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# AGRICULTURE TODAY

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EVERGREEN  
REVOLUTION

**Aatmanirbhar Krishi for Aatmanirbhar Bharat**

**Shri Narendra Modi**  
Hon'ble Prime Minister, INDIA



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*From the CEO's Desk...*

## From Green To The Evergreen Revolution!

Since the green revolution, land has witnessed an indiscriminate and prolonged use of chemicals, and its effect on human health, environment and ground water pollution have been extensively debated. These pertinent concerns have led to the concept of **Ecological Agriculture**, which is being recognized as the most critical and essential desideratum for an environment-friendly future.

**Stubble Burning** is another catastrophe that is seriously detrimental to environment and soil. It leads to depleting air quality index, loss of nutrients and low productivity. Paddy farmers find stubble burning an economic and quick way to get rid of paddy stubble to prepare land for wheat. **Indian Council of Agricultural Research (ICAR)** and several conscientious organizations have initiated measures to curb this practice. The experiments involve in-situ and ex-situ decomposition of paddy stubble to convert it into useful soil nutrients.

Preliminary results are exciting and indicate a positive solution to this menace. Several field trials have established that rice stubble and other crop residue can be converted to high value bio-compost using multi-microbial sprays. Combined with government initiatives such as Mulcher, Rotavator, Happy Seeder etc, stubble burning can easily be eradicated.

Developed and developing countries are shifting towards eco agriculture with the objective to manage the available resources for sustainable farming and to preserve biodiversity. High yielding varieties and chemical intensive agriculture undoubtedly raised the food production potential of the world, making it possible to feed the masses. However, over-dependence on agrochemicals and their injudicious usage has adversely affected the delicate balance of the ecosystem. This has led to the movement for non-chemical interventions and **ORGANIC FARMING** for meeting the nutrient requirements, plant stimulation and combating pest and diseases. With increasing consumer awareness and preference for organic food, the relevance of biological means in crop management is increasing. Biological Farming combines the best of conventional and organic farming with an emphasis on sustainability and attaining naturally productive soils that display high levels of biological activity with the use of bio pesticides, bio-fertilisers and bio-stimulants.

**Organic Farming is emerging as a holistic approach to eco-agriculture with ecological and socially responsible land use.**

Eco-Agriculture explicitly recognizes the ecological synergies and keeps agriculture sustainable. This form of agriculture conserves soil and water resources, protects climate, enhances agro-diversity, ensures biodiversity, meets the demand for food and safeguards livelihoods. In short, it ensures that the environment thrives, the farm is productive, the farmer makes a net profit and society has enough nutritious food.

Happy Reading

*Mamta*



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**Sh. Narendra Modi**  
Hon'ble Prime Minister  
INDIA



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**DR. M.J. KHAN**

## Think Farmer Prosperity, Think FPOs

India continues to be one of the world's leading agriculture producers. This has not elevated the living conditions of our farmers. They remain impoverished, debt ridden and marginalized.

One of the main reasons for this paradox is the scale at which agriculture is practiced by individual farmers in India. More than eighty percent of the farmers in India are small and marginal. Their area of operation is less than two hectares. The disadvantages in being small in scale of production, scale of operation and marketable surplus highly limits their profitability and income. We continue to have huge gaps between farm and markets.

Timely, easy and cheap access to markets is crucial. Poor post-harvest handling and perishability of produce severely reduces the chances of small farmers in recovering income from marketing of produce. Lack of storage facilities and processing opportunities also exacerbates the situation. The situation demands alternate models that shall increase the scalability and profitability of farming.

The solution is that more and more FPOs must be formed. There has been progress in this direction, and more needs to be done.

The success of FPOs to a large extent depends on a slew of disparate and disconnected entities such as banks, retailers and the corporate sector. The value chain required for the development of FPOs is not limited to one participant. A congenial ecosystem is a must for development of producer organizations because they have to deal with the most vulnerable part of agri-value chain.

It starts from the farm and goes on till processing and the far-away markets. The critical ecosystem services include emergency credit, consumption credit, production credit, retail services of inputs for agriculture and other agricultural



production services required by small and marginal farmers. Unless these services are provided by a producer organization, it cannot divert the surplus produce from the local trader or shop keeper to the producer organization.

In addition, the producer organization can take up other services related to facilitating linkage with the banks and line departments for ensuring infrastructure access for the business. Dedicated technical support is needed to provide the requisite knowledge to FPOs to migrate to a more value-addition and agribusiness-focused model. Private sector, knowledge institutions and NGOs can be suitable additions to this collectivization. The role of FPOs in upscaling the income potential of small farmers is immense. Their role in the entire supply chain from input to marketing is under-explored.

FPOs need financing partners to facilitate capital infusion. The credit worthiness of FPOs needs to be popularized and promoted. Business competence is another criteria crucial for the success of the FPOs. Data and technology can expedite the professionalization of FPOs.

# Eco Friendly Agriculture: Our Need, Not Choice

**T**he move towards eco-agriculture shall involve innovative thinking on the part of all stakeholders. Eco agriculture is not negotiable. It is a must for our survival. Our body systems are not designed for the residue of harmful chemicals that are sprayed over crops. These residues also reach us through harmful products fed to dairy animals, poultry birds or fish in order to maximum production or supposedly save them from disease.

It is so saddening that we as a civilization have resorted to short-cuts in everything. Farmers set fire to crop residue of paddy so that they have the field ready for the next sowing. Who knows more about the damage to the soil than the farmer? Yet, lakhs of farmers across north India assume year after year that flood irrigation and heavy chemical usage shall take care of all concerns. The attitude of *Chalta hai* and *Merey ko kya* has harmed us immensely.

When a wrong becomes a collective activity, *nahin chalta*.

Covid has taught us how essential it is to value that each of us does the right thing.

Sometimes some innovative ideas used on a farm are basic intelligence. Like the solar-powered insect trap promoted by ICAR to kill most of the pests that damage crops. The bulb glows for about four hours after sunset. It attracts harmful insects and flies in the field, which get killed after coming in contact with the electrified fence around the bulb. Agri scientists say the low-investment device can keep the environment clean, minimizing the need for harmful chemicals.

There are other ways to stop using insecticides if one has the will. Keet Saksharta Mission (KSM) of Jind has the potential to revolutionize pest management for crops. KSM has redefined crop protection through pest identification. Plants are inhabited by friendly and unfriendly insects. KSM found that plants use insects as per their need at different stages of the crop. Through smart management, farmers can use insects for complete pest management. The initiative is led by villagers – most of them women. The reach of this knowledge must be maximized through the country.

By adoption of such eco-friendly ways, our dependence on harmful fertilizers and chemicals must end.



FROM THE  
EXECUTIVE  
EDITOR'S DESK



**RAJNI SHALEEN CHOPRA**

FROM THE EXECUTIVE EDITOR'S DESK

# STATES MUST STRATEGIZE AGRO-CLIMATIC REGIONAL PLANNING

WE HAVE TO ENCOURAGE  
THE YOUTH, PROMOTE  
START-UPS IN  
AGRICULTURE SECTOR

**T**he agricultural sector of the country, our farmers, our villages are the very basis of Aatmanirbhar Bharat, a self-reliant India. When they remain strong then the foundation of Aatmanirbhar Bharat will remain strong. Modernization in the field of Indian agriculture is the need of the hour. Adopting new alternatives, new innovations, along with traditional farming, are equally important to create new opportunities for employment in the agriculture sector. This will help increase the income of farmers.

Today, sustained efforts are being made to remove every small and big difficulty in the way of the farmers' journey from the 'seed to market' and to ensure their prosperity and progress of agriculture. We have to expand the country's agriculture and processed food sector into the global market. We need to increase the number of agro-industries clusters near the villages so that the villagers can get farming related employment







**The Kisan Rail service is a major step towards increasing the income of the farmers of the country. This will bring about a major change in the farm economy. This will also strengthen the country's cold supply chain.**

in the village itself.

We have to make concerted efforts to get a complete solution from irrigation to sowing, harvesting, earnings and technology in the cultivation of the country. We have to encourage the youth and promote start-ups associated with the agriculture sector. There are many agricultural products that our farmers can produce not only for the country but can also supply to the world. It is necessary for all the states to strategize their agro-climatic regional planning and help their farmers accordingly.

In the last few years, a holistic approach has been adopted from agriculture to animal husbandry and fisheries. The result is that even during the corona period, agricultural exports in the country have increased considerably. But our potential is many times more than that.

Steps are required to strengthen small farmers. Therefore, we need to work for making our farmers Aatmanirbhar and give them freedom to sell their harvest and infuse diversity in crops. The Kisan Rail service is a major step towards increasing the income of the farmers of the country. This will bring about a major change in the farm economy. This will also strengthen the country's cold supply chain.

New solutions are necessary to create maximum employment in villages and to create new facilities for improving the life of the farmers. With this goal,

agricultural reforms are being carried out one after another. Our government began to work with a new approach after we came to power in 2014. We focused on the small difficulties of the farmers of the country and the modernisation of agriculture simultaneously to prepare them for future needs.

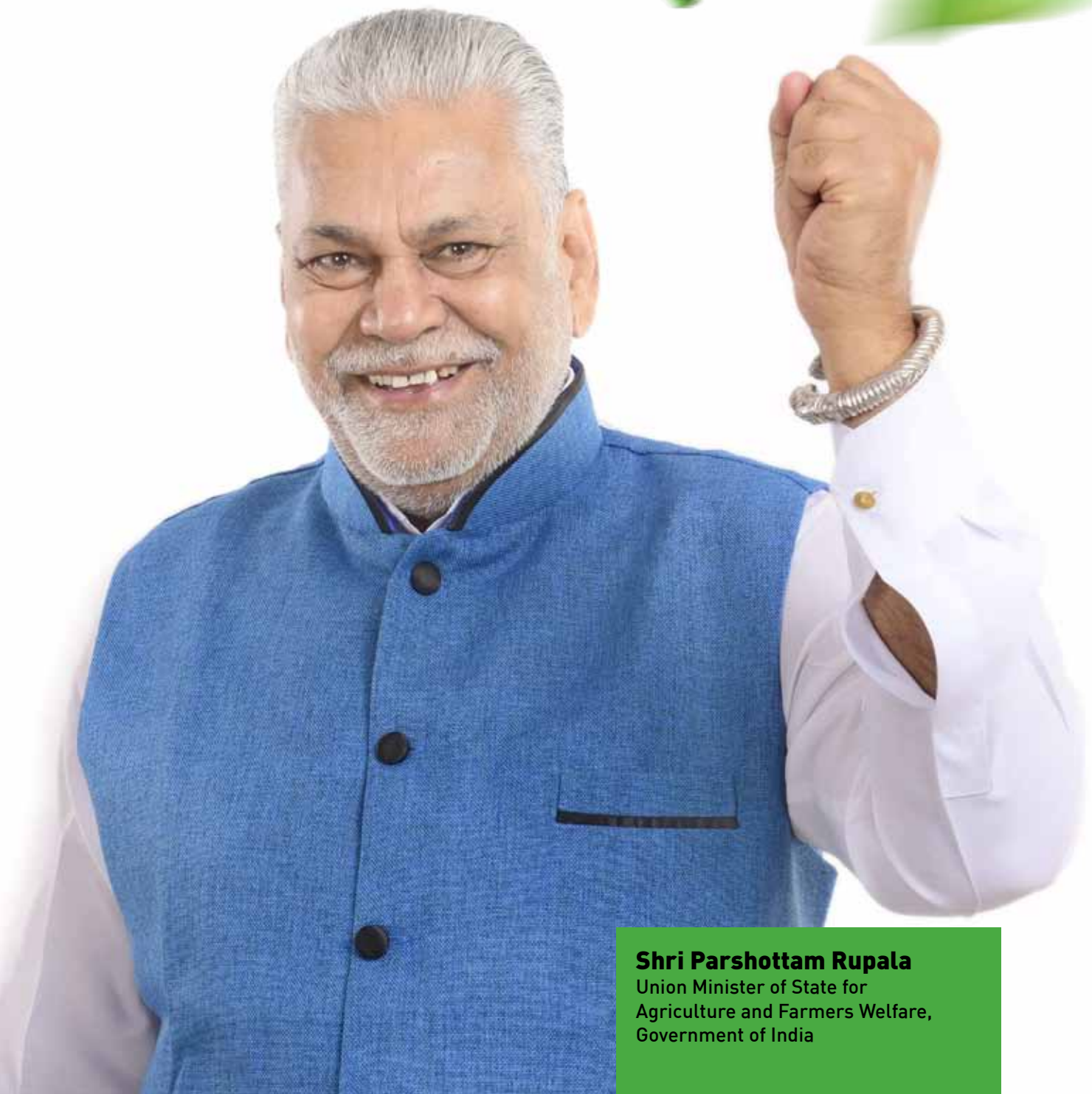
Our government has endeavoured to ensure that farmers of the country get fair prices for the crops. We have given one and a half times the cost to the farmers, as per the report of the Swaminathan Committee which was hanging fire. The MSP was available on a very few crops, we also increased the number of crops.

It is equally necessary to expand one's approach with changing times. We have to modernize India's agriculture in the 21st century and crores of farmers of the country have taken up this responsibility and the government is also committed to move forward with them.

We want our farmers and the agriculture sector to have the same opportunity to develop as the poultry and dairy sectors have. When there will be many companies and different competitors in the business, the farmers will also get higher prices of their produce and their better access to the market would also be possible.

FARMERS' WELFARE

# OUR GOVERNMENT IS COMMITTED TO SUSTAINABLE AGRICULTURE



**Shri Parshottam Rupala**

Union Minister of State for  
Agriculture and Farmers Welfare,  
Government of India

**T**he Government of India under the esteemed leadership of our Prime Minister Shri Narendra Modi ji is committed to sustainable agriculture through redirecting public policies and is supporting farmers through various programs. The Government of India has put in place a National Action Plan on Climate Change (NAPCC) under the Prime Minister's Council for Climate Change (PMCCC). This aims to evolve and implement strategies to make agriculture and allied activities more resilient to the changing climate.

The Government of India is promoting organic farming in a big way for ensuring sustainable productivity, food security and soil health. This is being done through the dedicated scheme Paramparagat Krishi Vikas Yojana (PKVY), which has been in operation since 2015. The scheme is being implemented in a cluster mode to facilitate marketing of organic produce, especially for smallholders. All farmers who undertake organic farming under this scheme are provided assistance of up to Rs 50,000 per hac. for organic conversion, organic inputs, on farm inputs, production infrastructure, etc.

The target of the scheme is to bring an area of 25.0 lakh ha (2500,000 ha) under organic farming by 2025. As of now, an area of 6.19 lakh ha area has been covered and 15.47 lakh farmers have been benefitted in 30934 clusters. Equal emphasis has been laid on providing efficient marketing of organically produced agricultural products so that farmers can get premium price for their produce. This will directly impact their incomes and the livelihood sustainability.

Towards this end the Government of India is actively promoting brand building and their publicity. As of now, about ten brands have been recognised for promotional campaigns. Another initiative of the Government has been the Development of dedicated Jaivik kheti (Organic Farming) ([www.Jaivikkheti.in](http://www.Jaivikkheti.in)) portal. This directly connects the consumers with the producers, which is a win-win situation for both. Consumers get genuine and high quality organic food products and the producers get remunerative prices for their produce. A total of 4.36 lakh (436,000) farmers have been registered on the organic farming portal and are benefitting from the portal.

## CHALLENGES

There are challenges in shifting towards organic farming. Our experience has shown that the remunerative returns to farmers may not be immediately available. This becomes a challenge in redirecting public policy and support to sustainable agriculture. Towards this end, the Government of India is working through various interventions as I mentioned.

Further, the role of Research and Development cannot be over-emphasised in delivering sustainable agriculture, as is evident from our experience and the global experience. Several steps have been taken through research to make agriculture sustainable in India. The Indian Council of Agricultural Research (ICAR) is a National level organization

with a network of state and federal level institutions involved in developing and disseminating cutting edge technologies in the field of agriculture in India.

## CLIMATE-RESILIENT, STRESS TOLERANT VARIETIES

ICAR launched a flagship network project titled National Innovations in Climate Resilient Agriculture (NICRA) during 2011. NICRA has developed seven climate resilient varieties and 262 abiotic stress tolerant varieties. Their success stories are stress-tolerant varieties of different crops. These can withstand drought, flash floods due to heavy rains, salinity and heat stress. Their success has been demonstrated on the farmers' fields across the country.

Fifteen climate resilient technologies for natural resource management have been developed to deal with drought, flood and excess rainfall. Over the past nine years, 16,958 training programs were conducted throughout the country to educate stakeholders on various aspects of climate change and resilient technologies. These covered 5,14,816 stakeholders including farmers.

India is also actively working to make available nutritious food to its people. To achieve this, ICAR has released 71 bio-fortified varieties in different crops. These are some of the many interventions the Government of India under the leadership of Hon'ble Prime Minister Shri Narendra Modi ji. The interventions are improving the lives and livelihoods of the millions of farmers while making agriculture a sustainable source of livelihood. Jai Kisaan, Jai Hind and Jai Bharat.

**The Government is promoting organic farming in a big way for ensuring sustainable productivity, food security and soil health. This is being done through the dedicated scheme Paramparagat Krishi Vikas Yojana (PKVY), which has been in operation since 2015. The scheme is being implemented in a cluster mode to facilitate marketing of organic produce, especially for small holders**



# THE BLUEPRINT

**E**co Agriculture is the broad term that can be described or can be used all inclusively as agro-ecology, regenerative, Organic etc. It is increasingly being recognized as the way to save the planet. A timely transition to sustainable eco agriculture is essential to protect the food security, well being of people and farmers' prosperity.

After the Green Revolution, the time is for

Evergreen Revolution based on Eco Agriculture or Agro Ecology. In 2018, FAO stated: Eco Agriculture to transform food and agriculture system addressing the root and emphasizing improving efficiency in the use of resources, conserving, protecting and enhancing the natural eco systems, protecting and improving livelihood, equality and well-being and enhancing the resilience of people, community and ecosystem.

## WHY

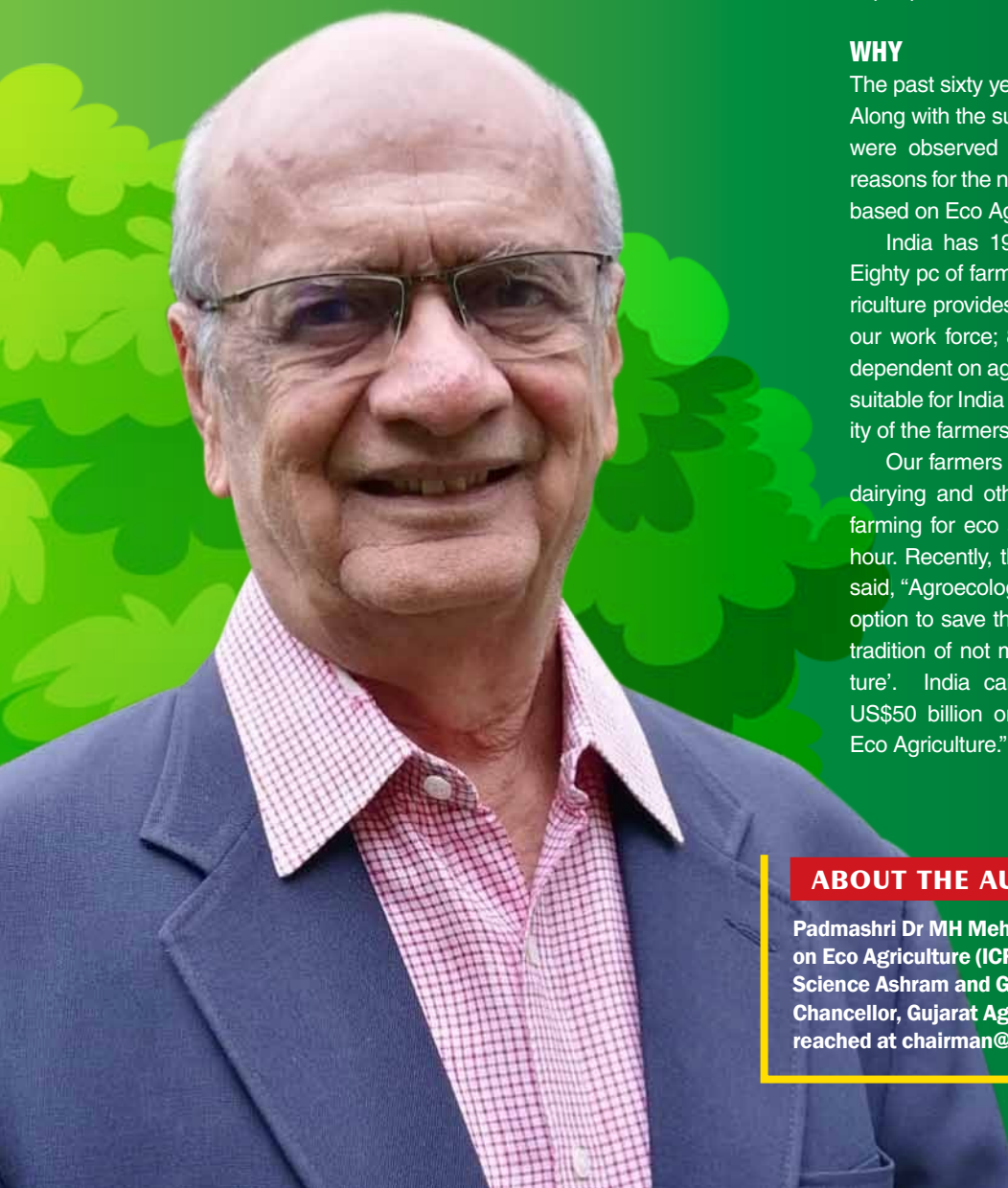
The past sixty years led to the Green Revolution. Along with the success, several adverse impacts were observed globally. The following are the reasons for the need for an Evergreen Revolution based on Eco Agriculture.

India has 190 million ha under agriculture. Eighty pc of farmers are small and marginal. Agriculture provides employment to nearly 56 pc of our work force; 800 million of our population is dependent on agriculture. Eco agriculture is most suitable for India for food security and sustainability of the farmers.

Our farmers toil round the year with farming, dairying and other related activities. Integrated farming for eco agri practice is the need of the hour. Recently, the Vice Chairman of NITI Ayog said, "Agroecology - Eco Agriculture - is the only option to save the planet. It is in line with India's tradition of not man vs nature but man with nature'. India can access carbon credit worth US\$50 billion or more through propagation of Eco Agriculture."

## ABOUT THE AUTHOR

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## Conventional Agriculture (CA) in Asia and Time for Eco Agriculture

1. Soils and the environment are being massively damaged leading to poor soil fertility and land degradation
2. Poverty has reduced but is not eliminated. Inequalities are rising
3. Sustainability of smallholders farming is the key as 80 pc of world food is produced by small or family farmers
4. Yields have risen but are slowing
5. Over-dependence on synthetic fertilizers and pesticides, issues related to mono-cropping
6. Vulnerability to climate change: Farmers' and public health is being undermined
7. Eco Agriculture holds significant potential for sequestration and reduction of green house gases



Global Experts Meeting - Tell us HOW

### HOW

The real question, however, is not Why Eco Agriculture but How? Our Global Expert Committee for Eco Agriculture /Organic Farming was invited to meet Prime Minister Shri Narendra Modi. The committee comprised John Fagan of Iowa, USA; me; Hans Harren of Millennium Institute, Switzerland and Thimmaiha of Bhutan. The PM began the meeting by saying, "We are convinced that Eco Agriculture or Organic Farming is the way forward. The question is HOW? How do we expand this system to national scale?" HOW is the most important question worldwide.

At Indian Chamber of Food and Agriculture (ICFA), the importance of Eco Agriculture in the present and future was recognized. A working group representing experts from various fields, scientists, farmers' bodies, industries and institutions was formed. After wide rounds of consultation, the Global Advisory Committee was formed.

It was decided to take up a Road Map and Action Plan preparation. It was soon realized that though policy matters



Time Now for Evergreen Revolution – Prof. M.S. Swaminathan

and incentives by the central and state governments are important, participation and actions is needed at all levels. Subsequently, several roundtables and national and international meetings have been organized through the Working Group of ICFA for Eco Agriculture. These became very successful with enthusiastic contribution from all sectors.

As the next logical step, three expert groups have been formed to help prepare the Road Map and Action Plan. They shall work on a) Policy matters, b) Agri bio inputs and c) Technology transfer and extension to grass root levels.

As a follow up, several special meetings, round tables and national and international conferences were held. These helped to create awareness and actions at different levels. It is also good to see the formation of several societies, foundations, programs and industrial associations working for a common mission. These include AIOI (Association of Indian Organic Industries), BIPA (Bio Industries Production Association), AIBA, BASAI, IFOAM, PMFAI etc. Many small and big foundations, NGOs and farmers' groups are working tirelessly in remotest areas contribute to visible/invisible revolution and bring hope for better days ahead.



Roundtable organised by Indian Chamber of Food and Agriculture (ICFA) on EcoEco Agriculture - Road Map and Action Plan





All these associations and NGOs will help the march towards Eco Agri Revolution. We also see several NGOs and industries taking up small and large projects that not only demonstrate successful models but help multiply them.

### SOME GOOD INDICATORS

There are many visible and invisible changes. Some indicative examples are listed here.

GOI Agriculture Department has formed a special cell, NCOF, etc. Many states have provided policy support for procuring eco-friendly inputs like bio-fertilizers and bio-pesticides to supply to

India generates millions of tons of agro waste annually. Converting it in-situ at farm to high value bio composts using consortia of micro organism mixture will be a win-win solution for all

farmers. Formation of courses and training programs and organic industries and exporters etc. are good developments. Bio-input Industries - mostly in SME sector are growing very well and playing a great role in this mission.

Namami Gange declared organic farming up to 5 kms on both the banks of the Ganga river. APEDA, NAFED, Solidaridad, Organic India etc are taking up or supporting many projects. These are some examples of the good signs for the road ahead. The lowering of input costs for the farmers on one hand, and the huge potential for local and export markets for organic products is realized by all.



Bio inputs Industries are important for this great mission: Dr APJ Abdul Kalam

### BIO COMPOST

Eco-friendly inputs like bio fertilizers, bio pesticides, bio stimulants and bio composts etc are emerging very fast. The role of bio composts needs special attention. India generates millions of tons of agro-waste every year. Converting them in-situ at farm to high value bio-composts using consortia of micro organism mixture can bring a huge jump in improving farm economics, better soil and water management and environment.

There are many good examples all over, but there are glaring problems and inadequacies as well. Crop residue burning in rice fields in the northern states is one such huge problem. Several practical demonstrations of converting crop resi-





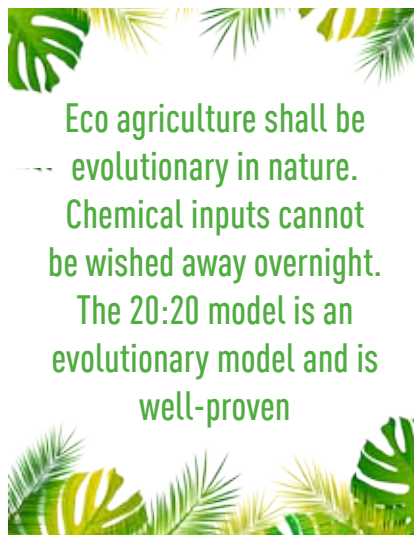
due to in-situ bio composts have still not resulted in large scale application. It is a classic case of how we fail to combine our collective energy so that we convert a big problem into a big opportunity. If done soon, this will immensely help the economics and environment. It will also form the strong basis for eco-agriculture revolution on a large scale.

### THE ROAD AHEAD

Eco agriculture is the way for Evergreen Revolution leading to food security and sustainability of farmers. It may not be a sudden change but will be evolutionary in nature. Chemical inputs cannot be wished away overnight. The emergence of eco-friendly inputs, integrated farming practices and scientific in-situ conversion of agro wastes will be the way ahead for adaptation by the smallest farmers. The 20:20 Model is an evolutionary model and is well-proven. This means 20 percent reduction in input cost with 20% higher production. This can be doubled and tripled

in the subsequent years. Its adaptation is showing visible changes in various parts of the country.

Some states have a good budget for these purposes including procuring standard eco-friendly inputs. This will have to increase substantially for all the states so that the 20:20 Model is increasing adopted.



### AGRICULTURE POST COVID

Post Covid, the word Glocal has come to stay. The value of close-to-nature technology is being highly appreciated. Agriculture is being looked up as a solution for climate change instead of a contributor. The holistic approach for agriculture will be the base for the coming Evergreen Revolution.

We need to strengthen and expedite this through a) Policy frame work b) Combining practical wisdom and new technology advances c) Capacity building and training for skill development and marketing.

It is important that rather than focusing on the fear-provoking symptoms of collapse such as climate change and Covid, we must focus on a brighter, wholesome future. We must come together while working in harmony with nature.

Eco agriculture is the right and sustainable mission for Evergreen Revolution and of greatest benefit for the smallest farmers.

# IMPLEMENTING EVERGREEN REVOLUTION

# THE CRUCIAL ROLE OF SOIL HEALTH

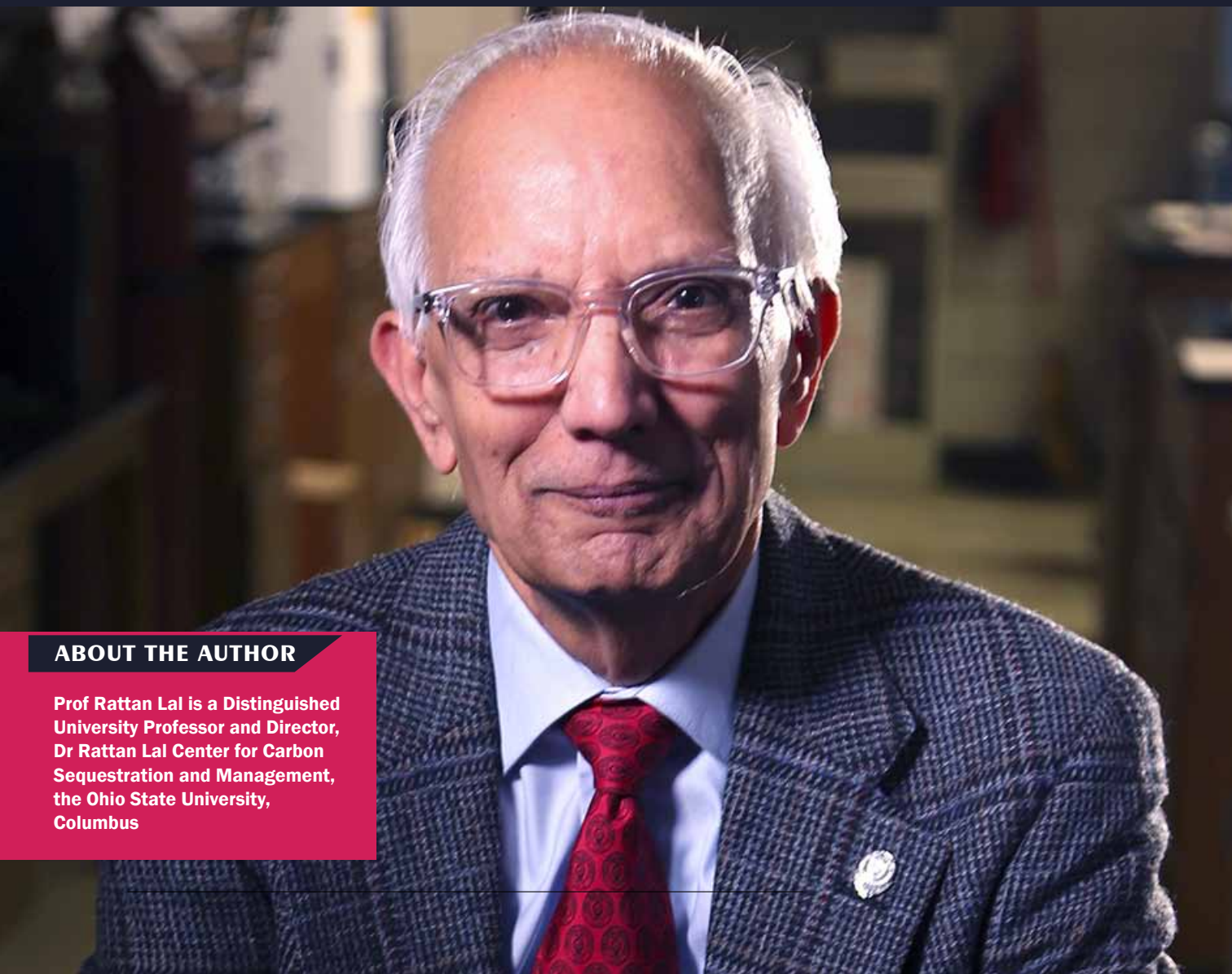
India's agricultural production is a global success story. Between 1947 and 2020, population of India increased by a factor of 4.2 from 330 million to 1380 million. In contrast, food grain production increased by a factor of 6 from 50 million tons to

more than 300 million ton. Similarly, horticulture production increased by a factor of 10, milk by 9 and fish by 13. India transformed from food importing to a food exporting country (20 M ton or USD 40 B per year) and with food grain reserves of 50 M ton.

Yet food grain production in India can be doubled through widespread adoption of recommended management practices. Indeed, India is supporting 18 per cent of the human and 31 per cent of the livestock population of the world on 2.4 per cent of world's land area and 4

## ABOUT THE AUTHOR

Prof Rattan Lal is a Distinguished University Professor and Director, Dr Rattan Lal Center for Carbon Sequestration and Management, the Ohio State University, Columbus





per cent of the world's water resources. This is a commendable accomplishment.

### Major challenges ahead

There is no cause for complacency because even the bigger challenges lie ahead. There is a wide spread problem of soil degradation ( e.g., erosion, salinization, soil organic carbon and nutrient depletion, decline in soil structure, soil contamination), depletion of the ground water reserves and eutrophication of surface and ground waters, and pollution of air. The problem lies in over fertilization or under fertilization and indiscriminate use of agro-chemicals, excessive use of flood-based irrigation, unnecessary and excessive plowing, in-field burning of crop residues and uncontrolled grazing.

Despite the progress, there remains a widespread problem of under nutrition and malnutrition. The objectives of this article is to describe technological and policy options to reverse the degradation trend, restore soil health and implement farming practices for accomplishing the ever green revolution.

### Time to Restore Damaged Soils

Soil quality refers to soil's capacity to produce essential goods and services for human wellbeing and nature conservancy. Soil quality comprises of four inter-related components: physical, chemical, ecological and biological.

The latter, depending on activity and species diversity of soil biota, refers to soil health. It refers to "soil's capacity, as a dynamic biologically active entity within natural and managed landscape to produce numerous ecosystem services including net primary productivity, food and nutritional security, biodiversity, water purification and renewability, carbon sequestration, air quality and atmospheric chemistry, and elemental cycling for human well-being and nature conservancy" (Lal,2016).

Health of soils of agricultural ecosystems of India is in an urgent need of restoration. These are degraded and



**The problem lies in over fertilization or under fertilization and indiscriminate use of agro-chemicals, excessive use of flood-based irrigation, unnecessary and excessive plowing, in-field burning of crop residues and uncontrolled grazing**



polluted at present and characterized by low organic matter or SOM content (Less than 0.5 per cent in the surface layer). An optimal range of SOM content is about 2.5 to 3.5 per cent for soils of the tropics and sub-tropics. The damaged soil may take 20-30 years to be restored through conversion to a restorative land use and adoption of recommended soil/ crop/livestock management practices. Thus, there is need for a paradigm shift. We need to reconcile the need for enhancing and sustaining production of an adequate amount of nutritious food with the absolute necessity of restoring soil health and improving environment quality. The latter includes quality of soil, water, air and of biodiversity.

### Soil-Centric Green Revolution 2.0

The green revolution of the 1960s and 1970s was seed centric. It was based on growing improved varieties of grain crops (wheat, rice, soybean etc.) with liberal use of chemicals, tillage and irrigation. The green revolution of the 21st century must be mindful of the following:

- a) Soil based, with focus on soil health and its' resilience
- b) Ecosystem based with reliance on eco-efficiency of inputs
- c) Knowledge based and





dependent on proven technology for sustainable management of natural resources (e.g., landscape, water, air, biodiversity).

This involves adoption of practices popularly called as “regenerative agriculture” (Lal, 2020). This refers to farming techniques that restore rather than degrade soil health. In general, “regenerative agriculture is inspired by eco-innovation, powered by non-carbon energy, driven by a circular economy and green infra-structure and supported by re-carbonization of the biosphere as the bedrock of sustainable development”(Lal, 2020). Thus, sequestration of soil organic carbon is an important criteria of regenerative agriculture. Some examples of regenerative agriculture include a system-based conservation agriculture (Lal, 2015), agro-forestry etc. which involve recycling of biomass as a soil amendment.

### The Three Basic Laws

Simply put, regenerative agriculture is based on the three basic laws:

**Law of Return:** This states that all materials removed (harvested from soil or depleted such as plant nutrients, SOM stock, bio-diversity) must be returned to sustain the soil’s functionality (Howard, 1945).

**One Health Concept:** This states that “health of soil, plants, animals, people, ecosystems and the planet is one and indivisible” (Lal, 2020).

**Rights of Soil:** Being a living entity, soil has a right to be protected, restored,





### Course Correction

For improving health of the people and the environment, it is the time to bring about drastic transformation in the way soil is mismanaged to produce crops and raise animals. It is important to recognize the following:

- 1) Soil fertility cannot be managed just by dumping chemical fertilizers
- 2) Structure of a crusted and compacted soil cannot be improved just by ploughing
- 3) Soil acidity cannot be corrected just by liming
- 4) Drought cannot be alleviated just by flood irrigation.

These are symptomatic treatments of the problems and do not address the underlying causes. The strategy is to bring back the life-giving capacity of the soil by enhancing soil health. Soil is a living entity. Life in soil (activity and species diversity of soil biota) must thrive and flourish so that it can generate ecosystem services essential for human wellbeing and nature conservation. This can only be done by restoring soil organic matter content to above the critical level by creating a positive soil/ecosystem carbon budget (Lal, 2016).

### Judicious and discriminate use of chemical fertilizers, in combination with bio-fertilizers and recycling is the prudent strategy



organic matter content can be Rs 1200 to Rs 2000 per acre per year.

### Evergreen Agriculture

In this context, Prof MS Swaminathan proposed the concept of “Evergreen Revolution” (Swaminathan, 2000), also called as evergreen agriculture (Garrity et al, 2010). Garrity and colleagues focused on the integration of crops with trees as an agroforestry system.

The evergreen revolution is focused on eliminating chemical use, reducing irrigation and on producing long-term, sustainable growth in yields to feed the world's growing population. Prof Swaminathan focused on the need of promoting climate resilient farming. He emphasized that productivity

must increase, but in ways which are environmentally safe, economically viable and socially sustainable according to the concept of “Evergreen Revolution” (Swaminathan, 2000). The focus of evergreen revolution is on climate-resilient farming.

It is important to enhance the soil nutrient pool through integrated systems of soil fertility management. Judicious and discriminate use of chemical fertilizers, in combination with organic sources (biofertilizers) and recycling, is the prudent strategy. The dosage is the difference between a remedy and a poison, says an ancient proverb. Fertilizers should be used following the 4 R concept – right amount, right formulation, right rate, and right mode of application. Balanced application of fertilizers (N, P, K, Ca, Mg along with micronutrients such as Cu, Zn, Fe, Mo etc.) is essential based on the soil test and expected crop yield. The focus must be on the efficiency of fertilizer use rather than on the rate of fertilizer use. The efficiency of fertilizers can be drastically improved by restoring soil health. The objective is to enhance eco-efficiency (Lal, 2019) by integration of livestock with crops and trees (Lal, 2020).

As Mahatma Gandhi had said, “To forget how to dig the earth and tend the soil is to forget ourselves.”



thrive and managed judiciously (Lal, 2019).

Further, farmers must be rewarded for restoration of soil health and sequestration of soil organic carbon based on the societal value of soil carbon (Lal, 2014).

Societal value is vastly different from market value, since the latter is based only on the demand and supply principle. Payments for ecosystem services through enhancing and sustaining soil





# SUPPORTING ECO AGRICULTURE **APEDA** BOOST TO EXPORT OF ORGANIC PRODUCTS

India has been bestowed with wide range of climate and physio-geographical conditions. It is most suitable for growing various kinds of field crops and horticultural crops. The agricultural production of the country showed a tremendous growth with the green revolution technology of the late 1960s, the spread of irrigation, and the expanded use of biochemical fertilizers. However, as the indiscriminate use of chemical farm inputs has had

adverse effect on the soil properties and also on the microflora and fauna, the need for alternate options have emerged.

Organic Agriculture has been defined as a production system that sustains the health of soils, ecosystems, and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition,

innovation, and science to benefit the shared environment and promote fair relationships and good quality of life for all involved.

In many parts of the country, farming is being followed by use of seeds adaptable to local conditions, crop rotation, on farm inputs for soil conditioning and pest and disease management, better means for soil and water conservation etc. Though the principles of organic farming are being practiced in these farms, the absence of certification does not allow such products to be labeled as organic.

## Organic certification and export

With the adoption of an organized system which is verified through a third party, such products can fetch premium price while contributing to the sustainability of ecosystem. As India has seen



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India has been able to demonstrate that compliance can be met at each level of handling of the product and consistent supply of credible organic products can be made while contributing to the sustainability of ecosystem. The strength and integrity attained throughout the years has paved way for double digit growth of organic products export



demand of certified products in primarily developed countries, an institutional mechanism has been developed in the country. It was notified as National Programme for Organic Production (NPOP) under the Foreign Trade Development Regulations (FTDR) Act of Directorate General of Foreign Trade (DGFT). NPOP is implemented under the overall guidance of Department of Commerce as the apex body. Agricultural and Processed Food Products Export Development Authority (APEDA) functions as the Secretariat for the implementation of this government initiative.

### Organized Agriculture Trade Sectors

Organic certification and export commenced in India primarily to cater to the organized agriculture trade sectors. This was mainly in the plantation sector wherein product handlers were defined to ensure the source of raw material. However, as demand has increased for other products also in overseas markets, certification has expanded to other agricultural crops and products.

Considering the local conditions of India and in order to include small and marginal farmers under the certification system, grower group certification has been introduced under NPOP. Under this system, group of farmers can collectively get certified in an affordable manner enabling them to supply adequate quantum of certified products. This has brought about a revolution in the Indian

organic farming community. Certification of cultivable land has expanded to 34 States and Union Territories. Under NPOP, 1.36 million farmers are certified making India with the largest number of producers in the world.

As Indian forests are source of medicinal plant products, the plant products such as stem, flower, bark, root, bud, fruit etc. can also be certified as organic provided the collection from forest area is done without affecting the sustainability. The export of minor forest produces caters the demands of ayurvedic, pharmacological and cosmetic industries.

### Expansion of Product Categories

Over the years, the need for expansion of product categories has also been felt. Efforts have been taken to develop production standards for Organic Livestock, Poultry, Aquaculture, Apiculture etc. Meanwhile, there has been demand for Organic Animal Feed in the organic Livestock and Poultry rearing sector of importing country resulting in inclusion under the scope of NPOP. Several other categories such as Mushroom, Seaweed, Aquatic plants and Green House Crops have also been included in NPOP.

Though organic fibre has already been covered under the certification system as an agricultural crop, the processed form of fibres has been recently included along with Organic Cosmetics and personal care products on voluntary basis.

Like any other certification system, the establishment of control system requires time. The accreditation of Certification Bodies for these new product categories have been granted based on the compliance in the certification programme. Amongst the new product categories, export of organic dairy product has started to some destinations. The export of other products is also in the pipeline.

With the mandatory requirement of certification for domestic trade of organic products also, the farmers and handlers are being made aware of the compliance requirements. They are also being sensitized regarding handling the



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export requirements subsequently.

In addition to meeting the requirements of the importing countries by following the regulatory requirements, efforts have been taken by India to ease the export of organic products. This has been achieved by establishing agreements with major importing countries. NPOP has been granted equivalence by European Union and Switzerland. Unprocessed plant products can be exported to these countries without additional certification. Based on the equivalency with EU, Indian organic products are permitted for export to Great Britain after post Brexit.

### Certification Bodies Network

In most countries, certification is a value-driven activity. This leads to increased costs, which are finally reflected in the end product being exported. However, NPOP gives opportunity to state government organizations to function as Certification Bodies apart from the private organizations. This is based on the competence and system established for inspection and certification as per ISO 17065. Out of 32 Certification Bodies accredited under NPOP, 12 are state government organizations which are eligible to operate anywhere in the

country.

The export of Indian organic products has grown from 13 million USD in 2002-03 to 1040 million USD during 2020-21. During past four years, the export of organic products has shown an annual increase of 25%, 40% and 47% in 2017, 2018 & 2019 respectively except in 2019-20 where it has been declined due to Covid 19. During 2020,-21, there has

been a growth of 51% in terms of value (million USD) compared to the export in 2019-20.

As it is evident in the global organic trade, the major markets of organic products are developed countries mainly covering USA, European Union etc. Indian organic products have been exported to 58 countries during 2020-21, with major destinations as USA, European Union, United Kingdom, Canada and Switzerland. The export has been presently limited to raw and processed agricultural products constituting of oil cake meal, oilseeds, cereals and millets, sugar, fruit pulps/purees, plantation crops, sugar, pulses, dry fruits, spices and condiments, medicinal plant products, tubers etc.

India has been able to demonstrate that compliance can be met at each level of handling of the product and consistent supply of credible organic products can be made while contributing to the sustainability of ecosystem. The strength and integrity attained throughout the years has paved way for double digit growth of organic products export. This has created better market penetration of Indian organic products in major importing and a reason for the millions of Indian farmers to be proud of too.

### TRACENET BY APEDA

With the increase in the area under certification and products exported from India, it was challenge to ensure that every consignment shipped from India can be traced till the farm. Thus, the application of technology has been brought into the certification as a tag and the web based traceability system, Tracenet was launched by Agricultural and Processed Food Products Export Development Authority (APEDA). Through Tracenet, the movement of any organic product from one to another can be traced. India has been pioneer in developing such a traceability system for organic products in the world

# WHY INDIA WILL EMERGE STRONGER AFTER THE SHOCKING 2ND COVID WAVE



**H**istory tells us India is not a country that is known for proactive planning. Look back in history and tell me – when did we have proactive planning? Foreign occupation to poverty to the current crisis – all is the outcome of our casual attitude and reactive mindset.

Unless we get a major hit from outsiders, including terrorist attacks, biological threats, war, or natural calamities, we take time to wake up. By that time, damage is done. Irrespective of political ideology, this happens because we are happy and satisfied under-performers as a society. We do not strive for excellence. Our political leaders believed in populism in place of excellence in governance. This breeds corruption, nepotism, and all those ills which ultimately lead to painful crises. The second Covid wave is just a reminder of that.

At the same time, we are good at crisis management. Once pushed to the wall, we learn to respect the in-house talent and support them. Af-

ter all, now there is the question of survival. I am sure we will emerge stronger after this crisis as well. We will come out with the best of skills, talent, planning, and resource allocations.

Let me share a few recent examples:

- After the 1962 India-China war, we started looking at defense forces. Today we can defend ourselves against China with equal might.
- After the Bhuj earthquake, we started looking at disaster management planning. Now we have a very well-developed National Disaster Response Force (NDRF).
- After the Mumbai terror attack, we have much better national security systems.
- When the USA denied us cryogenic technology, we started focusing on space research seriously.
- When we were denied supercomputers by the USA, we started focusing on computer hardware systems.
- When we were denied crucial remote sensing data for defense purposes, we started looking at spy satellites seriously.
- After the stock market crisis of

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1992, we created a security market regulator. With time, we developed some of the best stock exchanges in the world.

- After the crisis of NPAs and serious tax violations, we have one of the best financial transactions and digital payment systems in the world.
- Lately, the role of DRDO in new technologies is building confidence
- Our experience with the surgical strike, the airstrikes etc.

There are many more such examples that forced India to improve its governance but only in response to the crisis.



### We Need A Crisis To Improve

India needs a crisis to improve. Which-ever sector in India that you want to improve – first bring in a crisis in that sector. You will find the best outcomes after the crisis. Without pain, we seem to make no gain. We also have short memory, so we need these crises frequently. Hopefully, the use of digital technology, real-time monitoring, tracing and tracking will reduce the need for such painful reminders.

### How the second Covid wave will improve India

After this crisis, many sectors will get

due attention. The following are the areas where the policymakers must focus:

1. All hospital standards, layouts and designs need a serious relook. Essential services like oxygen generation plants, quick testing methods, telemedicine to monitor home quarantine patients, on-line reports, transparency in hospital billing, and only digital payments from patients must be made mandatory for all hospitals. No exception and no discretion should be allowed in good governance models. Experience has taught us that discretions are misused, and corruption creeps in. Any violation must be

finied at 10 times the gain from the corrupt practice or behavior by the regulator after investigating the facts. No need to run after overloaded courts. Disincentivize and kill the motive of profiteering. The focus of the management must be on good services and respectable and fair profits.

2. Covid Vaccination Dashboard model must be replicated in every sector. All hospitals and public utilities including food testing and drug testing laboratories, schools, airports, bus travel, ports, power plants, etc. must be linked to a common portal like the Covid Vaccination Dashboard.

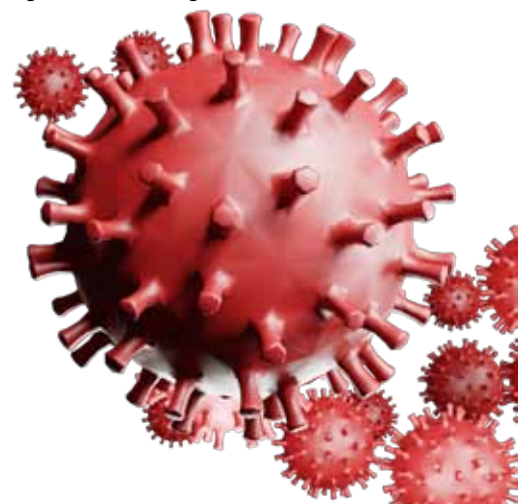
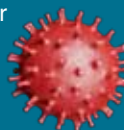
3. Disturbance in oxygen supply has exposed the flaws in urban planning and also in our social infrastructure. We must think new. The fundamental issue is: what should be the population density in a city? Do we need large overcrowded cities with millions of people in them? Can any infrastructure sustain this excessive load including hospitals? Migration to big cities must be dis-

### Challenge to Swadeshi Movement

Please note that bad designs and bad calibration can aggravate crises. There can be no compromise on the performance and quality of the products under the Aatmirbhar Bharat mission. India does not want unreliable, poor quality and junk production in the name of the Aatmanirbhar and Swadeshi agenda.

Every product under Aatmanirbhar Bharat and Swadeshi must be among the best in the world. This is a challenge to all those who are promoting Swadeshi. If suppliers cannot produce or offer products of specified quality, do not allow the Swadeshi label on that product. Quality Compromise will give a bad name to the swadeshi movement. Once there is trust in local products, why will consumers buy imported products?

The priority must be to review all the laws, procedures, and systems which are coming in the way of achieving excellence as a nation and promoting and supporting mediocracy. This needs political will. All political leaders may not such political will due to shortsighted political interests. The society must weed them out.





couraged by using modern communication technologies and highways to build towns every 50 kilometers.

Incentivize people to move to small towns by higher taxes on people living in highly populated cities and lower taxes on less populated cities. This means a high cost of maintaining infrastructure in a high-density population. There can be slabs linked to population density and city surcharge to ensure this. Population control measures should be considered to ensure sustainable development.

4. Distribution issues of oxygen are a great reminder for logical planning. After the Mumbai terror attack, NSG created more bases and centers to ensure quick response. The oxygen supply crisis will also highlight the gaps in essential item planning like oxygen, life-saving drugs, ammunition, fuel, high rise fire rescue options, fully equipped ambulances and cranes on highways, railway relief trains, high sea disaster rescue systems, explosions in toxic chemical and nuclear plants, bio-terrorism threats, etc. All these things must be reviewed in a vast country like India. Preparedness and alertness to respond is key to minimize the damage. Hopefully, Home Ministry with the Defense Ministry and other relevant ministries will create a separate division for this purpose.

5. Atmanirbhar Bharat Mission should be prepared to deliver high technology medical and security services. These are crucial in ensuring a reliable supply chain. Example: oxygen generators, tankers, testing kits and tools, reli-

### How long a reactive society?

The day India will start thinking proactively, we will become a hub for global innovations. India will be the biggest and the most attractive market and investment destination in the world. Our problem is not resources. Our problem as a society is a laidback and compromising attitude. The day we as a society change our mindset, and the day we demand excellence and deliver it, no one can stop India's growth to glory.

Covid gave us the reason to think again. Let us utilize this opportunity. Let us all play our positive role to make India great again.



able home use medical testing kits and equipment. We must have an aggressive plan to build research capabilities in agriculture and health sectors because locally developed vaccines are the biggest hope in this crisis.

6. Food, Feed and Fuel Security need special attention. India's 140 crore and an equal population of livestock need food and feed every day. In the first wave we were saved because of surplus stocks of food. The second wave of Covid and its oxygen supply crisis has exposed the weak links.

This crisis is a good development

because now all supply lines will be evaluated carefully. Proper mapping and planning is needed. Next time if anything goes wrong, the people of this country are not going to spare anyone. Policy makers must start planning from now onwards about food and feed supply situations in India. Our growing population will make life difficult for all stakeholders. There is need to evaluate supply lines for all crops, livestock, fisheries, etc from production to warehousing to post harvest management including distribution. This must be affordable as well.

### The way forward

Covid is here to stay. We have got a warning call that our systems must start rolling. I am sure that by the time the third wave starts, things will be much better and manageable. The issue is execution, speed, and precision. I am sure the Indian political leadership understands this. Today we have better technologies to execute our plans along with real-time monitoring. We all have to play our role as Team India.

Please stay safe and stay healthy.



# NAFED: PROMOTING THE ORGANIC ROUTE FOR SUSTAINABLE AGRICULTURE

**O**rganic farming is a system which avoids or largely excludes the use of synthetic inputs such as fertilizers, pesticides, hormones, feed additives etc. and relies upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection. As per FAO, "Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs."

Government of India is promoting organic farming through the scheme Paramparagat Krishi Vikas Yojana (PKVY), with the aim of promoting sustainable agriculture. Under the scheme Organic farming is promoted through the adoption of the organic village by cluster approach and PGS certification. NAFED has been implementing organic farming projects in association with private associates for more than a decade now in the



**NAFED**

*More than 60 Years in Service*

states of Uttar Pradesh, Punjab, Bihar and Uttarakhand covering a total area of around 45,000 ha.



## Projects presently under implementation

Government of India has allocated 50 clusters in the State of Uttarakhand (Nainital) and 50 clusters in the State of Bihar (Champaran) to NAFED under PKVY for implementation of organic farming projects. The Odisha Government has allotted 450 hectares of land to NAFED in the districts of Koraput, Rayagada, and Kalahandi under the Mission for Integrated Development of Horticulture for Adoption and Certification of Organic Farming in the State.

The ground work for commencement of organic farming in the identified clusters in these states has been initiated and teams of NAFED officials and the technical experts are conducting field visits for this purpose. Farmers are being motivated to take up organic farming through awareness programmes at the cluster level. The response of the farmers has been encouraging and they are showing keen interest and registering themselves for the projects. During the visits farmers are briefed about on farm and off farm inputs and preparation of fields as per NPOP guidelines. Efforts are also made to undertake organic farming as per tra-





ditional / tribal methods.

In Rayagada District of Odisha, which is inhabited by tribal people mostly, farmers are cultivating perennial crops like Cashew, Mango and Pineapple. Awareness campaign and baseline survey has been completed by NAFED in identified areas of around 150 hectares in the district. Many farmers in the district have agreed for converting to organic cultivation.

In Koraput District, NAFED had organised Capacity Building Training Programme in December 2020 in several villages like Bondagoda, GP-Khudi and



Awareness Campaign And Baseline Survey in Kalahandi district of Odisha



Awareness Campaign And Baseline Survey in Koraput district of Odisha



Awareness Campaign And Baseline Survey in Rayagada district in Odisha



Decapar GP-Sarishapada. Around 160 farmers have registered for organic farming in the region covering an area of 150 hectares in three clusters.

In villages like Bondaguda and Decapar also, several farmers have registered and attended training programs on *Adoption of Organic Farming for Organic Certification under NPOP/NSOP Standards*. These covered a wide range of topics like bio-diversity maintenance of organic farming, procedures in accordance with guidelines under MIDH (NHM), organic certification procedures, Formation of FPOs, Making of Sulphurs, Organic Potash, On-Farm Organic Input production etc. Organic Packages of Practices for crops like Ginger, Turmeric, Vegetables, Paddy etc were also discussed in the training programs.

Based on the evaluation of performance of the ongoing project of organic farming of 450 hectares in Odisha, the Director Horticulture has further allocated 800 hectares to NAFED for organic farming for FY 2020-21. At present a baseline survey of 800 hectares in Koraput and Rayagada is in progress.

NAFED plans to bring more area under organic cultivation by implementing organic farming projects in other states across the country. The organic produce under the projects would be sold through NAFED Bazaar and other outlets across the country with the aim of providing market linkages and better price remuneration to the farmers.

ECO AGRICULTURE REVOLUTION

# VITAL ROLE OF BIO INPUTS

India is on the path of moving from Green Revolution to Eco Agri Revolution or Ever Green Revolution. The role and potential of biological products (agri-bio inputs) as the key component is increasingly appreciated at all levels.

Bio-inputs hold enormous growth opportunities because they are eco-friendly, cost effective, and farmer- and consumer-friendly. They have a major role to play, because climate change is emerging as a major challenge globally.

## Sustainable Growth in Agriculture

Bio- inputs play a pivotal role in eco-friendly, cost effective, farmer and consumer-friendly sustainable growth in agriculture. It is a laudable way of producing enough food in a sustainable manner without the harming environment. Eco agriculture is recognised as most critical and essential desideratum for environment friendly future. India is steering towards Eco- Agri Revolution with the indispensable role of bio inputs in making it a reality.

The concept of bio input in agriculture was not much popular even among progressive and large industries as there were several

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challenges. However, in the last two decades there has been a striking change.

Many new-generation products are now in the market, and the demand is growing rapidly. Bio products are increasingly being used in conjunction with traditional inputs in conventional farms. A 20 per cent mix of conventional and bio inputs is the popular trend initially. As for organic farming, the trend is toward certified bio-input packages to help improve productivity and disease control.

The use of bio inputs, including microalgae bio stimulants, bio composts from farm wastes, can considerably help farmers to realize higher produce. The main driving forces for the demand for bio products are environmental concerns, consumer awareness, farmers' need for low-cost inputs, and the fast rate of development of newer and more effective bio products. It has been seen that even small, illiterate farmers adopt new and better products faster than expected.

### Crop Benefits

Strengthening the use of bio-inputs in agriculture follows a global trend in agriculture. The attempt is to improve yields while reducing costs and developing farming systems based on more sustainable resources. It is a colossal opportunity to become the transforming agent on this shift in agriculture.

The use of biological products is be-



**Mr Sarkar is passionate about painting and photography**

ing rapidly adopted by growers looking to increase crop productivity while reducing the use of chemicals. The effort is to improve production efficiency, add organic matter to their soils and eliminate chemical residues. Biological products known as bio stimulants are proven to

provide crop benefits from germination through harvest. They optimize nutrition, vigour and minimize the effects of stress during crop production, leading to better overall crop quality and productivity.

Bio inputs in Eco Agriculture also inputs lead to a greater variety of food, produced under higher quality standards. This is beneficial for consumers in terms of increased food supply. It also leads to lower prices and improved nutritional quality of products using superior technologies. These ultimately add value to the entire gamut of farming systems.

Bio-inputs are gaining more and more space and higher demands from different stakeholders worldwide. Currently, there are already dozens of farming activities in different parts of the country, using different types of bio-inputs obtained from biological resources. The wide array of bio-input includes everything from inoculants, plant growth promoters, bio-fertilizers, ingredients for plant and animal nutrition, plant extracts, pest, parasites, and diseases controlling agents. These are made from beneficial micro-organisms such as fungi, bacteria and mites or herbal compounds, using technologies that have biological agents in their composition, either for plants and animals, as well as for post-harvest and food processing.

**Our manufacturing processes are based on a soft biological process that does not use chemicals for the extraction of microalgae. Our products result in a lower carbon footprint for growers**

### Seaweed extracts and Microalgae

Seaweed extracts currently occupy the





largest share of the bio stimulant market. There is a degree of variability associated with these products. This is due in part to the harvesting of seaweed from different open water locations all over the globe. Microalgae also contain high concentrations of proteins, peptides and amino acids and many other bioactive natural compounds not found in seaweeds. Because of this, microalgae are rapidly emerging as a preferred source of plant-based bio stimulants. These provide many advantages over the current seaweed, kelp, and amino acid-based products available in the market. There are over 60,000 highly diverse known species of microalgae, each with unique properties for applications in crop agriculture, human diets, animal feeds and many other industries.

### The Future of Agriculture

Increasing population, increasing average income and globalisation effects in India will increase the demand for quantity, quality, nutritious and variety of food. Pressure on decreasing available cultivable land to produce more quantity, variety and quality of food will keep on increasing. The future of agriculture is a very important question for the planners and all other stakeholders. Efforts are being done to convert all the challenges in agriculture into opportunities and this process is the future of agriculture.

Demand for fruits and vegetables, dairy products, fish and meat is going to increase in future. More competition will be there among private companies giving innovative products, better seeds, fertilisers, plant protection chemicals,



customised farm machinery and feed for animals etc in cost effective ways at competitive prices giving more returns on investment by farmers.

### AlgaEnergy International

AlgaEnergy International is committed to play a strong role in the Eco Agriculture revolution with the help of nature's biological powerhouses – single cell mi-

croalgae, microbes and natural extracts of these organisms and of higher plants, to create a portfolio of best possible sustainable agricultural products.

AlgaEnergy was founded over a decade ago with the vision of developing and commercializing natural and sustainable 21st century solutions for a variety of market sectors based on the dynamic diversity of microalgae. Over 60,000 different species of microalgae are known to exist and grow in a wide range of environments. Microalgae are biological powerhouses that can be used as a natural source of unique molecules for products across many sectors, including crop agriculture and animal health and nutrition.

AlgaEnergy has created its International Agribusiness with the priority to bring novel biological solutions to growers around the world. Currently we have subsidiaries in approximately a dozen countries that work closely on a regional basis with commercial and R&D partners, as well as directly with growers.

Bio stimulants produced by AlgaEnergy are derived from single-cell microalgae strains that are carefully selected for their crop benefits. These are grown in closed and highly controlled production systems to create novel, effective crop inputs. AlgaEnergy's incorporation of multiple species with known crop

### SUPPORT FOR RESEARCH AND DEVELOPMENT

We must support research that illuminates more information on the mode of action of our products and use this information to help educate the industry itself, and growers and consumers, of the benefits of natural biological based products.

We need to be proactive about legislating supportive regulatory guidelines that bring uniformity to the marketplace about biological products. This harmonization of regulatory guidelines, at a minimum, needs to be regional, and we should set as our goal making such guidelines global.

Finally, our industry sector needs to continue to innovate at an accelerated pace to bring to market the most efficacious products possible. There is a tremendous wealth of biological diversity from which to create unique and valued products that continue to advance sustainable agricultural – especially Eco Agriculture methods around the world. It is up to us to understand the needs of the market and use our expertise to create products that promote sustainability for the environment, and also for the farmers and the consumers that we serve.

benefits creates products that are highly adaptable and provide benefits to all agronomic crops, production systems and geographies. This enables the AlgaEnergy microalgae-based bio stimulants to deliver consistent agronomic benefits across diverse growing conditions.

AlgaEnergy is the global leader in microalgae innovation with over five decades of research knowledge at their access. The company has identified microalgae species with specific activity for agriculture providing crop growth, development, stress tolerance, nutrient assimilation, and plant vigour benefits to a wide variety of crops. The products are shelf-stable for at least two years. These are compatible with traditional crop inputs and easily incorporated as a vital part of an overall crop production management strategy.

AlgaEnergy grows their microalgae in photo-bioreactor growing systems. These utilize CO<sub>2</sub> from natural gas power generation to produce the highest quality and most sustainably produced microalgae-based products. AlgaEnergy uses an advanced enzyme-based digestion process called UPT® to optimize the effectiveness of the full range of essential crop beneficial components including carbon, organic crop nutrients, amino acids, antioxidants and all major plant growth molecules in physiologically relevant amounts and ratios to help optimize crop production.

### AlgaEnergy's International Agribusiness

AlgaEnergy's International Agribusiness promotes solutions that ensure sustainability. Improving agricultural systems is the central tenet of AlgaEnergy's International Agribusiness. For us this means less reliance on synthetic chemistries and mineral-based nutrition products. We improve soil health by contributing organic carbon and supporting the development of a rich microbial community in the soil. We promote the use of residue-free products to create healthier crops that are also healthier for consum-



ers and safer for the environment. We are committed to deliver sustainable solutions for farmers and growers. AlgaEnergy formulates and produces powerful and sustainable technology-driven solutions for improving the world's agricultural markets.

Our initial product portfolio was based entirely on unique microalgae products. Today we have expanded our portfolio of solutions to include best-in-class microbial products and natural pest control products.

We are actively innovating – innovation is in our DNA. AlgaEnergy will soon debut a unique new class of crop inputs that combine microalgae with other biologicals to bring new modes of action for improved crop nutrition, bio-stimulation, bio-pesticides for bio-control of diseases and pests.

AlgaEnergy has created a vision of sustainability from growth of our microalgae to the manufacture of our products, and to the benefits our products bring to

the environment as well as the prosperity of our customers. Our microalgae product facility has ISO14000 environmental certification and uses CO<sub>2</sub> from any energy production plant that would otherwise be released to the atmosphere.

Our manufacturing processes are based on a soft biological process that does not use chemicals for the extraction of microalgae. Our products result in a lower carbon footprint for growers. We assess our contributions to reductions in CO<sub>2</sub> emissions from the manufacture and use of our products. We minimize our internal activities that would create environmental stress by, for example, using trains vs. flying when possible.

Behind our product portfolio is our focus and commitment to use sustainable methods of production for all the products we develop and sell. For example, AlgaEnergy uses CO<sub>2</sub> emissions from a natural gas power plant in the production of our microalgae. Our microalgae production facility is located on the site of a large combined-cycle power plant. We pipe CO<sub>2</sub> directly from that facility to our microalgae growth tubes and other microalgae production platforms.

We at Algaenergy international Agribusiness have taken the pledge to support the development of Eco Agriculture solutions. The biologicals industry and the agricultural industry in general needs to continue to educate, legislate and innovate.



ORGANIC FARMING

# ROUTE TO ECO AGRICULTURE & GOOD HEALTH



**A**s part of the Green Revolution a few decades ago, Indian agriculture went through a dramatic transformation, and converted itself to an industrial system with the adoption of modern methods and technologies. This resulted in a spike in production and productivity of all crops in the country. The long-term effects of this transformation on the natural resources were observed a few decades down the lane, with degradation of soil, water pollution, extinction and endangerment of flora and fauna, as well as significant health danger posed by the residual harmful chemicals and pesticides used in farming.

To counter these negative developments, scientists, farmers and also the government are coming together to promote organic farming as a viable option to save the environment, and human lives from getting endangered in the future.

## ABOUT THE AUTHOR

**Mr Subrata Dutta is Group Managing Director of Organic India. He is known as a turnaround specialist in the industry for his transformational and path-breaking initiatives in top global brands across diverse sectors of FMCG, Retail, Lifestyle and Travel in companies such as PEPSICO, Wimco, Himalaya, and Samsonite.**



Especially during the pandemic, organic farming has recorded huge spike in demand with people shifting their focus to organic food to ensure better immunity.

## What is Organic Farming?

Based on unique values, and principles like health, ecology, environment, and care, organic farming is a completely natural and sustainable farm management practice that has been a tradition in our Indian farming system. It is a holistic farm management approach that aims to create a socially, environmentally, and

economically sustainable food production system. The core philosophy behind this method is based on managing the agro-ecosystem rather than relying on external farming inputs, such as pesticides, artificial fertilizers, additives, and genetically modified organisms. This method of farming is labour-intensive. It leads to employment generation in rural areas, and long-term improvement in the quality of resources.

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FACT**



When Mr Dutta is not travelling to faraway places to enrich his experiences, he likes to apply the laws of physics to business management

### Why The Switch to Organic Farming

Consumers are increasingly conscious of food safety, personal health and environment health. Organic food has become a major alternative for consumers to overcome the negative consequences of chemical-intensive farming methods. Many farmers see organic farming as a way to increase and stabilize production, and earn with public support and market demand. Organic farming has multiple benefits.

**Health:** Organic food carries low concentration of chemicals and stimulates good health.

**Toxin and GMO-Free:** Organic food products guarantee non-toxic chemicals and GMOs. No antibiotics or hormones are given to the livestock. Organic producers and processor undergo strict announced certification inspection by the third-party inspectors to ensure proper required quality standard.

**High nutrient content:** Organic fruits, vegetables, grains and edibles have low residues of pesticides, making them safe food and high on nutrients.

**Environment:** The main focus of organic farming is agro-ecology practices. It can reduce water, air and soil pollution. It promotes conservation of biodiversity, strengthens the ecology and develops self-reliant systems. Natural methods like mulching, crop rotation, crop residue management and other improved organic

With more and more people realizing the importance of organic farming for environment preservation and human health, there is an obvious shift in global consumption patterns



### Present status of organic farming

Thirty percent of the total organic producers in the world account for 2.59 percent i.e. 1.5 million hectares of the total (57.8 million hectares) organic cultivation area. India ranks ninth in terms of the world's organic agricultural land and first in terms of the total number of producers (IFOAM, 2019). It is a matter of concern that most of our organic farmers are struggling due to poor policy measures, inadequate knowledge, increasing input cost and lack of market knowledge (ASSOCHAM report, 2018).

Organic farming is yet to taste success. Sikkim is India's first organic state. A survey by Centre for Science and Environment, New Delhi, found that Sikkim is not complemented with an increase in availability of organic manure.

IFOAM campaign like Honest Food and GOI schemes, programs and projects are encouraging farmers and consumers towards organic farming and organic food.

practices reduce green gases, which helps in mitigating climate change.

**Economics:** Certified organic food products fetch a higher price in the market over conventional food products. This benefits the farmers associated with the organized supply-chain system.

### What are Organic Food Products?

Organic is something which is not artificial or synthetic. It does not adversely impact any form of life in the ecosystem. It is food grown without the use of chemical-based fertilizers or pesticides. It is not genetically modified and irradiated. Food can be considered organic – whether plant or animal-based – if it is fed and grown with organic matter along with a condition of welfare to the ecosystem. Food grown in kitchen gardens can be considered organic with the use of natural fertilizer and pesticides.

Farmers grow organic food with certified organic products, using renewable resources and with a view to conserving soils and water. The purpose is to improve environmental quality for future generations under strict government authorized practice and regulation. Companies offering organic produce are certified by the government after following due rules and regulations. They process and market the organically cultivated food products by farmers.

### India's Strength

Organic Agriculture has always been India's inherent advantage and strength. Although the importance and benefits of organic farming are known to all since a very long time, the high price of the organic products led people to opt for foods produced through chemicals-supported agriculture. With more and more people realizing the importance of organic farming for environment preservation and human health, there is an obvious shift in global consumption patterns. Led by health awareness among the consumers and concerns of sustainability, organic products are on the forefront locally, nationally and also globally.



# FAMILY FARMER

## Subscription Model In Farming is Win-Win

Covid has brought home the importance of good food for strong immunity. It has opened up new markets and high demand for naturally grown food products. A new model of retail for fruits and vegetables is amidst us. This is the Subscription Model. Among the pioneers of this model in India is actor-cum-farmer Mr Rajesh Kumar. He is best known for his roles such as Subodh Thakkar in the Star Plus hit comedy-drama series *Baa Bahoo Aur Baby* and as Rosesh Sarabhai in Star One hit sitcom *Sarabhai vs Sarabhai* and the sequel *Sarabhai vs Sarabhai: Take 2*.

In real life, the Take 2 of the actor is as a farmer. His Instagram handle describes his profile well. *Actor by profession, farmer by choice*.

Mr Kumar spoke to The Agriculture Today Group about his passion – farming



**W**e have the Family Lawyer, the Family Doctor, The Family CA. It is time we also have the Family Farmer.

After many hits and trials, a lot of passion and a roller-coaster ride of successes and mis-steps in agriculture, we have hit upon this concept of Family Farmer which is relatively new in India. This is the Subscription Model for farmers. Farmers undertake organic or natural farming, and deliver the chosen fruits and vegetables to their client base every week.

### Natural Farming Only

We grow a wide range of fruits and vegetables in a village near Mumbai. We undertake only natural farming, and follow two methods. These are

the Subhash Palekar Natural Farming method and the CV Reddy model of natural farming. Both Shri Palekar and Shri Reddy have been awarded the Padma Shri for their path-breaking work for the development of agriculture in India.

In organic farming, bio fertilizers and bio pesticides are used. We don't use any of these. For pesticides, we use the leaves and other parts of plants known for their anti-fungal or anti-pest properties. There are many simple methods which natural farmers use. For example, take chaas (buttermilk) which has been left to ferment for a week or more. If you pour this over a plant, it will rid the plant of any fungal attack. Plus the leaves will have a beautiful, natural gloss.

Our biggest validation comes from our subscriber base, which is steadily growing. Families tell us they have shifted to consuming more vegetables. They can feel a distinct difference in energy level. Vegetables cook so much faster. Vegetables and fruits have a burst of flavour, which was not the case earlier.

### How the Subscription Model Works

Every week, we share with all our subscribers the fruits and vegetables that are to be harvested. They tell us their personal choice – what all they want from the produce being harvested. In this way, a week's supply of fruits and vegetables comprising about 10 to 12 kilograms is delivered to every family.

It is the complete nutrition assurance of our products that has made consumers stay with us and find value for money. For example, just a generation ago, we used to consume *neem* in one form or another. It has major medicinal properties. We do all our pest control through *neem* leaves. In this way, we are providing valuable immunity boost to people.

We want to involve the young generation and make them aware of the natural wonder that is agriculture.



### Help farmers through Subscription Model

There are thousands of conscious consumers who truly want to help farmers. There are many Indians who are so committed to public good that they even want to adopt villages to contribute to their welfare. They can make a beginning by helping farmers through the Subscription Model.

The farmers are afraid to shift from the wheat-paddy cycle, where they get assured MSP. If farmers can be assured of a good price for their produce and the right price for their efforts, they shall have the confidence to shift to horticulture, where they can get a higher income.

If ten families adopt a farmer and work on subscription basis, it will be a win-win situation for farmers and consumers alike.



We want to make them aware of the difference made by chemical-free farming.

### Market Linkages For Natural

#### Farmers

We are thrilled by the appreciation and the increasing demand. A group of farmers from Nasik have joined us. They shall be able to supply their fruits and vegetables to families in Mumbai. These farmers tell us that earlier, they could not reach the right buyers with their produce. Since fruits and vegetables are a perishable commodity, they had to sell these at whatever price they got. Now these farmers are happy that they have been able to get the right price for their



efforts.

We have been earning revenue for about four months. We should break even by the end of the year. My friends and I have pooled our resources for expansion. We invested in drip irrigation and other technologies that are farm friendly and help us save on resources.

### Our Experiments in Bihar

In September 2017, Sadhguru Jaggi Vasudev launched a campaign of Isha Foundation titled Rally for Rivers to tackle the scarcity of water across rivers in India, and instill awareness about protecting rivers. This was a month-long, nationwide campaign.

I was the anchor for this campaign for Bhopal, Lucknow and Delhi. After five-six days, I reached my native place, Barma in Bihar. There is a river there, about a kilometer wide and about 250 kilometers long. It used to be a perennial river, but now it did not have even a single drop of water. Heavy plantation along the river bank would keep the river alive. But now the river has water only during the monsoon.

This caused a major tectonic shift within me. I thought, what is the point of accusing the government or the society? What is the point of saying we should do this or do that? It is important to jump in and try to make a difference ourselves. It is important to take people along and see what change we can bring about ourselves. I know that bringing the river back to perennial life is a generational project. Entire belts along the river shall have to shift to horticulture.

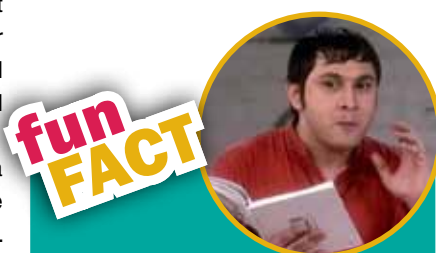
I am trying to do my bit by creating a model in my village for horticulture. The farmers in our area are still skeptical. They do not know whether horticulture can get them a regular income, so they are watching our experiments.

### Our Bihar Plantation

I had thought that farming will be a smooth ride for me at Barma in Bihar, because it is my native place. I was wrong. We faced many challenges.



The farmers are afraid to shift from the wheat-paddy cycle, where they get assured MSP. If farmers can be assured of a good price for their produce and the right price for their efforts, they shall have the confidence to shift to horticulture, where they can get a higher income



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FACT**

**I enjoy farming, but my passion to act will never cease. Comedy is serious business and I feel proud that I am good at it and my work is unique. I want to do more such roles in the future and entertain viewers.**

We are working on 17 acres in Bihar. This is our family land. We are trying to develop our land as a model farm. We have about 500 lemon trees, about 2,000 guava trees, about 800 papaya trees, green chillies over five acres. We have mangoes.

We are trying to show the farmers that when you shift from conventional farming, you can have income throughout the year. It shall reach completion in a few months. Organized work on the farm has been going on for two years. We have installed drip irrigation. We have streamlined electricity usage on the farm.

I observe that even now, farmers are not ready to shift to drip irrigation. There are challenges in this process of adaptability. They still resort to flood irrigation, which leads to heavy loss of water.

We are at a point where income from our farm shall be generated on a regular basis. In the next few months, we shall come to know what are our recurring costs, how much we earn. The farmers in the neighbourhood are watching us and evaluating our performance.

### Farmers Have Land Holding, They Need Hand-Holding

Farmers are scared to shift from the convention wheat-paddy cycle. They do not know whether they shall be able to make money from horticulture. Farmers half land-holding, but they need hand-holding. Because of insecurity, they don't want to make the shift.

Small farmers take land on rent from big land-holders. Then they want to maximize the gains from this land. In order to maximize the yield, they apply chemical fertilizers, chemical pesticides and all that they can to get more and more from the land. In this way, use and abuse – both are happening to the



### The Delhi Chapter of Shivaang Naturals

We have undertaken the Subscription Model of home delivery of fruits and vegetables as part of our farming initiative called Shivaang Naturals. We now want to provide naturally grown vegetables and fruits to consumers in Delhi. For this purpose, we have identified fertile land on the Delhi-Aligarh Road. Post monsoon, the service shall be launched in Delhi.

We still have to identify and reach out to subscribers. We named our initiative Shivaang Naturals as a spiritual tribute to the Divine. It is the essential philosophy of Existence: Everything comes from nothing and everything goes back to nothing.

for decades now. All these malpractices are impacting the food we eat, and it is a worrying situation.

So what do you want to do about this situation? You can send a message on WhatsApp or post it on social media, and you get thumbs-up or some other emoji in response. Or you decide to become a farmer yourself and aim for the bigger change, the real change. I am happy I opted for the latter. This decision has changed my life in amazing ways.

### Farming in Palghar, Maharashtra

In January 2019, I took land on lease in Palghar district in Maharashtra. We started moringa farming with 10,000 saplings over 17 acres. Moringa has a robust export market, but heavy monsoon damaged the crop.

Fortunately, some other farmers in the area gave us ten acres for farming. Here, we started our experiment in community farming. All those families who were part of community farming took up 1,500 square feet each, where they were invited to come with their children and choose the vegetables and fruits they wanted to grow. From this, we came to our model of subscription farming, which has proved to be a success among farmers and consumers alike.



land. The organic content of the soil has suffered drastically by this abuse, and is alarmingly low.

Have you ever wondered why farmers use 60 horsepower tractor to till the land which we used to till with two bulls? It is because the soil has become so hard that it can be tilled only with such heavy horsepower. The top soil has got cemented by wrong farming methods



## NEED OF THE HOUR

# AGROCHEMICALS LITERACY IS VITAL



**A**griculture has supported our country's economy through extremely tough times. While the overall GDP deficit was -23 per cent, the agriculture sector was growing at the rate of 3 per cent. No matter how much progress has been made in any other field, the backbone of the country's economy has once again proved to be the agricultural sector.

But the farmer, who is backbone of the economy, has been left impoverished due to rising production costs.

Seeds, labour, agro-inputs i.e. agro-chemicals etc. are mainly included in the increasing cost of production. Farmers spend more than needed in the application of agricultural inputs due to technical illiteracy.

The farmers illiteracy is especially evident regarding the use of pesticides. Today, farmers spend the highest on agro-chemicals. Mostly farmers go to the Krishi Seva Kendra in case of crop disease or pest infestation. They buy the agrochemicals given by the Krishi Seva Kendra operator.

It is important that the operator of the agricultural service center should possess appropriate knowledge of precise inputs application. Unfortunately, there is no or little training available to Krishi Seva Kendra operators that will give them knowledge of proper and quantitative use of market inputs like bio-stimulants



**Biome**<sup>TM</sup>  
Our innovations your Edge to Lead  
**Technologies**

### ABOUT THE AUTHOR

**Dr Prafull Gadge** is well-known scientist-entrepreneur and industrial consultant in the field of Agricultural Biotechnology. His areas of expertise are product innovation, process development and industrial problem solving. Till date he has served more than 150 agrochemical companies and provided several commercially viable strategies for plant protection and high productivity through the eco-friendly biological approach

or biological pesticides for first aid and chemical pesticides.

### Excessive Application

Devoid of any kind of technical knowledge, farmers are often advised or delivered more inputs or agro-chemicals than they need. It is an ignorant idea that the results will be seen by either one or by the other input. This increases the production cost of farmers. To avoid this, it is necessary to have a prescription in order to reduce the cost of production in the field by providing the necessary and essential inputs by the experts. It will also help to stop the damage to the environment.

Often, the use of agrochemicals at the right time, in the right amount, and at the right place demonstrates effectiveness. For example, humic acid-soil conditioner in biostimulants should be applied to the roots in the soil. But it is widely recommended to spray on the leaves, which has no effect on the crop, which increases expenses of buying and spraying.

Currently, the market demand for residue-free and organic agricultural products is increasing. The demand for related agricultural inputs and pesticides is also increasing. Lack of literacy among farmers and agri service centers creates difficulties in production of exportable pesticide-residue free, certified organic produce.

The use of chemical pesticides is expected to be in line with the guidelines of the economic threshold level. But, often – if not every time in the early stages, high intensity chemical pesticides are suggested or given to the farmers. This increases the cost of production, leaves residues of toxic pesticides that



**Biome Technologies offers R&D services, regulatory guidance, training and advisory services to the agri-input sector. Biome Technologies also offer skill development training to bridge the gap between industry, academia and farmers to contribute in the nation's development. Our awareness programs help farmers lower production cost and increase income**

costs and avoid environmental damage. If we are applying global standards for the production of pesticides, then applying the relevant standards for the use of pesticides in the field will definitely benefit the farmers and the environment. It will also provide food free of toxic residue. Residue-free agricultural products are in great demand in the global market. These products are priced higher than the market price by the traders and are guaranteed to be purchased on contract basis.

If the farmers are aware of label claim on pesticides, maximum residue level (MRL), pre-harvest interval (PHI), harvesting period, etc., it will be easier to do profitable export quality farming with minimum production cost.

In farming, like in any other business, it is necessary to reduce production costs, increase productivity and product quality through proper technical training for inputs and chemicals literacy. Only then the backbone of the economy will stay strong.

Biome Technologies offers R&D services, regulatory guidance, training and advisory services to the agri-input sector. Biome Technologies also offer skill development training to bridge the gap between industry, academia and farmers to contribute in the nation's development. Our awareness programs help farmers lower production cost and increase income.





# BUILDING A SELF-RELIANT INDIA



**T**here is a deep connection between humans and nature. Man is the best expression of the brilliance of nature. But this superiority is yet to be proved. This is the root cause of the problem. Pure food, clean air, water, environment etc – all that man needs for his existence is provided by nature. Why haven't humans fully appreciated this reality? The system of nature is constantly at work to give man and all living beings the daily support of life and existence. Adequate mineral deposits on the surface of the earth, water, botanical biodiversity, climate change, wind, moisture – everything is working in a natural rhythm in such a way that all living animals can exist comfortably in their given spaces. Then why is human life on earth not successful? Why is there artificiality and arbitrariness in human activities?

If you want to live with nature, you have to understand the systems of nature. Whenever man has been arbitrary with nature, he has paid for it. This faulty behaviour has been the root cause of all the problems. Answers to challenges faced in farming, nature, environment, economic self-reliance, employment etc. – all

these can be found if the thought and action of man is correct at all times. Effective and enduring social change shall be possible only if there is qualitative change in human mindset.

Qualitative change means that there should be a shared view on the reality and a collective endeavour to find solutions. The entire natural system is available to every human being to study and understand. Artificialness and arbitrary development is not a positive direction. It moves man towards destruction.

## **Balance in ecology and economy**

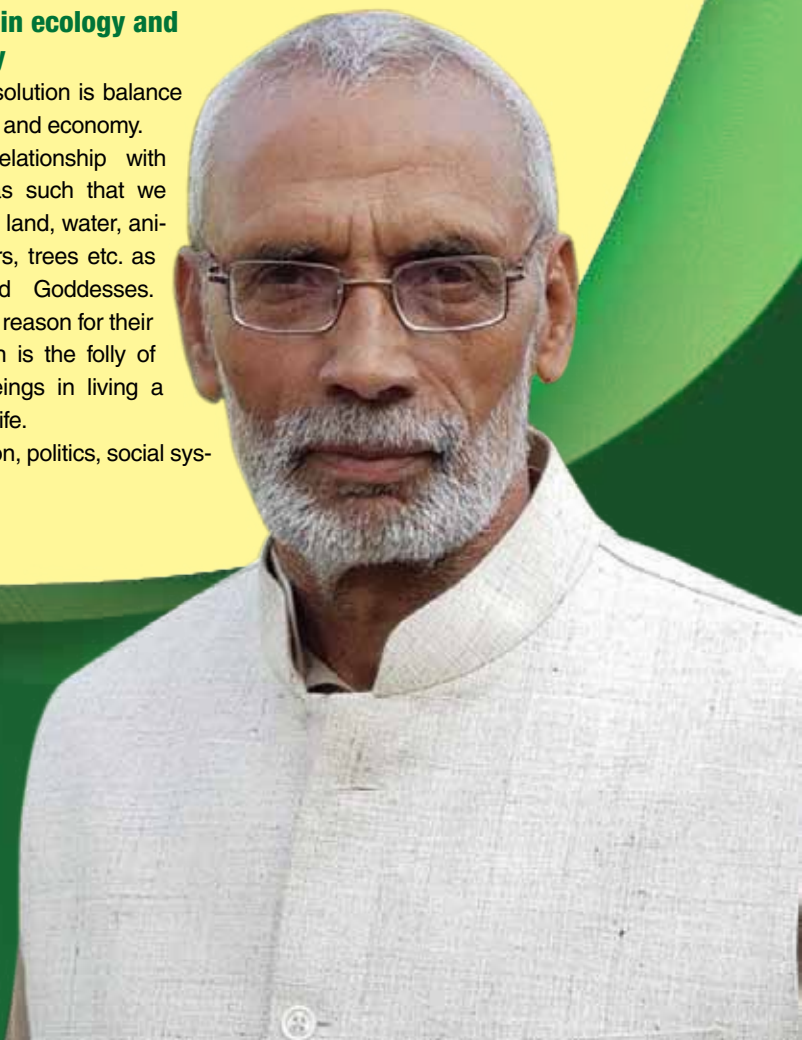
The only solution is balance in ecology and economy.

Our relationship with nature was such that we referred to land, water, animals, rivers, trees etc. as Gods and Goddesses. Today, the reason for their destruction is the folly of human beings in living a balanced life.

Religion, politics, social sys-

## **ABOUT THE AUTHOR**

**Shri Bharat Bhushan Tyagi is a farmer and educator at Bulandshahr, UP. He was awarded the Padma Shri in 2019. He organises weekly training for farmers at Bulandshahr and has trained over 80,000 farmers. He is also a recipient of Progressive Farmer Award by Prime Minister Shri Narendra Modi**





tems – everything is dominated by trade. Money is the only standard of development. At the heart of money-making is the profit mindset. Profit refers to giving less and taking more. For this reason, the emphasis was on increasing production volume, ignoring the ecology of inputs and outputs in agriculture. The result was that we lost diversity and quality. Most of our actions were anti-nature.

The direct impact of such thinking was seen on farming. Farmers were caught in the mire of artificial costs, sales and pricing. The middlemen kept flourishing. The farmers became steeped in deep debt after they relinquished the traditional wisdom associated with agriculture – of living with nature.

In modern farming, the cost of production of machines, etc. is market-centric. The entire system of selling and pricing of the produce of the farmers is part of an arbitrary market cycle. The market has looted the farmers in the name of supply and demand. Only the farmer knows this pain. The country has suffered much from Netajiri. Market and market laws could not protect the farmers from exploitation. The need is for an integrated approach to agriculture. This shall lead to farmer welfare.

### Value of New Farm Laws

The new farm laws have the ability to double farmers' income. These are a his-

**The new farm laws are a historical initiative aimed at farmer welfare. But farmers could not understand their importance and ridiculed them**

torical initiative aimed at farmer welfare. But farmers could not understand the importance of the farm laws. They ridiculed them. Weak mentality increases man's paranoia so much that he loses the ability to distinguish between the good and the bad.

We need the new agriculture laws for the common good of small and marginal farmers in India. These laws empower farmers with better production management, quality certification processing and value addition. The farmers shall be able to find efficient marketing systems by aligning as FPOs. It is essential for farming to develop as business. It is wrong to assume that traders shall take over land.

Farmers need to act responsibly. There is a major need for qualitative increase in the income of farmers. Farmers have a bigger role in achieving this than the government. By itself, the government cannot increase farmers' income. The farmers have to change their thinking and schedule. Farmers should take on the role of entrepreneurs and businessmen. They must keep accounts of crop production. Economic analysis is the responsibility of

the farmers. Even a small shop or business does not run without accounting. Then how can it be ignored in farming? Farmers need to be given opportunities for self-reliance in farming in order to secure a good future for themselves and their children.

### FPOs: A Vital Link

The farmers themselves should bear the responsibility of forming 10000 FPOs, as has been envisaged by the government. If the farmers start focusing solely on the welfare of the farming community, they shall be able to realize the merit in the new farm laws. The need for these laws and their utility shall be understood.

Capital investment in farming comes from prudent thinking and labour. From this shall flow employment and trade. Our land gives us 1000 grains from a single grain that we sow. Then why do we have high indebtedness in the farm sector? Why has the farm sector been neglected? It is the farmers who must look for the answers to these questions, and the solutions.

We have a golden opportunity to realize the dream of self-reliant India if we realize the potential of the new agricultural policies with correct thinking. Our plans need a definite purpose. Organic farming is a meaningful alternative for our future. Let us work together to make our nation prosperous.



# NATURAL RESOURCE MANAGEMENT AND ECOLOGICAL FARMING

**E**cological farming is recognised as the high-end objective among the proponents of sustainable agriculture. It is a vision of sustainability and food sovereignty in which food is grown with health and safety first. Control over food and farming rests with local communities, rather than transnational corporations. Ecological farming is not the same as organic farming or conservation agriculture or climate resilient agriculture. There are many similarities, and they are not necessarily incompatible. Ecological farming includes all methods, including organic, which regenerate ecosystem services. These include prevention of soil erosion, water infiltration and retention, carbon sequestration in the form of humus, and increased biodiversity. Many techniques are used including no till, multispecies cover crops, strip cropping, terrace cultivation, shelter belts, pasture cropping etc. Eco-farming combines modern science and innovation with respect for nature and biodiversity.

## Role of Natural Resource Management

Eco-farming combines modern food science with respect for nature and biodiversity. It ensures healthy farming and healthy food, soil, water and climate. Accordingly, Natural Resource Management (NRM) research has contributed towards developing cost effective, eco-friendly, socially acceptable scientific farming practices in farmers' participatory mode addressing issues at ground level keeping in view the farmers' resource availability, traditional indigenous technology knowhow and grassroot farm innovations.

The major concerns of NRM are low farm productivity & profitability, land degradation, low water productivity, soil health deterioration & low nutrient use efficiency, abiotic stresses including climatic aberrations and loss of tree cover and deterioration in ecosystem services. The following eco-friendly farm technologies developed could be effectively integrated to shape ecological farming in the country.

**Micro level land resources management:** Initiated agricultural land use planning at 1:10,000 scale i.e at block level covering different agro ecological sub-region of the country, based on the soil characteristics, climate, water availability/irrigation facilities, socio-economic imperatives etc to utilise the full potential of land and water resources choosing the right crop/cropping system suitable for the region.

**Bio-intensive cropping systems:** Identified and documented bio-intensive cropping systems for irrigated, rain-fed, arid, hill and coastal ecosystems of the country for effective crop diversification.

**Agro-forestry:** Standardized different agroforestry modules for arable and non-arable lands.

**Integrated Watershed Management:** Developed 84 IWM models for different regions of the country with location specific bio-engineering measures to check soil erosion and rehabilitation of eroded lands.

**Wind erosion:** Developed sandune stabilization and



## ABOUT THE AUTHOR

**Dr Suresh Kumar Chaudhari is Deputy Director General (Natural Resource Management), Indian Council of Agricultural Research (ICAR), New Delhi**

shelter-belt plantation technologies to check wind erosion & desertification.

**Multipurpose Rubber Dam:** Developed multipurpose rubber dam for watershed to reduce soil erosion, create water storage facility, enhance groundwater recharge, and quick and safe disposal of sediments.

**Drip Irrigation Scheduling:** Developed drip irrigation scheduling of various crops/cropping systems for different regions of the country for judicious use of water.

**Organic Manures:** Developed technology for preparing organic manures such as phosphocompost, vermicompost, bio-enriched compost etc. using available rural organic wastes and in-situ crop residue recycling.

**Biofertilizers:** Developed liquid Biofertilizer technology with higher shelf-life using improved and efficient strains of biofertilizers specific to different crops and soil types.

**Organic Farming :** Developed organic farming package of practices of 52 crops/cropping systems for different region of the country.

**Integrated Farming System models:** Developed 45 IFS models encompassing field and horticultural crops, agroforestry, livestock, fisheries suiting to small and marginal farmers of different agro-ecological regions of the country to enhance farm productivity and profitability. Integrated Organic

### Benefits:

- It ensures healthy farming and healthy food.
- It protects the soil, the water and the climate.
- It does not contaminate the environment with chemical inputs or use genetically engineered crops.
- Maintain ecosystem services

### Seven Basic Principles of Eco-Farming

- **Food sovereignty:** Food production should be ecological in both origin and destiny. Producers and consumers, not corporations, should control the food chain and determine how food is produced.
- **Rewarding rural livelihoods:** Eco-agriculture is instrumental in rural development, food security and fighting poverty.
- **Smarter food production and yields:** Eco-agriculture can create higher yields to help feed the world.
- **Biodiversity:** Promoting diversity in crops, instead of monocultures.
- **Sustainable soil:** Soil fertility can improve using eco-farming methods and refraining from chemical fertilizers and inputs.
- **Ecological pest protection:** Farmers can control pest damage and weeds effectively through natural means instead of chemical pesticides.
- **Food Resilience:** Diverse and resilient agriculture, not monoculture crops, is the best way to protect communities from shocks from climate and food prices.

Farming System models have also been developed.

**Resource Conservation Technologies :** Several Resource conservation technologies viz., zero-tillage, bed planting, laser land levelling, raised and sunken bed system, System of Rice Intensification (SRI) have been recommended for higher productivity and to save time, labour, energy, water, and

nutrients and, thereby, reduce cost of cultivation.

**Solar Farming:** Developed agri-voltaic solar farming system for agricultural and crops generation of electricity.

**District Agricultural Contingent Planning:** Developed district agricultural contingent plans to facilitate appropriate agro-advisories to farmers in the event of adverse climatic situations (droughts, cold waves, floods, salinity, alkalinity, acidity and nutritional disorders etc).

All these measures are being promoted through various GOI schemes namely National Mission for Sustainable Agriculture (NMSA), Prime Minister's Krishi Sinchai Yojana (PMKSY), Parampragat Krishi Vikas Yojana, National Horticulture Mission, Rastriya Krishi Vikas Yojana etc. The Indian Council of Agricultural Research through IISWC provides technical support and organizes regular training courses for field functionaries and farmers.





## EVOLUTION OF ECO-AGRICULTURE SYSTEMS

# Towards Climate Resilient Agriculture

**E**co-agriculture is the need of the hour because of a fully integrated approach to agriculture, conservation and rural livelihoods, within a landscape or ecosystem. McNeely and Scherr (2003) have identified six sets of strategies that can advance the goals of Eco-agriculture:

- Creating biodiversity reserves that benefit local farming communities.
- Developing habitat networks in non-farmed areas of agricultural landscapes.
- Reducing land conversion to agriculture by increasing farm productivity.
- Minimizing agricultural pollution.
- Modifying the management of soil, water and vegetation to increase natural capital.
- Designing farm systems to mimic natural ecosystems.

## EVOLUTION OF ECO-AGRICULTURAL PRACTICES

**Panchagavya:** These agriculture practices are traced back to Indus valley civilization.

The eco-friendly organic liquid formulation made from products obtained from the cow is widely used. It is a fermented product made from milk, urine, dung, curd and clarified butter. This, added with other ingredients, has the potential to promote growth and provide immunity in the plant system.

**Agnihotra system of agriculture:** Agnihotra has its origin in the most ancient Vedic sciences of bio-energy, agriculture and climate engineering. This ancient Vedic farming technique promises an increase in crop yields with minimal input costs. The practice is used to treat the atmosphere, the soil, plants, pests and disease problems. Seeds were treated with cow's urine and Agnihotra ash. Through this process, seed-borne diseases were controlled. Agnihotra system of agriculture is still in use in various parts of India and rigorous amount of research is going on it.

**Biodynamic agriculture:** This alternative form of agriculture resembles that organic farming. It is based on the work of Rudolph Steiner, who suggested organic



Nutrient management with natural ways to restore soil nutrients such as bio-fertilizers, selection, cultivation and recycling of organic seeds can lead to good eco-agricultural practices

## ABOUT THE AUTHOR

Dr Nutan Kaushik is Director General, Food & Agriculture Foundation, Amity University, Noida. She has been awarded various prestigious fellowships viz. USDA Cochran Fellowship, NFP Fellowship of Govt. of Netherlands, DBT CREST Fellowship, BIRAC BEST INNOVATION 2016 etc



practices, green manures and crop rotations, and other steps such as paying attention to astrological calendars. A number of agronomic assessments have not supported claims of the methods' superiority, though there are national associations of biodynamic farmers in about ten countries.



**Permaculture:** This was introduced in 1929. The work of JR Smith was seminal for permaculture theory and practice. Permaculture is a design philosophy that focuses on creating ecological human ecosystems and food production processes that adhere to particular guidelines and principles. Permaculture can be applied to almost every site-specific ecological farming method. A permaculture agriculture system requires passive energy systems, safe on-site waste disposal, conserved and assured water supply, controlled fire, cold, excess heat and wind factors.



**fun FACT**



**Dr Kaushik's favourite stress buster is listening to Sufi music**

**Organic farming:** This was introduced in 1940 by Lord Northbourne. Organic farming is a production system that forbids or limits the use of synthetic fertilizer, pesticides, growth regulators and livestock feed additives. Crop rotations, crop residues, livestock manures, green manures, off-farm organic wastes, mechanical agriculture, mineral-bearing rocks and elements of biological pest control are used to preserve soil fertility, provide plant nutrients, control insects, weeds, and other pests. It also aims to minimize the wastage and pollution.

**Reduced till/ Zero tillage agriculture:** This was promoted by Edward H. Faulkner in the 1940s. It reflects an 80-year evolution that has gradually put into practice what soil scientists and farmers have long known – that mechanical tillage has negative effects on soil health, structure, and function, as well as disturbing and altering the soil. Tillage has some immediate benefits, the most

immediate being easier crop establishment and then weed control. It has long-term negative effects on soil fertility and productivity, including loss of soil carbon, changes in soil organism populations (numbers, diversity, and activity), and soil erosion. As a result, a growing number of farmers are abandoning tillage, and more than 115 million hectares of agricultural land are now farmed without it. It includes conversational agriculture strategy of eco-agriculture that has eliminated the tillage.



**Regenerative Agriculture:** This has been in use since 1980s. It was introduced by Robert Rodale. It relies on nature's built-in ability to combat pests, improve soil fertility and boost productivity. It entails the need to continually regenerate the resources that the system necessitates. In practice, regenerative agriculture achieves these aims by using low-input and sustainable farming systems.

**Bio-intensive agriculture:** This was introduced by John Jeavons in 1999. It aims to attain maximum yields from the minimum area of land, seeking self-sufficiency and sustainability. This system uses open-pollinated seeds which can be naturally pollinated by insects or wind, rather than hybrids. It involves loosening the soil down to 24 inches, which helps with good aeration. Compost is used for the nourishment of crop, which also helps in holding water. Much of this system derives from traditional agricultural knowledge and practices. The consequences of dwindling crop production due to global warming and climate change can also be miti-





gated by bio-intensive farming.

All of the above systems have focused on maintaining the ecological balance.

### INPUTS SUPPLIED IN ECO-AGRICULTURE PRACTICES

**Nutrients management:** Eco-agriculture practices focus on restoring and maintaining the soil's nutrient balance and revive fertility. Animal dung, forest leaf litter, bone meal, slaughter house waste, blood meal and green manures are essential organic sources for nutrient management and soil fertility. The quality of produce is determined by the nutrient content of the raw material and the composting process. Establishing the necessary levels of nutrients in each soil is required, and should be based on the specific needs of that soil. Biological services such as bio-fertilizers and other microbiological inputs have also received a lot of attention and are being widely promoted.

The other well-used approach to increase soil fertility is crop rotation. A well-designed crop rotation can increase the productivity of soil, control common root and stem diseases, con-

trol soil erosion and establish a sustainable environment. Management of crop residues is also an important approach to increase soil fertility and avoid soil damage.

**Seeds:** These are often overlooked as a fundamental part of our food and agricultural systems. Yet this tiny resource has enormous impact on how we farm and what we eat. Seed also has a big influence on the quality of our food, from its appearance to its taste and nutritional value. Seed has limitless potential for transforming our food system, particularly when combined with the principles that founded the organic movement – health and ecology. Plants that have been bred under organic and natural conditions have a higher chance of adapting to these production systems.



The challenges of eco-agriculture can be very different from those of traditional farming, where synthetic pesticides and fertilizer sources are widely used to combat pests, diseases, and other problems. The seed must be genetically diverse, lend itself to recycling and be certified organic. It must not be hybrid and never have been produced from genetic engineering nor contaminated with GMO.

**Weed/Herb Control:** This is the process of keeping or reducing the weed population and its development to a degree that doesn't cause economic damage to the crop while causing the least amount of pollution to the ecosystem. In eco-agriculture, good weed management entails creating conditions that prevent weeds from growing at the wrong time and in the wrong location, since that can cause serious problem for crop cultivation.

There is a need of complete sustainable eco-friendly weed management programme throughout the farming period. Weeds can be controlled by pathogen like fungi, bacteria, viruses and virus like agents. Among the classes of plant pathogens, fungi have been used

to a larger extent than bacteria and virus or nematode pathogens. Bio-herbicides is a preparation of living inoculates of plant pathogens formulated and applied in a manner analogous to that of herbicide in an effort to control or suppress the growth of weed species.

#### **Pests and disease management:**

In eco-agricultural practices, pest and disease management is a dynamic process that necessitates the incorporation of all management elements, such as the use of resistant varieties, biological diversity on the field, balanced feeding, a consistent supply of nutrients, and the use of preventive and curative measures. Maintenance of soil health and biological activity through timely incorporation of organic manures is also important for crop protection. Biofertilizers such as *Rhizobium* and *Azotobacter* assist in the mobilization of nutrients and the promotion of growth. Pathogens are unable to enter seeds because of the high microbial population surrounding them. *Azotobacter* produces a fungistatic complex that aids in the reduction of pathogen attack in soil. If preventive crop protection practices fail to sufficiently prevent economic losses, then it may be necessary to take curative actions which involve mechanical control with traps, sticky plates or hand picking, biological control with natural predators or antagonistic microbes and natural pesticides based on herbal preparations or other natural products.

**Energy input:** Human labour, draught animals and engine-driven machinery is commonly used for eco-agriculture. Operations involving planting, weeding, spraying, harvesting (horticultural commodities) requires human labour. Engine driven machinery and draught animals are used for ploughing, soil preparation, water lifting, pulling inputs and threshing. Improvements in energy efficiency can lead to ecological and economic win-win situations. The paradigm is shifting toward renewable energy resources in the eco-agricultural practices. These include solar energy,



wind energy, micro-hydro energy and biomass energy. Solar energy is used in cold storage and wind energy is used for the operation of electric water pumps.

**Water inputs:** Good agricultural water management is important in eco-agriculture. Agricultural water management means using water in a way that provides crops and animals the amount of water they need, enhances productivity, and conserves natural resources for the benefit of downstream users and ecosystem services. Eco-agriculture aims at optimizing the use of on-farm resources and at a sustainable use of natural resources. Active water retention, water harvesting and storing of water are important practices which are being adopted.

Water retention reduces evaporation from the soil surface, preserving soil organic matter in the upper soil layers and, consequently, increasing water retention capacity of the soil. Water harvesting and storage refers to the collection of rainstorm-generated runoff from a particular area (a catchment) in order to provide water agricultural use. The water thus collected can either be utilized immediately, as for irrigation, or be stored in above ground ponds or in subsurface reservoirs, such as cisterns or shallow aquifers, for subsequent uti-

lization.

Farmers' access to modern agricultural inputs is the backbone of every agricultural revolution. These above-mentioned methods apply modern science and technology within a theoretical and practical context. It incorporates ecological concepts and insights in order to make agriculture more profitable and sustainable. Nutrient management with natural ways to restore the soil nutrients such as bio-fertilizers, selection, cultivation and recycling of organic seeds can lead to good eco-agricultural practices. Sustainable eco-friendly weed control and maintenance of soil and plant health with bio-control agents for pest and disease management are also very crucial for maintaining smooth farming. Energy conservation and agricultural water management improvements will result in economic and ecological beneficial situations. These dynamic farming systems are a combination of agricultural and ecological experience that can be used to revise and alleviate the existing widespread tensions.

**Acknowledgment:** Funding from Asia Pacific Network, Japan is duly acknowledged.

- Dr Nutan Kaushik, Navdeep Singh Plaha, Ayushi Sharma



## PROJECT SANJEEVNI

# NEW TECH BOOSTS ECO AGRICULTURE

**N**utritious food produced with least crop care chemicals and less water is one of the goals of 21st century Eco Farming movement.

Eliminating chemical fertilizers 100 per cent has proven difficult in partly degraded land with higher salinity and lower organic carbon for all commercial farmers. Classical organic farming adoption has always resulted in lower yields by 30 to 40 per cent. There is also market reluctance to pay higher price to compensate the loss of income for the five transition years. In addition, small farmers are not able to manage the complexity of organic certification.

Another aspect has been that organic Farming has been insisting on Natural Farming, and is not guided

solely by sustainability. One needs to be pragmatic about transition of agriculture practices. The challenge is how to make natural processes more efficient using human ingenuity and achieve zero or minimum toxicity, highest nutritionally dense food with sustainable farming inputs.

## Project Sanjeevni

Zydex has launched *Project Sanjeevni* to revive land fertility using new innovative *Zytonic Bio Technology*. This allows farmers to transition from chemical fertiligation completely in one or two crop cycles. They are also able to maintain the transition and raise the yield consistently with

improved quality of produce. We feel that this is a new revolution in Eco Agriculture movement, and will be a win-win for all.

The key was to address the biological, chemical and physical aspects of the soil to make nutrition availability and supply very efficient through biological processes. The zytonic technology platform uniquely addresses the improved uptake capacity of the plant. The soils become soft and porous, allowing denser and large root zone especially white roots,

## ABOUT THE AUTHOR

**Dr Ajay Ranka is Chairman & MD, Zydex Group. He founded Zydex in 1997 as a textile speciality chemicals company. Mr Ranka is the author of several patents that are registered in 55 countries globally and has also served as a member of the Technology Development Board, GOI. Zydex has delivered 200 plus innovative and world-class products and solutions. With a growing workforce of more than 800 employees, Zydex is a global player with footprint in over 40 countries**





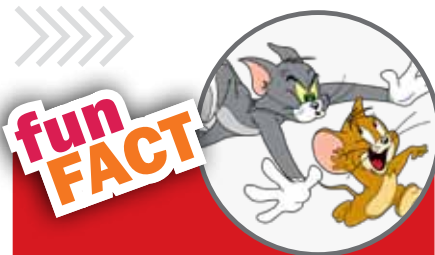
making rhizosphere large. The mycorrhizal inoculation helps to create dense hyphae network. This further enhances nutrition and water uptake, leading to better germination and survival (15-20%) typically in less or excess rain conditions in India. This creates an opportunity for the farmer to raise yield output by 15-20 pc as more than 90 pc farm area is supporting plant distribution and root mass.

With the use of zytonic technology, farmers can reduce water consumption by 30-40%. Reduced moisture levels and better uptake (mycorrhiza hyphae) keeps the nutrition density in fruits and grains high with improved taste and shelf life.

### Soil Health & Organic Carbon

The Zytonic-M Biofertilizer treated plants have darker green foliage, enhancing photosynthetic activity to produce higher sugar and carbohydrate content in the plant. The excess liquid carbon is pushed out as root exudates to feed the enhanced soil biology. This will enable improved fertility of soils, going forward in every crop cycle.

Role of Farm manure is to provide high quality aerobic biology, high humus



**fun  
FACT**

**Walk, swim and watch comedy  
serials. Great to be alone and  
shut your mind and enjoy funny  
situations**

content, free flow form for better distribution. It is critical to support biology and bio-farming needs 1 MT /acre every crop as food support.

India produces approximately 1000 million tons of animal dung every year. Part of it is surface composted in a static pile. The rest is used as fuel. Poor bio digestion leads to poor quality of farm yard manure (FYM).

### Fungal Bio Digestion

The key to the success of Eco- Farming is providing new generation of *Fungal Bio Digestion* technology to make FYM fully digested in 50 per cent time, increase the humus content as seen

by dark brown or blacker colour, rich in biology and free flowing with adequate moisture and release of micro-nutrients. 1 MT per acre is highly recommended and should be available to every acre, every crop cycle. This is feasible based on availability in India if we eliminate its use as fuel.

This is critical to provide organic food material for the biology to grow their population quickly and keep them active. The *Zytonic Godhan* technology developed by Zydex allows static composting on surface to be efficient and fast, saving labour and follow the current practice. This upgradation will increase the value of FYM for the farmer from 0.5-1 Rs to 5-7 Rs per Kg (high quality compost).

The NPK consortia selection and integration to create Zytonic NPK was a key breakthrough to get the nitrogen mineralization happening very efficiently, even to support crops like maize, sugarcane, wheat, rice, cotton etc. P&K have been available in Indian farms in large quantities in insoluble form. Making the bacterial solubilization process efficient for P&K was the key development on the Zytonic NPK technology platform. This is the combination of Zytonic M, the mycorrhizal inoculation with bio-digested manure. It led to yield improvement without any need of chemical inputs like Urea, DAP, Potash etc.

The large root zone active rhizosphere make the plant very healthy. It has more robust stem growth and bigger canopy with efficient photosynthesis. The need of crop care chemicals also is reduced substantially, reducing left over toxic residues. The new technology also makes Zytonic Zinc and Zytonic K to address the Zinc deficiency through biological means. Farmers can also apply K solubilizing bacteria at flowering and fruiting stage to maximize the yields.

This new protocol of *Project Sanjeevni* will be the true game changer for land revival, making eco farming and animal husbandry a commercial success in the future. We hope that 100 pc elimination of toxic crop care chemicals also will be possible in very near future.

**The new protocol of *Project Sanjeevni* will be  
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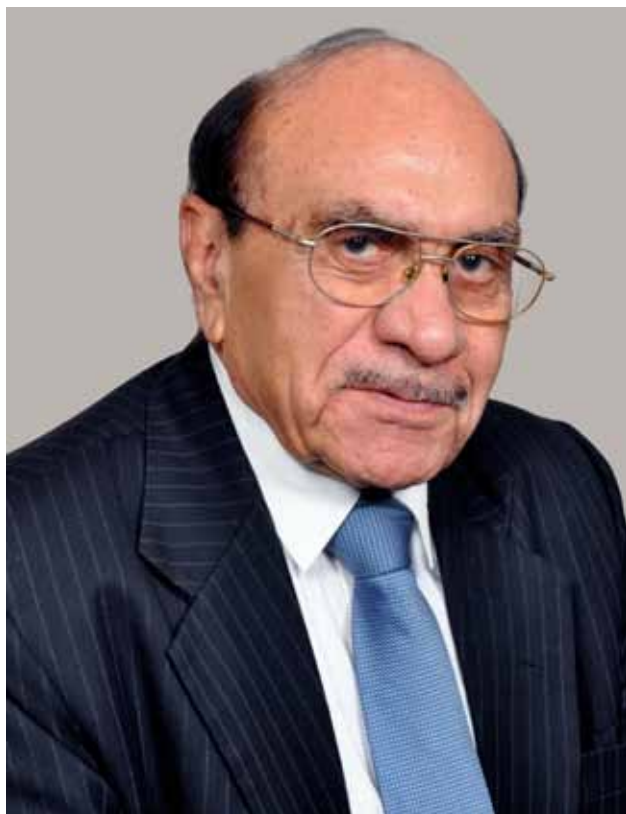


# BAMBOO FARMING

## FOR EVERGREEN REVOLUTION

**B**amboo farming is a good example of sustainable farming. It doesn't require chemical fertilizers or chemical pesticides, and needs limited water available through annual rainfall or through drip irrigation systems. Bamboo is also one of the fastest growing plants on earth.

Bamboo farming has been modernized to enhance yield per acre of land. Typically in the bamboo forests managed by forest departments, the yield of bamboo biomass is 1-2 ton per acre per year. The biomass yield from well managed bamboo farms varies from 20-40 tons per acre per year.



**Bamboo Plantation in hilly terrain at ANJI, China**

Bamboo plantations are established for harvesting bamboo culms (poles), biomass and shoots. Bamboo can be planted on almost all types of soils including hilly terrains, which adds to greening of the barren landscapes. Government organizations like Planning Commission, Department of Biotechnology, National Mission on Bamboo Application and National Bamboo Mission recommend bamboo species for plantations in various regions/applications.

### Popular Bamboo Categories

Globally there are 90 genera and roughly 1,500 species of bamboos. These are divided into two categories i.e. Sympodial bamboo (Clumping Bamboo) and Monopodial bamboo (Running Bamboo). In India there are 130 species of bamboos, mostly from the sympodial category.

### ABOUT THE AUTHOR

**Mr Mehta has over 50 years of professional experience in the manufacture of sustainable materials**



Mature Clumps of sympodial bamboos

### Sympodial Bamboo

Bamboos of this category grow very well in tropical and sub-tropical zones and are popular in India. This category has a clumping rhizome (root). Bamboo culms grow close to each other in a tight bunch. There are 150-200 clumps per acre. The yield (biomass/culms) varies from 20-40 tons per acre per year. Bamboos reach maturity after four to five years. Bamboo culms can be colour-coded to enable selective harvesting after four years.

### Monopodial Bamboo

These grow in temperate climates, like in Arunachal Pradesh in India. The rhizome is spread out with buds. Bamboo culms grow in straight formation. This category is also called invasive bamboo, and is popular in China, Japan and Vietnam. Many countries are exploring methods to grow monopodial bamboos in some of their regions like Himachal Pradesh in India.

### INTERESTING FACTS

- \* Bamboo is a great plant for creating green environment and for containing global warming.
- \* Large bamboo farms have been

established in South America and Africa by business organizations and they are earning carbon credits.

- \* In Florida, USA, farmers are planting bamboos for harvesting bamboo shoots.
- \* Bamboo is a crucial element in the balance of oxygen and carbon dioxide in the atmosphere.
- \* A grove of bamboo releases 35% more oxygen than an equivalent stand of trees (area basis).
- \* Bamboo plantation is a proven alternative to reduce carbon footprint of individuals.
- \* Bamboo can be harvested in 3-5 years versus 10-20 years for most soft woods.
- \* Bamboos have high tensile strength of 28,000 psi compared to tensile strength of steel, which is 23,000 psi.



Monopodial bamboo plantation



fun  
FACT

Mr Mehta feels happy to watch  
the shifts in social attitudes that  
empower women to be progres-  
sive and self-reliant

- \* Bamboo plantations are known for soil conservation. The canopy of the bamboo plants reduces the impact of rainfall, preventing massive soil erosion.
- \* More than 1,500 commercial products are being manufactured with bamboos as it is hardy, light and flexible and has texture like wood.
- \* Bamboos can tolerate extreme climatic conditions that most plants cannot. Bamboo was the first plant





to re-green after the atomic blast in Hiroshima in 1945.

- \* The use of bamboo dates back to over 3,000 years as per the Chinese literature.

### Traditional Bamboo Plantations

#### \* Bamboos in Homesteads

The productivity of homestead cultivation is high as the house owners ensure that clumps are healthy and productive. It adds to family income.

#### \* Bamboo Windbreaks

Bamboo windbreaks are planted along the boundary of crop farms/horticulture grove. Over time these provide bamboo culms.

#### \* Bamboo Plantations along Waterways, Highways

This helps in containing dust, minimizing noise pollution, and provides bamboo culms for marketing.

### Agroforestry

These are planted on bunds of crop farms.

### Block Type Plantations

Two to three bamboo species are planted

### Bamboo Oxygen Parks

A bamboo grove releases 35% more oxygen than an equivalent stand of trees (area basis). This unique advantage has prompted many cities to set up oxygen parks in urban areas by planting bamboos. Some such parks have been set up in South India.



Bamboo Oxygen Park

so that loss due to flowering is staggered.

There are 130 bamboo species in India and this number includes some of the imported species. The choice of the species will be depend on

- Location, climatic and soil conditions
- Commercial end-use

- Market preference
- Demand of processing industries
- Eating Habits for Bamboo Shoots

### Bamboo for New Age Products

Business organizations and R&D labs have developed processes to use bamboos to manufacture Bio CNG, Bio Ethanol and Biochar. Processes have been developed for ensuring good quality and longer shelf life of processed bamboo shoots, ensuring removal of toxins. There is need to popularize these shoots in India and export them.

In September 2019, Prime Minister Shri Modi announced that 26 million hectares of degraded lands will be restored by 2030. This shall require large plantations of trees and bamboos. Bamboos slow down water run-off and retain soil moisture.

Greater emphasis needs to be given to ensure that sustainable practices are followed in bamboo farming, including application of new age products, biochar and bio-fertilisers to reduce consumption of water and improve yields.

By following these practices, bamboo plantation owners can earn carbon credits, making bamboo farming a profitable option.



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## ORGANIC FARMING

# ROUTE TO EVERGREEN REVOLUTION

**O**rganic Agriculture is a system of farming which can be regarded as Route to Evergreen Revolution. The following are some of the factors why we may say so.

**Sustainable:** Sustainable agriculture emphasizes the conservation of its own resources. Eco Agriculture through organic farming uses organic manure and nitrogen-fixing legumes as green manure to maintain soil fertility, as much as possible. It helps in maintaining sustainable environment around

farming system.

**Non-Polluting Agriculture:** Organic Farming benefits are attributable to reduced or no chemical use, less soil erosion and water conservation that creates a healthier environment. Organic farming minimizes the use of pesticides and other synthetic chemicals, thereby reducing major environmental hazards like soil erosion, air pollution, water pollution etc. It ensures the restoration of health of soil, purity of water and air, plus growth of flora and fauna.

**Conserve Natural Resources:** All



### ABOUT THE AUTHOR



Mr Ajay Katyal is a pioneer of the Indian organic movement since 1999. One of the founding members of the Association of Organic Industry (AOI), Mr Katyal is Director and CEO of his organic food venture, Nature Pearls Private Limited. It was declared as the Second Best Company - Organic Exports (Food) at the Jaivik India Awards 2018





chemical fertilizers and ammonia are replaced with organic inputs. This ensures that top soil health is improved. It also helps in preserving the natural habitat along with encouraging birds and other natural predators to live happily in the farmland which acts like natural pest control. Organic farming celebrates biodiversity and good health, and it removes harmful toxins from our environment and from our food. That is something to encourage and celebrate.

**Promote Bio-Diversity:** Crop rotation builds soil fertility. It helps promote biodiversity, which promotes greater health across all living species. As organic farms provide safe havens to wildlife, local ecosystems also improve.

**Remunerative to Farmers:** Organic farms tend to bring in more profits, despite requiring more working hands. Advanced organic practices give a profitable edge to farmers in the organic sector when compared to traditional farming practices. Interest in organic farming has been rising in the last few years and hence bringing in more customers. Currently, the demand for organic food is growing faster than supply. Countries like the UK and US must import organic food from abroad (often developing economies like India). It will create opportunities for farmers.

#### **Suitable for Small And Marginal**

**Farmers:** For various reasons, organic farming has been adopted by small and marginal farmers. Many farmers traditionally practice organic agriculture due to lack of availability of inputs for intensive agriculture. These farmers are following organic farming under compulsion as they are located in no-input or low input use zones.

**Restore Soil Health, Retain Friendly Microbes:** Major components of organic farming includes use of green manuring crops, vermi-composting, crop rotation, biological management like inter-cultivation, mixed cropping, mixed farming etc., animal husbandry, aquaculture, organic manures and bio fertilizers. All these factors ensure use of beneficial microorganisms (bio fertilizers) which makes soil and atmospheric nutrients available to the crops for increased crop production for an eco-friendly pollution free environment.

**Prevent Contamination of Water by Chemicals:** Pure water availability will be biggest issue for coming future generations. Organic farming helps in keeping our water supplies unpolluted and clean by preventing polluted chemical and pesticides runoff.

**Safe and Healthy Produce:** Organic produce tends to have lower

nitrate content than non-organic varieties, leading to fruits and grains that not only taste better but also have higher antioxidant levels. Science has shown that organic food tastes better than products that come from farms that follow chemical-intensive farming.

**Health Cost of Community:** Organic products are better equipped in terms of nutrients they carry over their conventional counterparts, they will definitely help in maintaining good health. In today's technological era where many people lead a sedentary life, maintaining a healthy diet structure free of chemical inputs is important. Organic farming can help in achieving this. It will save money on the economic front, where we spend a lot of on medicines and on ways to keep ourselves fit.

**Fight Climate Change:** Climate change and global warming are major concerns. Developed economies are spending much to address this issue, as it is impacting human lives. Organic farming reduces the use of non-renewable energy. It avoids the use of chemical pesticides and fertilizers, which require large amounts of fossil fuel for production. Organic farming also returns more carbon to the soil, which lessens greenhouse effect and global warming.



## AGRICULTURE AT CROSSROADS

## SOLUTION: BIO-AGRICULTURE

“An estimated 25.9 per cent of the global population – 2 billion people – were affected by moderate or severe food insecurity in 2019, an increase from 22.4 per cent in 2014. People experiencing moderate food insecurity are typically unable to eat a healthy, balanced diet on a regular basis because of income or other resource constraints. Those facing severe food insecurity – around 750 million people – tend to run out of food and, at worst, go a day, or days, without eating. Along with conflict, climate shocks and the locust crisis, COVID-19 poses an additional threat to food systems, indirectly reducing purchasing power and the capacity to produce and distribute food, which affects the most vulnerable populations. In 2020, up to 132 million more people may have suffered from undernourishment because of COVID-19 and recent increases in food insecurity are likely to worsen as the Covid pandemic continues.

The share of small-scale producers among all food producers in Africa, Asia, and Latin America ranges from 40 per cent to 85 per cent. However, their productivity

is systematically lower, on average, than that of larger-scale producers, and in most countries their incomes are less than half of the incomes of their larger counterparts, as shown by data collected from selected countries. The lockdown measures in place to prevent the spread of the coronavirus have caused businesses and local markets to close, and small-scale food producers are often not allowed to get their products to consumers. Small-scale food producers, already disadvantaged, are being hit hard by the effects of the pandemic.”

Sustainable Development Goals Report 2020 ( source: <https://unstats.un.org/sdgs/report/2020/>)

The importance of sustainability can never be over-emphasised, especially in agriculture. Agriculture is not a mere activity to produce food for population. It is a way of living and giving due importance to all the elements. The United Nations through its Sustainable Development Goals has been advocating safe and sufficient food for all and doubling the agricultural productivity and income for small-scale food producers while

## ABOUT THE AUTHOR



**Dr Roger Tripathi** is CEO & Founder, Global BioAg Linkages and Primary BioAg Innovations. A passionate and persistent global business leader with broad based multinational-multicultural background, Dr Tripathi has worked and lived in most continents

ensuring sustainable food production systems and resilient agricultural practices by 2030.

The 2019 Global Agricultural Productivity Report, "Productivity Growth for Sustainable Diets, and More," by Virginia Tech's College of Agriculture and Life Sciences highlighted that global agricultural productivity needs to increase at an average annual rate of 1.73 percent to sustainably produce food, feed, fiber, and bioenergy for 10 billion people in 2050. (source: Accelerating global agricultural productivity growth is critical -- ScienceDaily)

### Bio-Agriculture Only Option

Bio-Agriculture (also referred as Eco-agriculture, bio-dynamic agriculture and many other names) is not just the best but only option to achieve these goals and feed our increasing population. It will not be wrong to say that bio-agriculture increases productivity and production while reducing the chemical usage and hence contributing towards minimizing negative climate impact. Bio-Agriculture goes hand in hand with Integrated Crop Management because it embraces an integrated approach to agriculture to conserve biodiversity, enhance agricultural production (and productivity), and improve livelihoods. It



**Dr Tripathi enjoys change management challenges in taking the businesses to the next level, and doesn't believe in good enough**

encompasses the health of land (soil), water, plant, microbiomes, environment, and humans. This holistic approach to food production systems drives to make them sustainable.

The chemical-based agriculture replaced traditional agricultural practices to ensure food security, but requires continuous input of varied resources, which are limited. Chemical inputs did increase agricultural productivity. But this came at a price. The price of increased food production was soil degradation and infertility, loss of soil bio-diversity, water pollution, climate change and more.

Though it was necessary to increase food production in the past, it is more important now to continue maintaining and increasing this level of production

while regenerating the soils to ensure food production for thousands of years to come. With the unrestricted use of chemicals enough harm has been done to the soils and environment. Agriculture uses 70% of water and has led to 60% loss of biodiversity and 30% of total carbon emissions. Now is the high time to work on reversing these effects, it is going to be a demanding and slow process but not impossible.

### Consumer Push for Bio-Agriculture

Besides the push from scientists and researchers to move towards sustainable agriculture, a pull has been generated in the market with increasing consumer awareness. Poverty is declining globally (excluding pandemic effect). With increasing disposable income as well as access to education, consumer preferences are changing. Consumers are more focused not just on the quality of produce but rather quality of the whole value chain. They are now interested in knowing where their food comes from. Consumers want transparency in the process. Though this is widely prevalent in developed economies, developing countries are also observing similar trends in high income and upper-middle income







groups.

Taking a holistic view of all these factors, degrading soil, climate impact, increasing burden on land, economic stress to small farmers and meeting evolving consumer demand and preferences, it becomes clear that Bio-Agriculture is the solution. Agriculture today is at a crossroads. It is being looked upon to feed the ever-growing world population with shrinking resources, and at the same time, it is required to be sustainable, resilient, and to mitigate climate change. Therefore, there is a need for Evergreen Revolution, which has already initiated but efforts are still few and scattered.

Evergreen revolution is our hope for survival of future generations. Earth's resources have depleted substantially in the process of feeding humans. We have made unjustified use of resources and need to think about what we want to leave for coming generations. There is a need to reverse the chain of changes. We can begin with slowing the pace and then reversing it. The increasing awareness amongst all the stakeholders is favorable.

Bio-Agriculture is a vital component of evergreen revolution, because it amalgamates the practices of conventional and organic food production systems to make the food production viable, sustainable, and profitable. Bio-Agriculture practices

### Bio-agriculture is paving the way for profitable and sustainable agricultural systems for all the stakeholders

reduce chemical load on land and are light on farmers' pocket when compared with conventional agriculture. Regulatory frameworks in different parts of the world are being developed for bio-agriculture and to bring bio-agriculture inputs into mainstream.

#### Global Adoption

Brazil's agriculture ministry published Bio-inputs decree and biostimulants regulations and have lower fees for low-risk products to promote new bioagriculture input registrations. USDA is working on defining biostimulants and its regulatory framework. The European Green deal supports bioprotection. The European Parliament voted on March 27, 2019 to approve the compromise text of the EU Fertilising Products Regulation (FPR), which shall come into effect on July, 2022. India recently harmonized the draft of existing toxicological guidelines/ protocol for registration of bio-pesticides (Microbials) in January 2021.

All these regulatory occurrences

in different countries indicate a paradigm shift taking place in the global agricultural industry. Time has come for Bioagriculture to not be an alternative agricultural approach anymore, but an integral part of the way we do "agriculture".

The Bio-agriculture industry is booming with new technologies being used to develop innovative and biologically-based plant protection and plant nutrition products aimed at preserving/regenerating soils, triggering plant's natural processes to withstand abiotic and biotic stresses, as well as their ability to absorb nutrients and water more effectively, among others. All of this growth is being fueled by investors who see the need for a radical change in the way we produce food today. The value of the global bio-agriculture market was estimated to be USD 9.5 billion in 2020. The market is further expected to grow in the forecast period of 2021-2026 at a CAGR of 12% to reach a value of USD 18.9 billion by 2026. (Source: Bio-Agriculture Market Size, Share, Growth, Forecast 2021-2026 (expertmarketresearch.com))

The wide recognition is that the agricultural system must change and become more sustainable, so that long-term food production for all is possible. This has pushed the development of new technologies in Bio-Ag. It is also triggering the development of regulatory frameworks to fit these innovative bio-ag inputs all around the globe. The market demand for sustainable produce will also keep rising, and therefore, consolidating the growth in this sector.

Bio-agriculture is paving the way for profitable and sustainable agricultural systems for all the stakeholders. The time is ripe for bio-agriculture and evergreen revolution. The global agricultural community should continue strengthening and unifying the efforts to develop a truly sustainable agricultural system, based on sound technology and proof of concept and aiming to achieve food safety and food security.

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# SOY INTEGRATED FARMING SYSTEM OF SOLIDARIDAD IN MP STRENGTHENING SUSTAINABLE PRODUCTION SYSTEM WITH SMALLHOLDERS

**S**olidaridad, a resource organisation, is committed to establish sustainable production systems in Madhya Pradesh. Solidaridad is striving hard to bring evergreen revolution in targeting cropping systems through making farmers adopt ecological regenerative model. This encompasses soil health improvement, input use efficiency, enhancing carbon sequestration, minimum tillage, water conservation and use and minimising environmental pollution.

## **SOLIDARIDAD INTERVENTION: MORE WITH LESS**

The key emphasis is to sustain the productivity of soybean-based cropping

systems at optimum level at limited cost of production without deteriorating our natural resources or polluting the environment. Solidaridad has adopted and successfully demonstrated a unique concept of *Model 20:20*, originally proposed by renowned scientist Dr M H Mehta. This model envisages increase in productivity by 20 pc and reduction of cost of production by 20 pc. The model relies on optimum use of microbial

consortium and use of bio-formulations for managing biotic stresses and growth promotion along with good agricultural practices in the cropping systems

The pilot studies using the model establish that it is feasible to enhance the yield of soybean by more than 20 pc with considerable reduction of cost. The additional good agricultural interventions that go along the model are the following: preparation and soil



### **ABOUT THE AUTHOR**

**Dr Suresh Motwani is General Manager, Solidaridad Network Asia. He coordinates Solidaridad's Edible Oil Sustainability Initiatives in Asia**



incorporation of organic manures (FYM, Compost and Vermicompost) utilizing local resources, shunning with practice of burning crop residues and in-situ use of residue decomposer, local preparations for nutrient management (Matka Khad, Vistara Khad, Jeevamrit, Vermiwash) pest management (Dashparni, the extract from ten types of leaves from botanicals which have repelling, antifeedant and killing properties for pests) and their use in crops, and also the use of Tricoderma spp and neem oil for crop protection measures.

### Reduced cost of cultivation

To further enhance pest management, pheromone traps, yellow sticky cards and bird perches were introduced. The effort has considerably avoided the use of agro-chemicals, reducing environmental hazards. It has significantly reduced the cost of cultivation and increased the net income of small and marginal farmers. These interventions were extensively demonstrated by the Solidaridad chain of trained field staff to farmers. These interventions were fast learned, practiced and adopted by the farmers. Farmers prepared formulations for crop management with minimum cost. They were relieved from the expenses which are mostly advised by local input dealers.

We organized field days, inter-village exposures, exposure and reorientation of extension workers and lead farmers to research institutions. We also organized training sessions for lead farmers with sizable number of demonstrations. The cadre of trained farmers and extension personnel further disseminated it in their respective clusters by showcasing the practices in their own crops. Our extension model lays emphasis on cross learning, sharing of experiences, networking etc. Solidaridad established "Farmer Field Schools". These constitute basic units of extension services which are the centre of technology dissemination and



**Dr Motwani likes to write poems and short, reflective passages**

diffusion. Farmers, mostly smallholders, are replicating the practices and also mobilizing others for the same thorough on-field demonstration. These are set up jointly and taken care of by Solidaridad and knowledge partners.

### Soy Integrated Farming System

In view of large area under soybean-wheat and soybean-chickpea in MP, Solidaridad is attempting to diversify the systems with introduction of vegetables to meet nutritional needs of farmers and enhance income. Efforts are also underway to promote multi-enterprise farming with introduction of rearing of dairy animals and poultry for further income generation.

For soil quality, regular recycling of organic resources is promoted for regenerative agriculture. All these interventions are to mitigate the challenges posed by global climatic change and boost sustainable agriculture. In addition to the use of ICT to sensitise farmers, we organize social events like Women Week on IWD, Soy Week during June, World Water Day, World Environment Day, World Soil Day, Family Farming Day, Kisan Diwas etc. The gender issue is always kept in mind to enable and empower rural women.

With increasing demand for sustainable soybean and processed products, Solidaridad has joined hands with Soybean Processors of India. With repeated consultations with stakeholders, a sustainable framework for sustainable soybean has been

developed and is in the process of authentication by the MP government.

### Market Linkage

Access to fair price for the produce is also a focus area for us. We are working on this through FPCs. Fourteen FPCs are in different stages of promotion and maturity, and are engaged in forward and backward linkages for input and output. Farmers are assured of the price, quality input and extension services at much lesser cost. It has freed them from clutches of market intermediaries and input dealers who indulge in distortive and exploitative trade practices.

Solidaridad has constantly provided technical support, networking and facilitation support to enable FPCs to engage with diverse stakeholders like financial institutions, eNAM, IFFCO, NABARD, NCDEX, MP Agro, and agro industries like Vippy etc. Solidaridad is providing vital support in business planning, raising bankable proposal, value chain development, primary processing, providing price information and market intelligence.

Together with ever-growing support of farmers and our team of trained manpower and subject matter specialists, Solidaridad is tirelessly working to take farmers towards evergreen revolution. This is possible through viable self-sustaining production systems. It is essential to ensure ecological sustainability, social wellbeing and economic viability, and at the same time adapt and mitigate biotic and abiotic stresses emanating from climate change. Efforts are being made to improve rural health by educating them to use appropriate food sources to mitigate rampant malnutrition. The model promoted by Solidaridad under its Soy Programme is witnessing a deep impact and making steady inroads into the current production system. We continue to strive to make a larger impact by scaling it up with the new ICT solutions and sensor-based technology.



# AI FOR ACCELERATING EVERGREEN REVOLUTION

Indian agriculture battles with numerous challenges. We have elevated dependency on monsoon, degradation of cultivable land, depleting soil fertility, intensive use of inorganic fertilizers and pesticides, and low yield per hectare among others. Further, when the crop is harvested yet another set of challenges appear such as quality testing before procurement, unfair return of their hard work and labour, lack of market linkages, and middlemen that eat into the farmer's earning.

## AI FOR FARMERS

Till a few years back, Artificial Intelligence in agriculture was a theoretical promise but with very few on-ground applications. But today, the scenario is very different. AI can be a catalyst and positively impact the entire agrarian value chain. AI can help in improving:

- a. Farm productivity
- b. Eliminating supply chain constraints
- c. Expanding market access
- d. Enhanced Farmer Visibility to Retail or Customer

It is estimated that AI in global agriculture could be a \$4 billion opportunity by 2026. This boom is expected from interventions across the value chain.

An increasing number of Agtech startups are implementing AI-based solutions, using data science and machine learning algorithms for assessing crop damage to produce quality and everything in-between.

For example, crop modelling is an effective way to utilizing weather, soil, inputs, and other data about the crop environment. These models then simulate crop development, growth, yield, water and nutrient uptake. This predictive data-based decision-making is critical for the

crop and the farmers.

The remote sensing data provided by the satellites combined with the data on soil health (moisture and temperature), weather prediction, and analysis provides accurate information to farmers. Many districts across India in the states of Assam, Bihar, Jharkhand, Madhya Pradesh, Maharashtra, Rajasthan, and Uttar Pradesh are implementing AI in agriculture.

Some Industry-Government partnerships in AI have been innovatively used to develop an AI-powered crop yield prediction model to provide real-time advisory services to farmers. The predictive tools use AI to select high yield seeds, improve crop productivity, boost soil yield, regulate the wastage of agricultural inputs and warn of pest or disease outbreaks. They also connect farmers with appropriate Agri-tech companies for remedial solutions for their crop.

## ABOUT THE AUTHOR

**Dr Venkat Maraju is the CEO of SourceTrace, a SaaS Agtech company revolving around sustainable agriculture and empowering farmers across 32 countries, impacting over 1.5 million farmer livelihoods. During his prolific career, he has worked with NASA, BOSE, ComauPICO, founded a venture company, and led impactful agtech companies in the world**



## DATA STACKS

Data is where the transformative power of AI lies. This data can come from multiple sources – sensors, drones, mobile devices, satellites, or even from other databases. How this data is processed to bring new insights is where the magic lies. For example, we have seen AI process data around the farm- farmer mapping, what is being grown, quality of soil, moisture levels, pests and diseases, and more.

Insights from these analyses can be useful to multiple stakeholders such as crop insurers, seed suppliers, compliance agencies, governments and donor organizations among others. As per farmers, AI helps them make better decisions and have access to cutting-edge information in real-time. Advisories for crop, good agricultural practices for pest and disease management to providing valuable weather advisory are few of the dominant use cases.

There are interventions in the case of input prices and suboptimal input utilization using predictive analytics, satellite imaging, and machine learning. Traceability solutions are being adopted for large-scale quality testing at the field and post-harvest produce handling and monitoring.

The massive amount of data being churned has created platforms for price transparency, quality including checking any malpractices in the supply chains. Similarly, for seamless execution of cultivation and harvesting, many large farms are using agricultural bots (ag bots) and drones for seeding, imaging and harvesting small perishables like berries, and grapes.

### Benefits for Food Supply Chain

The numerous forms of Artificial Intelligence include natural language processing, machine learning, deep neural network learning, virtual reality,

### Future of AI in Agri-Food Industry

Although large farms are adopting AI to help the start-ups scale their AI-enabled solutions, what is needed is to increase investments – both public and private – especially from venture capitalists.

TraceNext is one such commercial solution that combines the power of AI-based Rapid quality testing with Blockchain-based Traceability from farm-to-fork for over 23 commodities such as tea, coffee, spices, herbs, grains, nuts, and extracts or essences.

Rapid quality testing of farm produce is currently occurring in isolation, that too by a minority of the supply chains. The parameters that need to be checked for by the buyer before the harvest is moved from the field to the processing center usually take multiple days or even weeks, and they are costly. These result in loss of freshness of the crop and lower returns for the farmer. It is critical to shorten the cycle of testing critical trade parameters like moisture, color, uniformity, etc. so that these can be spontaneously measured by Rapid Quality Testing products, and the harvest moves relatively faster for processing – saving both time and costs.

Ultimately, as the food chains are yet fragmented, and MIS has driven the heightened adoption of both AI and Blockchain, the move will strengthen food safety infrastructure. It will also lead to more equitable and sustainable farming and indeed fewer mass recalls.

computer vision, and others. These methods provide an automated data analysis capability that supports human decision-making more accurately.

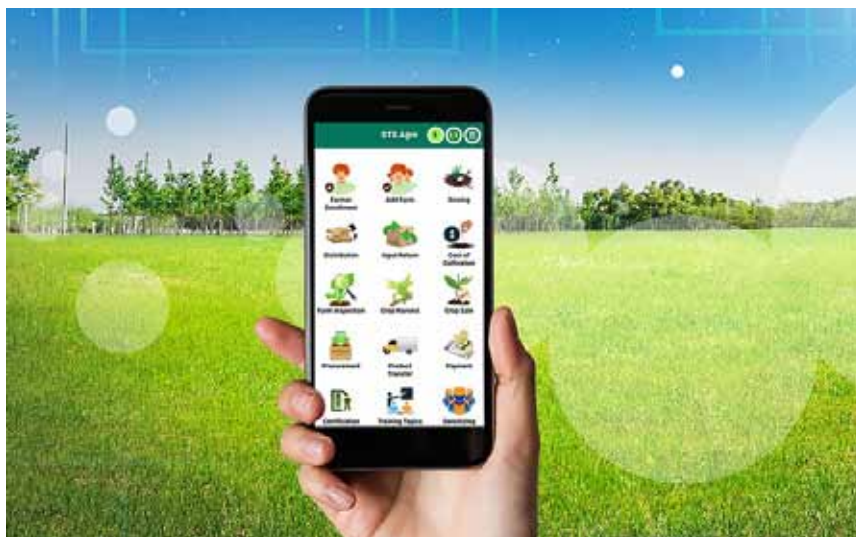
In combination, these tools function in a cloud-based environment and connect the farmers and food processors (suppliers) with multiple restaurants, grocery stores, food distributors, and direct-to-consumer (d2c). They enable the supply chain to divert food sources to the food needs without undue delay or excess cost.

Another main reason for adopting AI is food safety factors that affect the entire agricultural supply chain, whether we consider the use of chemicals on farms, unfair labor practices, and up to the challenge of food waste at the consumer and retail level.

The pressure to produce high-quality crops has accelerated globalization. It has multiplied the incidents of contamination leading to more foodborne illness, food safety scandals and health scares among consumers.

Food safety regulatory bodies such as EFSA, USFDA, CFIA are unique to each region and country. Yet they all are looking to provide access to safe foods. Ag-tech covers all critical events of the agriculture value chain from production and processing to packing and distribution, to storage and finally retail sales.

Recent research by Frost and Sullivan on technologies enabling food safety considers Artificial Intelligence (AI) and Blockchain as the most widely accepted and implemented technology. Others such as Gene editing, intelligent packaging, biosensors and more are applicable on specific case basis.







# GENOMICS-ASSISTED BREEDING 2.0 FOR SUSTAINABLE AGRICULTURE

**Accelerating genetic gains through genomics-assisted breeding 2.0 approaches will deliver higher produce for smallholder farmers while ensuring sustainable agriculture and environmental protection**

**E**cological agriculture takes cognizance of the fact that the “symptoms” point to a larger problem facing us – poor agricultural practices resulting in a poor ecosystem that affects crop production, yield, soil fertility, etc. There is a need for a holistic approach that can address these shortcomings and provide an overall solution for the challenges faced in the global agricultural landscape.

The world needs to adopt and increasingly deploy modern scientific tools and practices into our crop breeding programs to accelerate the delivery of improved crop varieties in farmers’ fields.

In an open access feature review published recently by Cell Press in the 25th Anniversary Issue of Trends in Plant Science, Feeding the World: The Future of Plant Breeding, scientists from the International Crops Research Institute for the Semi-Arid Tropics, Murdoch University (Australia), ICAR- Indian Institute of Pulses Research, Iowa State University (USA), Leibniz Institute of Plant Genetics & Crops Plant Research (Germany), Huazhong Agricultural University (China) and Cornell University (USA) present a comprehensive approach of designing future crops. This approach has been dubbed “genomic breeding” or genomics-assisted

breeding (GAB) 2.0.

The strategy is to optimize crop genomes with the accumulation of beneficial alleles and purging of deleterious alleles for designing future crops. In the coming decades, GAB 2.0 is expected to play a crucial role in breeding more climate-smart crop cultivars with higher nutritional value in a cost-effective and timely manner while ensuring sustainable and environmental protection.

## **GAB: The Game-Changer**

Fifteen years ago, Genomics-Assisted Breeding (GAB) was presented as a milestone future approach in the



## **ABOUT THE AUTHOR**

Prof. Rajeev Varshney, an agricultural scientist is a Research Program Director - Genetic Gains; and Director, Center of Excellence in Genomics & Systems Biology at ICRISAT and Adjunct Professor with Murdoch University, Australia and 10 other universities/institutes in Australia, China, Ghana and India. He is the recipient of the Shanti Swarup Bhatnagar Prize and Rafi Ahmed Kidwai award, the topmost sciences and agriculture awards from GOI



10th Anniversary Issue of Trends in Plant Science, Feeding the World: Plant Biotechnology Milestones. It was envisaged in 2005 that GAB will be a gamechanger for the development and delivery of improved crops varieties (high yielding and resistant to pest and disease, and abiotic stresses).

The success stories we have today speak for themselves. For instance, GAB has expedited timelines of breeding progress across a range of crop species, with the development of more than 130 publicly bred cultivars of different crops. The majority of the noteworthy crop products delivered by GAB include improved cultivars with elevated resistance levels against important diseases such as bacterial blight and blast in rice and rust in wheat, etc.

### Key products with biotic stress resistance in some cereal and legume crops through GAB

- Rice: improved rice varieties with resistance to blast and bacterial blight disease
- Wheat: improved varieties resistance to stress response and other agronomic and quality-related traits
- Pearl millet: improved variety with higher resistance to downy mildew
- Barley: improved lines with resistance to eyespot, barley yellow mosaic viruses, and barley powdery mildew
- Soybean: several soybean cyst nematode and multiple disease-

resistant genotypes

- Groundnut: introgression lines showing higher yield and increased rust resistance
- Chickpea: high-yielding and Fusarium wilt and blight resistant varieties

Among abiotic stresses, tolerance to submergence, salinity and drought remained the key target traits for improvement using GAB. Similarly, several varieties with higher nutrition quality have been developed in many crops through GAB. These varieties include higher grain protein content wheat varieties, improved fragrance and intermediate amylose content rice varieties, quality protein maize cultivars, high oleic acid content groundnut varieties, etc.

Recent advances in genome sequencing, genetic diversity analysis, phenotyping and genome editing technologies can identify and accumulate

superior alleles for target traits in crop improvement.

### Key advances in upstream science technologies for accelerating crop improvement

- Availability of reference genomes and genome-wide surveys on comprehensive diversity panels pave the way to associate the allelic variation with phenotypes.
- Methods are now available to evaluate the genetic worth of the vast genetic resources archived in gene banks and streamline application of these resources in crop improvement programs.
- Precise genome editing technologies in concert with enhanced trait architectures enable innovative solutions to engineer complex trait variation.
- High-throughput phenotyping methods are beginning to alleviate the challenge of accurate, precise and large-scale measurements of plant performance.
- Optimized speed breeding protocols remain crucial to accelerating breeding advance when applied with genomic breeding approaches.
- Sustaining gains from genomic breeding mandates fast-tracking exploitation of the minor effect alleles, accumulation of favorable alleles and purging of deleterious alleles.

Development of disease resistant, pest-resistant, abiotic stress tolerant and better quality/nutrition varieties through GAB 2.0 is expected to reduce application of pesticides, insecticides and fertilizers in growing these varieties. Such varieties are also expected to deliver higher produce to farmers while ensuring sustainable agriculture and environmental protection. The plant breeding community will continue to be armed not only with a vast array of data but also with the proper tools and technologies to decipher and implement the knowledge to feed a growing world.







## E-KRISHI KENDRA

# DIGITAL REVOLUTION

## CHANGING FACE OF INDIAN AGRICULTURE

**E**-Krishi Kendra is an open access platform for providing agriculture's digital services under a single roof. It touches the lives of millions of farmers, clocking a positive growth year to year. It is seen as an emerging field focusing on agricultural growth and rural development through improved information and communication processes.

The digitalization and the spread of mobile telephony and internet in rural areas allow farmers and entrepreneurs to gain access to information, services and markets. The internet, mobile phones and other tools to collect, store, analyses and share information digitally – all have spread quickly. Some specific factors matter, such as age, literacy and education of target group, farm size, gender, motivation, awareness, information sharing influence, use of mobile phone and confidence in the information. E-Krishi Kendra reduces the gap by implementing the F2B, B2B and B2C platforms for agriculture.

### DIGITAL INFRASTRUCTURE FOR AGRICULTURE

Digital technologies and analytics are revolutionizing agriculture. E-Krishi Kendra provides the digital infrastructure for enhanced farmer awareness in all aspects. Internet and mobile technologies transformed traditional agriculture to digital agriculture. This transformation is accelerating with the use of the online agriculture portal, E-Krishi Kendra. This has emerged as an e-commerce platform with vast agricultural network. The portal's digital agriculture service shall enable Indian agriculture to reach its full potential.

### HIGHLIGHTS OF E-KRISHI KENDRA

E-Krishi Kendra, an e-commerce platform, has a professional and positive approach for the range of tasks in agriculture, assisted by digital services. It is committed to ensuring consistent services throughout the year. It is a podium for the blooming of agri-business

### ABOUT THE AUTHORS



Ms Naima Shaikh is Managing Director of AgriDigi Tech Private Limited & PhD Research scholar, ASPEE Agribusiness Management Institute, Navsari Agriculture University, Navsari.



Mr Narendra Savaliya is CEO of AgriDigi Tech Private Limited

with an e-commerce platform. It offers multi-disciplinary agronomic services on a single platform, and an integrated e-education portal for agriculture students. E-Krishi Kendra is an initiative to conduct long-serving integrated distribution services on a single platform. It provides the framework for e-trading of agricultural produce.

### PECULIARITY OF E-KRISHI KENDRA

E-Krishi Kendra offers content generated by subject matter specialists. It provides low-cost solutions tailored to the specific needs of farmers. Agriculture-related news is updated daily. Regular updates are done for central and state government schemes. Success stories of progressive farmers are highlighted on a single platform. Agri experts give guidance on multi-disciplinary agriculture problems. Information regarding national and international agricultural exhibitions is available at one click. Through this portal, APP suppliers and buyers connect digitally and can create new business. Actual price discovery of agriculture produce and integrated agri produce distribution service is available on a single platform. Farmers can create their own distribution network.

### WORKING AREA OF E-KRISHI KENDRA

The reach of E-Krishi Kendra includes farmers, agri-input, agri-experts, agri students/professions and Agri-Bazaar.

E-Krishi Kendra provides multi-disciplinary agronomic services and information to farmers on a variety of issues related to farming, commodity markets and government schemes. It enables direct marketing of farm products. It is the hub for connecting farmers to agri-experts with a steady stream of information and services. These services assist and benefit farming throughout the year. E-Krishi Kendra provides Timeline (Social Media Corner), Purchase Corner, Government Corner, Crop Sell Corner, Solution Corner, Training Corner and Recent Events Corner for farmers.

### Broad Spectrum Benefits

E-Krishi Kendra offers input availability at finger touch, customized trading of agri commodities, advisory for all the needs of farmers from experts, and student asset as the future of Indian agriculture. The digital infrastructure offered by E-Krishi Kendra shall empower Indian agriculture.

Visit [www.ekrishikendra.com](http://www.ekrishikendra.com)



The portal offers new ways to connect, collaborate, conduct business and build bridges between people. E-Krishi Kendra is a B2B and B2C online portal which help to grow business. E-Krishi Kendra provide Pageline (Social Media Corner), Sale corner, Crop purchase corner, Dealer system, Ad corner, Discussion corner and Recent Event corner for Agri Input sector.

E-Krishi Kendra is a platform where farmers connect with buyers, retailers, traders, corporate sector, industrial users, exporters, etc for selling their agricultural produce through the Agri Bazaar facility at better and competitive rates. E-Krishi Kendra provides Pageline (Social Media Corner), Farmer Crop (B2C) Corner, B2B (Buy/Sell) Corner, Commodity Update Corner, Discussion corner, Placement Corner and Event Corner for Agri Bazaar.

Through the portal, agricultural experts can give valuable information to farmers, along with solutions. E-Krishi Kendra provides diverse interactive platforms like Live Video Corner, Groupline Social Media corner, Advice Corner, Blog Corner, Discussion Corner, Training Corner, Student Corner for Agri Experts etc.

It is an integrated e-education portal for agriculture students. It provides the

students with information regarding the best agriculture organizations, enabling them connections for a bright future. E-Krishi Kendra provides Studentline (Social Media), Study Corner, Job Corner, Blog Corner, Discussion corner, Training Corner, Event Corner for Agri Students etc.

### BENEFITS FROM E-KRISHI KENDRA

Efficient delivery of agri extension services can ensure that even small and medium sized farmers get benefits from optimum agri information. E-Krishi Kendra offers flexibility to order agri inputs online and get input products at comparative prices. Users can reap rich revenue on investments. It reduces delivery time and transportation cost.

It offers users opportunities to manage business from anywhere in the world. Suppliers and buyers can connect digitally and create new business. Experts digitally connect with farmers to provide end to end integrated solutions. Experts exchange their knowledge with each other on one platform. Experts give guidance to students across the country at one place. It strengthens the distribution of agri-products by ensuring transparency and barrier-free intra-state and inter-state trade of agri commodities. It gives price realization to farmers through reduced gap between producer's price and consumer's rupee. It ensures fair and remunerative price to farmers through price discovery. E-Krishi Kendra offers improved market links to help sustain the use of technical improvements. E-Krishi Kendra enables e-learning for students with agri experts. Students can strengthen their future through interaction with the best agricultural organizations.





## ECO-AGRICULTURE REVOLUTION

# CIRCULAR ECONOMY IS THE WAY FORWARD

It is important for India and rest of the world to adapt a circular economy to promote the principals of agro-ecological and other innovative approaches. These may facilitate our attempt towards attaining sustainable agriculture.

### Securing Food and Nutritional Security, Preparedness for another Pandemic or Epidemic

Globally the concept of the bio-economy has become more visible. It is gaining importance within the policy process for the past decade. By adopting bio-economy strategies, governments are laying the foundation for policy support and investment. These in turn enable pioneering research and facilitate the development of new and advanced technologies. They support education and capacity building, drive forward the industrialization processes, create awareness and help stimulate consumer demand.

New dynamics in bio-economy policy development are evolving outside of governments, with stakeholder-driven

and industry-driven strategies on the rise. These emerging initiatives represent excellent examples of the great extent to which bio-economy is gaining importance globally. Hence the focus on these new and emerging policy trends.

In 2019 BASAI adopted to work towards attaining majority of the UN Sustainable Development Goals under its national charter. Regional strategies that create synergies from local specialization are gaining momentum. National strategies continue to capitalize on thematic prioritization and specializations.

India along with the rest of the world has been facing challenges with respect to systemic climate, biodiversity, economic

and health crises. BASAI has sensed an opportunity in promoting the bio-economy for helping resolve these crises, not only within the country but globally too. We are currently in the process towards evaluating the existing bio-economy policy strategies and instruments in India and around the world that seek to stimulate, support and steer transformation dynamics towards a sustainable bio-economy. BASAI is likely to publish its report by June 2021.

### Principals of Agro-Ecology

Primarily, BASAI is looking into the best possible route in promoting the principles of agro-ecology that have been set by the United Nations. The consolidated set of



### ABOUT THE AUTHOR

Mr Vipin Saini is a Regulatory Affairs & Techno-legal Specialist, Educationalist, Environmentalist, Toxicologist, Data analyst, Writer and Publisher. He is CEO, Biological Agri Solutions Association of India (BASAI), the Founder Trustee of Sunrakshan Foundation and the Associate Editor of the Content CropCare Division at Krishi Jagran

these agroecological principles are:

**Recycling:** Preferentially use local renewable resources and close as far as possible resource cycles of nutrients and biomass.

**Input reduction:** Reduce or eliminate dependency on purchased inputs.

**Soil health:** Secure and enhance soil health and functioning for improved plant growth, particularly by managing organic matter and by enhancing soil biological activity.

**Animal health:** Ensure animal health and welfare.

**Bio-diversity:** Maintain and enhance diversity of species, functional diversity and genetic resources. Maintain bio-diversity in the agroecosystem over time and space at field, farm and landscape scales.

**Synergy:** Enhance positive ecological interaction, synergy, integration, and complementarity amongst the elements of agro-ecosystems (plants, animals, trees, soil, water).

**Economic diversification:** Diversify on-farm incomes by ensuring that small-scale farmers have greater financial independence and value addition opportunities. These will enable them to respond to demand from consumers.

**Co-creation of knowledge:** Enhance co-creation and horizontal sharing of

**fun  
FACT**



**Cooking for the family is the greatest stress buster for me. No matter how tired I am or how much stressed, cooking is the ultimate relief I get. Thanks to my Mom, who taught me the basics of Indian cooking and my desire to learn and innovate**

knowledge including local and scientific innovation, especially through farmer-to-farmer exchange.

**Social values and diets:** Build food systems based on the culture, identity, tradition, social and gender equity of local communities that provide healthy, diversified, seasonally and culturally appropriate diets.

**Fairness:** Support dignified and robust livelihoods for all actors engaged in food systems, especially small-scale food producers, based on fair trade, fair employment and fair treatment of intellectual property rights.

**Connectivity:** Ensure proximity and confidence between producers and consumers through promotion of fair

and short distribution networks and by re-embedding food systems into local economies.

**Land and natural resource governance:** Recognize and support the needs and interests of family farmers, smallholders and peasant food producers as sustainable managers and guardians of natural and genetic resources.

**Participation:** Encourage social organization and greater participation in decision-making by food producers and consumers to support decentralized governance and local adaptive management of agricultural and food systems.

These 13 basic principles of agro-ecology along with the UN SDGs enable a circular economy to achieve agriculture sustainability the Indian way.

## Going the EU Way

In order to make products fit for a climate-neutral, resource-efficient and circular economy, we have to reduce waste. We have to ensure that the performance of front-runners in sustainability progressively becomes the norm.

The EU Commission is looking towards proposing a sustainable product policy legislative initiative.

The core of this legislative initiative will be to widen the eco-design directive beyond energy-related products. This will make the eco-design framework applicable to the broadest possible range of products and make it deliver on circularity.

As part of this legislative initiative, and, where appropriate, through complementary legislative proposals, the Commission will consider establishing sustainability principles and other appropriate ways to regulate the following aspects:

- i. improving product durability, reusability, upgradability and reparability, addressing the presence of hazardous chemicals in products, and increasing their energy and resource efficiency
- ii. increasing recycled content in







- products, while ensuring their performance and safety
- iii. enabling remanufacturing and high-quality recycling
- iv. reducing carbon and environmental footprints
- v. restricting single-use and countering premature obsolescence
- vi. introducing a ban on the destruction of unsold durable goods
- vii. incentivising product-as-a-service or other models where producers keep the ownership of the product or the responsibility for its performance throughout its lifecycle
- viii. mobilising the potential of digitalisation of product information, including solutions such as digital passports, tagging and watermarks
- ix. rewarding products based on their different sustainability performance, including by linking high performance levels to incentives

### Regenerative Agriculture

This also works for a circular economy. The current degradation of biodiversity and soil fertility has led to increasing calls internationally to “reverse the direction of travel” of global agriculture from degenerative to regenerative approaches. The definition of regenerative agriculture used in this report is “a system of principles and practices that generates agricultural products, sequesters carbon, and enhances biodiversity at the farm scale”.

Important practices associated with regenerative agriculture are:

- 1) Minimising or avoiding tillage
- 2) Eliminating bare soil
- 3) Encouraging plant diversity
- 4) Water percolation
- 5) Integrating on-farm livestock and cropping operations

Some systems also prioritise the minimisation of pesticides and synthetic fertilizers i.e. regenerative organic

agriculture.

The regenerative systems are conservation agriculture; organic crop production and grazing; tree crops; agroforestry including tree-intercropping, multi-strata agroforestry and permaculture, and silvopastures; multi-paddock grazing systems, and rewilding.

The opportunities for regenerative agriculture occur in the global context of limited land, an increasing population and demand for food, and the need to reduce greenhouse gases and enhance biodiversity. There is agreement that existing intact ecosystems of high biodiversity need to be protected from agricultural expansion. There is also agreement that reducing waste and constraining per capita consumption of animal products is desirable. Whilst some have contrasted land sparing and land sharing approaches, there is increasing agreement that enhancement of biodiversity will benefit from land sparing approaches at a range of scales.

India needs to accelerate its transition towards a regenerative growth model that can give back to the land more than it takes, advance towards keeping its resource consumption within its national and regional boundaries, and therefore strive to reduce its consumption footprint and double its circular material use rate in the coming decade.

Disclaimer: Views expressed are personal views of the author and in no way reflect the views of Biological Agri Solutions Association of India (BASAI)

### Major environmental benefits

Each of the nine regenerative agriculture systems investigated can offer environmental benefits in terms of increased soil and above-ground carbon storage and/or enhanced on-farm biodiversity. Their effects on yield, revenue, and production costs depend on the baseline situation and the specific system. In many situations, conservation agriculture can sustain yields and/or lead to reduced production costs. Adding organic amendments to crops not receiving fertiliser can increase crop yields. Although certified organic production generally reduces crop and livestock yields compared to well-managed non-organic production, securing an organic premium typically results in greater profitability. The effects of agro-forestry systems on food production are closely linked to the tree densities and whether the trees also provide feed and/or food. In some places, rewilding can be appropriate.

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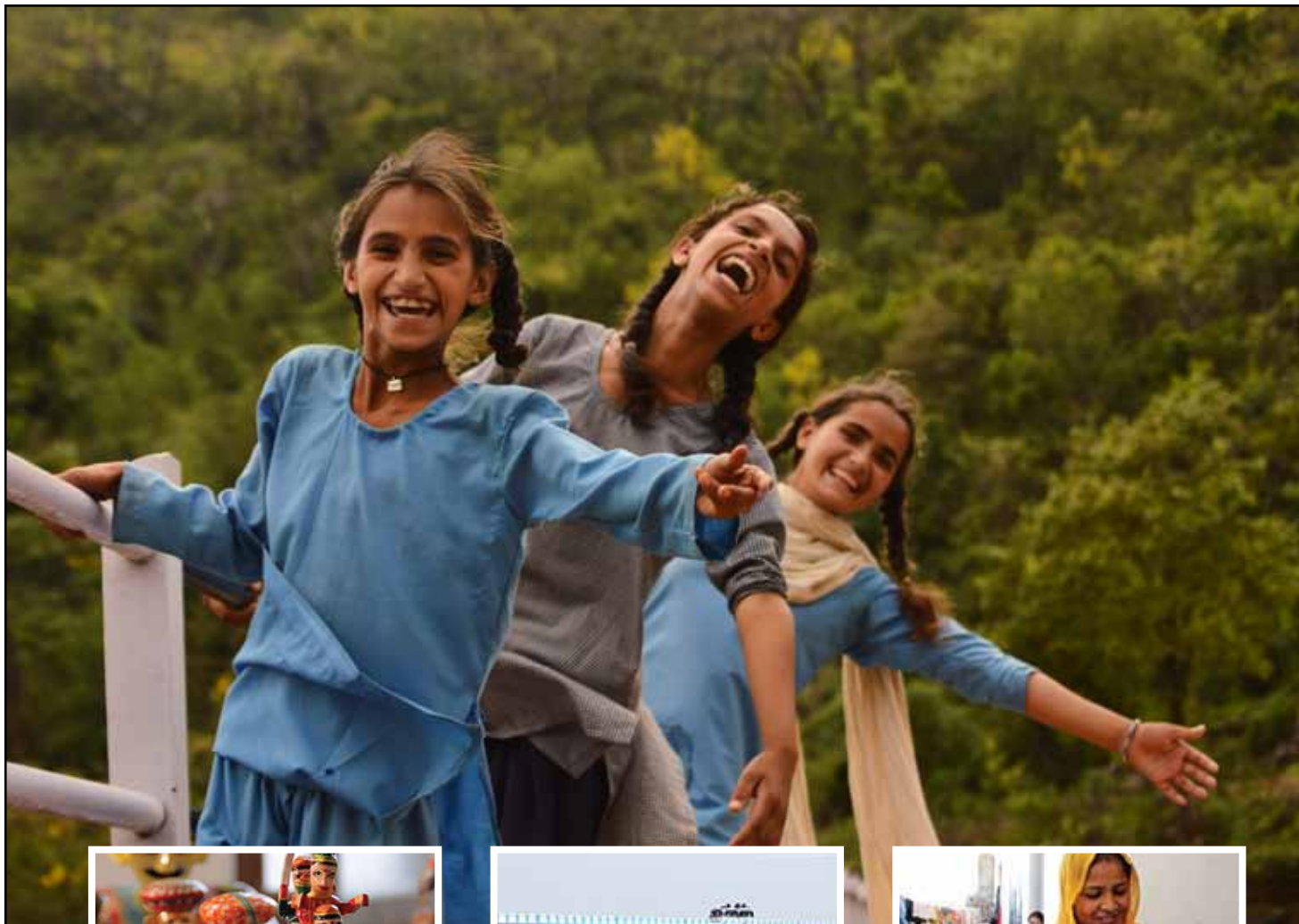
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