



ISSN : 2582-6344  
Volume - 4, Issue -7

# Times of Agriculture

A Resonance in Agriculture  
Monthly Agriculture E-Magazine

July-2024

# BharatAgri

Revolutionizing Indian Agriculture



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# Times of Agriculture

A Resonance in Agriculture

## From the Editor's Desk

Dear Readers,

We hope you enjoy the July issue of **Times of Agriculture**. Yesterday, on **July 23**, the Honorable Finance Minister announced the budget, allocating **1.52 lakh crore rupees** to the agricultural sector, which is higher than last year. In this budget, the minister emphasized natural farming, setting a goal to involve one crore farmers in natural farming this year. Additionally, new crop varieties will be developed, along with many other important issues addressed in the budget.

However, any technology needs to reach farmers to be effective. Therefore, it is essential that every new technology and variety reaches the far corners of the country. Bharat Agri is working in this direction. It is an agri-startup launched in 2017, providing farmers with fungicides, weedicides, insecticides, agricultural tools, and seeds through an e-commerce platform, reaching distant parts of the country. In this issue, we have made Bharat Agri our cover story, aiming to provide readers with detailed information about this startup.

The primary objective of such startups is to deliver new technologies, chemicals, and quality seeds to farmers, which is a significant step towards their upliftment. This startup not only supplies inputs to farmers but also offers expert advice, and solutions to crop-related problems. The country needs more such startups that can reach out to farmers and deliver various agricultural inputs at the grassroots level.

Dear readers, we hope you enjoy this July issue. We welcome your suggestions and comments, which inspire us to work better.

Thank you very much, and enjoy reading!

**Editor-In-Chief**

**ISSN No.** : 2582-6344  
**Frequency:** Monthly  
**Month** : July  
**Volume-** 4, **Issue-** 7  
**Pages in Magazine-** 38

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## BharatAgri

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# AGRICULTURE UPDATES



## ₹ 1.52 Lakh Crore Boost for Agriculture in Union Budget 2024-25

In a significant boost to the agriculture sector, the Union Budget 2024-25 has allocated ₹1.52 lakh crore, introducing various measures to enhance productivity and resilience. Union Finance and Corporate Affairs Minister, Smt. Nirmala Sitharaman, unveiled key initiatives, including the implementation of Digital Public Infrastructure (DPI) in agriculture. Over the next three years, this initiative, in collaboration with state governments, will cover farmers and their lands, with a digital crop survey for Kharif crops being undertaken in 400 districts this year. Details of 6 crore farmers and their lands will be included in registries, and Jan Samarth-based Kisan Credit Cards will be introduced in five states. To achieve self-sufficiency in pulses and oilseeds, the government will enhance production, storage, and marketing, aiming for 'atmanirbharta' (self-reliance) in oilseeds like mustard, groundnut, sesame, soybean, and sunflower. Large-scale clusters for vegetable production will be developed near major consumption centers, promoting Farmer-Producer Organizations, cooperatives, and start-ups to streamline supply chains.

Financial support will be provided for establishing Nucleus Breeding Centres for Shrimp Broodstocks, with NABARD facilitating financing for shrimp farming, processing, and export. Highlighting the government's commitment to farmers, higher Minimum Support Prices have been announced for all major crops, ensuring at least a 50% margin over costs. Additionally, the Pradhan Mantri Garib Kalyan Anna Yojana has been extended for five years, benefiting over 80 crore people.



## After USA, AMUL to venture into Canada

The Gujarat Cooperative Milk Marketing Federation (GCMMF), which markets under the Amul brand, is expanding its US product range after launching fresh milk in partnership with the Michigan Milk Producers Association. GCMMF's Managing Director, Jayen Mehta, announced today that half of the fresh milk sales are coming from Amul Gold. He stated, "This is an opportunity we sense for not just milk, but even for other fresh products like dahi, buttermilk, paneer, sweets, lassi, and so on." "We have already launched our fresh milk in the US market. Amul Gold currently accounts for half of our total sales. In the next one month, we will be expanding into Canada by launching fresh milk," Jayen Mehta, Managing Director of GCMMF, told Business Line on the sidelines of the 116<sup>th</sup> Annual General Meeting of the IMC Chamber of Commerce and Industry in Mumbai on Friday. GCMMF markets and sells milk and milk products under the brand Amul.

In March, Amul tied up with the Michigan Milk Producers Association for selling fresh milk in the East Coast and Midwest markets of the US. GCMMF is already exporting Amul products like cheese, frozen snacks, beverages, and ice creams to the Canadian market. During the AGM of the IMC Chamber of Commerce and Industry, Mehta mentioned, "New opportunities and challenges" as it is already helping countries like Sri Lanka and Kenya to set up milk cooperatives on the lines of Amul. As Amul sets its vision on global markets, GCMMF is investing ₹11,500 crore over the next three years to expand its milk processing and ice cream manufacturing network in India.



# Amul

## ICAR launched ‘One Scientist, One Product’ scheme

The Indian Council of Agricultural Research (ICAR) will launch its ‘One Scientist-One Product’ programme on July 16<sup>th</sup> to improve research in the field of agriculture and animal husbandry. Explaining the programme, ICAR Director-General Himanshu Pathak told reporters in Delhi that the ICAR had given a target to all 5,521 scientists under the institution to come up with a product, a technology, a model, a concept or a good publication. At the beginning of every year, the scientist or a group of scientists will have to identify the product, and the ICAR will map the scientist’s or the group’s work. *“We will monitor it at the institute level every three months and at the headquarter level every six months. This is a long plan,”* he said.

The scheme has key objectives, including target-oriented research, where each scientist works on a specific goal such as developing seed varieties or technologies. It prevents duplication by assigning unique targets to scientists and includes regular progress monitoring every three months and biannual self-assessments. Long-term goals include releasing 100 new seed varieties within the government’s 100-day plan and increasing the area under climate-resilient paddy seeds from 15% to 25% of the total kharif acreage. The scheme will work for five years. *“This year, we’re prioritising seed hubs for high-yielding oilseeds and pulses varieties. ICAR is also working to develop 100 new seed varieties and 100 farm technologies in 100 days as part of the Centre’s 100-day action plan.”*



## Andhra Pradesh's Natural Farming Model Win Gulbenkian Prize

The Andhra Pradesh government initiative, Andhra Pradesh Community Managed Natural Farming (APCNF), has won the 2024 Gulbenkian Prize for Humanity. The APCNF will share the one million euro prize money with the renowned soil scientist Rattan Lal and the SKEEM of Egypt. They were awarded the prize for their substantial contribution to global food security, climate resilience and ecosystem protection. The APCNF shares this year's one million euro prize money with two others-renowned soil scientist Rattan Lal and Egypt-based SEKEM, a conglomeration of NGOs and businesses championing holistic approaches to tackle climate change. The three recipients of the award were selected out of 181 nominations with nominees from 117 nationalities by a jury chaired by Dr. Angela Merkel, former German Chancellor and the current president of the jury of the CGF.

The APCNF is a Statewide programme supporting smallholder farmers to switch from chemically intensive agriculture to 'natural farming', through practices such as using organic residues and minimising tillage to improve soil health, reintroducing indigenous seeds and diversifying crops, including trees. The initiative was launched in 2016 by the Government of Andhra Pradesh to find a sustainable solution to farmers' distress caused by economic crises in agriculture and climate change. Andhra Pradesh is also supporting 12 other States in the country and this year (2024-25) the State plans to send its farmers to five different countries to take this seeding of natural farming to farmers there. "The Andhra Pradesh government has decided to use this prize money for seeding the programme in other countries.





## **NABARD announces Agri SURE fund to promote startups and rural enterprises**

The Government is poised to launch the 'Agri Fund for Start-Ups & Rural Enterprises' (AgriSURE) to support start-ups and agripreneurs through investments in sector-specific, sector-agnostic, and debt Alternative Investment Funds (AIFs), as well as direct equity support to start-ups working in Agriculture and allied sectors. This initiative aims to foster innovation and sustainability in India's agricultural sector through the establishment of a Rs 750 crore Category-II Alternative Investment Fund (AIF). The fund will offer both equity and debt support, specifically targeting high-risk, high-impact activities in the agriculture value chain. The announcement was made at the Pre-Launch Stakeholder meet held at NABARD Headquarters in Mumbai. The fund will be set up with an initial corpus of ₹750 Crore with 250 crores each from NABARD and the Ministry of Agriculture, and 250 crores from other institutions. The fund will focus on innovation in agriculture, enhancing the farm produce value chain, creating rural infrastructure, generating employment and supporting Farmers Producer Organizations (FPOs). The fund is designed to operate for 10 years, extendable by two or more years.

Underscoring its commitment to fostering innovation, NABARD also launched the AgriSURE Greenathon 2024. The hackathon aims to address three key problem statements: "Smart Agriculture on a Budget," which tackles the high cost of advanced agriculture technologies that hinder small and marginal farmers. "Turning Agri-Waste into Profitable Business Opportunities," focusing on transforming agricultural waste into profitable ventures; and "Tech Solutions Making Regenerative Agriculture Remunerative," which aims to overcome economic hurdles in adopting regenerative agriculture practices.



## **Haryana removes age gap on farmer aid scheme**

The government of Haryana recently made a major change to the “Mukhyamantri Kisan Evam Khetihar Mazdoor Jeevan Suraksha Yojana,” a program that helps farmers and farm workers get money. These changes, which took effect after a recent government meeting, get rid of the age limits that were on the scheme’s recipients before. Before the most recent change, the plan said that only people between the ages of 10 and 65 could get compensation. The recent government meeting, which was led by Chief Minister Nayab Singh Saini and also included Agriculture Minister Kanwar Pal, decided to get rid of these age limits. So, now people outside of these age groups can also take advantage of the benefits of this scheme. This includes kids younger than 10 and adults older than 65.

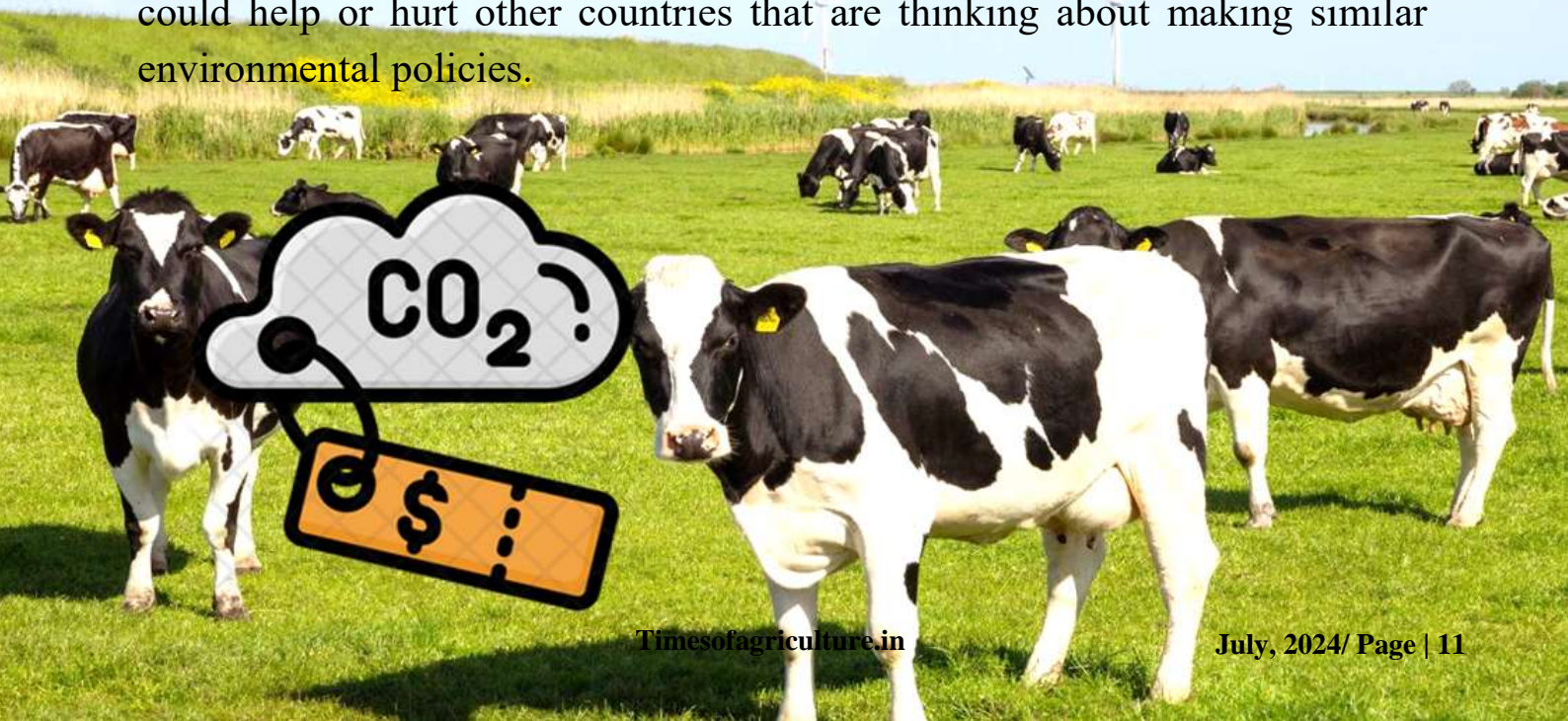
The ‘Mukhyamantri Kisan Evam Khetihar Mazdoor Jeevan Suraksha Yojana’ is an insurance program for farmers and farm run by the government. The program was made to give people financial protection. It offers up to 2 lakhs INR in insurance coverage in case of accidental death or permanent incapacitation of the insured. The plan doesn’t ask beneficiaries to pay a premium, which makes it easy for everyone to use. It started in 2019 and is meant to cover millions of people in the state’s farming community. The lifting of the age limit is expected to expand the safety net that the Haryana government provides, making sure that all people working in agriculture, no matter what age, can get financial help in the unfortunate event of an accident involving farm machinery. This step is part of a larger strategy review of agricultural and horticultural projects, with the Chief Minister in charge of making sure they are carried out quickly and effectively.



## Denmark imposes the worlds first carbon tax on livestock emission

Denmark's government approved a plan to put in place the world's first carbon emissions tax that targets farms. This is a big step for the country in its efforts to leave less of an impact on the environment, which are mostly driven by its strong pork and dairy production sectors. Agriculture is Denmark's biggest source of pollution, even though the country exports a lot of dairy and pork goods. Because of this, the Danish government has decided to tax each cow 672 krone (\$96) a year starting in 2030. This tax is based on the greenhouse gases that cows produce. This project is part of a bigger deal that includes putting 40 billion krone (\$3.7 billion) into projects that fix the environment, like planting trees and making wetland areas.

The Danish dairy business supports climate goals, but they have mixed feelings about the way taxes are being used. Some important people are worried about how the measures might affect competition and how well they work. Critics say the policy is too complicated and comes with a big risk that can't be promised to work. They say it could stop people from investing right away in green technologies. The first few years of the tax will bring in money to help the farming industry switch to better methods. But there is a call for the tax system to be in line with EU rules so that Danish farmers don't lose out in the market. Denmark's innovative tax plan could help or hurt other countries that are thinking about making similar environmental policies.



## **Agriculture sector has an average annual growth rate of 4.18 % over the last five years**

Economic Survey 2023-24 presented in the Parliament on 22 July 2024 by Union Finance and Corporate Affairs Minister Smt. Nirmala Sitharaman. As per the survey report, in the last five years, the agriculture sector has grown at an average growth rate of 4.18 per cent per year. The country also has a comfortable stock of food grains, around 40 per cent of which is distributed to two-thirds of the population free of cost. India exports more than 7 per cent of its food grains. The growth in the agriculture and allied sectors has contributed positively to the growth of the Indian economy. Economic Survey says that the Indian agriculture sector provides livelihood support to about 42.3 per cent of the population and has a share of 18.2 per cent in the country's GDP at current prices.

Economic Survey suggests that to promote efficiency in agriculture marketing, and improve price discovery, the government implemented the e-NAM Scheme and as of 14<sup>th</sup> March 2024, more than 1.77 Crore farmers and 2.56 Lakh traders have been registered on the e-NAM portal. The Government of India launched the scheme to form and promote 10,000 FPOs in 2020 with a budget outlay of ₹6.86 thousand crore till 2027-28. As of 29 February 2024, 8,195 FPOs have registered under the new FPO scheme, and equity grants of ₹157.4 crore were released to 3,325 FPOs. Credit guarantee cover worth ₹278.2 crore was issued to 1,185 FPOs.

This survey also highlighted that as of January 31, 2024, banks issued 7.5 crore Kisan Credit Cards (KCC) with a limit of ₹9.4 lakh crore. An area of 90.0 lakh hectares has been covered under micro irrigation in the country under the Per Drop More Crop (PDMC) scheme from 2015-16 to 2023-24. It is estimated that for every rupee invested in agricultural research (including education), there is a payoff of ₹13.85.



**COVER  
STORY**

# BharatAgri

**Revolutionizing Indian Agriculture**



## About the Author

**Siddharth Dailani**

*Co-founder, BharatAgri*



India's agricultural sector is the backbone of the nation's economy, employing over half of its workforce and contributing significantly to GDP. However, traditional farming practices often grapple with inefficiencies, leading to lower yields and income for farmers. BharatAgri was born out of this very challenge, with a vision to **transform Indian agriculture through technology-driven solutions.**

## **The Vision: Empowering Farmers Through Innovation**

Founded in 2017 by Sai Gole and Siddharth Dialani, BharatAgri's mission is to empower Indian farmers by leveraging the power of technology. They believe every farming family is an entrepreneur, and their goal is to equip them with the knowledge and resources they need to achieve sustainable growth and prosperity.

## **Founders' Journey: A Commitment to Understanding the Ground Realities**

Unlike many agritech startups, BharatAgri's founders, Sai and Siddharth, took a unique approach. Before embarking on their entrepreneurial journey, they dedicated two complete agricultural cycles to hands-on farming. This immersive experience provided them with a firsthand understanding of the challenges faced by farmers, including agronomy, soil health, plant diseases, access to farm inputs, and achieving fair market prices for produce.

Equipped with this invaluable knowledge, they embarked on a mission to develop practical solutions. They conducted rigorous field trials near Pune to refine their advisory services and ensure they were effective and accessible to farmers across diverse geographical regions. Today, BharatAgri's impact extends to millions of farmers across India, providing them with actionable insights, doorstep delivery of farm inputs, and a commitment to sustainable agricultural practices.



Farm-level personalization

Weather Based Dynamic Advisory

Satellite Based Crop Monitoring

Decentralized network of 200 sellers

Multiple regional logistics partners

Convenience: 3 Day delivery

Inhouse intelligence to select right logistics partner and marketplace seller

100% Algorithm generated advisory



# Transforming Agriculture with Technology

BharatAgri operates as a comprehensive e-commerce platform that caters to the multifaceted needs of Indian farmers. Here's a closer look at the pillars of their success:

## *Data-Driven Approach*

BharatAgri harnesses the power of data analytics, artificial intelligence (AI), and machine learning to deliver personalized recommendations and solutions. This ensures that farmers receive targeted advice specific to their farm's unique needs and local conditions.

## *AI-Powered Farm Advisory Services*

Farmers can register on the BharatAgri platform and provide details about their farms, including crop types, land area, irrigation methods, and soil composition. This data is then analyzed by AI-powered systems, along with weather patterns, soil maps, and satellite imagery. Based on this comprehensive data set, the platform predicts potential pest outbreaks or crop diseases, enabling proactive advisories to be issued to farmers. These advisories are designed to prevent problems before they arise and optimize crop growth throughout the season. Farmers also receive recommendations on managing specific diseases or challenges affecting their crops, including suggestions for appropriate fertilizers, pesticides, and other interventions.

## *Addressing Quality Concerns*

BharatAgri understands the importance of trust in the agricultural sector. The platform ensures the authenticity of all products, addressing concerns that farmers may have about quality and reliability when purchasing from local stores. This not only empowers farmers to make informed decisions but also fosters long-term loyalty to the BharatAgri brand.





## Streamlined Procurement of Agricultural Inputs

In addition to expert advice, BharatAgri allows farmers to conveniently purchase high-quality agricultural inputs directly from the platform. This eliminates the need for farmers to travel to distant markets or rely on middlemen, often leading to inflated prices or counterfeit products. Through BharatAgri, farmers can access a diverse product portfolio, including those not readily available locally, at competitive prices. Orders are placed conveniently through mobile devices, with doorstep delivery within a short timeframe (typically 3-4 days).

### Overcoming Challenges: A Catalyst for Innovation

BharatAgri's journey has not been without its challenges. Here's a look at some of the hurdles they've overcome and how they've adapted:

- **Smartphone Penetration:** Initially, low smartphone penetration in rural India posed a challenge for reaching farmers effectively. However, with the increasing affordability of smartphones and internet access, particularly due to the rise of platforms like YouTube and Facebook, BharatAgri has capitalized on this shift by adopting **mobile-first outreach strategies**.
- **User Education and Multilingual Support:** Despite smartphone adoption increasing, a significant number of farmers still require support in understanding and applying scientific farming advice and navigating online purchases in their native languages. To address this gap, BharatAgri has developed an **AI-powered customer support system**, including a user-friendly chatbot that resolves a substantial portion of user queries efficiently. This not only enhances customer service but also empowers farmers with the confidence to navigate the platform and access the resources they need.

140+

Million Farmers get Personalized Farming Solution

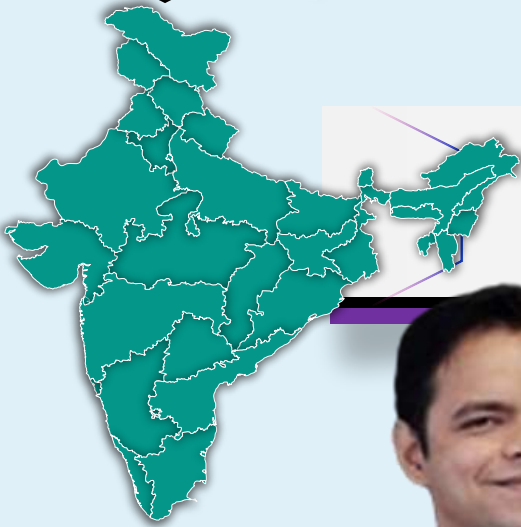


Bharat Agri boasts an active user base of

2M+ Farmer

1 Lakh

Orders placed per month by Farmers on the Bharat Agri platform.



Bharat Agri delivered products across India on

19K+ pin codes



Sai Gole

- **Technological Integration and Expansion:** BharatAgri recognizes the need for continuous improvement and technological innovation to stay ahead of the curve. They are constantly **upgrading their platform features** to provide an even more seamless and user-friendly experience for farmers. This includes:
- **Advanced Recommendation Systems:** BharatAgri is moving beyond basic recommendations by incorporating sophisticated AI algorithms that can suggest not just individual products but also **integrated crop management solutions**. This holistic approach considers factors like soil health, weather patterns, and potential pest or disease threats to provide farmers with a comprehensive strategy for optimizing crop yields.
- **Voice-Enabled Support:** Understanding the limitations of text-based communication in rural areas with varying literacy levels, BharatAgri is exploring the integration of **voice-enabled support systems**. This will allow farmers to access information and ask questions in their native languages using voice commands, making the platform even more accessible and inclusive.

BharatAgri's dedication to empowering farmers has resulted in impressive achievements in a short period. The company has garnered strong investor backing from marquee investors like Arkam Ventures, Capria Ventures, and India Quotient, fueling their growth and expansion plans. They have successfully raised \$15.7 million in funding and boast a user base exceeding 2 million active farmers, demonstrating widespread adoption and trust within the Indian agricultural community. Farmers place over 100,000 orders per month on the BharatAgri platform, with products being delivered to over 19,000 pin codes across India, signifying the impact.



BharatAgri is making in transforming agricultural practices nationwide. Additionally, the platform offers a comprehensive product portfolio exceeding 10,000 SKUs (Stock Keeping Units), encompassing a wide range of essential agricultural inputs, simplifying the procurement process and catering to the diverse needs of farmers.

## Looking Ahead: The Future of BharatAgri

BharatAgri is poised for continued growth and innovation, with a vision that extends beyond product sales to encompass the holistic development of the Indian agricultural sector. They plan to expand their geographical footprint to new regions across India, ensuring that their services benefit an even larger population of farmers. The company is committed to continuously enhancing its product portfolio, incorporating the latest advancements in agricultural technology and sustainable solutions. Additionally, BharatAgri envisions itself as a comprehensive knowledge hub for farmers, planning to develop educational resources and training programs to empower farmers with the latest knowledge and best practices in sustainable agriculture.

## Conclusion

BharatAgri's story is one of dedication, innovation, and a deep understanding of the challenges faced by Indian farmers. Their data-driven approach, AI-powered solutions, and commitment to accessibility are revolutionizing the way farmers operate. As BharatAgri continues to grow, its impact on Indian agriculture promises to be even more profound, ensuring a brighter future for farmers and the nation as a whole.

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## Previous Issues



## Website Statistics (June 2024)

171K

Monthly  
Pageview

69K

Monthly  
Visitor

1.9M

Monthly  
Impression

## Social Stats



6.5K



5.1K



6.7K



1.7K



2K



## INDIA'S CHALLENGE FEEDING A NATION, CONTRIBUTING TO THE WORLD

### About Author



**Aswani Kotheri**

Business Development & Partnerships at Think Round Inc., San Francisco

The world faces a daunting challenge: ensuring enough food reaches everyone's table. This complex issue, known as global food security, is threatened by a multitude of factors, demanding innovative solutions and international cooperation. Let's explore these challenges and potential solutions, with a specific focus on India's role in the global food security equation.

### **A Perfect Storm: Demand Outpaces Supply**

At the heart of the problem lies a growing population. Projections estimate Earth will house 10 billion people by 2050, placing immense pressure on food production systems. Unfortunately, these systems face significant headwinds. Land degradation, caused by deforestation and desertification, shrinks the amount of arable land available. Climate change adds another layer of complexity, with extreme weather events disrupting agricultural production and reducing crop yields. The irony is stark: as the need for food increases, our ability to produce it steadily declines.

### **India's Challenge: Feeding a Nation, Contributing to the World**

India, the most populous country globally, grapples with its own food security challenges. Despite significant progress in recent decades, achieving self-sufficiency remains a critical objective. Additionally, ensuring equitable distribution and access to food for its vast population remains a challenge. However, India also presents a unique opportunity. With a population of approximately 1.44 billion people, India accounts for around 17.3% of the world's 8 billion inhabitants.

### **Beyond production: Distribution and waste in India**

The issue of food security in India goes beyond just production. While the country boasts the title of the world's largest producer of milk, pulses, and certain spices, a complex distribution system and post-harvest losses can leave some populations vulnerable. Improving infrastructure for storage and transportation can significantly reduce food waste and improve access across the nation.

### **Sustainable concerns: Can India lead the way?**

India's journey towards sustainable food production holds immense potential for the world. The country is actively exploring climate-smart agricultural practices, such as water-saving irrigation techniques and promoting crops resilient to extreme weather events. Additionally, India's vast pool of scientific talent can contribute significantly to research and development of new and improved crop varieties.

### **A multifaceted approach: India's contributions**

India can play a key role in building a more secure global food system. Here are some ways the country can contribute:

- **Sharing knowledge and expertise:** India's advancements in sustainable agriculture can be shared with other developing countries through training programs and technology transfer.
- **Promoting regional cooperation:** Collaboration with neighboring countries can create more robust food security networks in South Asia.
- **Investing in agricultural research:** Continued research on drought-resistant crops and improved farming techniques can benefit not just India, but the entire world.
- **Building a resilient food system:** Investing in infrastructure, storage facilities, and early warning systems for extreme weather events can improve India's own food security and provide a model for other nations.

### **A call to action: A more nourished world awaits**

The challenges of global food security are significant, but India's role as a potential leader and active participant in solutions cannot be overstated. Through innovation, collaboration, and a commitment to sustainable practices, we can build a more secure food system that nourishes a growing population. By addressing these issues and harnessing India's vast potential, we can ensure a future where everyone has access to the food, they need to lead healthy and productive lives. ■



# GREEN TEXTILE TECHNOLOGY

## About Author



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The term "green production" refers to a production that lessens ecological hazards and scarcities and pursues sustainable development without harming the environment. Eco-friendly production is referred to as green production. Products are manufactured from environmentally friendly materials, and waste is decreased by recycling, reuse, and remanufacturing. Both organic apparel and recycled fashion can support environmentally sustainable growth.

Green or eco-friendly production involves practises like reducing and recycling. The field of "green technology" encompasses a recurrent set

of energy production and non-toxic clean product tactics. Green textiles have the potential to significantly alter the apparel industry's approach to environmental challenges. Making eco-friendly choices can help protect our natural resources.

## **Pollutions due to textile industries**

One of the sectors of the global economy that releases the most pollutants is the textile industry. Surveys reveal that textile waste takes up almost 5% of all landfill space. In addition, the processing and dyeing of textiles contributes 20% of all freshwater pollution. They become worthless and barren in the long run because it pollutes the land. At least 8,000 chemicals are used to turn basic materials into textiles. The majority of them are scattered on the crop but fall on the ground. Similar to this, textile factories discharge toxic waste onto surrounding land. The majority of the water consumption (72%) takes place in the chemical wet processing. Other major uses of water in the textile industries are following:

- wet processing (dyeing, printing, and finishing)
- water treatment for purpose cooling (processing cooling tower)
- steam generation (boiler water)

- domestic purpose (soap solution).

From wet processing mills, two main types of fluid (waste water) are produced. Fluent is produced during the primary dyeing process, and this fluent comprises strong chemicals and intense colours as well as a high load of pollutants such biological oxygen demand (BOD) and chemical oxygen demand (COD).

## **Methods to develop eco-friendly textiles**

### **1. Recycling**

The technique of recycling used garments and other textiles for reuse or material recovery is referred as textile recycling. The product's renewability comes first and foremost. Resources that can be replaced quickly are known as renewable resources. It serves as the industry's cornerstone for recycling textiles. Natural and synthetic fibres differ fundamentally when it comes to recycling clothes.

- Sorting is done on the unwearable material that arrives by colour and material type. Fabric that has undergone colour sorting does not require additional dyeing.
- The colour sorting eliminates the need for redyeing, which saves energy and reduces pollution.



Then, the textiles are drawn into fibres or shred, occasionally introducing new fibres into the yarn. Materials are pulled into fibres or shred. Other fibres could be woven into the yarn depending on its required purpose.

However, not all fibres are spun into yards. For textile filling, such as in mattresses, some are compressed.

For textiles made of polyester, the clothing is first shredded, then granulated, and then turned into polyester chips. These are then melted and utilised to make fresh polyester fibres that are then used in new polyester fabrics.

## 2. Organic clothing

For textiles to be considered organic, they must be produced from natural materials like plants or animals that have been harvested or from organic manufacturing. When dyes are used on organic clothing, they should either be made from plants or minerals, or if not, they should be eco-friendly, low impact dyes. In the dyeing process, no heavy metals or other dangerous chemicals should be utilised. All facets of the organic apparel industry are approached with an ethical and environmentally conscious mindset. Wet processing techniques that are sustainable and advantageous are required.

## 3. Natural fibers

Natural fibres are those created by geological, animal, and plant processes. They can be utilised as a part of composite materials, where the qualities are affected by the orientation of the fibres. Additionally, natural fibres can be matted into sheets to create goods like paper, felt, or cloth. Some natural fibres are as following:

● **Plant fibres-** Abaca, Bamboo, Coir, Cotton, Figue, Flax, Hemp, Jute, Kapok, Pine, and Sisal are examples of plant fibres.

● **Animal fibres-** Alpaca, Angora, Byssus, Camel hair, Cashmere, Catgut, Llama, Mohair, Pashmina, Rabbit, Silk, Wool, and Yak are examples of animal fibres.

● **Mineral fibre-** Asbestos



● **Additional natural fibers:** Rayon, Azlon, and Organic Linen.

## 4. Natural dyes

Natural dyes come from plants, invertebrates, or mammals. They can also be colourants. Vegetable dyes derived from plants, including roots, berries, bark, leaves, and wood, as well as other biological sources like fungi and lichens, make up the majority of all natural colours.

● **Animal dyes-** Cochineal insect (red), cow urine (Indian yellow), lac insect (red, violet), murex snail (purple), octopus/cuttlefish, and other animal-derived colours (sepia brown).

● **Plant dyes-** Catechu or Cutch tree (brown), Gamboge tree resin (dark mustard yellow), Himalayan rhubarb root (yellow), Indigofera plant (blue), Kamala tree (red), Larkspur' plant (yellow), Madder root (red, pink, orange), Myrobalan fruit (yellow, green, black), Pomegranate peel (yellow), and Weld herb are examples of plant-derived dyes (yellow).

## 5. Additional textile methods using natural resources

**Non-chlorine bleaching-** Hydrogen peroxide is used in chlorine-free bleaching to whiten clothes. The natural breakdown of hydrogen peroxide into oxygen and water results in no dangerous chemical residue on the fabric

or in the effluent. It is also known as Green Bleach at times.

## Low-temperature dyeing procedures:

By operating at ambient temperatures and requiring no steaming of the fabric to set or fix colours, cold or low temperature dye methods conserve energy.

**Dry heat fixation** Reactive dyes generated with the inkjet technique can be fixed via dry-heat fixation. Instead of using steam, the coloured or printed fabric is run over hot iron plates. By adopting a different technique from steam repairing, this technique saves both water and energy.

**Reusing dye bath-** It is the process of using previously used dye bath water in new dye baths. Since somewhere between 10% and 50% of the dye from one bath does not bond to the fabric, there is a significant amount of water saved by using the bath again.

**Eco bleach:** Eco bleach whitens natural fabrics by combining sunshine with the phosphates and silicates found naturally in cow dung. This method of bleaching is the greenest.

**Ink-jet printer-** ink-jet printing is a technique for transferring pigment and dye to fabric. Due to its lower water usage, water wastage, and energy consumption when compared to other commercial printing methods, it is regarded as the most efficient and





environmentally friendly way of printing.

**Eco finishing:** A finishing process that is most suitable and within the norms of eco label standards is called Eco Finishing.

### **Reusing water in the textile sector**

Water is used extensively in the textile business. Throughout the whole production process, water is needed to clean the raw materials and for several flushing processes. The waste water produced throughout the various production phases needs to be cleaned from fat, oil, colour, and other contaminants.

The varied requirements of each fibre (silk, cotton, polyester, etc.), of the textile process (such as scouring, desizing, dyeing, washing, etc.), and of the different quality required for the finished fabric make it challenging to set a general quality standard for textile water reuse.

### **Benefits of eco clothing besides being more environmentally friendly**

- The harmful chemicals on our conventional clothing come into ready and prolonged contact with our skin, causing us skin irritations and even allergies.
- Mainstream clothing is frequently contaminated with chemical dyes and garment finishes (e.g., finishes to make your clothing wrinkle-free, anti-bacterial, etc.).

- Some of these substances may even enter our bodies through our skin. Eco-friendly clothing is not only more pleasant to wear, but also better for our skin.

- For instance, in warm weather, organic cotton is absorbent, soft, and easy to wear. Eco-clothing made of soy fibre is lightweight and even has UV protection.

### **Restriction of eco-friendly textiles**

#### **Fibres**

- Price can fluctuate by harvest results or agricultural politics.
- Lower durability, fibre treatments can improve this considerably.
- Moisture absorption, which causes swelling of the fibres.
- Lower strength properties, particularly its impact strength.

#### **Dyes**

**Price-** Compared to synthetic dyes, natural dyes may require a greater quantity to colour a certain amount of fabric. For instance, five grammes of synthetic dye can colour one pound of cotton, while 230 grammes of natural dye are required to colour the same amount of fabric. Because of this, natural colours cost more to use than synthetic dyes.

**The colour payoff-** Natural dyes' colour payoff has a tendency to diminish soon. Furthermore, quality might not be as reliable as what synthetic dyes can produce.

**Availability-** Another problem with natural dyes is their lack of accessibility.

In contrast to synthetic dyes, which can be made year-round in laboratories, it might be challenging to make since the availability of raw materials can vary from season to season, place to place, and species.

**Effects that can be harmful-** Natural dyes can also be somewhat damaging. Hematein and haematoxylin, which are present in logwood, can have negative consequences when inhaled, consumed, or absorbed through the skin.

### **Conclusion**

Since the eco-fashion sector is still in its development, clothing producers and fashion designers currently bear the primary responsibility for using sustainable materials and practises. Eco-friendly apparel and accessories are expanding rapidly in the fashion industry. The fashion business is focusing on organic clothing rather than synthetic or fibre clothes that place a lot of pressure on nature, attracting brilliant designers from all over the world.

We must take the initiative in this important step as well as the fashion industry, which must support the chart. To achieve this, we must recycle the fabrics and put them to reversible use. As a result, the clothes will last longer and less pressure will be placed on farmlands to grow a large quantity of cotton using chemicals.

The best method to build an eco-friendly fashion industry is to free the land from chemicals.





# BEE VECTORIZING

## HARNESSING POLLINATORS FOR SUSTAINABLE AGRICULTURE

### About Author



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Agriculture has witnessed various advances over the years, but one of the most fascinating and ecologically healthy is Bee Vectoring Technology (BVT). This technology uses bees' natural behaviour to deliver biological compounds that protect crops from diseases, increase yields, and minimize the need for

chemical pesticides. Bee vectoring is the process of utilizing commercial bees to deliver natural control agents to flowering crops in order to manage major crop diseases and pests while boosting crop quality and productivity.

### What is bee vectoring technology?

Bee Vectoring Technology uses bees, specifically honeybees and bumblebees, to transport and disperse beneficial microbial agents to crops. These agents, which are mainly fungi or bacteria, are carried to plants by bees while foraging for nectar and pollen. Before leaving the hive, the bees go through a specifically built dispenser containing biological substances. As they visit flowers, they deposit these agents, which colonize the plants and protect them against pests and disease.

BVT has developed a natural precision agriculture system that replaces chemical pesticides and ineffective crop protection spray

treatments with organic pesticide alternatives for commercially grown bee crops. BVT's Precision Vectoring is completely safe for bees and may eradicate trace amounts of natural pesticides. When compared to traditional chemical pesticides, it provides better crop protection and productivity while also enhancing soil, microbial, and environmental health.

### How does BVT work?

BVT works in three steps, which are as follows:

**Dispenser system:** A dispenser carrying biological agents is positioned at the entrance of the bee hive. As the bees leave the hive, they pass through the dispenser and pick up the agents on their bodies.

**Pollination and distribution:** Bees naturally pollinate crops, transferring beneficial microorganisms from the bees to the plants.



**Colonization:** Once on the plants, biological agents colonise their surfaces, forming a protective barrier against infections and pests. Some agents can even promote plant growth and improve immune responses.

### **The working concept of bee vectoring technology (BVT) system**

The BVT inoculum delivery mechanism is housed within the shell of a commercial wasp nest. The dispenser is a detachable tray that contains powdered crop control inoculum and product mix for bees to pick up as they exit the hive. When the bees come into contact with the flowers, they deposit a small amount of Vector it powder on each plant they visit, with a visit rate of about 10 per minute. Beekeeping Technology (BVT) works with commercial beekeepers employed by farms to pollinate crops. BVT built a honeycomb dispenser with a patented natural and organic fungicide in powder form. When the bees leave the hive, they go through the powder before transporting it to the crops. When bees land and shake to release pollen from plants, the fungicide collects in the blooms, forming a barrier against some pests. It is a biological agent that serves another biological agent.

### **Benefits of bee vectoring technology**

**Eco-friendly:** BVT significantly reduces the need for chemical pesticides, which can harm beneficial insects, contaminate water supplies, and pose health risks to humans. By utilizing natural pollinators and biological agents, BVT supports sustainable farming practices.

**Targeted application:** Unlike spraying methods, which can result in the widespread application of chemicals, BVT ensures that the protective agents are delivered directly to the plants that need them. This precision reduces waste and minimizes environmental impact.

**Enhanced crop protection:** The beneficial microbes used in BVT can offer protection against a range of fungal, bacterial, and viral diseases. Additionally, some agents can improve plant vigor and yield by promoting better nutrient uptake and growth.

**Cost-effective:** BVT can lower the overall cost of crop protection. Reduced reliance on chemical pesticides means lower input costs for farmers. Moreover, healthier plants and higher yields can lead to increased profitability.

**Supports pollinator health:** By integrating bees into the crop protection process, BVT highlights the importance of pollinators in agriculture. Healthy bee populations are crucial for the pollination of many crops, and BVT promotes practices that protect and support these essential insects.

### **Challenges and considerations**

While BVT presents numerous advantages, it is not without its challenges. The effectiveness of the technology can be influenced by factors such as weather conditions, bee health, and the specific crop being treated. Additionally, there is a need for ongoing research to identify the most effective microbial agents and to develop best practices for different agricultural settings.

### **Revolutionizing the agricultural sector through bee vectoring**

Agriculture is undergoing a modern revolution with enormous market potential for natural pesticides. This transformation is creating numerous opportunities in food production and biological processes. The sector is poised for rapid growth, needing to produce 70% more food over the next 20 years to meet the demands of a growing population. Bees play a crucial role in the future of agriculture, and Bee Vectoring, with its innovative dispensing system, is set to become a significant industry player. The increasing demand for effective, organic

pesticide solutions, driven by a more environmentally and health-conscious society, positions bee vectoring to make a substantial economic and environmental impact with its novel inoculum delivery system.

Bee Vectoring Technologies (BVT) provides crop protection through pollination, avoiding the harmful effects of chemical sprays. Founded to protect flowers from pathogens and pests, BVT's system is essential for achieving high yields and quality in various crops. The comprehensive system aims to enhance yields, improve product quality, and extend shelf life without relying on chemicals or water, benefiting the environment. This product serves as a natural enemy of plant pathogens, whether through another insect that preys on pests or a fungus that targets harmful insects.

### **Future prospects**

The outlook for Bee Vectoring Technology is bright. With ongoing research and increased adoption by farmers, this technology is set to evolve and improve. Advancements such as improved dispenser designs, more effective microbial formulations, and enhanced monitoring systems will further boost the efficacy and reliability of BVT.

### **Conclusion**

Bee Vectoring Technology embodies a perfect fusion of nature and innovation. Utilizing bees to deliver biological agents, this approach provides a sustainable and effective alternative to chemical pesticides. As the agricultural industry increasingly seeks eco-friendly solutions, BVT emerges as a promising path toward a greener, healthier future. With ongoing research and development, Bee Vectoring Technology could transform crop protection and cultivation, benefiting farmers, consumers, and the environment.





# CLIMATE RESILIENT AGRI-FOOD SYSTEM IN MEGHALAYA

## About Author



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Climate Change is no more a myth; it is a reality and affecting globally. Besides, by 2050, the world will be the home of 9.6 billion and food production must increase by at least 60 percent to meet the demand, as reported by Tilman et al., 2021. India is the second most populous nation and needs to increase food production to 400 million tonnes by 2050. Climate change is a major threat to the agri-food system not only in India and Indian states but globally. To mitigate, adapt, and act in the face of climate change and food insecurity, local communities must be empowered within climate-resilient agri-food systems to enhance their livelihood security.

### Climate change impact on Indian agri-food system

Agriculture is the main occupation for 50 percent of the

population in India. Climate change is impacting the agri-food production system in India as a whole. As predicted, the South Asian zones may experience a warming effect of 2° to 6° C during the 21<sup>st</sup> century (Ravindranath, 2007). As per the global report prediction, a loss of 10- 40 percent in crop productivity is estimated for 2100 (<https://icar.org.in/node/1738>). In the absence of the adoption of adaptation measures, rainfed rice yields in India are projected to reduce by 20%, wheat yield 19.3% and Kharif Maize by 18% in 2050. The huge impact of climate change would be seen among the small Indian states/Union Territories such as Manipur, Nagaland, Goa, Sikkim, Andaman & Nicobar Island, Dadar & Nagar Haveli, Mizoram, Meghalaya, Arunachal Pradesh etc.

### Climate resilient approaches for sustainable agri-food system

However, due to strong community led approach to adopt climate resilient technologies, and indigenous knowledge among the tribal helped Meghalaya to become sustainable.

Meghalaya is primarily an agriculture and bio-resources-based economic state. Meghalaya is landlocked with hilly terrain, existing favorable

temperatures for food production, water reservoir, forest-based economy, and strong community laws and customs for protecting nature. The state population dynamic is 74 percent are tribal and 26 percent are other communities (population census 2011). Mostly the tribal of the state (Garo, Khasi-Jaintia) are dependent on sustainable sources of livelihood; the forest, water bodies, shifting cultivation fields (jhum), terrace farming or *bun*, home gardens, and valley-based paddy system.

### ❖ Community-based forest management:

Meghalaya is one of the states in India covering an area of approximately 22,429 square kilo-meters, out of this area about 70% of the state is forested. These forests are protected and managed by the tribal people through institutional arrangements developed to benefit the community as a whole. Under customary law, these forests are classified into different types depending on their intended use. Locally these forests are known as Law Kyntang (sacred forest), Law Shnong (village forest), Law Adong (village-restricted forest), Law Raid (forests belonging to a group of villages), Law Ri-Sumar (private forest on community land), Law Ri-Kynti



(private forest on private land) Law Lum Jingtup (cemetery forest) and Law Kur (clan forest). Forests are the main source of good number produce which provides livelihood for socio-economic development. The major forest products are bamboo, broom-grass, bay leaf, timber, fuel wood, packing leaf, wild pepper, aromatic and medicinal plants.

❖ **Water bodies management:**

The state of Meghalaya is blessed with bountiful water resources that need to be harnessed. Therefore, the community-based Integrated Basin Development and Landscaping Programme, govt. of Meghalaya included Integrated Water Resources Management, the creation of Small Multipurpose Reservoirs (SMRs), and the generation of water-centric livelihoods such as Fisheries, Aquatourism, etc. The objective is not only to capture surface run-off and water along the drainage lines, and reduce erosion but also to formulate water policy and aim at better river governance.

❖ **Jhum Cultivation to settle cultivation:**

Jhum cultivation is a traditional farming system that existed since time immemorial and is an important source of livelihood to the tribal. The Jhumias used to cultivate rice, maize, pumpkin, ash gourd, and many other vegetable products. However, due to the disadvantages of farming practices to the ecosystem, soil conservation, killing of micro-organisms, land degradation, and deforestation, it is not encouraged. The Meghalaya Basin Development Authority promoted community-based agro-forestry and conducted training for farmers. In 2022, the government launched the Payment for Ecosystem Services (PES) model to create 'Green Guardians' and through financial rewards, foster community ownership by involving participants in decision-making and capacity building. PES accounts for 15% of the state's annual budget (INR 45 Cr) for green governance wherein 50,000 hectares have been targeted for conservation by paying INR 15,000 /ha/year to

**Investment opportunities in Meghalaya**

Agriculture/Horticulture	IT Sector	Skill Development	Eco-Tourism
The Meghalaya has specialty produce such as Lakadong turmeric, Khasi Mandarin, Black pepper, cashewnut, banana, pineapple, bay leaf, broom etc. and mostly these produce are by default organic in nature. Therefore, there is a significant opportunity to go for value addition, and supply chain.	It is the era of information technology; however the Meghalaya is still in the nascent stage. Therefore, huge invest opportunity in IT sector to train youth and come up with various IT-farm, fin-tech etc.	Youth are educated but lacking in specific skills. Therefore, Skill development in various aspect such as handloom, bamboo craft, pottery, etc.	<ul style="list-style-type: none"> <li>✓ Infrastructure development and well tourism services</li> <li>✓ Promotion and adoption of Carbon Credit policy to reduce emissions.</li> <li>✓</li> </ul>

beneficiaries. The scheme pays INR 8000 / ha /year for 5 years as a base rate. In addition, INR 5000 per ha/ year is given to beneficiaries protecting natural forests already registered as community reserves.

❖ **Terrance farming:**

Terrance farming in the state of Meghalaya is gaining momentum. 1 lakh ha of land converted into organic cultivation through Mission Organic Value Chain.

❖ **Eco-tourism:**

Meghalaya is the home of natural beauties, a perfect destination for tourists. Its climatic condition, natural resources, lakes, hilly terrain, ethnic cuisine, festivals, root-bridge, crystal clear river, etc. provide a reason to visit. The state has developed a PPP Policy 2021 with an innovative community private-public partnership model along with the creation of state-owned land banks to increase private sector investments in the tourism and hospitality sectors. The Cooperative-led tourism model and formation of Tourist Site Management Committees have been undertaken to ensure community

management of tourism sites and assets along with employment generation.

❖ **Adoption of indigenous technologies for sustainable food production:**

The tribal are known for various ITKs. Similarly, in Meghalaya, the farmers are using their indigenous knowledge for sustainable food production. Among the various ITKs, the use of bamboo drip irrigation for efficient use of water, bun system of farming, multiple cropping based of production under hill farming, multi-tier farming (Areca nut-Blackpepper-Banana-Ginger/turmeric), use of colocasia in the rice field to protect from insect-pest, etc.

**Conclusion**

The agri-food production system in the state of Meghalaya is nature-based and diversified. This diversity is fundamental for imparting resilience to agri-food supply systems and climate change adaptation. In this regard, the food system developed and nurtured by indigenous communities of Meghalaya has important lessons not just for India but for the world as well.



# GREEN GOLD IN ARID ZONES

## FODDER TREES AS LIVESTOCK NUTRITION PILLARS

### About Author



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**F**odder trees are those that produce fragile twig shoots or sprouts from woody sections, and whose leaves are to some degree nibbled by both domestic and wild animals. In an agroforestry system, fodder trees can be planted with other crops or on separate ground that is typically unsuitable for other crops. Trees have many benefits over crops, one of which is their ability to access underground water through their extensive root systems, especially during dry spells. Tree fodder is sometimes referred to as emergency or scarcity fodder when it comes to livestock, and it is especially important for small ruminants (sheep and goats) and other browsing animals (camel). It is

estimated that 60% of the total feed that is available for sheep and goats comes from tree fodders alone. This is especially true for goats and camels, since they browse on top feeds for over 90% of their time and only graze on surface vegetation for 10% of their time, even in situations where there are in sufficient top feeds available. Easy establishment and rapid early growth to effectively compete with weeds, thornlessness and perenniality, high productivity under repeated cutting, grazing, or browsing, resistance to local pests and diseases, high seed production ability or reliable vegetative propagation, little to no fertilizer requirement, and high production of forage with high quality in terms of protein and mineral contents, palatability, and digestibility are some of the desirable qualities of trees and shrubs cultivated for fodder production. One promising solution to India's lack of green fodder is to provide top feeds.

### ***Prosopis cineraria* or Khejri aka Shami**

The Indian Khejri tree, which is commonly found in Rajasthan's dry and desert regions, is resistant of drought and can withstand severe weather. The tree's capacity to fix nitrogen is also well-

known; this property enhances soil fertility, aids in soil conservation, and halts desertification. It is appropriately dubbed Kalpvriksha of arid places since it offers wholesome fodder for animals, edible pods for human food, and fuel wood for home energy. Khejri leaves are tiny, yet they are quite tasty and full of nutrients. A fully mature tree should produce between 50 and 60 kg of dry feed annually on average. Protein (12–14% CP) and phytochemicals (6–12% tannins) are abundant in the feed.



### ***Azadirachta indica*, or neem**

Neem is a native of the Indian subcontinent, a plant that tolerates dryness well and produces copious amounts of feed even in the dry season. Such an evergreen plant can much help to mitigate the nutritional deficiencies that ruminants suffer during the dry season, given the sharp decrease in the availability of feed at this time. Neem





leaves make up up to 20% of the diet that sheep and goats are fed, and there are no negative repercussions from doing so. A mature tree may yield 350 kg of dry leaves annually, which could be fed to animals in times of famine. The bitter flavor makes it less appetizing, yet large ruminants frequently eat dry leaves. The nutritional value is 50–60% TDN and 6–7% DCP. Neem cake may be added to concentrates at a rate of up to 10% and utilized as feed as well. Neem oil and cakes are widely distributed throughout India since they are utilized in agricultural activities as insecticides and neem-coated urea. Neem works well for reclaiming soil in salinity-prone locations and fixing dunes.

### Jal (Species of *Salvadora*)

*Salvadora oleoides* is known as "Khara Jal," or saltbush, and *Salvadora persica* as "Meetha Jal," or toothbrush tree. *S. oleoides* coppices fairly well; a parent stem encircled by a ring of root suckers forms a dense, nearly impenetrable growth. The tree yields acceptable leaf fodder for camels, sheep, and goats as well as delicious fruits. The locals love the fruit, especially whether it's raw or in juice form throughout the summer. About 20–25 kg of dry leaf feed can be produced annually by a fully developed tree. The leaf fodder is a good source of calcium (2.3–3%) and has a moderate CP (9.0–11%). It is also rich in phytochemicals (tannins and saponins). Jal can be planted as an agroforestry plantation or on field bunds. Often, the tree is chopped down to make camel dung. Cattle are known to produce more milk when given fruits. Seed cake has



12% protein content and can be fed to animals.

### *Ailanthus excelsa*, or Ardu

Although it may be cultivated in a variety of soil types, sandy loam soil is the most ideal. Forage and food crops can be grown alongside *A. excelsa*, a coppicer tree with rapid growth. An established tree yields between five and seven quintals of green leaves twice a year, in the months of May and June. Ardu leaves provide great tree fodder for camels, sheep, and goats because of their high palatability. The fodder has an excellent digestibility (60–65% total digestible nutrients; TDN) and roughly 16–20% crude protein. As such, it shows



potential as a feed that may support moderate animal output.

### Jjube from India (*Ziziphus nummularia*)

In arid parts of India, one of the oldest fruit/fodder trees that has been grown is the Indian jujube, or ber. The leaves are a rich source of protein (11–14%) and are enjoyed by both camels and small ruminants. Its leaves are



nutrient-rich animal feed because they provide 6–8% digestible crude protein and 50–58% total digestible nutrients. In rural locations, this tree is frequently grown as a top-feed species. This top-feed can supply animals with feed, even during drought years when typical field crops fail. In winter, the tree is regularly chopped down for its edible leaves, called Pala. In a year, a

fully mature tree can yield 2.5–3 kg of dry feed leaves. More so than Khejri leaves, camels, goats, and sheep like the leaves.

### Moringa (*Moringa oleifera*) or drum stick

It is mostly planted commercially for its pod and leaf output, but it is also highly pleasant to cattle, goats, sheep, and camels. This tree is now advised for intensive fodder cultivation with close row spacing due to its high leaf nutritional levels. One can collect six or seven cuttings of feed in a year. 80–100 kg of dry leaf feed can be produced by a fully developed tree. The leaf has a high concentration of CP (22–25%), but even fodder, including twigs, can supply 15–18% CP and 60–70% TDN, which can partially replace concentrate in a livestock's diet. It is also a rich source of phytochemicals, which have been shown to improve the health,



nutrition, and productivity of cattle. In desert regions, drumsticks can serve as a substitute for green feed.

### Silvi-Pasture method for dry areas

The biomass availability is doubled by a silvipasture system that uses a two- or three-tier system. Combining rows of fodder trees of any kind with pasture containing "Dhaman" grass (*Cenchrus spp.*) or "Sewan" grass (*Lasirus scindicus*) can effectively maintain the arid ecosystem by preventing dune shifting, minimizing soil erosion, using water as efficiently as possible, and producing biomass from forage for sustainable integrated or mixed crop-livestock farming. In this area, one hectare of ground may successfully raise seven or eight sheep. With a two-tier and three-tier silvipasture system, the biomass yield is 25 and 35 Q DM/ha, respectively. ■



# IMPORTANCE OF CLEAN MILK PRODUCTION IN THE INDIAN DAIRY INDUSTRY

## About Author

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Dairying is a significant contributor to the national economy and socio-economic development in India, benefiting both rural and urban people. In India, milking animals has never been considered a separate activity from agriculture. Thus, the rural economy is inextricably linked with milch animals. Our country's economy is heavily reliant on dairy production. It contributes to increasing the food supply, creating jobs, and improving nutritional standards. It is a significant source of revenue for small and marginal farmers. Today's customer awareness of "quality" makes milk quality a crucial aspect of dairying. Quality milk production, as well as farmer cleanliness and sanitation, are vital for the food chain. Quality is

achieved through an integrated strategy, from farm to customer. To meet quality criteria, family clean milk production (CMP) methods must be strictly adhered to over time.

### Milk production in India

India is the world's largest milk producer, accounting for 24.64% of total milk output in 2021-22. India's milk production has increased by 58% over the last nine years, between 2014-15 and 2022-23, reaching 230.58 million tonnes in 2022-23. The average yield per animal per day for exotic/crossbred is 8.55 kg/day/animal, while indigenous/non-descript yields 3.44 kg/day/animal.

### Clean milk production

Clean milk is defined as the milk drawn from the healthy animal's udder, which is collected in clean utensils and free from any extraneous matter like dung, dirt, flies, hay, drug residues, and any pathogenic microbes, toxins, residues, pollutants, and metabolites. Freshly drawn milk from the udder is seldom sterile as the udder itself harbours bacteria and contamination occurs during production, procurement, and transit which can adversely affect its quality.

### Factors affecting the quality of milk

The quality of milk is highly influenced by various factors like off-flavor and odor, microbial contaminants, somatic cells in milk, antibiotic and drug residues, residues of plant protection agents, etc.

#### 1. Off-odor

Milk may acquire off-flavors from various sources, these are feeds and weed flavors (wild onion and garlic, strongly flavored feedstuffs like lucerne silage or other silage), cow-barny flavor (develops due to the poorly ventilated and or unclean and inadequately cleaned milking barn), rancid flavor (due to presence of fatty acids), oxidizing agents (due to exposure of milk to sunlight, contact of milk with oxidizing agents such as rust, copper, and chlorine), fly sprays, medications, strongly flavored disinfectants, etc.

#### 2. Contamination

There are certain bacteria capable of multiplying in unprocessed milk and then surviving the pasteurization and refrigeration process. The primary source of contamination is an environment that includes air, dust, dusty feeds, dusty barns, dairy





equipment, diseased animals, contaminated udder, etc.

### 3. Others

Use of various pesticides, herbicides, growth hormones, etc. for higher fodder productivity, antibiotics, hormonal preparations, and feed additives to enhance animal productivity have increased. These substances enter into food chain through animals and pose a danger to human, animal, and ecosystem health.

### Bacteriological standards for raw milk

Grade	MBRT test (hrs)	Resazurin disc number (hr)	SPC count per ml (lakh)
Very good	5 and above	-	< 21
Good	3 to 4	4 or higher	2-10
Fair	1 to 2	3.5 to 1	10-50
Poor	0.5	0.5 to 0	>50

The SPC of pasteurized milk should not exceed 30,000 per million.

### Measure to produce quality milk

#### 1. Milker and milking procedures

Milkers should be free from any contagious diseases, and avoid sneezing, coughing, and smoking during milking. Pre-dipping is a very effective step in mastitis control. Drawing of milk should be started 45-90 seconds after stripping, a layer of germicide after milking prevents bacterial growth in the udder.

#### 2. Milking animals and their environment

- a) **Animals:** Animals should be free from any disease. Feeding of feedstuffs free from any odor, aflatoxin, phytotoxin, heavy metal, and radioactive substances. Teat and udder should be properly



washed and cleaned with disinfectant and then dry.

#### b) Environment-

- **Animal house-** the long axis of the house is preferred in such a direction that maximum benefit of sunlight can be obtained. Keep house dry while providing adequate ventilation, light, and cleanliness. Pkkaa floor should be non-slippery and washed. Clipping and flaming the hairs from the udder 3-4 times a year is a new approach and takes 75% less time.

- **Milking utensils-** milking pails should have smooth surfaces so that they would be easy to clean, wash, and dry using permitted sterilizing disinfectants. Straining should be done to remove sediments and other foreign materials. Utensils should be washed immediately after disposal of milk.

#### 3. Milk handling:

- **Filtering-** To get rid of suspended debris, milk should be filtered through a sieve after being milked.
- **Storage-** Milk should be kept cold and clean, and the space where it is

kept should be free of extraneous elements like chemicals.

- **Marketing of clean milk-** The market should receive milk as quickly as feasible. Cans with closed mouths ought to be utilized for transit. To avoid heated times of the day, it is best to deliver milk early in the morning and evening.

#### Conclusion

A series of preventive measures are used in clean milk production to keep animals healthy and free from illnesses like mastitis. Each animal is carefully cared for and monitored to ensure that the highest quality milk is produced without sacrificing the animal's output. Most of farmers have a moderate level of knowledge and adoption of various aspects of the clean milk production system. Clean milk production should be motivated through organizing training and demonstrations at the field level. Local livestock supervisors, livestock development officers, and extension workers should make efforts in this direction.

■■■





# PROTECTING THE GUARDIANS OF OUR FIELDS

## About Author

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Institute

Agriculture serves as the backbone of India's economy, contributing 21% to the country's GDP and employing approximately 52% of its population. Despite this significant dependence on agriculture, challenges such as low work efficiency and a shortage of human labor persists. As a result, machines are progressively assuming critical roles on farms. Currently, the farm power per hectare in India stands at 1.75 kW/Ha. Projections indicate that by 2050, this figure would be 3.5kW/Ha approximately. This shift toward mechanization underscores the need for sustainable and efficient agricultural practices.

A Farmer faces a multitude of problems including various occupational hazards, some of which can have fatal consequences. The diverse cropping patterns across India's basins and plateaus corresponds to a wide varieties of machinery used in agriculture. Consequently, the country grapples with a variety of farm safety challenges. These hazards include accidents caused by machinery such as tractors, threshers, chaff cutters, and cane crushers. Additionally, natural calamities such as lightning strikes, snake or animal bites etc. During scorching summers, workers are at risk of heat exhaustion or heat stroke due to prolonged exposure to the sun. Exposure to chemicals like pesticides and insecticides further compounds the safety concerns. Even minor injuries from hand tools, partial hearing loss, and acute respiratory problems contribute to the overall risk landscape.

Dr. L. P. Gite, an Emeritus Scientist and former Project Coordinator for the AICRP on Ergonomics and Safety in Agriculture, sheds light on the severity of the issue. Each year, approximately 7.6 lakh agricultural

accidents occur in India, resulting in the deaths of around 45,000 workers. To be noted as a concern that in most cases the victim is a major or sole bread earner for the family. These accidents collectively lead to a staggering economic loss of ₹54,000 crores. Tractors and tractor-operated implements account for 31% of total accidents, followed by animal-drawn equipment (22%), threshers (14%), electric motors, and pumps (12%), and chaff cutters (9%).

Farm accidents are often preventable, and prioritizing safe machinery with intact safety features is crucial. For threshers and chaff cutters, consider using conveyor feeding systems. Equally important is organizing training sessions and awareness campaigns for workers, addressing challenges like chemical exposure and animal bites. Recognizing the need for an autonomous body, we propose its establishment. This body would conduct training camps across Indian states, ensuring the safety of agricultural workers. Additionally, it could engage in research activities to enhance farmer safety and enforce relevant legislation. Despite the rapid integration of tractors,





threshers, and chemicals into rural livelihoods, safety concerns remain unaddressed. Currently, employers bear the responsibility for safety and security, while workers lack accountability. We often find workers deliberately chewing tobacco while spraying insecticides. The workers are also unaware of the labels in the pesticide, and seem less bothered about red, green or yellow labels of chemicals while dealing with them. To rectify this, the proposed autonomous body could serve as a quasi-judicial entity, investigating farm accidents and recommending preventive measures. Furthermore, it would serve as a central hub for farm safety policies and initiatives.

Not only machines both plants and animals also affects the farmer's health. Healthy farm animal will help

farmer to avoid several zoonotic diseases like anthrax, brucellosis, leptospirosis, rabies etc. Less known but important is the Farmer's Lung Disease, also known as hypersensitivity pneumonitis, is a respiratory condition caused by inhaling organic dust particles. It primarily affects individuals who are exposed to mouldy hay, straw, and grain dust. The immune system reacts to these inhaled antigens, leading to inflammation in the lungs. Symptoms include coughing, shortness of breath, fatigue, and fever. Chronic exposure can result in irreversible lung damage. Prevention involves minimizing exposure to the causative agents and using protective gear. Many of workers adhere to traditional practices, often overlooking safety precautions. They assert that their long-standing methods are effective and that they've built immunity to diseases.

Additionally, some farmers view safety gear as an unnecessary expense. Unfortunately, this resistance to change can lead to hazardous situations, especially when machines are modified without proper safety features. It's crucial to emphasize the importance of protective equipment and educate farmers about the risks they face.

Ensuring farm safety isn't just a responsibility; it's an investment in the well-being of our farmers, their families, and the entire community. Let's cultivate a culture of safety—one where every seed sown and every harvest reaped is rooted in care and protection. Together, we can nurture healthier farms and happier farmers.





# TOMATO ANALYZER

## A VITAL TOOL FOR MODERN BREEDERS AND RESEARCHERS

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**M**easuring fruit morphology and colour traits of vegetable and fruit crops in an objective and reproducible way is important for detailed phenotypic analyses of these traits. Tomato Analyzer (TA) is a software program that measures 37 attributes related to two-dimensional shape in a semi-automatic and reproducible manner

Measuring fruit morphology and colour traits of vegetable and fruit crops in an objective and reproducible way is important for detailed phenotypic analyses of these traits. Tomato Analyzer (TA) is a software program that measures 37 attributes related to two-dimensional shape in a semi-automatic and reproducible manner. Digital phenotyping aims to accurately describe a trait based on analysis of electronic images. Computer-based analysis of objects from digital images has the potential to increase the objectivity of data collection while reducing subjective characterization that is typically prone to bias. Measuring fruit morphology and colour traits of vegetable and fruit crops in an objective and reproducible way is important for detailed phenotypic analyses of these traits.

### **Need of tomato analyzer**

Tomato Analyzer which is rapidly becoming the standard for fruit morphological characterizations. Ontology terms for the parts of the fruit were developed, as well as intuitive

mathematical descriptors that quantify many shape features based on the boundary of the fruit. Tomato Analyzer is designed to provide analysis of slices of tomatoes, peppers.

### **Genesis**

Software development was funded by the National Science Foundation Plant Genome Research Program to Esther van der Knaap.

### **Insights into tomato analyzer**

The terms and descriptors were implemented in TA for phenotypic measurements of fruit shape in a semiautomatic and reproducible manner. Currently, TA features 37 attributes with unique mathematical descriptors. For some of the attributes (e.g., for distal end angles and blockiness of the fruit), the user can select where the measurement is taken. Shape and size diversity can also be analyzed *via* morphometric studies, defined as the quantitative analysis of a biological form. Morphometric analysis uses the position of and distance between landmarks of the object as the source of morphological data. This method has

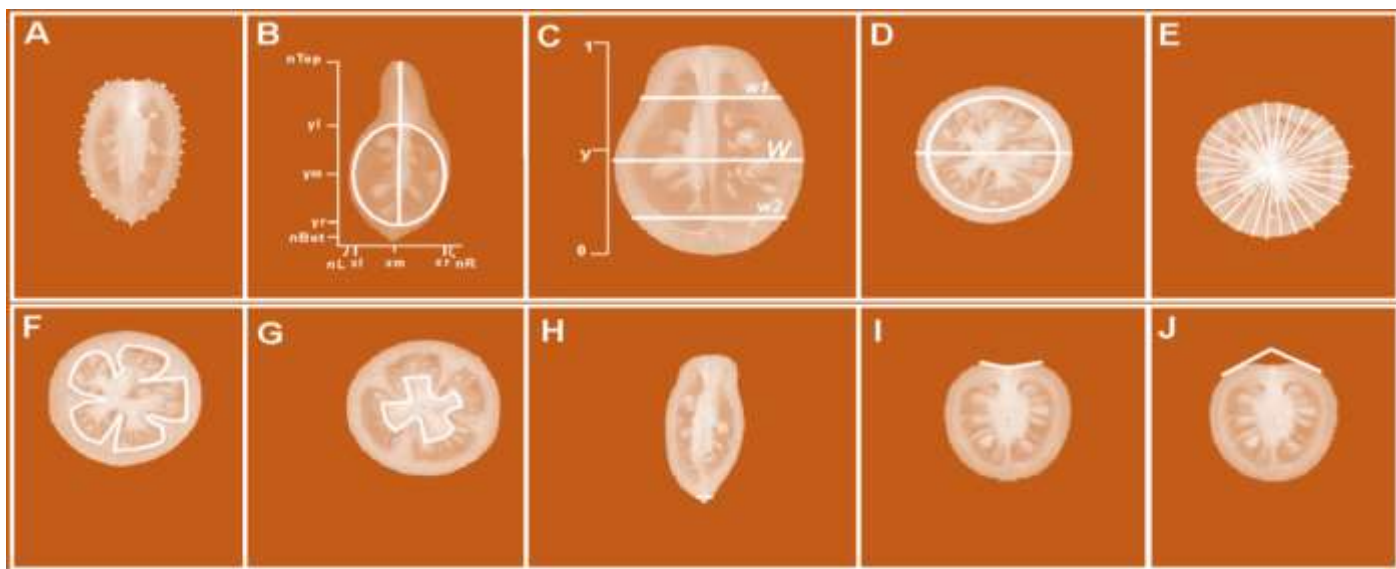


Fig. 1. Descriptors of fruit morphology attributes. (A) Morphometrics, (B) internal eccentricity, (C) obovoid and widest width position, (D) pericarp area, (E) lobedness degree, (F) pericarp and septum area, (G) placenta area, (H) distal end protrusion, (I) proximal end angle at 2%, and (J) proximal end angle at 20%.

been used to investigate phenotypic variation for studies in systematic and classification.

Morphometric analyses require neither prior knowledge nor predetermined notions of the shape features that the researcher wants to measure. Morphometrics and attribute analysis, have different and complementary strengths. On the one hand, the morphometric analysis is less biased and more high-throughput than attribute analysis, as it is less dependent on extensive manual manipulations.

TACT (Tomato Analyzer and its Colour Test)

TACT is designed to collect objective colour measurement from JPEG images. Images are collected using a flatbed scanner covered with a cardboard box to minimize the effect of shadow and provide a black background. Images of fruit taken with a digital camera on a black background are also appropriate. Instructions for collecting,

importing and analyzing colour from images are available in the TACT manual. We show that TACT is a tool that is reliable, precise, amenable, and affordable for digital image analysis of colour.

#### Software implementation

The TA software was previously described by Brewer *et al.* (2006). Briefly, it was implemented in the programming language C++ using Visual Studio 6.0 (Microsoft Corp., Redmond, WA). The image input/output was made possible via the image processing library Computer Vision and Image Processing 3.7c. The image will be saved in a jpeg or tiff format. TA was designed to run on the Windows operating system. The program is free and can be used for academic or private purposes.

#### Conclusion

Tomato Analyzer, as the name implies, was originally designed to analyze the morphology of tomato fruit.

It is a module for colour measurement to expand the array of objective phenotypic analyses implemented. TACT was applied to other fruit and vegetables of various colour and colour uniformity. Overall, it was able to accurately capture and describe the characteristic colour for each crop. Colour uniformity was also well characterized for fruit that tend to have nonuniform pigmentation, as in the strawberry. Its application could go beyond the colour analysis of fresh crops. In food science, discolouration after processing or cooking can occur and is an important issue. The acquisition of potato tuber images to evaluate after-cooking darkening. Such discolouration could be measured with TACT by defining the specific range of hue values that best represent the undesired discolouration.





# Times of Agriculture

A Resonance in Agriculture

Monthly Agriculture e-Magazine

ISSN No. : 2582-6344



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