: the Intensive Dairy Development Programme, Strengthening Infrastructure for Quality & Clean Milk Production, and Assistance to Cooperatives. In 2021, NPDD was restructured with an increased focus on quality improvement and increasing organized procurement, processing, and marketing.

**National Livestock Mission (NLM)**, which began in 2014-15, supports dairy entrepreneurship by offering subsidies for establishing cattle breeding projects, helping farmers and cooperatives improve their dairy infrastructure and incomes.

**Rashtriya Gokul Mission (RGM)**, launched in December 2014, aims to conserve and develop high-quality indigenous cattle breeds to improve milk production. With an initial allocation of INR 500 crore, the scheme was revamped in 2020 and extended until 2026 with a revised budget of INR 2400 crore. The mission has led to significant improvements, such as a 57.6% increase in milk production from 143.6 million tons to 230.6 million tons, and a 24.3% rise in average bovine productivity.

**Dairy Processing and Infrastructure Development Fund (DIDF)**, initiated in 2018, focuses on modernizing milk processing plants with a total outlay of INR 11,184 crore. This fund offers financial assistance to various dairy stakeholders, such as cooperatives and milk producer companies, to improve processing capacity and infrastructure.

**White Revolution 2.0** is an ambitious initiative to boost milk production while empowering women and addressing malnutrition. The program targets increasing milk procurement to 1,000 lakh liters daily by its fifth year, up from the current 660 lakh liters. This initiative seeks to improve milk yield, with a focus on increasing productivity through genetic improvements, better breeding techniques, and enhancing milk production in rural areas.



The success of White Revolution 2.0 will play a pivotal role in addressing the growing issue of malnutrition, particularly among children, by ensuring better milk availability for the underprivileged. The introduction of modern technologies like **Sex-Sorted Semen** and **Embryo Transfer** is expected to increase the number of high-yielding cows, which will significantly contribute to the rise in milk productivity across the country.

### **Future Prospects in Dairy Sector**

The future of India's dairy sector holds immense potential with continued focus on modernization, improved productivity, and market formalization. The adoption of advanced technologies such as **In Vitro Fertilization (IVF)** for high-yield cows and genetic advancements will accelerate the growth of milk production. Furthermore, efforts to curb rising milk prices and formalize the milk sector will help make dairy products more accessible, benefiting both producers and consumers. The government's strategic plans, including further investment in dairy infrastructure, livestock health, and the development of indigenous cattle breeds, are poised to strengthen India's position as the world leader in milk production. With the growing emphasis on sustainability, efforts to reduce methane emissions from livestock and improve the overall ecological footprint of the dairy sector will be crucial in ensuring the long-term success of the White Revolution 2.0.



# Fuelling of Integrated Post-Harvest management projects for strengthening horticulture sector by National Horticulture Board

The National Horticulture Board (NHB) was set up by the Government of India in 1984 as an Autonomous organization under the administrative control of Ministry of Agriculture and Farmers Welfare and registered as a society under Societies Registration Act with its headquarters at Gurugram. Presently, NHB has 29 field offices located all over the country. The broad aims and objectives of the Board are to develop production clusters/hubs for integrated hi-tech commercial horticulture, development of post-harvest and cold chain infrastructure, ensuring availability of quality planting material and to promote adoption of new technologies/tools/ techniques for Hi-tech commercial horticulture etc. Currently, Sh. Priya Ranjan, IFS is the managing director of the board.

As of 2023, India was estimated to have harvest and post-harvest losses of major agricultural and allied produce worth 926 billion Indian rupees. Fruits and vegetables registered the most losses across other agricultural categories. National Horticulture Board (NHB) is implementing a sub-scheme for integrated post-harvest management. Under this scheme, credit linked back-ended subsidy at the rate of 35% of the capital cost limited to Rs 50.75 lakh per project in general area is given to the beneficiaries and 50% in case of Northeast, hilly & scheduled areas, cost limited to 72.50 lakh.



## About the Author

**B. Raja**

Deputy Director, National Horticulture Board, Chennai

National Horticulture Board contemplates on the development of modern-post harvest management infrastructure as an integral part of area expansion projects and standardizing post-harvest management protocols, prescribing critical storage conditions for fresh horticulture produce and bench marking of technical standards for cold chain infrastructure. Activities regarding projects relating to pack house, ripening chamber, refer van, retail outlets, pre- cooling unit and primary processing are mainly covered in this scheme.

**Cost norms under this scheme are as follows:**

SI No	Component	Project cost with specifications	Subsidy pattern
1	Pack House	Rs 4 Lakh/unit with 9MX6M	50% subsidy
2	Integrated pack house	Rs 50 Lakh/unit with 9MX18M	35% subsidy
3	Ripening Chamber	Rs 1 Lakh/MT	35% subsidy
4	Refer Van	Rs 25 Lakh	35% subsidy
5	Retail Outlets	Rs 15 Lakh/unit	35% subsidy
6	Pre- cooling unit	Rs 25 Lakh/6MT	35% subsidy
7	Cold room	Rs 15 Lakh/30MT	35% subsidy
8	Primary processing	Rs 25 Lakh/unit	35% subsidy

**Revision in the scheme guidelines of NHB, including its implementation design, documentation and sanctioning process**

To avail the subsidies regarding integrated post-harvest management projects, the farmers or the promoters must first apply for a term loan in any commercial banks or financial institutes. After the sanctioning of loan, GoC (Grant of Clearance) have to be applied through NHB website along with the detailed project report (DPR), technical data sheet (for protected structures and cold storage), bank sanction letter, bank appraisal note, legal search report and land documents. Only after the approval of GoC by NHB, the farmers can commence their project and the bank can disburse the term loan to the promoter.



In case if the project has started or the loan is disbursed prior the approval, the project will be rejected. The project should be completed within eighteen months from the date of first term loan disbursement.

After the completion of project, joint inspection team (JIT) consisting of officials from NHB, lending bank and State horticulture department/ ICAR will visit the project site, evaluate the various production components - planting material, irrigation, mechanization, good agricultural practices, land development, store room and labour quarters - as per the cost norms furnished in NHB guidelines and derive the eligible project cost (EPC). On completion of the project, the applicant has to furnish the project completion certificate, term loan disbursement certificate, Chartered accountant certificate, NOC from NHM-MIDH, undertaking, etc. for claiming the subsidy. The subsidy will then be released based on the EPC worked out by the JIT and IC/PAC.

### **For more details**

Visit [www.nhb.gov.in](http://www.nhb.gov.in) and contact State and Head office.

### **Head Office Address:**

National Horticulture Board, Ministry of Agriculture & Farmers Welfare, Govt. of India, Sector- 18, Institutional Area, Gurugram, Haryana, 122015. Email: [md@nhb.gov.in](mailto:md@nhb.gov.in), [sho.south@nhb.gov.in](mailto:sho.south@nhb.gov.in), Tel. No: 0124-2342992

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# Prime Memberships in Agriculture: Driving Retailer Success with Subscription-Based Loyalty Programs

In today's agricultural marketplace, loyalty programs have evolved into powerful tools for driving customer loyalty, profitability, and growth. nurture.retail's Prime Membership program exemplifies this shift, setting new standards in the B2B agri-retail sector through a loyalty-driven, subscription-based approach. This program, created specifically for agri-retailers, bridges crucial gaps in service, pricing, and support, showing how loyalty initiatives can foster lasting partnerships and empower retailers to thrive.

## The Shift to Subscription Models in Agri-Commerce

While loyalty programs are standard in other industries, agriculture poses unique challenges for retailers, such as fluctuating prices and limited working capital. nurture.retail Prime addresses these needs by providing tailored incentives and support, turning loyalty into a powerful business asset.

## nurture.retail Prime: Transforming Loyalty in Agri-Commerce

nurture.retail Prime is the first subscription-based loyalty program exclusively for agri-retailers, helping over 15,000 members succeed in today's dynamic market. With a modest membership fee, agri-retailers can access a comprehensive suite of benefits tailored to their unique needs, transforming traditional rewards into a partnership-oriented approach.

## Core Benefits of nurture.retail Prime

The impact of nurture.retail Prime comes from delivering practical, measurable benefits. Here's what makes it a game-changer for agri-retailers:



About the Author

**Ankit Laddha**

Head of nurture.retail  
and nurture.farm



- **Cashback on Orders:** Members earn cashback on every order, creating valuable savings to reinvest in stock, marketing, or operations, strengthening their business base.
- **Immediate Rewards:** Offering instant gratification on purchases, Prime allows retailers to see benefits immediately, empowering them to make quick, impactful business decisions.
- **Retailer Kavach Insurance:** Recognizing the unpredictable nature of agriculture, nurture.retail Prime includes "Retailer Kavach," an insurance feature that provides a financial safety net, increasing retailers' resilience in a volatile industry.
- **Dedicated Support and Exclusive Access:** Prime members enjoy faster response times and priority access to sales events, training, and workshops, ensuring uninterrupted operations and enriching product knowledge that ultimately enhances service to the farmers they serve.

### Real Impact and Growing Value

Since its launch, nurture.retail Prime has provided retailers with substantial financial value and operational advantages:

- **Extensive Membership and Savings:** Over 15,000 retailers use nurture.retail Prime, and members collectively order more than 10,000 tons of agri-inputs directly from manufacturers, gaining significant savings and streamlined operations.
- **Unmatched Convenience and Value:** Prime members receive 3x the benefits per order and priority delivery—even in remote villages—providing exceptional financial value and convenience.
- **Building Resilience Against Uncertainty:** Through the Retailer Kavach, 10% of Prime members have received claim payouts for weather-related losses, demonstrating the essential role of insurance in navigating agricultural risks.

### A Strategic Resource for Agri-Retailers

nurture.retail Prime showcases how loyalty programs can evolve into strategic assets. For agri-retailers, it offers savings, growth opportunities, and operational efficiency. Exclusive benefits like priority service, insurance, and dedicated support equip Prime members with unique advantages, enhancing their market position and enabling sustained success.

Through nurture.retail Prime, nurture.retail has created a model loyalty program that fosters growth and resilience in B2B agri-commerce. This program serves immediate needs and long-term partnerships by combining financial value, dedicated support, and exclusive resources. As agriculture continues to evolve, nurture.retail Prime provides a powerful blueprint for loyalty initiatives that help agri-retailers excel in a competitive marketplace.





## Previous Issues



## Website Statistics (October 2024)

202K

Monthly  
Pageview

72K

Monthly  
Visitor

2.1M

Monthly  
Impression

## Social Stats



6.5K



5.5K



8K



1.7K



2.1K



# BLOSSOMING VENTURES

## HOW AGRI STARTUPS ARE TRANSFORMING THE FLORICULTURE SECTOR

### About Author



**Keerthivasan R.\***  
Research Scholar  
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Professor and Head  
Department of Floriculture and  
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The global horticulture industry greatly comprises the floriculture sector, which is rapidly transforming, thanks to the entrance of innovative Agri-startups who are changing how flowers are produced, marketed, and delivered. Due to growing interest towards the use of flowers in ornamental landscaping, celebratory occasions, and even in daily use, people involved in agriculture-oriented entrepreneurship and innovation have found the opportunity to build an effective, efficient and environmentally sound technology business that helps

boost productivity and connects to clients. This paper looks into the dynamic change in the practice of growing and selling flowers with particular focus on the role and achievements of Agri-startups in this area.

### Growing importance of floriculture in agribusiness

Floriculture holds a unique position within the agricultural sector, with a global market valued at over \$70 billion and growing annually. Beyond its economic value, the floriculture industry plays a vital role in creating jobs, supporting smallholder farmers, and contributing to the cultural heritage of many regions. Countries like the Netherlands, Colombia, India, Kenya, and China lead in floral exports, but emerging economies are fast catching up, thanks to technological advancements and the efforts of forward-thinking startups.

Agri-startups are identifying untapped opportunities in this vibrant industry and are focusing on innovations that address key challenges, such as high production costs, climate sensitivity,

supply chain inefficiencies, and sustainability concerns.

### Technological innovations in floriculture

The incorporation of technology is one of the key driving forces behind the growth of floriculture startups. These ventures are leveraging advancements in the following areas:

#### ● Precision agriculture:

Precision tools such as drones, IoT sensors, and remote sensing devices are transforming flower cultivation by providing data-driven insights into soil health, temperature, humidity, and nutrient levels. This technology enables farmers to optimize resource use and minimize waste, leading to better yield and quality.

#### ● Vertical and indoor farming:

In response to land scarcity and climate challenges, several startups are embracing vertical farming and indoor growing environments for flowers. By creating controlled ecosystems, they can grow delicate florals year-round, ensuring consistency and





reducing dependency on seasonal factors.

- Automated cultivation and harvesting:** Labor shortages in the agriculture sector pose challenges for the floriculture industry, which often requires delicate handling. Automated systems, including robotics, are now being developed to handle tasks like planting, watering, pruning, and harvesting flowers, which reduces labour costs and enhances precision.
- Post-Harvest Technologies:** Freshness is paramount in the flower industry, and startups are addressing this with innovative post-harvest solutions. For instance, advanced packaging methods, cooling systems, and specialized logistics processes extend the shelf life of flowers, ensuring they reach customers in perfect condition.

### **Sustainable Floriculture: A priority for modern agri-startups**

The shift towards sustainability is a defining feature of today's floriculture industry. Many startups are adopting environmentally friendly practices to meet the growing demand for sustainable products:

- Water-saving irrigation techniques:** Floriculture can be a water-intensive industry. Innovative startups are using drip irrigation, hydroponics, and water recycling systems to reduce water usage,

which is particularly important in drought-prone areas.

- Organic and low-chemical farming:** To reduce the ecological footprint of floriculture, startups are introducing organic farming practices, limiting the use of chemical fertilizers and pesticides. These practices not only improve soil health but also result in flowers that are safer for consumers and better for the environment.
- Waste reduction and upcycling:** Some floriculture startups are also finding ways to repurpose waste products, such as using discarded flowers to make natural dyes, fragrances, or organic compost, thus promoting a circular economy.

### **Disrupting traditional supply chains with digital platforms**

One of the major bottlenecks in the floriculture industry has been the complex and fragmented supply chain, where flowers often pass through multiple intermediaries before reaching consumers. Agri startups are bridging this gap by establishing direct-to-consumer (D2C) platforms, reducing the costs and time associated with traditional distribution networks.

- E-Commerce and subscription models:** Startups have introduced direct online sales and subscription-based models, allowing customers to purchase fresh flowers directly from growers. These platforms not only ensure

faster delivery but also help flower farmers get fairer prices by eliminating middlemen.

- Blockchain for transparency:** Blockchain technology is being explored by some startups to enhance transparency and traceability in the floriculture supply chain. This ensures that consumers know where their flowers are sourced from, fostering trust and enabling fair trade practices.

### **Success stories: Agri startups blossoming in the floriculture sector**

Here are a few inspiring examples of Agri-startups that are transforming the floriculture landscape:

- Farmers fresh zone (India):** This startup focuses on creating a robust farm-to-table model, connecting local flower farmers directly with consumers. By leveraging digital platforms, they ensure fresh flower delivery to customers while supporting small farmers with fair wages and technical support.
- Bloomscape (USA):** Bloomscape is reimagining the indoor plant and flower market by providing home delivery of fresh flowers and plants, complete with care instructions. Their D2C model capitalizes on the online shopping trend, with a focus on sustainability and educating consumers on flower care.
- Flower Farms Kenya (Kenya):** Flower Farms Kenya is a social enterprise that provides Kenyan flower farmers with access to international markets. By partnering with global retailers and using digital platforms for direct sales, they empower local communities and support sustainable practices.
- AgriLyst (USA):** AgriLyst offers a platform for floriculturists to monitor greenhouse conditions remotely, providing real-time insights and analytics to improve flower quality and yield. This technology optimizes resource use,





reduces waste, and helps farmers achieve higher profits.

### **Future of floriculture: Opportunities for growth**

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The rise of Agri-startups in floriculture signals a promising future for the industry. With the integration of technology, sustainability practices, and efficient supply chains, these startups are helping the sector meet the rising demand for flowers while minimizing environmental impact. As consumers continue to prioritize sustainability and

quality, the floriculture industry is expected to see further growth and innovation.

### **Conclusion**

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Startups focusing on flower cultivation are the torchbearers of a sector that has a rich history and significance as well as high profitability. With the help of technology, a desire for sustainability, and combined with unique business models, these instruments develop floriculture to a better, greener, and more customer-oriented industry. As

these startups are still on the rise, they do not only sustain millions of flower farmers but also help people all over the globe enjoy fresh and aesthetically pleasing flowers that are grown in a sustainable manner. Meso- and small entrepreneurs such as these “sprouting ventures” or “blossoming ventures,” as they call themselves, encourage the development of the floriculture industry in a time when the industry is in transition and rich in possibilities.



# SWEET BASIL SEEDS

## NUTRITIONAL AND HEALTH BENEFITS

### About Author



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Sweet basil seeds are commonly known as sabja or kamakasturi seeds that come from the sweet basil plant (*Ocimum basilicum*), an annual culinary herb belongs to the Lamiaceae family. Sweet basil is widely cultivated across the India particularly among regions of Andhra Pradesh, Telangana, Karnataka, Madhya Pradesh, Maharashtra, Jammu, Assam, West Bengal, Bihar and Uttar Pradesh. In Karnataka, it is extensively grown in Ballari, Chamarajanagar, Kolar, Davanagare, Mysore, Shivamogga, Gulbarga, Udipi and Dakshina Kannada districts essentially for the purpose of aromatic leaves and edible seeds.

The herb has been used in traditional medicines (Unani, Ayurveda and Siddha) from the ancient times due to its expectorant, flatulence relieving, antidiabetic, anti-inflammatory, antiaging, antipyretic, diuretic, antiviral and antimicrobial properties. Sweet basil leaves are used either fresh or dried to add a distinctive flavour and aroma to the foods. They are also utilised in the manufacture of beverages, liqueurs, vinegars, teas and essential oils. Sweet basil seeds are aromatic, black in colour, small in size, ellipsoid in shape with dimensions ranged between 2.31-3.11 mm length, 1.30-1.82 mm width, 0.99-1.34 mm thickness. They produce considerable amount of mucilage when soaked in water that remains tightly bound to the seed core.

The prevalence of lifestyle diseases in India has increased dramatically over the last few decades. A study conducted by Indian Council of Medical Research (ICMR) revealed that the national prevalence of diabetes is 11.4%, prediabetes is 15.3%, hypertension is 35.5%, generalized obesity is 28.6%, abdominal obesity is 39.5%, hypercholesterolemia is 24% and

high low-density lipoprotein (LDL) cholesterol is 20.9%. Further, the past decades portrayed an increase in life expectancy as well as public's concern of leading a healthy life. The connection between diet and health is well established long ago with certain foods possessing nutraceutical components (dietary fiber, protein, vitamins, minerals, antioxidants) exhibiting additional health benefits compared to others.

The sweet basil seeds are excellent source of dietary fiber (48.5 g/100 g), protein (8.6 g/100 g) and energy (328 Kcal/100 g). The high dietary fiber intake is beneficial in reducing the risk of prevailing lifestyle diseases such as constipation, obesity, cardiovascular problems, diabetes, gastrointestinal disorders and cancers. The regular consumption of sweet basil seeds is associated with improved satiety and better management of body weight, blood glucose and cholesterol levels. The seeds are also good source of omega-3 fatty acid ( $\alpha$ -linolenic acid) that has been associated with reduced cholesterol level, arterial plaque buildup, inflammatory biomarkers, blood pressure and



preventing heart diseases.

The sweet basil seeds are rich source of calcium (568 mg/100 g) compared to chia seeds (463 mg/100 g), ragi (364 mg/100 g), almonds (228 mg/100 g) and milk (121 mg/100 g). They are good source of magnesium (261 mg/100 g) like amaranth seeds (270 mg/100 g), soybean (259 mg/100 g) and cowpeas (213 mg/100 g). Further, they are good source of potassium (594 mg/100 g) like chia seeds (407 mg/100 g) and banana (358 mg/100g). The consumption of foods rich in calcium, magnesium and potassium is beneficial in reducing the risk of brain stroke, hypertension, osteoporosis, cardiovascular diseases, muscular diseases and type 2 diabetes.

Sweet basil seeds also possess good amount of microminerals such as zinc (7.0mg/100 g), copper (1.9 mg/100 g) and manganese (1.9 mg/100 g) essential for proper functioning of immune system. The zinc content in

sweet basil seeds is comparable to pumpkin seeds (6.6 mg/100 g), cashew (5.3 mg/100 g) and flax seeds (4.9 mg/100 g). The copper content in sweet basil seeds is much higher than the chia seeds (0.9 mg/100 g). Thus, sweet basil seeds offer better health benefits than the chia seeds. Further, sweet basil seeds are also potential source of antioxidants such as phenols (210 mg gallic acid equivalent/100 g) and flavonoids (144 mg quercetin equivalent/100 g). The dietary antioxidants play a vital role in preventing the inflammation driven diseases (cardiovascular diseases, cancers, neurodegenerative diseases) by scavenging free radicals and attenuating the oxidative damage. Thus, sweet basil seeds are being considered as ‘super seeds’ of 21<sup>st</sup> century.

Now-a-days sweet basil seeds are gaining popularity as a healthy kitchen staple across the globe. They are often used to enrich fruit drinks, lassi,

sharbat, lemonades, smoothies, frozen desserts and soups. They provide cooling effect and protect the body from heat stroke. This makes them a popular addition to drinks during hot weather to prevent dehydration and fatigue. A typical serving is about 1 to 2 tablespoons of dry seeds added to 200 to 250 mL of drink. Hot drinks hydrates the seeds in one minute, drinks at room temperature takes 3 to 5 minutes and cold drinks takes about 20 minutes. The seeds are also added as whole or milled to the bakery products as a source of dietary fiber.

Gradual addition of seeds to the diets of people with low fibre intake to is advisable to avoid bloating, discomfort and the digestive system to adjust. Dry seeds should be cleaned and stored at room temperature in an airtight container ideally in a cool, dark place.



**Sweet basil plant**



**Sweet basil seeds**



**Soaked sweet basil seeds**



**Sweet basil seed lemonade**



**Sweet basil seed crackers**



**Sweet basil seed cake**





**Rose falooda with sweet basil seeds**



**Mango falooda with sweet basil seeds**



**Nannari sharbat with sweet basil seeds**



**Sweet basil seed lassi**



**Butter milk with sweet basil seeds**



**Sweet basil seed pudding**



**[Top 24 Agriculture Startups in India Transforming Agriculture \[2024\]](#)**





**FORTIFIED**  
SAMPOORNA POSHAN  
SWASTH JEEVAN

# UNDERSTANDING FOOD FORTIFICATION IN A SIMPLE WAY

## About Author



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Now-a-days we hear a term, 'Fortified Food' quite often used in our day to day life. So let us just explore this word 'Fortification' in a technical yet simplified way.

### Knowing food fortification

Fortification means an act or a process of fortifying or strengthening. Hence the same applies to food. WHO defines Food fortification as, a practice of deliberately increasing the content of one or more micro-nutrients in a food to improve its nutritional quality. In simple terms, food fortification is the process of adding few nutrients in post-harvest food in order to enhance it in nutritional terms.

### Why is food fortified?

Some foods lack a variety of micronutrients since they do not exist in them naturally. Plants extract nutrients from soil and store them in their tissues that are carried forward to the food we eat.

Due to excess exploitation of soil, it lacks various nutrients which reflect in food. Adulteration also leads to malnutrition. India is ranked 101<sup>st</sup> out of 116 nations on the World Hunger Index 2021. Hunger and malnutrition cause a loss of human capital, low economic output, poor cognitive and learning abilities, low rates of school retention, and poverty as a result. Although these impacts cannot be reversed, they can be avoided in nature. Thus, Food fortification seems to be an answer to the above problems in order to fulfill the basic nutrient requirement of an individual.

### When did the food fortification began?

Food fortification was first done in 1920 by addition of iodine to table salt to prevent goiter among school children in Ohio. In India, food fortification started in 1950's.

### Process of food fortification

In food fortification process, the food to be fortified is blended with the addition of key vitamins and minerals such as iron, iodine, zinc, Vitamins A and D. The vitamins and minerals to be added are known as premix or fortificants. In fortifying cereals and grains, they are powdered and blended with premix and by the process of extrusion the desired shape is obtained. In liquid foods i.e. in milk or oil the fortificants are added in the liquid state and in the spray dried powder in solid form.

The various examples of fortified foods include rice, dal, wheat, vegetable oils, milk, milk products, fruit juices, sugar, cereals, salt etc.

### Benefits

- Prevent illnesses brought on by nutritional deficiencies.
- Helpful during pregnancy.
- Supports in the growth and development of children.
- Helps to meet basic requirements of food.
- Beneficial for the elderly.

### Disadvantages

- Increased chance of nutritional overdose.
- Compared to whole foods, fortified foods have more calories. Consequently, processed fortified food can lead to binge eating and slow weight growth.
- Eating just fortified foods and avoiding fruits and vegetables might result in malnutrition.

### Current status

As per the government scheme on food fortification, Rice was selected as medium since it is the staple food for major population in India. The Phase-I of the scheme covered beneficiaries under the Integrated Child Development Services (ICDS) and Pradhan Mantri Poshan Shakti Nirman (PM POSHAN). Based on the success of the first phase, the fortified rice distribution was extended to PDS as part of the second phase. Currently, the third phase of fortified rice distribution via Public Distribution System (PDS), also called ration shops, is on track with 439 districts covered.







# YOUTH IN AGRICULTURE

## INSPIRING THE NEXT GENERATION OF FARMERS

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**Dr.** Kanayo Nwanze, Former President, the International Fund for Agricultural Development (IFAD) once quoted "Youth are the future of agriculture, and it's essential to provide them with the skills, knowledge, and resources to succeed". This quote clearly indicates that the indispensable sector vital to the Indian economy which has been traditionally associated with older generations should now be handed over to the new wave of young, techno-savvy and innovative farmers who can revamp the agricultural industry.

With approximately 600 million people under the age of 25, India

constitutes World's largest youth population and engaging this demography in agriculture is pivotal for addressing the food security and ensuring a legitimate food supply for the nation. Young people bring innovative ideas, fresh perspectives and an eagerness to adopt new technologies, promising the development and modernization of the agricultural sector (Federation of Seed Industry of India, 2019).

Furthermore, encouraging young people to pursue employment in agriculture can help close the generation gap and ensure the industry's long-term survival.

### Importance of youth in Indian agriculture

In a country, where most of the people rely on agriculture for their livelihood, the involvement of young generation is crucial. They can introduce cutting-edge technologies such as precision farming, organic and natural farming, integrated farming, hydroponics as well as various digital platforms to enhance productivity and market reach.

With increasing rural-urban migration, the role of young farmers in sustaining rural economies is more important than ever. Their ability to

adapt quickly to new methods and technologies can help bridge the gap between traditional and modern agriculture (Hassan, 2024).

### Encouraging youth participation in Agriculture

Agriculture provides many job opportunities for young people in a variety of sub-sectors, including agricultural production, livestock, agri-inputs, and agro-processing. Aspiring entrepreneurs can capitalize on the growing demand for organic products, value-added items, and specialized markets for exotic commodities. The advent of precision agriculture and digital agricultural technologies creates chances for young people with backgrounds in science, technology, engineering, or mathematics (STEM) to utilize their knowledge in agriculture. Smart farming, Unmanned Aerial Vehicles (UAVs), and data-driven decision support systems are just a few examples of innovative technologies transforming the business. Because of a lack of exposure to the full range of available options, career pathways, and potential growth within this industry, India's young population perceives it as a low-status, low-income profession. Another important barrier for young people starting agribusinesses is access



to land and resources. High land prices and the fragmentation of agricultural holdings make it difficult for young entrepreneurs to secure the resources they need to establish their businesses.

Furthermore, agricultural education and training in India frequently focuses on traditional practices, with little emphasis on novel techniques and technologies. This educational gap may make it difficult for young people to acquire the necessary skills to prosper in an ever-changing agricultural landscape.

### Success stories

Prasad Rama Hegde, a young progressive farmer from Karnataka, has set an example for the youths who are fleeing to cities in quest of employment, leaving their prospective fields fallow. He is passionate about collecting and maintaining diverse crops such as Arecanut (*Areca catechu*), Coconut (*Cocos nucifera*), Jackfruit (*Artocarpus heterophyllus*), Mango (*Mangifera indica*), Banana (*Musa spp.*), Black Pepper (*Piper nigrum*), Cocoa (*Theobroma cacao*), medicinal plants, and the list goes on to reach 1000 different species on his 1.77 hectares of farmland.

Sadhu Mari, a young tribal, aged 24 years from Odisha owned 4 acres of land out of which 3 acres were unproductive upland. He used to cultivate 1 acre of paddy but the yield could hardly suffice to meet the need of his family. Sri Mari approached the Badanala micro-watershed committee for support and guidance to take up some off season vegetable crops in his land by using the available irrigation. During this, a training programme for unemployed youth was being organised at School of Horticulture, Kandhamal, Odisha. After completion of the training, he was supported with inputs out of Rain fed Area Development fund for off

season potato and coriander cultivation in 2 acres of land. Besides input assistance from the Government he had invested an amount of Rs 12,000/- of his own fund and worked hard along with his family members. He got a net income of Rs 60,000/- out of 2 initial crops within a period of 4 months. Now he is earning Rs 2,20,000/- per annum from farming and living a life of comfort and dignity.

### Role of technology and innovation

Young farmers are more likely to experiment with and adopt new technologies. For example, drones, automation, and data analytics are transforming how crops are planted, monitored, and harvested. The use of artificial intelligence and IoT (Internet of Things) can help in making agriculture more efficient and sustainable, addressing issues like water scarcity and soil degradation. Innovations like hydroponics, regenerative agriculture, and vertical farming also allow farming to be done in urban areas, making agriculture more accessible to younger generations.

### Support to the youth: Overcoming challenges

While there are several success stories, youth in agriculture still face various challenges. These include limited access to land, capital, and resources, as well as a lack of training and mentorship. To attract more youth towards agriculture, there is a need for policy support, easier access to loans, and educational programs that highlight the potential of modern farming as a viable career.

To inspire young people to pursue jobs in agriculture, we need a multifaceted approach that addresses their obstacles while highlighting the benefits available.

- Raising awareness
- Investing in education
- Providing young agripreneurs with access to land, capital, and resources through initiatives like PM-KISAN and ACABC.
- Encouraging the use of modern technology and digital tools in agriculture to increase its appeal and efficiency for younger generations.
- Collaboration among government, farm industry, and educational institutions is crucial for increasing youth engagement in agriculture.
- The Indian government should continue to design and implement policies that encourage youth participation in agriculture, such as skill development programs, financial incentives, and resource availability.

### Way forward

The new generation of farmers is crucial for the future of agriculture. By embracing technology, sustainable practices, and new business models, they are redefining farming and proving that it can be profitable, impactful, and rewarding. Young farmers are not just cultivating crops; they are cultivating hope for a better, more sustainable future. By investing in youth and making agriculture an attractive career path, we can ensure this vital industry continues to grow and innovate. Agriculture and agri-systems offer enormous opportunities for employment and growth to the country's educated youth. Collaboration among government, industry, and educational institutions is critical in these endeavors, and together we can ensure a bright future for agriculture and the nation.





# AI IN RICE PEST MANAGEMENT

## A COMPREHENSIVE ANALYSIS OF CURRENT APPLICATIONS AND FUTURE PROSPECTS

### About Author

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Rice, as a staple food for over half of the global population, faces significant challenges from insect pests that can devastate crops and threaten food security. Traditional pest management approaches, while valuable, often fall short in providing timely and accurate pest detection and control measures. The emergence of AI technologies has opened new frontiers in agricultural pest management, offering sophisticated tools for early detection, accurate identification, and effective control strategies. Historical approaches to pest management relied heavily on manual inspection and expert knowledge, requiring considerable time and resources while being susceptible to human error. The transition to AI-

powered systems represents a paradigm shift in how we approach pest management, offering automated, accurate, and scalable solutions that can significantly improve crop protection outcomes. Modern pest management systems utilize a layered AI architecture that combines various technologies, including computer vision systems for capturing and processing visual data from the field, machine learning algorithms for pattern recognition and decision-making, deep learning networks for complex feature extraction and classification, edge computing for real-time processing and response, and cloud integration for data storage and distributed computing capabilities. The foundation of effective AI-based pest management lies in robust data collection systems, encompassing high-

resolution imaging devices, IoT sensors for environmental monitoring, drone-based surveillance systems, mobile device integration, and automated data preprocessing pipelines. These systems work in concert to provide comprehensive pest monitoring and management capabilities.

### Deep learning applications in pest identification

Convolutional Neural Networks (CNNs) have emerged as the backbone of visual pest identification systems. These sophisticated networks excel at feature extraction from pest images, pattern recognition across diverse pest species, damage pattern analysis, growth stage classification, and real-time image processing. To address the challenge of limited training data, transfer learning approaches have proven particularly

**Table 1: Yield Loss and Major Pest of major crops**

Crop	Yield Loss	Major Pest
Rice	Upto 41 %	Yellow stem borer, Gall midges, Hispa
Wheat	Upto 7ton/ha	Aphids, Brown mite, Wheat thrips, Ghujhia weevil
Cotton	Upto 100%	Pink bollworm, Whitefly, Tobacco caterpillar
Potato	Upto 95%	Potato tuber moth, Colorado potato beetle, Cutworms
Sugarcane	Upto 25%	Pyrilla perpusilla, Sugarcane aphid, Mealybug
Pulses and Oilseed	Upto 30-35%	White grubs, Weevils, Blister beetle





True: Leaf Folder (Larva )  
Predicted: Leaf Folder (Larva )



True: Stem Borer  
Predicted: Stem Borer



True: Pyrilla Perpusilla  
Predicted: Pyrilla Perpusilla



True: Demsel Fly  
Predicted: Demsel Fly



True: Stem Borer (eggs)  
Predicted: Stem Borer (eggs)



True: Pyrilla Perpusilla  
Predicted: Pyrilla Perpusilla



True: Demsel Fly  
Predicted: Demsel Fly



True: Pyrilla Perpusilla  
Predicted: Pyrilla Perpusilla



True: Demsel Fly  
Predicted: Demsel Fly

**Fig 1: Rice Pest Classification using EfficientNetB0 deep learning model**

effective. These approaches include adaptation of pre-trained models for pest identification, fine-tuning strategies for local pest varieties, domain adaptation techniques, and model optimization for resource-constrained environments. The success of these deep learning applications has significantly improved the accuracy and reliability of pest identification systems.

### Machine learning in pest classification

The field of pest classification has been transformed by various machine learning algorithms, each bringing unique strengths to the challenge. Support Vector Machines (SVM) excel in multi-class pest classification, while Random Forests

provide robust ensemble-based decision making. Gradient Boosting Machines offer improved classification accuracy, and K-Nearest Neighbors enable similarity-based classification. Decision Trees provide interpretable classification rules that can be easily understood by agricultural experts. Successful pest classification relies heavily on effective feature engineering, including morphological feature extraction, behavioral pattern analysis, temporal pattern recognition, environmental correlation analysis, and damage pattern characterization.

### Implementation and current applications

Modern implementations of AI pest management systems focus strongly

on accessibility and ease of use, with smartphone-based pest identification apps leading the way in field deployment. These applications are typically connected to cloud-based decision support systems and real-time monitoring platforms, providing integrated pest management interfaces and user-friendly reporting systems. Furthermore, these AI solutions are being seamlessly integrated with existing agricultural systems, including precision agriculture systems, smart irrigation networks, weather monitoring stations, crop management platforms, and farm management information systems. This integration ensures that pest management becomes part of a holistic approach to agricultural management.

Advanced predictive models have revolutionized pest management by incorporating multiple data sources, including weather pattern analysis, soil condition monitoring, crop phenology tracking, historical pest occurrence data, and climate change impact assessment. Sophisticated algorithms predict

pest population trends through life cycle modeling, population growth prediction, migration pattern analysis, breeding condition assessment, and resistance development monitoring. These predictive capabilities enable proactive pest management strategies, allowing farmers to take preventive measures before pest populations reach damaging levels.

### Challenges and limitations

Despite the significant advances in AI-based pest management, several technical challenges remain. These include data quality and quantity requirements, model accuracy in varied conditions, infrastructure requirements, processing power limitations, and



integration complexity. Practical constraints also pose significant challenges, including the cost of deployment, user training requirements, maintenance needs, connectivity issues, and resource availability. Addressing these challenges requires a coordinated effort from researchers, developers, and agricultural stakeholders.

### Future directions and emerging trends

The future of AI in pest management looks promising with emerging technologies offering enhanced capabilities. Edge AI implementation, blockchain integration, advanced sensor networks, quantum computing applications, and augmented reality interfaces are all set to revolutionize pest management further. Future developments are focusing on system interoperability, scalable solutions, automated deployment, cross-

platform compatibility, and global data sharing networks. These advancements will make pest management systems more efficient, accessible, and effective.

### Economic and environmental impact

The implementation of AI-based pest management systems has demonstrated significant economic benefits, including reduced pesticide usage, lower labor costs, improved crop yields, better resource utilization, and enhanced prediction accuracy. From an environmental perspective, these AI solutions contribute to sustainable agriculture through targeted pest control, reduced chemical usage, biodiversity preservation, ecosystem protection, and resource conservation. The positive impact on both economic and environmental aspects makes these systems increasingly attractive for modern agriculture.

### Conclusion and recommendations

The integration of AI, ML, and DL in rice pest management represents a significant advancement in agricultural technology. While challenges exist, the potential benefits in terms of improved efficiency, accuracy, and sustainability make these technologies increasingly valuable for modern agriculture. Priority areas for future research include enhanced model accuracy, reduced resource requirements, improved accessibility, integration capabilities, and sustainable implementation strategies. To facilitate wider adoption, focus should be placed on technology standardization, infrastructure development, training programs, financial support systems, and international collaboration. Continued research, development, and implementation of these systems will be crucial for addressing future food security challenges.



[Bharatagri: Revolutionizing Indian agriculture](#)



[From Tea Stall to Farming Frontiers: The Journey of Gramik's Founder](#)





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