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# Times of Agriculture

A Resonance in Agriculture

Monthly Agriculture E-Magazine

November-2022



# ONE NATION ONE FERTILIZER

*Revival in Fertilizer Industry*



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## FROM THE EDITOR'S DESK

Dear readers, we are pleased to announce on released of November issue of **Times of Agriculture e-magazine**. Like every issue, this time also various agricultural activities are being presented to you in a very interacting manner. November issue's theme is '**One Nation One Fertilizer**' scheme. This scheme is being implemented in the entire country by respected Prime Minister Narendra Modi.

Through this scheme all fertilizers will be linked under the name of '**BHARAT**' brand. This is a great step taken in the fertilizer industries. In this magazine issue, we have discussed '**One nation one Fertilizer**' in detail and through graphics it has been explained that how this scheme will prove to be beneficial for the farmers.

Your immense love and support towards the magazine inspires us to do more good work. Our goal is to connect you all with the latest and latest agriculture information. Hope you like this issue of ours, please share it with your classmates and colleagues also so that they can also get new information about agriculture.

Thanks a lot and best wishes.

**Dr. Devraj Singh**  
Editor-In-Chief

# Times of Agriculture

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Monthly Agriculture e-Magazine



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**Editor-In-Chief**

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*“Times of Agriculture”* is agriculture monthly e-Magazine initiated for the purpose of providing information about recent innovations and technologies in agriculture and allied sectors. This e-Magazine gives a platform to dignitaries like scientists, researchers, scholars, students and innovative farmers to share their views and vivid ideas about agriculture. The main objective of this e-Magazine is to provide an open access platform for authors to get on the soapbox and spread awareness regarding the technologies and awareness in agriculture sector by e-publishing articles addressing the upcoming needs in the field agriculture.



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## ONE NATION ONE FERTILIZER

*Revival in Fertilizer Industry*



## Cover Story

### One Nation One Fertilizer: Revival in fertilizer industry

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# AGRICULTURE UPDATES



# India's rank 107 in Global Hunger Index

India has experienced remarkable economic growth in recent years and remains one of the fastest growing economies in the world. However, hunger and malnutrition are still areas of concern in spite of many strides.

India has **slipped 6 places** and ranked **107**, out of 121 countries, in Global Hunger Index (GHI) 2022. Global Hunger Index 2022 is an annual report jointly published by two European NGOs of Concern **Worldwide and Welthungerhilfe**.

It was **first published in 2006**. It is published every October. The 2022 edition marks the 17<sup>th</sup> edition of the Global Hunger Index 2022.



# PM Kisan Samman Sammellan 2022

Prime Minister of India inaugurated the PM Kisan Samman Sammellan 2022 at **Indian Agricultural Research Institute (IARI)** in New Delhi. PM released the **12<sup>th</sup> instalment** of Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) funds. Rs **16,000 crores** were transferred to over 8.5 crore eligible farmers as part of the scheme.

PM also inaugurated **600 'Pradhan Mantri Kisan Samruddhi Kendras' (PMKSK)** under the Ministry of Chemicals & Fertilizers. Under this scheme, more than 3.3 lakh retail fertilizer shops in the country will be converted into PMKSK in a phased manner.



# Approval of GM Mustard

Genetic Engineering Appraisal Committee (GEAC) that functions under the Union Ministry of Environment, Forest and Climate Change has approved seed production prior to commercial release of genetically modified (GM) mustard.

**Dhara Mustard Hybrid (DMH-11)** is an indigenously developed transgenic mustard. It is a genetically modified variant of **Herbicide Tolerant (HT) mustard**.

It contains two alien genes (**'barnase'** and **'barstar'**) isolated from a soil bacterium **called *Bacillus amyloliquefaciens*** that enable breeding of high-yielding commercial mustard hybrids. It has been developed by the Centre for Genetic Manipulation of Crop Plants (CGMCP) at Delhi University.



# Paul Varghese appointed Ninjacart head Reseller Platform

Ninjacart, India's leading agri-startup that leverages technology and data to organize the Indian agriculture ecosystem, has appointed **Paul Varghese** as **Head of its Reseller Platform**. The appointment comes as a part of Ninjacart's continued focus on strengthening both Ninjacart's Fulfillment and Platform businesses.

As Ninjacart's Reseller platform leader, Paul will contribute to the development of the company's strategy, GTM, teams, and execution capabilities.



## ‘CMFRI Kochi’ released juveniles of Grass Carp

In an eco-friendly move to clear aquatic weeds, the Ernakulam Krishi Vigyan Kendra (KVK) of ICAR-Central Marine Fisheries Research Institute (CMFRI), Kochi **released juveniles of grass carp**, a freshwater fish that eats aquatic plants, into Kadupadam Chira, Mookkannur in Angamaly. A joint mission to rejuvenate the waterbody with the support of Kadupadam Chira Samrakshana Samithi and Matsya Club, the fish-ranching was part of the Central government’s Swachh Bharat campaign.

Grass carp fish (*Ctenopharyngodon idella*) had been successfully used in the past too by the KVK to tackle the weed menace in the district.



CMFRI

# Cabinet approved Nutrient Based Subsidy (NBS)

Union Cabinet approved Nutrient Based Subsidy (NBS) rates for Phosphatic and Potassic (P&K) fertilisers for Rabi season 2022-23 from **1<sup>st</sup> October, 2022 to 31<sup>st</sup> March, 2023**.

Subsidy approved by Cabinet for the NBS Rabi-2022 (from 01.10.2022 to 31.03.2023) will be **Rs. 51,875** crore including support for indigenous fertilizer (SSP) through freight subsidy.



## *India as the world's largest producer, consumer of sugar*

India has emerged as the world's largest producer and consumer of sugar and its second largest exporter.

In sugar season (October-September) 2021-22, a record over **5,000 lakh metric tons** (LMT) sugarcane was produced in the country, out of which about **3,574 LMT** was crushed by sugar mills to produce about 394 LMT of sugar (sucrose). Out of this, 35 LMT sugar was diverted to ethanol production and 359 LMT sugar was produced by sugar mills.



# 3<sup>rd</sup> Advance Estimates of Horticultural crops 2021-22

Ministry of Agriculture and Farmers Welfare, Government of India releases the 3<sup>rd</sup> Advance Estimates of the area and production of various horticultural crops for the year 2021-22. According to the estimate, a record **342.33 million tonne** are estimated to be produced in an area of **28.08 million hectare**.

Total horticulture	342.33
Vegetable Production	204.84
Fruit production	107.24





## SAFAL – Odisha’s Common Credit Portal

Odisha Chief Minister Naveen Patnaik launched the common credit portal SAFAL to increase farmers’ access to loans.

SAFAL (Simplified Application for Agricultural Loans) is **India’s first online agricultural credit facilitation portal**. This common credit portal eases access to over **300 term loan** products provided for farmers and agri-entrepreneurs. These term loan products will be provided by more than **40 partner banks**. The portal acts as a one-stop solution for farmers and agri-entrepreneurs.



## 3 new Varieties of Basmati Rice

IARI has organized **Kisan Sampark Yatra** from September 27 to 29 this year to get feedback on the 3 new varieties of IARI Basmati varieties.

The three newly developed disease resistant varieties are **Pusa Basmati 1847**, **Pusa Basmati 1885** and **Pusa Basmati 1886**.

They are highly resistant to **bacterial blight** and **blast diseases**. This has been achieved with the help of molecular marker assisted breeding method or MAB.

# India Agribusiness Awards 2022

National Fisheries Development Board (NFDB), Hyderabad has been awarded the "India Agribusiness Awards 2022" for the Best Agribusiness Fisheries Sector Category at the 5<sup>th</sup> India Agribusiness Summit 2022 held as a part of "AgroWorld 2022" India International Agro Trade and Technology Fair 2022 held from 9<sup>th</sup> to 11<sup>th</sup> November 2022 at Indian Agriculture Research Institute, New Delhi. The "AgroWorld 2022" was organised by the Indian Chamber of Food and Agriculture (ICFA) at ICAR-Indian Agricultural Research Institute (IARI) New Delhi.

**Haryana Wins India Agribusiness Best state Award.**





# ONE NATION ONE FERTILIZER

*Revival in Fertiliser Industry*



About the Author

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**“One Nation, One Fertilizer”** programme, which aims to market fertilisers in the nation under the **“BHARAT”** brand name, was introduced by Prime Minister Narendra Modi on **October 18.**

This indicates that fertiliser packages will be the same design throughout the nation, bearing the labels ***BHARAT UREA, BHARAT DAP, BHARAT MOP, and BHARAT NPK,*** etc.

The government is making it mandatory for companies to market subsidised fertilisers under ‘Bharat’ brand. This is being done as part of the ‘One Nation, One Fertiliser’ (ONOF) scheme of the ***Fertiliser and Chemicals Ministry with an aim to prevent criss-cross movement of fertilisers and reduce high freight subsidy.***



With this, the government intends to *reduce the criss-cross movement of fertilisers* (urea, di-ammonium phosphate, and potash have fixed nutrient content as specified under the fertiliser control order and which does not change with brands) that will eventually help reduce freight subsidy bills and improve the availability.

### **About One Nation One Fertiliser**

Under the slogan "*One Nation, One Fertilizer*" One Nation One Fertilizer seeks to provide farmers with high-quality crop nutrients at reasonable prices. To make farming easier, the farmers will be given access to nano urea. *A sacksful of urea can only be replaced by one nano urea bottle.* The plan was put in place to stop the high freight subsidy-reducing Criss-cross movement of fertiliser brands. Under the new 'One Nation One Fertilizer' initiative, the companies are only permitted to advertise their name, brand, logo, and other pertinent product information on one-third of their bags. The "Bharat" brand and *'Pradhanmantri Bharatiya Jan Urvarak Pariyojana'* logo will have to be displayed on the remaining two-thirds of the space.



# 'BHARAT' BRAND



Actual Cost, Subsidy, MRP

One Uniform Logo

One Uniform Brand

Company

Message for Farmer (in 16 Language)

## Other Fertilizes



## What is PMBJP ?

One Nation One Fertilizer would be accomplished by introducing "Single Brand for Fertilizers and People" under the "*Pradhan Mantri Bhartiya Janurvarak Pariyojana*" fertiliser subsidy scheme, according to a statement from the **Ministry of Chemicals and Fertilizers**.

**Businesses are only allowed to display their name, trademark, logo, and other crucial product information on one-third of their bags** under the "One Nation One Fertilizer" programme. To all fertiliser companies, state trade organisations, and fertiliser marketing institutions, urea, di-ammonium phosphate (DAP), muriate of potash (MOP), and nitrogen phosphorus potassium (NPK) are all sold under the same brand name, Bharat Urea, Bharat DAP, Bharat MOP, and Bharat NPK, respectively.



# The Key Benefits With The Roll-out of 'BHARAT' Brand

## 1-Subsidy and MRP

- The maximum retail price of urea is currently fixed by the government, which compensates companies for the higher cost of manufacturing or imports incurred by them.
- The MRPs of non-urea fertilizers are on paper decontrolled.
- But companies cannot avail of subsidy if they sell at MRPs higher than that informally indicated by the government.
- Simply put, there are some 26 fertilizers (inclusive of urea), on which the government bears subsidy and also effectively decides the MRPs.

## 2-Supply plan

- Apart from subsidising and deciding at what price companies can sell, the government also decides where they can sell.
- This is done through the Fertiliser (Movement) Control Order, 1973.
- Under this, the department of fertilisers draws an agreed monthly supply plan on all subsidised fertilisers in consultation with manufacturers and importers.

## 3-Taking Credit

- When the government is spending vast sums of money on fertiliser subsidy plus deciding where and at what price companies can sell, it would obviously want to take credit and send that message to farmers.

# The Rationale Behind Bringing The New Scheme

Due to government regulations, there is *no product differentiation among different brands for each type of fertiliser.*



However, *farmers are generally unaware of this fact and prefer certain brands as a result of vigorous marketing strategies adopted by firms with strong retailer networks developed over time.*



Also, the *local retailers used to promote sale of those fertilizer brands which offered them higher commission.* As such farmers often ended up spending more to buy fertilizers of popular brands.



Fertilizer Control Order (FCO), issued under the *Essential Commodities Act, 1955*, has *laid down fertilizer-wise detailed specifications and any fertilizer, not meeting the said specification, cannot be sold in the country for agricultural purposes.*



# Significance of the scheme

01

## Standardisation

This will standardize fertilizer brands across the nation irrespective of the company that manufactures it.

02

## Affordability

Scheme will ensure affordable quality fertilizer of Bharat brand to the farmers. This scheme will result in reduction of the cost of fertilizers and increase their availability.

03

## Single branding

Competition among companies that push their brands will get reduced with this single branding, which will ensure sufficient supply of fertilizers across the country.

04

## Stopping urea diversion

It will also stop the diversion of urea for industrial purposes.

## Major Issues/ Challenges

### 1. Supply-side constraints

Retail food inflation has hit a 7.68 per cent mark.

India is facing a tight supply position in fertilisers, especially of phosphatic and potassic nutrients.

The challenges include securing supply from new sources, costlier raw material, and logistics.

The pandemic has impacted fertilizer production, import and transportation across the world.

### 2. Global issues

Major fertiliser exporters such as China have gradually reduced their exports in view of a dip in production.

This has impacted countries such as India, which sources 40–45% of its phosphatic imports from China.

There has been a surge in demand in regions like Europe, America, Brazil and Southeast Asia.

While the demand has increased, the supply side has faced constraints.

### 3. Other

There has been a steady increase in prices of raw material as well as logistics and freight costs.

The disruption in the logistics chain during COVID has caused the average freight rates for ships to jump up to four times.

Besides, prices of fertilisers such as DAP and urea, and raw materials such as ammonia and phosphatic acid, have risen up to 250–300%.

The total fertiliser subsidy bill is expected to reach Rs. 2.5 lakh crore this financial year, up from Rs. 1.62 crore in the revised estimates for the previous fiscal.

## Criticisms

### 1. Critics argue that completely commoditising fertilisers could:

- Impact their quality,
- Discourage manufacturers from bringing newer and more efficient products into the market if there is less scope for building a unique brand identity.
- It may also leave them as mere importers or contractors of fertilisers.

### 2. Brands not owned:

- Many manufacturers have also expressed reluctance to spend on a brand they do not own.
- Once in a while, some companies may bear the expense, but it will be difficult to spend continuously on advertisements where brand value for that company is zero.

### 3. Regulation:

A government brand will add another layer of regulation to the fertiliser manufacturing sector where almost every aspect- from product pricing to cost structure to geographical distribution and sale- is controlled by the government.

## Growth Fertilizer Industry in India

During the 2017-21 year, total fertiliser production was **414.85 LMT**. The total fertilizer output in the 2019-21 fiscal year is **462.15 LMT, an increase of more than 11.40% year-on-year**. Due to the favorable policy environment that stimulated investment in the public, cooperative and private sectors, the country's fertilizer production has surged. Currently, the country has **32 large-scale urea plants** generating urea, **19 units producing DAP and complex fertilisers, and 2 units producing Ammonium Sulphate** as a by-product.

India is a **leading importer of fertilisers** for its huge agriculture sector, which employs about 60% of the country's workforce and accounts for 15% of the \$2.7 trillion economy. To fertilise the crops, India depends on imports for its entire annual consumption of **4-5 million tonnes of potash and ships in a third of this from Belarus and Russia**.

### India Fertiliser Scene, 2020-21

<b>World's 2<sup>nd</sup> largest consumer</b> (N+P <sub>2</sub> O <sub>5</sub> +K <sub>2</sub> O)	32.55 MT
<b>World's 3<sup>rd</sup> largest consumer</b> (N+P <sub>2</sub> O <sub>5</sub> )	18.48 MMT
<b>World's largest importer</b> (N+P <sub>2</sub> O <sub>5</sub> +K <sub>2</sub> O)	10.90 MMT

## The way forward

It will be possible to lessen fertiliser black marketing with the government programme "One Nation One Fertilizer." Still, the true issues will become apparent in real time. As part of the **"Atmanibhar Bahrat"** Mission or to achieve fertiliser self-sufficiency, the government plans to implement One Nation One Fertilizer. This plan will assist the government in lowering fertiliser imports. The government will be credited for giving the fertiliser manufacturers substantial subsidies.

Instead of spreading fertiliser across the field, India should concentrate on increasing fertiliser efficiency through need-based application. The freshly created Nano urea by IFFCO shows encouraging results in cutting down on urea usage. These reforms will have a significant influence on improving agricultural output, reducing climate change, offering an alternative to chemical fertilisers, and balancing the financial burden of fertiliser subsidies on future Union Budgets.

# FLOATING SEEDBED FOR *AMAN* PADDY

## A CLIMATE RESILIENT TECHNOLOGY FOR FLOOD PRONE COASTAL ZONES

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IRDM, RKMVERI, Narendrapur

Out of a handful of constraints for rice production, submergence proves to be a serious one. As a result of the climate change, high intensity rain is seen in the early monsoon period i.e. during June-July, which results in waterlogging followed by submergence of 10-12 days. This adversity causes damage to the paddy seedling as well as the poses problems to seedbed preparation. Getting suitable areas for preparation of seedbed and sowing of *aman* paddy during flood is a serious threat for the farmers. Early floods are occurring when the farmers are

supposed to prepare the seedbed on their lands. When the water level falls down, farmers engage in making seedbeds but their effort does not fetch a desirable output as the crop period is affected by late transplanting of seedlings. Floating seedbeds are becoming popular among local farmers of the flood affected areas of the nation as a climate resilient technology to carry out the process of seedbed preparation and sowing even during flood.

### Why floating seedbed ?

A floating seedbed is generally defined as a seedbed which is not attached to the soil surface and can rise and fall with the water level. It consists of two parts: a floater and a growing substrate (soil). Floating seedbeds can save the seedlings from occasional torrential rain during monsoon period in coastal zone. The main aim of this technology is to get an early rice growing season with flexible time for transplanting. This

technology can prevent the rice seedbeds from prolonged submergence and crop failure. These seedbeds flee from immediate damage by floating over the standing water. The crop can be sown at the right time and a good yield can be expected as compared to late sowing due to sudden flooding. The seedlings obtained by this method are seen to be ready for transplanting at an early stage as compared to the traditional method hence, the seedlings can be transplanted early which reduces the transplanting shock faced by the seedlings and obtain a good seedling stand.

### Effects of submergence on rice seedlings

Rice is known to be a semi-aquatic plant but submergence for a long period of time is seen to exhibit a deleterious effect to the rice seedlings.

- Submergence results in low photosynthetic rates in seedlings due to less CO<sub>2</sub> availability and less light availability.
- Energy crisis occurs in submerged paddy seedlings due to low concentration of O<sub>2</sub> which leads to reduction in respiration rate and eventually causes the death of the plant.
- Leaf senescence is common in submergence due to reduction in chlorophyll content as a result of increase in ethylene production during submergence.
- As the concentration of O<sub>2</sub> inside the plant cells is less, the stored carbohydrates are utilized that leads to death of the plant cell as



(Source: thefinancialexpress.com.bd)

Fig 1: Floating seedbed of *Aman* paddy





submergence causes utilization of carbohydrates and hydrolysis of protein.

### **Preparation of floating seedbed**

The seedbeds are constructed on a bamboo frame which can float in the water and prevent the paddy seedlings from submergence due to excessive rainfall. The bamboo frame is covered with a polythene sheet and a thin layer of fertile top soil is placed in it as a growing substrate. The bamboo frames are either attached to bamboo poles at four corners to keep it fixed in position. Only it can rise and fall with water level. Or it is kept free by attaching itself with empty plastic vessel to help it floating. The seedbeds are kept attached so that they do not flow with the water currents during flood. The size of the floating seedbed is generally 10 ft. X 4 ft. and it requires around 25 seedbeds for sowing seed for 1 hectare transplanting of paddy.

Pre-germinated seeds are broadcasted over the floating seedbeds. Generally irrigation is not needed as the seedbed is floating in water. However, if required, water should be sprinkled over the seedling. The seedlings become

ready for transplanting at 25 days after sowing.

Another method uses banana logs as the base of the seedbed. The matured banana plants are chopped off and are attached to each other making a rectangular raft.

### **Advantages of floating seedbed technology**

- a) Floating seedbed allows the farmers to sow the crop early hence to obtain an early rice growing season with flexibility in transplanting in main field.
- b) Seedling becomes ready for transplantation 5-10 days earlier as compared to traditional paddy cultivation method. Thus early seedlings can be transplanted which gives more number of effective tillers and thus more grain yield.
- c) The seedlings can be protected against submergence.
- d) The floating seedbed can be placed on the land and used after the water dries up.
- e) The setup cost of floating seedbed is less and can be used for more than one sowing.
- f) Floating seedbed technology enables the farmer to utilize the time during flood effectively

which otherwise be of no use in traditional method of production.

- g) Floating seedbed technology can help to increase the area under crop production to meet the growing need of food.
- h) Apart from paddy, floating seedbed technology can be used for growing a variety of vegetables.

### **Conclusion**

Floating seedbed technology is an important climate resilient technology which can protect the seedbed and seedlings against submergence during monsoon at flood prone coastal areas and produces healthy seedling which can be transplanted at around 25 days thus producing early and effective tillers. This technology should be harnessed by the farmers to get maximum return during the adverse conditions and increase the food grain production to feed the increasing population. Government should take necessary steps to create awareness among the farmers regarding the use of floating seedbed technology to fight against weather adversity.

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# APIARY: INTEREST TURN INTO PROFESSION



## About Author



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**H**oney bees never count its man-days and benefit cost ratio. It never collects honey for their own use. Then how can I think of a profit by practicing Apiary- a simple and very meaningful question by Shri Jagadish Balikai, who is practices apiary from his own interest. Occupation and interests are two different things in life. He is bus conductor by profession but has done lot of work in increasing honey bee population. Basically he is from Ramadurga of Belagavi district and studied B.Com. The interest towards honey bee and their propagation was so intense that job never stopped him and he started apiary related work during weekend leisure time.

The beginning of this habit is very interesting. During his 8<sup>th</sup> standard, Jagadish was taken for school trip to Mevundeshawar kolla and surebana of Ramadurga taluk. Child mind is always curious and want to get experience of their surroundings. He along with his friends saw a bee unit near picnic spot

and without a second thought went to harvest honey. Bee never entertain disturbance and they got it back by bees back bite. After seeing their swollen body teacher scolded them and warned them not to practice any new thing without prior knowledge and practice. So interest started germinating towards honey bees. He shifted to Dharwad for education purpose and he came for masters. This skill started growing accidentally met Dr. Shantaveerayya entomologist working under GKVK, Bengaluru and learnt some skills. Later on continued his learning from well-known apiarist Mr. Venkatesh, Madhuvan of Alnavar taluk.

Jagadish had interest but didn't had his own land started seeking the help of other farmers to keep bee boxes in their field and assured that he never take a single rupee from them. He invested one lakh rupees taken from provident fund loan in purchase of honey boxes and began keeping in known farmers field. Began with 25 boxes and convinced farmers how bee colonies increase pollination of crops and yield levels.

Honey bee species of *Apis cerena indica* is a smaller than rock bee and larger than little bees and has capacity to produce nearly 5Kg honey from a single hive. Most of the time this species is suitable for apiarist for honey production purpose. Shri Guru Basava Mahamane, Basavanand swamiji and others utilises honey for their own medicines preparations and

Jagadish contacted and convinced them to have some hive units in their Ashrama premises also. Swamiji themselves invested 20 lakh rupees and started apiary. November to January being the season we can collect nearly 4 to 5 Kg of honey, hence Bees requires flowers for secretion of honey, so need flowering crops throughout the year.

Nature first eco village of Halligeri has very suitable eco system with flowering plants, forest trees. He has kept more than 75 boxes there also. Honey collected freshly from hives has mainly 18% moisture and needs to be processed immediately otherwise souring occurs and quality starts deteriorating. Govt. of Maharashtra has honey sale points in different locations for enhancing sale and such steps also needs to be taken up by Karnataka govt. also. Youth can start apiary as a hobby, source of self-employment and help in protection of biodiversity. Apart from environment, keeping aside self-interest and thinking what we get in return we have many lessons to learn from bees. Jagadish feels as a human being we have to learn this art, adopt and practice it. He is supplying honey, honey bee hive and apiary unit to the farmers and earning Rs. 30000/month.



# RESPONSE FARMING

## About Author



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In unexpected dry years, variable inputs are not fully utilised by the crop and often exacerbate water deficits. In unexpected years of good water supply, opportunities for high returns are foregone. Without the ability to predict the nature of the pending season, economic benefits from yield-improving technologies in risk climates will always be less than in more reliable ones.

## Concept

The concept is that improved information about water supply prospects, and about expected impacts of alternative actions which might be taken, will equipped farmers to more closely meet their goals. Response farming focuses on water, and on farm management with respect to water. This information is required by all farmers everywhere, but it is believed that the greatest need at this time is in rainfed



agriculture-specifically in semiarid areas of the developing world.

## What is response farming?

As a flexible system of farming in which key decisions affecting crop water utilization and crop yield are modified each season in response to pre-season and early season predictions of season rainfall parameters – Response Farming. The methodology identifies and quantifies rainfall related risks (Stewart 1984), and guides strategies for addressing them at farm level.

## Principles

The elementary version of RF, guides farmer decisions by comparing the environmental variable with reference values. Examples include the definition of

planting dates and rates of fertilizer application.

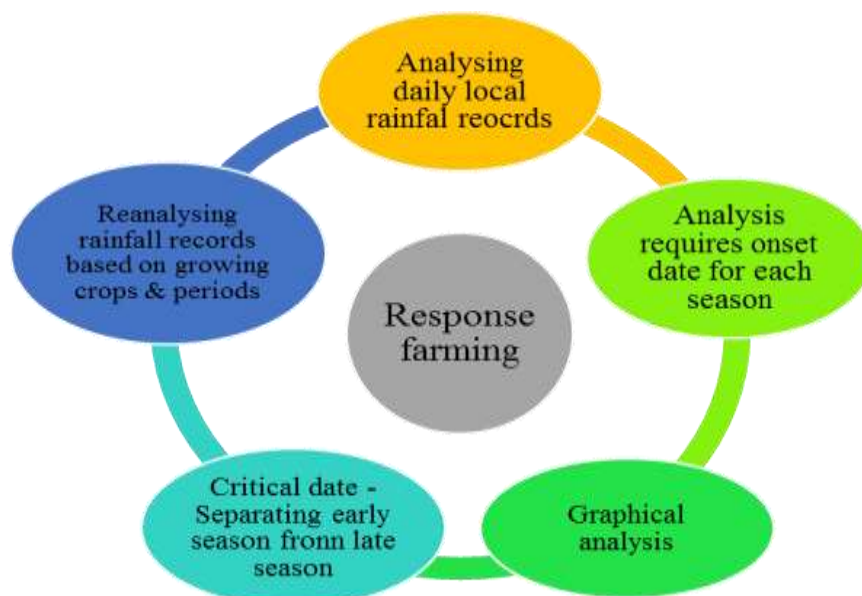
The decision tables have been centrally prepared by taking into account historical information on local climate effect on crop yields, local soil types and local crops, crop prices.

## Goal

To design sustainable cropping systems for low resource farmers in marginal rainfall zones, characterized by great Seasonal rainfall variability, uncertainty, and recurrent drought.

## Steps or methodology adopted

- Response Farming analyses require localized daily rainfall records.



- Determination of an onset date for each season of record - in terms of rainfall adequacy to start a crop within acceptable limits of risk.
- Graphical analysis follows - illustrating season duration, water amount, average daily intensity, amounts and intensities in specified growth stages, etc, have historically related to onset dates.
- Identifying critical date which separates early seasons from late seasons - selected arbitrarily by visual inspection of the graphs
- Reanalysis of the rainfall record, based on the crop selected and their growing periods - For example, early onset at some locations is often followed by relatively long dry periods before the rains gain strength again. This risk is easily mitigated or even eliminated by redefining onset to require sufficient buildup of soil water (prior to seeding) to assure both germination and seedling survival.
- Decision on acceptable planting criteria - the next step is to decide on slopes of plant rows to balance desired rainfall runoff (if any) with capture and infiltration of rain where it falls.
- The next decision concerns plant numbers and row spacing- affect seasonal crop water requirements and time sequences of soil water extraction.
- Another key factor is fertilizer, especially nitrogen (N), which is costly, yet essential to markedly



increase yields in good rainfall years.

### Response farming applications

- Farmers can improve their return by closely monitoring on-farm weather and by using this information in their day to day management decisions.
- Use of quantitative current data that are then compared with historical information and other local reference data (information on soils etc.).
- Using the long-term weather series, decision tools (usually in tabular or flowchart forms have been prepared in advance.
- The knowledge of local environmental/ agricultural conditions.
- The measurement of local “decision parameters” by local extension officer or farmer; and Economic considerations where applicable.

### Difficulties

Response farming, a technique that allows a farmer to adjust practices to the prevailing environmental conditions, can have limited effectiveness when data transmission facilities are weak.

### Conclusion

Response farming gives predictability of rainfall behavior based on onset dates of rain as created decision tables. It ensure sustainability of low recourse farmers to optimize yield and minimize risk instead of maximizing yield by developing coordination among agro meteorological, extension, local farmers make more success. Now, farming more viable if done in response to long-term climate info and seasonal forecast together with current weather information.

### Future thrust

- Strengthening of agro meteorological analysis and advices to farmers
- Predicting of season rainfall, and its behaviour patterns as they affect crop water use, growth and yield.
- Farm advisor to analyse the beginning rainfall events in each budding new season, and advise his farmer clients of their rainfall expectations in the coming season, and the steps they should be taking on response farming.
- Required more of on farm research / project.



# STRESS MANAGEMENT

## IN AGRICULTURE

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like bacteria, fungi, nematodes etc. are included in biotic stress.

### Impact of stresses on agriculture

#### 1- Abiotic stress

Abiotic stress includes drought stress, Heat stress, Cold stress, Salt stress etc. Plants are affected by no of abiotic stresses which impacts on the crop productivity. This abiotic stresses are interrelated with each other and creates many problems in plants like osmotic stress, malfunction of ion disturbance etc. Cold stress causes chilling injury and freezing injury in plants due to low temperature and freezing of fluids with in the plants where as Heat stress causes reduction of plant growth and crop quality, oxidative stress, alteration in photosynthesis, alteration in dry matter partitioning and yield reduction. High moisture stress is mainly due to excess of water in the field causes oxygen deficiency resulting depressed growth and survival of plants whereas Drought stress is mainly due to the scarcity of water hampering plant biomass production, quality and energy of plants as well as shorting the life cycle of the plants. Salt stress occurs due to problems like lack of rain, excessive evaporation and lack of drainage and constitute reactive oxygen species (ROS) such as  $H_2O_2$ ,  $OH^-$  are produced in plant cells, in mitochondria and chloroplast and

also decreases photosynthesis rate of the plants. Abiotic stresses are directly or indirectly effect the growth of plants by reducing water availability to plants due to increasing water soluble salt in soil and plants suffer from increased osmotic pressure outside the root and also effects water and ion status and photosynthesis of the plants. Drought and salinity affects photosynthesis by changing the levels of pigments, enzymes and the structure of the organelles. Under abiotic stress, the growth and development, metabolism and yield of plants are adversely affected.

#### 2- Biotic stress

Biotic stress occurs as a result of damage done by living organism such as bacteria, fungi viruses, parasites, beneficial and harmful insects, weeds, and cultivated and native plants. These biotic stress agents cause various types of diseases, infections and damage to crop plants and ultimately affected the crop productivity. The biotic injury impacts on crop yield through changing population dynamics, plant stress or coevolution and ecosystem nutrient cycling. Biotic stress agents directly deprive their host for its nutrients leading to reduced plant vigour and in extreme cases, death of the host plant. Biotic stresses are reduces photosynthesis,

**S**tress is a phenomenon that restricts crop productivity and also reduces plant's metabolic activities as well as growth and development of plants. The effects of stress on plant conditions are called strain. Stress is the action whereas strain is the reaction. Strain may be elastic or plastic. Elastic strain, Up to a point, a stress may be completely reversible as when the stress is relieved, the plant become normal. Plastic strain, beyond the point of elastic strain, the stress may be partially reversible or partially irreversible which is called plastic strain or permanent stress. In agriculture, crops are mainly affected by a wide range of environmental stresses. Mainly two types of environmental stress (biotic and abiotic) that effects plants growth and development. The abiotic stress damages crop plant worldwide and includes floods, drought, high and low temperature, salinity and radiation stress etc. On the other hand, attacks by various pathogens



as viruses infections reduces the rate of photosynthesis and chewing insects reduces leaf area of the plants. Biotic stress is a condition in which plant can't maintains its normal growth due to the infections within the plants by harmful microorganisms. These harmful microorganisms show various types of symptoms like stunting, wilting, chlorosis and browning of leaves within the plants. The infection in a plant by the combination of these harmful microorganisms (fungi, viruses, mycoplasma, nematodes and bacteria) causes severe damage to the plant, rather than infection by individual microorganism. The biotic stress is an adverse condition in which the yield losses of crop plants are very high. The biotic stresses are responsible for low productivity in many crop plants like cereals, pulses and others crops. The losses due to biotic stresses are not only hampering crop plants but also create high risk for food and nutrition security.

### **Management practices for stresses in plant**

Management practices for stress within the plants are very complex and difficult but the levels of stresses in plants are controlled up to a limit by different management practices.

### **Mitigation of Abiotic stresses**

#### **Drought stress**

Drought stress is controlled by foliar spray of 2% DAP + 1%

KCl during critical stage of flowering and grain formation, Split application of N and K fertilizer in cotton at 45 and 60 DAS, 3% kaoline spray at critical stage of moisture stress and Foliar application of 5% of cycocel in the plants.

#### **Flood stress**

Provide adequate drainage for draining excessive stagnating water around the root system, Balance use of fertilizer NPK (NPK + lime) and foliar spray of 100 ml ppm salicylic acid for increasing stem reserve utilization under high moisture stress.

#### **High temperature**

Overhead irrigation to avoid sunburn, plants need to be cultivated under shade condition and application of ethylene enhance the seed germination.

#### **Low temperature**

Pre-soaking treatment with GA<sub>3</sub> and proline increase the seed germination, ABA has a role in induction of freezing tolerance and application of Paclobutrazol increase the activity of scavenging enzymes.

#### **Salt stress**

Seed hardening with NaCl (10 Mm concentration), Spray of 100 ppm salicylic acid and Spray of 40 ppm of NAA for arresting pre-fall of flower /buds/fruits.

### **Mitigation of biotic stresses**

Biotic stresses are controlled by different mechanisms that have been developed through research

approaches to minimize the level of biotic stresses with in the plant. In the plants, the biotic stresses are minimize by studying the genetic mechanism of the biotic stresses agents (Bacteria, Fungi, Nematodes, Viruses and Mycoplasma) causing these stresses. It has been seen that Genetically Modified (GM) crops like *Bt*. cotton have proven to be the great effort against biotic stresses in plant. This is done by developing the resistant varieties of crop plants.

### **Conclusion**

Plants are constantly being exposed in the adverse conditions of the environment, but plants have developed different mechanisms to survive and adapt under various types of stresses (Biotic and Abiotic). Recent advances in the field of genomics have widened our view regarding plant signal transduction. The anthropogenic activities such as inappropriate irrigation, excessive fertilizers and exploitation of metal resources can increase salt stress. Under these stresses conditions, plant will adversely affected by Biotic and Abiotic stresses. This is minimizing by developing stress tolerant cultivars in order to secure food security. If these stresses are not controlled then the plants will continuously suffers from these stresses and this is a great thread for agriculture.

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# PUSA DECOMPOSER

## A BRILLIANT SOLUTION TO STUBBLE BURNING



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According to the newly established Commission for Air Quality Management (CAQM), Punjab, Haryana, and Uttar Pradesh in northern India have prepared comprehensive action plans to combat stubble burning in the upcoming winter season, with a possible increase in the use of the bio-decomposer solution created by the Indian Agriculture Research Institute (IARI) in Pusa. According to the Commission, the plans call for the adoption of bio-decomposer solutions on more than 6 lakh acres in Uttar Pradesh, 1 lakh acres in Haryana, 7413 acres in Punjab, and more than 4,000 acres in the nation's capital of Delhi.

### The Issue

Over 5.7 million acres of rice stubble are reportedly burned on fields in Punjab and Haryana alone every year, causing serious environmental problems, declining soil quality, and a loss of flora and

fauna. Delhi and the neighbouring areas are covered in stubble smog from October to December. Toxins transform Delhi's air into an unpleasant mixture of pollution, causing eye, skin, and lung irritations that make the city uninhabitable. According to WHO studies, Delhi is one of the most polluted cities in the world, and breathing in all this pollution shortens people's lives by an average of 9 years. The burning of agricultural residue by farmers from the nearby states of Punjab and Haryana is responsible for a large portion of this pollution. These farmers don't do this out of spite or malice; rather, they are compelled to burn stubble because they have no other feasible options. Burning is less expensive and doesn't further reduce their meagre income.

### PUSA bio-decomposer: what is it and how does it work?

IARI

created a bio-enzyme called PUSA bio-decomposer. Pusa Decomposer is a mix of seven fungi that produce enzymes to digest cellulose, lignin and pectin in paddy straw. The fungi thrive at 30-32 degree Celsius, which is the temperature prevailing when paddy is harvested

and wheat is sown. It turns the stubble into manure as it decomposes, enhancing soil health and lowering farmers' input expenditures for fertilizers for the following crop cycle. One acre of stubble can be broken down using 300 grammes of PUSA spray.

### What does PUSA stands for ?

The Imperial Agriculture Research Institute, the first agriculture institute in Asia, was founded in the village of Pusa in the Bihar district of Samastipur. Henry Phipps from the US provided the original funding for its establishment, and it is stated that Pusa is the place's name in honour of his contributions.

### How PUSA bio-decomposer is used on fields ?

1. A liquid formulation is formed using decomposer capsules and





fermenting it over 8-10 days and then spraying the mixture on fields with crop stubble to ensure speedy bio-decomposition of the stubble.

2. The farmers can prepare 25 litres of liquid mixture with 4 capsules, jaggery and chickpea flour. The mixture is sufficient to cover 1 hectare of land.
3. It takes around 20 days for the degradation process to be completed.

### **Advantage of PUSA Decomposer over Happy Seeder or another technique**

Cost-effectiveness is a requirement for any intervention to be widely accepted, and this is truer still when working with farmers whose livelihoods are in jeopardy. Despite receiving government subsidies, a Happy Seeder is a substantial investment that needs

high horsepower tractors to deploy. Only 15% of the nation's total tractor population is these models. Because of this, it is not a realistic choice for farmers who would rather burn their fields than use large gear. Balers operate in a similar manner.

### **Why is burning of stubble such a huge problem ?**

Many farmers harvest their crops with contemporary harvesters since they are quicker and do not degrade the grain's quality. However, the drawback of this is the enormous volumes of stubble produced, which in the case of paddy crops can reach heights of 5 to 6 inches. For the farmer, using manual labour or other devices to remove them would take a lot of time and money, so instead of burning the waste, he turns to a quicker and less expensive solution. Additionally, the farmer needs this in order to plant his next crop on

schedule. If he doesn't, his yield for the following harvest will be lower or delayed, which will have an impact on his ability to make money.

### **The harmful effect of stubble burning**

- It contaminates the atmosphere- Delhi's haze has riled both the public and policymakers.
- It eliminates soil bacteria as well as other plants and animals that are in the path of the fire.
- Significantly increases the agricultural sector's carbon impact.
- Endangers the economy and the environment.

### **Downsides of PUSA decomposers**

According to a number of specialists and farmers, it takes an exceptionally long time for the stubble to disintegrate in the fields after using the decomposer, and farmers only have a small window of opportunity to harvest their standing paddy before the following wheat crop is sown. Paddy stubble can take up to 40 days to totally disintegrate in some situations, but there is a significantly shorter window of time between paddy harvest and wheat sowing.

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# ORGANIC LIQUID MANURES



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In the modern era, farmers are relying on the adoption of cutting-edge technology and the indiscriminate use of chemical fertilizers to boost the production of the crop, which indirectly affects the health of the soil and decreases soil fertility. The use of chemical fertilizers not only increased the crop yield but led to accumulation of toxic substances in the soil, absorbed by plants indirectly affecting human health and harboring soil conditions essential for crop growth. In order to maintain the soil fertility status there is an urgent need of restoration of soil health through addition of organic matters, green manuring, crop rotation, use of ecofriendly organic fertilizers etc. The adoption of zero budget natural or organic

farming can help farmers to maintain soil fertility and soil productivity. Nowadays, the utilization of liquid manures has proved to be a successful intervention of maintaining soil and crop health.

Liquid organic manures are the fermentation- or decomposition-derived byproducts of organic matter, i.e. animal and plant waste. Utilizing liquid manures has made macro- and micronutrients, growth regulators, and other beneficial compounds more readily available. These substances strengthen and improve the physiological and biochemical processes of the plant and give it the ability to withstand biotic and abiotic stress. The availability of microorganisms and micro flora is increased by the liquid manures, boosting their microbial activity in the soil. When compared to commercial fertilizers, liquid manures are more advantageous and cost-effective for farmers to produce. Due to the availability of all necessary ingredients, the liquid formulations are employed as a foliar treatment on the leaves or applied to soil and are only needed in small amounts. The different liquid manures are Jeevamruth, Beejamruth, Panchgavya, Vermiwash, Biodigested liquid

manure (BDLM), biogas spent slurry.

## Beejamruth

Bijamrita / Beejamruth is a treatment for plants, seedlings or any planting material. It is effective in protecting young roots from fungus along with soil-borne and seed-borne illnesses that frequently affect crops after the monsoon period. It is composed of similar ingredients as Jeevamruth: Take 20 litres of water, 5 kg of local cow dung, 5 litres of local cow urine, 50 grams lime & handful soil from the bund of farm.

**Preparation:** Take 5 kg local cow dung in a cloth and bound it by tape. Hang this in the 20litre water up to 12 hours. Take one liter water and add 50 gm lime in it, let it stable for a night. Then next morning, squeeze this bundle of the cow dung in that water thrice continuously, so that all essence of cow dung is accumulated in that water. Add a handful of soil in that water solution and stir it well. Finally add 5 litre desi cow urine or human urine in that solution & add the lime water and stir it well.

**Application:** Add Bijamrita to the seeds of any crop as a seed treatment: coat them, mix them by hands; dry well and use for sowing.



For leguminous seeds, just dip them quickly and let dry.

### **Jeevamruth**

Jeevamruth is the traditional Indian bio pesticide and organic manure that is prepared by the unique technique of fermentation of the combined mixture of cow dung, cow urine, jaggery, pulses flour, soil and water. It is made up of two words “Jeevan” and “Amrit.” The first word Jeevan means “Life” and the second word Amrit means “Medicinal potion.” Farmers who spend lot of money on fertilizers and pesticides can save their money and use this amazing traditional medicine for plants.

**Preparation:** Take 100 kg of Desi Cow Dung (Cow dung is good only for 21 days, store it by keeping moist, sprinkle water and store in shade) and add 1kg Jaggery and 1kg gram flour. Further, mix the mixture well and store it as a heap for 48 hours in a shade It is 100% organic and have no harmful effects on soil health. Not only it is cost effective but it is beneficial for both plants and soil.

**Application:** It can be applied in liquid form. About 5-10% of Jeevamruth can be sprayed by mixing with water. 200 litres of Jeevamruth is sufficient for 1 acre of land. It is sprayed at an interval of 7-14 days.

### **Advantages of liquid manures**

1. They are readily available in water as compared to bulky organic manures.
2. The plants can absorb nutrients 20 times faster through foliar application as well as when applied in soil which increase crop yield.
3. The application of Jeevamruth and Beejamruth influence the photosynthetic activity of the crop and thereby increase grain yield.
4. The application of organic liquid formulations leads to healthier and better crop produce.
5. The application of organic liquid manures has led to improved soil structure and increased water holding capacity.
6. The application of Panchgavya helps in improving crop management factors viz

Integrated pest management, integrated disease management.

7. Beejamruth can be used for seed dressing and is applied and mixed with seeds before sowing of crop to enhance the activity of the microorganisms and as a growth promoting substance.
8. Beejamruth helps in improving the nutrient status, seed germination percentage and seed vigour in crop.
9. Liquid formulations help in improving the quality of the crop and accelerate the crop maturity date
10. The components used for preparation viz. cow dung, urine, earthworms etc. led to the production of ecofriendly organic liquid manures.

### **Disadvantages of organic liquid manures**

1. Liquid formulations give a bad odor.
2. They lead to high volatilization losses.
3. The spraying or application of liquid manures is not suitable for waterlogged areas.

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# DRONES IN VEGETABLE CROPPING SYSTEMS

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The primary goal of precision agriculture is identifying intra-field variability to enable a management response to plant stress that will maximize yield. Currently, farmers monitor crop health in high-value crops through labour-intensive scouting, destructive field sampling, and costly laboratory assays. Remote sensing is increasingly being used as an alternative tool for crop monitoring that more accurately accounts for spatial variations in crop stress across a field. Small unmanned aerial systems (UAS) have emerged in recent years as versatile remote sensing tools used by scientists and agricultural producers for collecting data at very high spatial and temporal resolutions. UAS provides precisely-timed, fine-grained data for

informing spatially variable management responses for maximizing crop productivity while minimizing natural resource degradation. One of the most promising applications of remote sensing in agriculture is identifying symptoms from biotic and abiotic plant stressors, such as nutrient deficiencies, pest pressure, and harsh environmental conditions. Generally, monitoring plant nutrition with remote sensing has been successfully demonstrated by numerous studies.

### **Use of drones in vegetable crops**

The use of drones in vegetables, and agriculture in general, has been increasing in recent years. Marketing and use of drone technology have proceeded in advance of research and development. Despite the hype around their operation, drones (or Unmanned Aerial Vehicles (UAV) or Remote Piloted Aircraft (RPA)) are essentially aerial platforms to carry out different tasks or capture data, depending on the payload and/or sensors they carry. The advantage of drones over the crop sensing platforms is that can be deployed easily, cover relatively large areas quickly and achieve ultra-

high resolution image capture. Additional sensors or payloads can also be fitted depending on the purpose of the drone. It is the sensor that is the critical element for the data or information capture and determines which drone can be used. The most common and accessible use of drones in agriculture is in photogrammetry. Photogrammetry is about taking a series of images that can then be interrogated to reveal some useful information about the subject. Common applications of drones in agriculture include:

- Digital RGB images or video capture of crop conditions,
- Multi-spectral sensor for crop sensing,
- Thermal cameras (crop and pest),
- Beneficial insect dispersal,
- Spot spraying of agricultural chemicals.

### **Digital RGB imagery**

High-resolution RGB digital imagery can be used for various purposes in vegetables. In most situations, it can be just as effective as multispectral imagery. Recent developments in software specializing in RGB image manipulation have now made RGB the standard in agricultural



assessments. Different vegetation indices enable the assessment of crop variability such as visible differences in plant and canopy size and irrigation patterns. This imagery can also be used to produce three-dimensional point clouds that can then generate 3D products such as crop digital surface models, contour lines, above-ground biomass, volume and surface water drainage maps. Automated plant counts Artificial Intelligence (AI) and Machine Learning (ML) now deliver automated plant counts and weed recognition.

### **Multispectral imagery for crop sensing**

There is a range of commercially available multispectral sensors that can be attached to drones. Multispectral sensors capture image data at specific frequencies across the electromagnetic spectrum. Additional wavelengths such as near-infrared are ideally suited to measuring photosynthesis in plants. Each time the sensor is triggered, 4 or 5 individual photos are taken simultaneously in different parts of the spectrum. Additional parts of the spectrum allow very small differences in plant health/ vigour to be assessed, which often won't be visible to human eyes or a normal RGB camera.

### **Vegetation Index**

Different cloud-based platforms e.g., Drone mapper, Dronedeploy, and Precision Mapper (Precision Hawk) (accessed by subscription) offer a range of vegetation indices derived from reflectance data captured by the multispectral sensor.

### **Thermal imagery**

Thermal imagery refers to the conversion of invisible radiation patterns arising from plants into a visible thermal (heat) map. Thermal imagery is primarily used to monitor crop moisture stress and water use. Thermal cameras have a far lower resolution than multispectral or RGB cameras. Thermal data will also require some form of temperature calibration, which is currently not easily done.

### **Processing and analytics**

Clever analytics are critical so that imagery or reflectance data can be converted to information of use on the ground, such as crop vigour maps (vegetation indices) and automated plant count plants in a field. There are a range of cloud-based platforms that complete processing and image or data analysis e.g., Drone mapper, Dronedeploy and Precision Mapper (Precision Hawk).

### **Beneficial insect dispersal and spot spraying operations**

These applications are generally carried out by commercial operators however, these services are still not widely available across vegetable growing regions. Beneficial insect dispersal via drone offers a time-effective option and also broader coverage than manual dispersal. Spot spraying of weeds usually requires two separate operations – one to sense the weeds and the next to spray them.

### **Drone operation**

Engaging commercial drone operator services Key considerations:

- Different applications require different cameras or sensors and have different flight specifications. For example, plant counts use RGB imagery and have a lower flying height (30 to 40 m) to achieve the necessary resolution compared with higher flight heights of 80 to 100 m for multispectral crop sensing imagery.
- The costs of commercial drone services vary greatly. Generally, the cost of these services is lower as the area of coverage increases. Travel costs will usually be additional.

■■■



# WINDOW GARDENING; BEAUTIFYING INDOORS

## About Author



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For people residing in condominiums and apartments, window gardening or container gardening serves a one of the great options for interior decor as the available space is limited. It is also a better choice for amateurs and garden lovers who don't have an access to develop garden outdoors or even at roof top. In window gardening, soil quality and water usage can be controlled as per requirement. During winter, it helps in providing delicious culinary herbs and green veggies when built up near to kitchen. One of the greatest advantage of this garden is that it is portable and can be shifted around whenever is needed. Fresh fruits and vegetables as well as flowers can be grown in window garden round the year. Window garden also help in beautification of living area, thus considered as an eminent inclusion to any house. The window or windowsill garden can be placed both indoor and outdoor area.

## Light for window gardening

Light is an essential factor for successful growth and development of plants. Therefore, before planning window garden, availability of light must be taken into consideration. If the chosen window area faces north, then plants requiring less sunlight like begonias, mints, ivies, impatiens, ferns, philodendrons and violets are selected to serve the purpose. However for windows facing south most of the sun loving plants such as tomatoes, many of the vegetables, dahlias, geraniums, petunias, nasturtiums, cacti and other succulents are chosen as they can avail minimum 7 hours of sunlight a day for thriving well. Windows facing towards north direction can assist both sun and shade loving plants, whereas for windows facing west, plants requiring less water should be selected as they are likely to get the heat during day time.

## Containers for window garden

Containers of all sizes and shapes, whether of ceramics, metals, plastics, mud or clay pots to wooden boxes, crocks, wash tubs, hanging baskets etc. can be effectively utilized for window garden. Starting

from a window box kept in the window sill to a table placed next to window can serve the purpose. One thing must be kept in mind that the selected container should be able to drain off surplus water in order to avoid water stagnation which later may lead to rotting of roots. Window boxes are preferred more than the round pots. Boxes fitting the length of window are desired with depth according to the window sill. Containers should be deep enough to hold several pounds of soil and water.

## Soil for window garden

Good quality sandy loam soil with proper drainage capacity should be collected for window-sill gardening. A layer of rocks or gravels should be placed at bottom of the container to facilitate drainage of excess water. The desired depth of soil varies as per the choice of crops such as flower crops and herbs require less depth of soil while roots crops (potato, carrot etc.) and vegetable crops with deep root system (tomato, eggplant etc.) needs more depth of soil to accommodate the deep root system. For vegetable crops like carrot, onion etc. interplanting with fast growing lettuce or other leafy vegetables can





be effective in efficient utilization of available space.

### Choice of plants for window garden

A number of plants can be taken up well in window or windowsill gardening. Some of the commonly selected plants are listed below.

**Flower crops:** salvias, lavenders, petunias, geraniums, nasturtiums, impatiens, begonias, zinnias, daisies, fuschias, jasimes, cacti, succulents and other bulbous ornamentals.

**Herbs:** Thymes, Parsley, Sage, Dill, Rosemary, Basils, Bays, Lemon verbenas, Marjoram, Hops, Sweet basil, Peppermint, Sorrel, Spearmint and Lemon balm etc.

**Vegetable crops:** Cabbage, peas, onions, peppers, lettuce, kale, tomatoes, carrots, garlic, scallions, bush and pole beans and beans etc.

**Vines:** sweet potato vine, ivy, vinca, portulaca, myrtle and creeping jenny etc.

### Care for window garden

After filling containers with soils and desired plants, they need to be taken care of. The plants are watered regularly as per the requirement. During summer, depending upon the plant type and amount of heat it receives throughout the day watering is done twice a day. The quantity and frequency of

irrigation can be scheduled according to finger test by sticking finger to one inch into soil, if it is dry then watered. Use of lukewarm water is preferable for watering and it should be given near to the plant base, not sprinkled over the leaves. Mulching can be provided which ensures conservation of water, temperature balance and also suppress weed growth. As in container gardens removal of nutrients is more likely from soil without the feasibility of natural replenishment, the plants raised within the container are fertilized monthly once. It can be carried out by incorporating fine compost or else by spraying with liquid fertilizer solutions. However, organic matter addition is preferable if edibles are grown. For ornamentals, NPK combination of 15-30-15 is recommended. Another important practice for window or container garden is to make sure dead head flowers i.e. removal of dried and dead flowers and twigs to facilitate fresh bloom growth in order to keep the plants looking lively.

### Take advantage of special features

**1. Adding light to indoors:** Window garden allows better light penetration to the room, that is mostly preferred for kitchen area in case of dark and

gloomy, as they provide more depth thus making room look brighter as well as bigger.

**2. Great for winter:** During winter periods, the portable window boxes can be placed on windowsills to avail full sunlight in day hours and can be again shifted back inside room to protect the plants from chilling nights.

**3. Just perfect for any room:** Though window gardens are generally preferred in kitchen rooms to grow desired herbs and veggies and can be maintained healthy by taking proper care, but they are also proved to be a perfect fit for bedrooms and living rooms as well by adding several coloured ornamentals.

**4. Adding beauty and value to the home:** Window garden are basically designed for addition of beauty to home space. They efficiently break the monotony of indoors and add some greenery and colours to it. Including a window garden to home can enhance the property value.

### Conclusion

Window gardening or window sill gardening or container gardening can escort life and colour to the house interiors. Growing a window garden provides a pleasant glimpse of outdoor, inserting a cheerful covering of window space or flowers to the sill. Besides, it helps to harness the sunlight to grow desirable herbs round the year. Apart from growing plants, window garden also creates eye appealing view in home. Therefore, garden window is considered to be the perfect window for nature lovers.



# SURVEY METHODS

## USING GLOBAL POSITIONING SYSTEM (GPS)



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A constellation of satellites transmitting navigational signals and a network of ground stations and satellite control stations used for monitoring and control make up the Global Positioning System (GPS), a space-based radio navigation system. At the moment, 31 GPS satellites are in orbit around the Earth at a height of roughly 11,000 miles, giving users precise information on position, velocity, and time everywhere in the world and in any weather. The Department of Defense (DoD) manages and operates GPS. GPS in civil aviation is regulated by the Federal Aviation Administration, which also receives reports of issues from users.

### Working of GPS

A worldwide network of satellite that broadcast radio signals from a medium earth orbit serves as the foundation for satellite navigation. The 31 Global Positioning System (GPS) satellite

created and run by the United States are most well-known among users of satellite navigation. Similar services are also offered by three additional constellations. Global Navigation Satellite Systems refers to these constellations and their additions as a whole (GNSS). The other constellations include GLONASS, which the Russian Federation developed and operates, Galileo, which the European Union developed and operates, and BeiDou, which China developed and operates. The international community has been given free access to all providers' systems. To enable the use of these constellations for aviation, all providers have created International Civil Aviation Organization (ICAO) Standards and Recommended Practices. 95 percent of the time, the basic GPS service gives users an accuracy of about 7.0 metres anywhere on or near the surface of the globe. Each of the 31 spacecraft transmits signals that, when combined with signals from at least four other satellites, allow listeners to pinpoint their location and time. Atomic clocks on board GPS satellites provide incredibly accurate time. In order for a receiver to continuously know what time the signal was broadcast, the time information is included in the codes that the satellite broadcasts. The

signal comprises information that a receiver can utilise to determine the satellites' positions and make other necessary changes for precise positioning. The range between the receiver and the satellite is calculated by the receiver using the time difference between the time of signal receipt and the broadcast time.

### GPS surveying

With the advent of GPS technology, surveying has undergone a significant transformation throughout time. What once required months of observation, measurement, and geometrical calculations now only requires a few hours or days. Today's surveyors rely on GPS to deliver precise and trustworthy data to clients across a variety of sectors and applications. The global positioning system, also known as GPS, is a satellite-based navigation system. Beginning in the 1970s, GPS was initially created for military applications before going fully operational in 1993. Since then, it has expanded its applications to include both personal and commercial ones. Satellites in the GPS system connect with ground-based receivers via a network. Four or more GPS satellites will communicate with the receiver when it requests data to determine its location, sending the position of the



satellite, the time the data was delivered, and the distance between the satellite and the receiver. The latitude, longitude, and height of the receiver are then determined using the data gathered from these satellites. Continuous data collection can be used to determine the receiver's changing position over time while it is moving, which can be used to determine speed. GPS can triangulate the signal and provide a location regardless of the time or weather.

### **How is GPS surveying done ?**

Nearly all GPS applications share technology with GPS surveying, however surveyors utilize GPS very differently. Technology and usage are the two main areas of variation.

- ✓ **Technology:** To improve the accuracy of the data they gather, surveyors employ more advanced technologies than standard GPS programmes. The receivers used for surveying include high-quality antennae and more advanced computation technologies, making them substantially more complex and expensive than those you would find in a conventional automotive navigation system.
- ✓ **Data Usage:** Instead of employing position data for navigation like a standard navigation system would, surveyors use the data from GPS technology to measure the distance between two places. For usage in a survey model, these

measures are gathered, then saved, processed, and displayed in a geographic information system, or GIS.

### **Types of GPS surveying**

**Static GPS baseline:** Two GPS receivers are used in the method to make it function. At the ends of a line that needs to be measured are these receivers. After that, the receivers simultaneously collect GPS data for at least 20 minutes; the precise length of the observation time depends on how long the line is and how precise the measurements must be. After all the information is gathered, a specialised piece of software is employed to determine the separation between the two receivers.

**Real-Time Kinematic observations:** RTK Observations use numerous points in quick succession as opposed to monitoring the location of two locations over a prolonged length of time. The RTK method uses two receivers, one of which is a static base station, just like the baseline approach. The Rover Station, another receiver, shifts locations throughout the measurement time. Within a few seconds, the geo-location of the Rover Station is gathered and saved.

### **Errors in GPS observations**

Like any other field surveying technique, the flaws in GPS observations can be generally categorised as,

- ✓ Gross errors.
- ✓ Systematic errors.
- ✓ Random errors.

### **Gross errors:**

- 1) Temporarily losing hold to a few satellites because of a dense tree, a tall building, or any other impediment close to the GPS antenna.
- 2) GPS signal tampering caused by nearby power lines or other similar objects with magnetic properties.
- 3) Improperly focused and/or levelled receiver antenna.
- 4) Inaccuracies in the height of the antenna centre above the ground.

### **Systematic errors:**

The reason why they are called systematic errors is because they follow a predetermined system that may be characterized by a functional connection. There are three categories under which systematic GPS inaccuracies can be placed.

- 1) Satellite related errors.
- 2) Receiver related errors.
- 3) Signal propagation errors.

### **Conclusion**

Different GPS systems are increasingly being used for precise point locating in a variety of applications. GPS measurement errors can come from a variety of sources. By implementing adequate observation techniques, certain errors can be reduced, while others can be eliminated by utilising suitable models. Understanding the sources of system failures and their effects is crucial for choosing an appropriate system. To attain the desired accuracy, appropriate models can be framed and adopted based on the nature and characteristics of the errors.







# MAPPING AND HERBICIDE APPLICATION THROUGH DRONE

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**D**rone is a flying device which can fly a pre-set course with the help of GPS and an autopilot coordinates. Drone stands for Dynamic Remotely Operated Navigation Equipment. Drone technology has provided the agriculture industry a high-technology makeover, with planning and strategy based on real-time data collecting and processing. Using plant protection UAV to spray the required amount of herbicide with minimum spray fluid and advent of drones for plant protection, chemical spraying might be the alternate source to apply herbicides. This technology has effective on time and resource utilization.

Keeping this in view a field experiment was carried out at Eastern block, Central farm unit, TNAU, Coimbatore during summer using Maize COH(M) 8 to identify the optimum quantity of spray fluid for herbicide application through drone in irrigated maize. The study was laid out in randomized block design with three replications. The treatments comprised of herbicides with different spray fluid application through drone viz., 40L, 60L, 80L/ha and 100 L/ha with recommended dose of pre emergence Atrazine, early post emergence tembotrione and post emergence 2, 4-D compared with 500L/ha by hand sprayer.

## Herbicide spraying through drone

Quadcopter type of drone was used for this study. By using a remote control, the sprayer module nozzle will be turned on. The spraying material (herbicide) and the controller section (used to operate the sprayer nozzle) are both contained in the spraying module. The command is sent by a remote controller that has been manually turned on. Before spraying calibration of drone is an important step. Make sure that no obstacle is near the UAV and hold the aircraft

horizontally and rotate it 360 degrees along the central axis and rotate it 360 degrees around its central axis. Atlast recycle the battery (battery reattachment) and the drone was calibrated.



Quadcopter – Hybrid drone



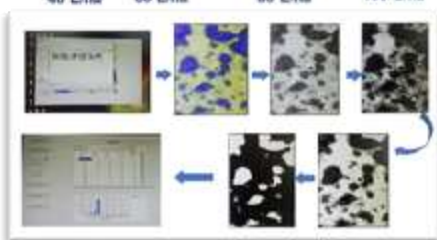
PE, EPOE and POE application by drone



After calibration, based on GPS route map was created and the way points were fixed. The drone was run once on the way point for creating boundaries for spraying. After fixing all the way points for each plot, recommended herbicide and spray fluid as per the treatment was filled in the tank. Then the pilot operated the drone as per route map and spraying was done as per treatment. During every spraying, the droplets were collected through Water-sensitive paper (WSP) samplers. The Image viewer and Deposit Scan software was used to evaluate the spray droplets that were captured on them in the lab. Both a micro droplet analyzer and a macro droplet analyser were used in the analysis.



Spray fluid 40 L/ha    Spray fluid 60 L/ha    Spray fluid 80 L/ha    Spray fluid 100 L/ha



## Mapping of weed infested area through drone

Weed mapping was done by Parrot ANAFI thermal drone. Segregation of weeds from crops through RGB (Red green blue band) analysis method with maximum likelihood classification. In supervised classification, the representative sample sites were selected by using known class and training sites were developed for procuring spectral signatures or pixel values corresponding to the respective class. The classification algorithm uses the spectral signatures from these training sites to classify the whole image, with nominal overlapping or without overlapping of classes.

Red colour indicated the weed infested area, green colour indicated the cropped area as maize and the yellow colour indicated the non-cropped as soil. The input data of this supervised classification are the mean vectors. These vectors are built during the training phase with labeled thumbnail images automatically assigned as crop or weeds. The classification accuracy is quantified using a classical metric deduced from the covariance matrix. The maximum likelihood classifier is assessed from the covariance matrix.



Parrot- ANAFI thermal drone



RGB image



Actual image captured by drone

The overall classification accuracy was 70-80%.

From the experiment, it was concluded that based on droplet deposition application of recommended dose of Atrazine (1.0 kg/ha) - Tembotrione (120 g/ha) - 2, 4-D (1.0 kg/ha) can be effectively sprayed through drones with the spray fluid of 80 L/ha and resulted in higher weed control efficiency and increased productivity of irrigated maize. ■

# VEGETABLE SPECIAL

## ALL IN ONE MICRO NUTRIENT SOLUTION

### FOR VEGETABLE GROWERS

#### About Author



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**B**elagavi district is one of the potential vegetable growing regions of Karnataka state. It has 41249.11 ha vegetable growing area with a total production of 783377.4 tons. The value of the produce is approximately ₹ 99556.97 lakhs (Source: KSDH, Belagavi 2019-20). The district is well connected to major vegetable markets like Mumbai, Pune, Goa, Bengaluru. The major vegetable

crops grown in the district are tomato, chilli, brinjal, potato, cabbage, watermelon, guard crops etc.

#### Challenges and scope for vegetable special

The major problem of vegetable production is nutrient management. Plants need major nutrients being N, P, K and micronutrients Zn, Fe, B, Cu, Mo, Mn. The farmers are well versed with major nutrients but with respect to the use of micronutrients their knowledge is limited. These micronutrients are needed in very small quantity but if not supplied can cause significant yield loss in vegetables.

The availability of soil micronutrients to the plant is very

important. It's mainly dependent on pH of the soil and most of micronutrients are available at 6.0 to 6.5 pH. The pH of the soils of our Krishi Vigyan Kendra, Belagavi-1 jurisdiction is above 7.00 under this condition soil application of these micronutrients is not available to crops.

Even though farmers wanted to add micronutrients; it should be in chelated or non-chelated forms which are costly. Problem with these micro nutrients is very late and slow uptake leads to wastage of nutrients, not in integrated form (FeSO<sub>4</sub>, ZnSO<sub>4</sub>, Boron, MgSO<sub>4</sub>, MnSO<sub>4</sub> & Calcium Nitrate) and soil application of these micronutrient is quite difficult in standing crop because need to mix up with soil otherwise nutrient loss is occurred.

#### Technological solution

In order address the challenges faced by the farmers of Belagavi district. ICAR BIRDS Krishi Vigyan Kendra, Tukkanatti came with foliar nutrition of micronutrients, which is cheaper and effective way of providing micronutrients to the vegetable crops. Arka Vegetable special (IIHR, Bengaluru) is a formulation containing micronutrients suitable for all the vegetables grown in district.

Since, it is a foliar spray formulation; the nutrients are available to crops irrespective of soil pH. This vegetable special technology was developed by IIHR Bengaluru then transferred to our KVK. Krishi Vigyan Kendra, Belagavi-1 is providing the vegetable special to the farmers of the district at reasonable price of Rs 200/kg.



Awareness programmes on role of Vegetables special in chilli plot at Umarani village



### Economics of technology

One kg of vegetable special is required per acre of vegetable crop for single spray. During the entire cropping period 3-4 sprays are required. The cost of the vegetable special is ₹ 200/kg. So, the expenditure per acre is ₹ 600-800. This is 60% cheaper than chelated or non-chelated micronutrient application.

Arka Vegetable Special is used as per recommendation, it improves 20-25% marketable produce yield and also enhance the produce quality in terms of shelf life and visibility of produce. Attractive quality produce steals the attention of the buyer in the market and fetches higher price compared to the other produce.

### Outcome of technology

The vegetables growers of districts are highly satisfied with the vegetable special. It has solved their problems in all the ways like economically cheaper and feasible, supplies all micro nutrients which is required to complete the life cycle of vegetable crop, foliar spray with water enhance rate of absorption and immediate result can be seen and also prevent wastage of nutrients.



**Foliar spray of Vegetable special on Tomato crop at Kankanawadi village of Belagavi district**

Vegetable special is all in technology when comes to micro nutrients and it has very significant quantitative (Improves crop yield) and qualitative results (Enhance quality of produce). Quantitatively it enhances the yield of produce up to 20-25 %. Qualitatively improves Shelf life, Colour and other Quality parameters of the produce which were able fetch 5-10% higher price than the other produce. Thus, farmers can easily get 15-20 % higher income by investing just ₹ 600-800 per acres.

ICAR BIRDS Krishi Vigyan Kendra, Belagavi-1 has transferred

this technology from IIHR, Bengaluru in 2011. Serving to the 1400 vegetable growers of the district so it covers 30-40% of the vegetable area by producing 2000 Kg of vegetable special. This effort of the KVK Belagavi-1 brings smile in vegetable growers of the district. This success emphasizes us to work more on this, henceforth KVK took stand on this technology and creating awareness regarding role of vegetable special in vegetable production in order to reach all the vegetable growers of Belagavi district.



# MOLECULAR BIOLOGY OF FLOWER REGULATION

## MEDIATED BY *ABA* UNDER DROUGHT

### About Author



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**A**bscisic acid (ABA) has long been recognized as a stress hormone due to its role in drought, osmotic, and salinity responses. Abscisic acid (ABA) plays a key role in Arabidopsis' drought escape. It is critical to understand the spatial context and effects of ABA signals on the floral network. FLOWERING LOCUS T (FT) is a major florigen that is produced in the leaf as a result of ABA signaling. ABA responses are regulated by FD transcription factors and FD-like proteins at the shoot apex. Both biology and agriculture can benefit from this knowledge of ABA signaling.

### Introduction

A crop's flowering time determines how well it adapts to various environments. Floral evocation includes the processes involved in the transition of apical meristems to floral meristems. The factors that promote floral evocation are a combination of external and endogenous factors. In addition to the external factors such as the length of the day (Photoperiod) and the temperature (Vernalization), there are also endogenous factors,

such as hormones, circadian rhythms, and phase changes to consider. In addition to this, plants are capable of adapting to drought conditions by anticipating flowering as a means of survival in order to survive. It is known that ABA is responsible for inducing flowering in response to drought conditions. ABA has been found to play a significant role in plant development and growth beyond stress responses. Under well-watered, non-stressed conditions, root tissues require ABA signaling to stimulate growth, hydrotropism, xylem formation, and suberin deposition, while leaves require it to initiate leaf growth. The purpose of this article is to examine the potential modes of ABA signaling and interactions that result in flowering.

### Flower induction pathways

There are four floral pathways in Arabidopsis thaliana, the model plant. Plant metabolism, photoperiod, vernalization, and gibberellic acid contribute to these pathways. There is a clear explanation of these pathways in a simplified form. In the first pathway, phytochromes and cryptochromes sense day length via photoreceptors. As a result of the interaction between these photoreceptors, CONSTANS genes (CO) are expressed. In turn, CO induces the floral transition through AGAMOUS-LIKE 20 (AGL20) / LEAFY (Meristem identity genes). As part of the Vernalization/autonomous pathway, the flowering process is either triggered by internal signals (autonomous pathway) or by low

temperatures (Vernalization pathway). In both of these pathways, FLOWERING LOCUS C (FLC) is inhibited, which is an inhibitor of LFY. Therefore, Vernalization suppresses the floral repressor (FLC), allowing flowering to take place. Phloem florigens (FLOWERING LOCUS T) are enhanced in the sucrose pathway to stimulate flowering. Furthermore, the Gibberellin pathway is involved in flowering via DELLA proteins.

### Photoperiodic Floral Regulation and ABA

Flowering plants are greatly affected by the photoperiod. Researchers have identified an interaction between drought escape flowering mechanisms and photoperiodic response in several plants. Arabidopsis flowering was accelerated and earlier in response to water deficits during vegetative stages compared to normal conditions. Adapting to drought by shifting flowering time is called drought escape. During drought conditions, this early reproductive potential also appears to share a photoperiodic dependency, as opposed to short days, where it displays antagonistic reactions (delayed flowering). In this regard, drought signals are positive indicators of early flowering in plants based on their photoperiodic status.

### Floral Transition Genes and ABA

GIGANTEA (GI) and CONSTANS (CO) are two of the most important floral genes involved



in the flowering perception process. In order for FT to be activated, GI and CO must interact. Under water deficit conditions, florigen expression is transcriptionally activated in CO mutants, a finding which indicates the interaction between GI and ABA promotes florigen expression in CO mutants. The mechanism by which ABA stimulates GI-dependent floral regulation remains unclear, however. As a result of its effect on the GIGANTEA, ABA modulates the expression of SOC1 (Suppressor of overexpression of Consens 1) in leaves indirectly, which in turn

controls FT transcription. Translocation of FT occurs in shoot apical meristems. It is believed that FT interacts with FD and FD like molecules in the shoot apical meristem, causing the expression of floral genes to be activated. As a result, ABA is involved in the regulation of flowering in plants when they escape drought.

### Conclusion

Plants incorporate drought escape mechanisms to cope with climate change. There might be a benefit or a disadvantage to drought escape mechanisms. As a result of DE, plants flower earlier and reach

senescence later in their lives. Plants are induced to flower by ABA when they encounter drought. Understanding how ABA influences floral evocation leads to the question of how this knowledge can contribute to improving yield under drought conditions. The manipulation of ABA during flowering, however, is very poorly understood. It is possible to discover crop yield improving strategies by examining the effects of ABA on flowering under drought stress.



# ZERO- BUDGET FARMING

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**Z**ero budget natural farming (ZBNF) is a method of chemical-free agriculture drawing from traditional Indian practices. The term 'Zero Budget' means the zero cost of production of

all crops. Zero budget natural farming guides the farmers in practising sustainable farming that helps in retaining soil fertility to ensure chemical-free agriculture and ensure zero-cost. This climate-resilient agricultural method aims at promoting agroecology and adopting low-cost agriculture practice wherein all critical inputs are gathered from the field and nothing is introduced from outside. Without spending money on these inputs or take loans to buy them the cost of production could be reduced and farming made into a "zero budget" exercise. Today still a small number of farmers in Madhya Pradesh, Punjab, Maharashtra and

Andhra Pradesh, Tamil Nadu use this farming method in India. It also called spiritual farming. Instead of commercially produced chemical inputs, the ZBNF promotes the application of jeevamrutha and bijamrita. Jeevamrutha is fermented microbial culture that adds nutrients to the soil, and acts as a catalytic agent to promote the activity of microorganisms and earthworms in the soil whereas, bijamrita is mixture of seed treatment. The ZBNF method also promotes soil aeration, minimal watering, intercropping, bunds and topsoil mulching. It discourages intensive irrigation and deep ploughing. Natural farming is a closed system, one that demands no human-supplied inputs and mimics nature.

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# THE APPLICATION OF NANOTECHNOLOGY IN THE AQUACULTURE SECTOR



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Aquaculture has emerged as the fastest-growing global food business in recent years, playing a critical role in meeting the increased need for animal protein. However, disease prevalence, chemical contamination, environmental degradation, and inadequate feed utilisation are major challenges impeding the sector's ability to contribute to global food security. In this regard, new pathways in science and technology have been opened to address these issues in aquaculture. Among these, nanotechnology has emerged as having enormous promise to improve aquaculture through the use of innovative nano instruments. It can provide new technology for drug management as well as vaccine liberation, ensuring civilised protection of farmed fish against disease-causing microorganisms. The purpose of this article is to provide an overview of nanotechnology and its uses in aquaculture.

## What is nanotechnology?

According to the United States National Nanotechnology Institute (USNNI), nanotechnology is the study and manipulation of matter with dimensions ranging from 1 to 100 nm. The nanometre scale (1-100 nm) is discovered inside this range, where the critical rules of chemistry and physics are irrelevant in nanotechnology. In general, the most important element of nanotechnology is its small size, as well as its various fields of application, most notably on a molecular level. Nanotechnology, on the other hand, refers to the study, design, fabrication, and use of functional matter at the nanometre scale. Nanotechnology is divided into two ways depending on its assembly and level of control over the atom: "bottom up" and "top down." Nanotechnology is being applied in a wide range of scientific sectors, including health, electronics, biomaterials, and energy production.

## Nanotechnology in aquaculture field

Nanotechnology has been shown to be a powerful modulator in various parts of aquaculture such as illness diagnosis, drug or hormone absorption, vaccinations, and food delivery, among others. Though commercial uses in aquaculture are limited, it has enormous potential for usage in the following fields, as listed below:

### 1. Fish growth:

Fish production can be enhanced by using nanotechnology to improve fish development rates in fish farming. Various Selenium sources (nano-Se and selenomethionine) added to the basal diet increased crucian carp (*Carassius auratus gibelio*) final weight, relative gain rate, antioxidant status, Glutathione Peroxidase (GSH-Px) activities, and muscle Se concentration (Handy *et al.*, 2012; Bhupinder 2014). Furthermore, nano-Se was found to be more effective than organic selenomethionine in increasing muscle selenium levels.

### 2. Water filtration:

Water quality degradation causes poor performance and harm to aquatic organisms such as fish (Boyd and Tucker 2012). Nano-enabled technologies are now available for removing contaminants from the water. Nanomaterials in the form of activated materials such as carbon or alumina, with additions such as zeolite and iron-containing compounds, can be employed in aquaculture applications for retaining aerobic and anaerobic biofilm for the removal of ammonia, nitrites, and nitrate pollutants.

### 3. Post-harvest technology:

The lure is coloured with normal dye in a convectional



manner, which lowers light reflection to a limited amount and hence reduces capture. Light is reflected in all directions when nano-based dyes are used in lures, resulting in a 2 to 3 times greater catch. Polyimide film is a common nano-film that has been produced.

#### **4. Fish disease control and diagnosis:**

The application of nanotechnology in fish disease control is divided into three categories: fish illness diagnostics, nanotechnology-based fish medicine, and nanoparticles for drug delivery. Nanotechnology has been identified as a viable method for successfully preventing and monitoring diseases and infections, as well as multiplying the benefits of aquaculture. Some of the fish health uses of nanotechnology include antibacterial or antifungal surfaces built from porous nanostructures, nanosensors in aquaculture systems for pathogen detection in water, and nanodelivery of veterinary goods and fish medicines through fish meals. Au-NPs were tested against microorganisms linked with fish illnesses and shown to have antibacterial action.

#### **5. Control of bio-fouling agents:**

Biofouling is one of the most important issues in fisheries management. In an aquaculture setting, the spread of bio-fouling organisms such as bacteria (as biofilm), algae (diatoms and

seaweed), and invertebrates (barnacles, mussels) is an expensive and hazardous worry, inflicting economic loss in a variety of ways. Coating or painting with metal oxide nanoparticles ( $\text{Cu}_2\text{O}$ ,  $\text{ZnO}$ ,  $\text{SiO}_2$ ) can control biofouling agents because coatings bound to metal nanoparticles provide an efficient antifouling surface and improve antifouling paint performance.

#### **6. Nano-biosensors:**

One of the most useful nanotechnology products is nano colloidal silver, which may act as a catalyst and kill a variety of bacteria, fungi, parasites, and viruses by inactivating an enzyme involved in their metabolism. When colloidal silver is employed, no antibiotic-resistant strains of bacteria have been found. Silver nanoparticles can kill methicillin-resistant *Staphylococcus aureus*.

#### **7. Nano-barcoding:**

A nano-barcode is a monitoring device composed of metallic stripes containing nanoparticles, with different striping variants used to encode information. Using nanobarcoding, the processing sector and exporters can monitor the source or track the delivery status of their aquaproduct till it reaches the market. Furthermore, when paired with nanosensors and synthetic DNA labeled with colour coded probes, the nano-barcode device has the potential to identify viruses as well as monitor temperature changes,

leakage, and other factors, hence improving product quality.

#### **8. Nanovaccines:**

Nanovaccines have a distinct character because they possess critical properties such as the ability to deliver antigens slowly or quickly through the delivery system and are also useful when utilised as primary immunostimulants. For vaccine distribution, various nanoparticles such as metal nanoparticles, liposomes, polymeric nanoparticles, virus-like nanoparticles, and immunostimulant complexes are used depending on the situation.

#### **Conclusion**

The fishing business is rapidly expanding to meet increased seafood demand. However, growing disease susceptibility and pathogenic infestation appear to be endangering the sustainability of the fishing business. Although the application of nanotechnology in aquaculture is still in its early phases, it has the potential to solve the bulk of aquaculture and fisheries challenges through more technical innovation at various levels. The Central Institute of Fisheries Education (India) is now conducting research on the application of nanotechnology in aquaculture and fisheries. The health management system now includes nanotechnological applications such as disease detection, nanovaccination, medication and gene delivery systems, and drug distribution.





# FOOD WASTAGE

## A POTENTIAL THREAT TO FOOD SECURITY



Food waste

manufacturing, transporting, and selling of food.

- Social benefits by providing donated, untouched, and safe food that would otherwise be thrown out.

### Solution for reducing food waste:

Globally, reducing food waste has been cited as a key initiative in achieving a sustainable food future. Sustainable Development Goal (SDG) addresses responsible consumption and production, which includes two indicators to measure in order to reduce global food loss and food waste.

- Reduce food waste by improving product development, storage, shopping or ordering, marketing, labeling, and cooking methods.
- Recover food waste by connecting potential food donors

### Food waste in India

About 40 % of the food produced in India is wasted. The UN has reported that about 190 million Indians remain undernourished. It is further estimated that the value of food wastage in India is around ₹ 92,000 crores per annum.

### Food waste:

Food waste is categorized into two types based on where it occurs from production to consumption.

- 1) **Food Loss:** Losses occurs before the food reaches the consumer as a result of issues in the production, storage, processing, and distribution phases are called as food loss.
- 2) **Food Waste:** Food waste refers to food that is fit for consumption but consciously discarded at the retail or consumption phases.

### Benefits of reduced food waste:

- Cost savings on labour through more efficient handling, preparation, and storage of food that will be used.
- Cost savings when purchasing only as much food as needed, and avoiding additional costs of disposal.
- Reduced methane emissions from landfills and a lower carbon footprint.
- Better management of energy and resources, preventing pollution involved in the growing,

### About Author



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One-third of all food produced for human consumption in the world is wasted or lost. Grown but uneaten food has significant environmental and economic costs. Obviously, this food wastage represents a missed opportunity to improve global food security and to mitigate environmental impacts generated by agriculture. Decomposition of food waste produces methane, a strong greenhouse gas that contributes to global warming. By 2050, food production will need to be 60 percent higher than current production, if production is to meet demand of the increasing world population. Making better use of food already available with the current level of production would help meet future demand with a lower increase in agricultural production.

Food waste occurs along the entire steps of production, from the farm to distribution to retailers to the consumer. Losses from mold, pests, or inadequate climate control, losses from cooking and intentional food waste are major reasons for food waste.



to hunger relief organizations like food banks and pantries.

- Recycle food waste to feed animals or to create compost, bioenergy, and natural fertilizers.

### Role to reduce food waste

#### 1) State and Local Governments

Government can incorporate food waste prevention and education campaigns, and implement municipal composting programs. Governments can provide tax credits to farmers who donate excess produce to local food banks.

#### 2) Businesses (Restaurants, Grocery Stores, and Institutional Food Services)

They can evaluate the extent of their food waste and adopt best practices. Examples include supermarkets selling damaged or nearly expired produce at discounted prices. Restaurants can offer smaller portions and donate excess ingredients and prepared uneaten food to charities. Schools may experiment with concepts that allow children to create their own meals to prevent less discarded food.

#### 3) Farmer

Farmers can evaluate food losses during processing, distribution, and storage and adopt best practices. Farmers markets can sell low quality produce, which are discarded, misshapen fruits and vegetables that do not meet the usual standards for appearance. Farms can sell fresh but unmarketable produce due to appearance to food banks at a reduced rate.

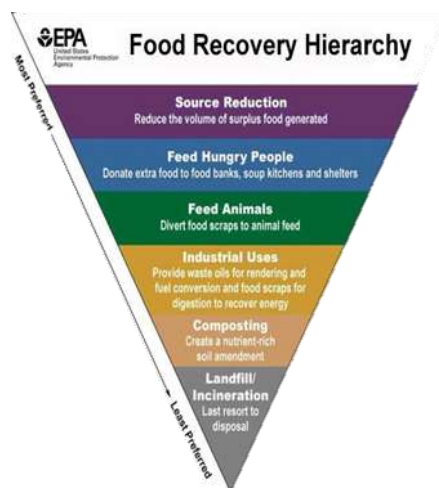
#### 4) Consumer

Consumers can learn when food is no longer safe and edible, how to cook and store food properly, and how to compost.

### United States Environmental Protection Agency- Food Recovery Hierarchy:

Food Recovery Hierarchy explain ways to handle excess food from the most preferred at the top of the pyramid to the least preferred at the bottom of pyramid.

- **Source reduction:** Earliest prevention by reducing the overall volume of food produced.
- **Feed hungry people:** Donating excess food to community sites.
- **Feed animals:** Donating food scraps and waste to local farmers who can use them for animal feed.
- **Industrial uses:** Donating used fats, oils, and grease to make biodiesel fuel.
- **Composting:** Food waste that is composted to produce organic matter that is used to fertilize soil.
- **Landfill or Incineration:** A last place for unused food.



### Food Recovery Hierarchy

### Impact of food waste:

#### 1) Natural resources

##### a) Land use

At world level, the total amount of food wastage in 2007 occupied almost 1.4 billion hectares,

equal to about 28 percent of the world's agricultural land area.

#### b) Water footprint

Globally, the blue water footprint for the agricultural production of total food wastage in 2007 is about 250 km<sup>3</sup>.

#### 2) Carbon footprint

FAO quantified, Global food loss and waste generate annually 4.4 Gt CO<sub>2</sub> equivalent or about 8% of total anthropogenic GHG emissions. This means that the contribution of food wastage emissions to global warming is almost equivalent (87%) to global road transport emissions.

#### 3) Biodiversity

Farming, including conversion of wild lands and intensification, is a major threat for biodiversity worldwide. These biodiversity impacts can then be linked to food wastage through the production phase for each commodity and region to detect hotspots of biodiversity impacts. cereal production is a main cause of food wastage in most regions, probably constituting the main threat to biodiversity, both in terms of deforestation and species' threats. This is due to the large extents of land that need to be converted for their production, usually leading to simplification and degradation of habitats.

#### 4) Economy

Besides its environmental cost, food wastage also represents a loss of economic value. On a global scale, the economic cost, based on 2009 producer prices, of the overall amount of food wastage in year 2007 totalled about USD 750 billion.



## USES AND BENEFITS OF

# ROTAVATOR TRACTOR/ POWER TILLERS OPERATED IMPORTANT AGRICULTURAL TOOL

### About Author



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A rotavator, also known as a rotary tiller, is a tractor-driven rotary tillage equipment that uses a series of blades to plow the land by cutting, pulverizing, mixing, and levelling the soil. Article mentions the types, uses and benefits.

A rotavator, also known as a rotary tiller, is a tractor-driven rotary tillage equipment that uses a series of blades to plow the land by cutting, pulverising, mixing, and levelling the soil. The rotavator is a cost-effective and efficient instrument for replacing cultivators, disc harrows, and levellers. Rotavator, also known as a rotary tiller, is tractor-driven rotary tillage equipment that uses a series of blades to plow the land by cutting, pulverising, mixing, and levelling the soil. The rotavator is a cost-effective and efficient instrument for replacing cultivators, disc harrows, and levellers. It is a

helpful agricultural tool that is used to prepare soil.

A rotavator is a large piece of gardening equipment that is used to break up, churn, and aerate the soil before sowing seeds and bulbs in gardens. Rotavators have a series of spinning blades that break through the soil. This increases drainage, levels the land, and prepares it for the planting of vegetable plants and crops.

### Uses of rotavator in agriculture

- Minimize fuel consumption and time duration
- Helps in breaking down soil and levelling of land.
- Used in primary and secondary tillage
- Seedbed preparation for sowing.

- Reduce the amount of fuel used and the amount of time spent by the farmer.
- Soil preparation takes time, but with the appropriate tools and equipment, you can make your business more efficient.

When it comes to soil preparation, a rotavator is a useful piece of equipment. This multifunctional piece of farming machinery is a motorised machine that turns the soil using rotating blades. rotavators, in general, are earth-turning machines that act similarly to tillers. While all rotavators perform the same job, several models have different features.

### Types of rotavator:

#### 1. Ground tiller:

A tiller also known as rotavator is a tool that breaks up soil



with a set of blades. Tilling is one of the most effective methods for creating healthy soil in a flower bed because it combines and loosens the soil, allowing for better drainage and irrigation.

## **2. Medium duty rotavator:**

This medium duty rotavator has greater power than a tiller. Gardens and allotments are the greatest places for it. These are more durable than tillers and they provide a superior finish while lowering the amount of effort required to rotavate your field.

## **3. Heavy duty rotavator:**

Heavy duty rotavators are the heaviest and most powerful. They're useful for preparing big sections of farmed land for cultivation. If you're working in really difficult terrain, you should invest in or hire a heavy-duty rotavator.

## **Advantages of using a rotavator**

The usage of a rotavator in agriculture provides for soil preparation without the use of a lot of work. The maximum amount of nutrients is supplied to the plants by turning the soil. The better the soil

structure, the greater the agricultural output, and hence the higher the profit.

The majority of industrial rotavator types is self-propelled and can drive both backwards and forwards. While the blades continue to rotate at the same pace, the gearbox permits the operator to vary the machine speed. The maximum speed that this piece of equipment can achieve is determined by the model that you purchase. Another benefit of purchasing a rotavator is that they are simpler to use than other forms of machinery that accomplish comparable tasks. Agricultural rotavator tractors can till enormous tracts of land quickly thanks to their powerful engines and broad blades. Farming becomes more effective and convenient when you own a rotavator. Farmers will usually find that their crops grow better in soil that has been prepared with the use of these agricultural tools. Agricultural rotavator tractors can till enormous tracts of land quickly thanks to their powerful engines and broad blades. Farming becomes more effective and convenient when you own a rotavator. Farmers will usually find that their crops grow better in soil that has been prepared with the use of these agricultural tools. Agricultural rotavator tractors can till enormous tracts of land quickly thanks to their powerful engines and broad blades. Farming becomes more effective and convenient when you own a rotavator. Farmers will usually find that their crops grow better in soil that has been prepared with the use of these agricultural tools. Agricultural rotavator tractors can till enormous tracts of land quickly thanks to their powerful engines and broad blades. Farming becomes more effective and convenient when you own a rotavator. Farmers will usually find that their crops grow better in soil that has been prepared with the use of these agricultural tools.

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## **Weed Control:**

As many as 4-6 passes at 3-4 weeks interval can be required to completely eradicate annual and. Perennial weeds operate the rotavator tractor with fast rotor speed and the shield raised so that the roots are thrown on the surface to die.

\*\*\*\*



# BREEDING OF TROUT FISH

## About Author



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There have been a number of fast-growing and economically successful species introduced to take advantage of the cold water resource, including carp and trout species. Fish hatcheries have traditionally produced fish through the culture of trout in raceways, where a flow-through system is kept in place to maintain the necessary degree of water quality. Due to the ideal temperature range (5°C to 18°C), trout farming is popular in the states of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, and Ladakh. Trout farming in India is having huge potential. Trout culture in raceways has been traditionally practiced for hatchery production of fish, where a flow-through system is maintained to provide the required level of water quality.

## Breeding system

### Development of brood stock

Transporting fish seed requires water that is at the right temperature. The release of fish seed following adequate acclimation is also crucial.

In general, males and females are kept apart. Some farms buy eyed eggs from other sources because maintaining brood stock may be expensive and labor-intensive. These eggs should be "certified disease free," but they should also be treated with iodine (100 mg/liter for 10 min) when

they arrive and progressively brought up to hatchery temperature.

Functional males are produced by oral administration of the male hormone 17-methyl testosterone through starter feeds at the fry stage.

### Stripping and fertilization

The dry method of fertilization without admixture of water is the most common approach. Reproduction of rainbow trout is well understood and the techniques are well-developed. Eggs are removed manually from females (under anesthetics) by applying pressure from the pelvic fins to the vent area or by air spawning, causing the fish less stress and producing cleaner, healthier eggs. Up to 2000 eggs/kg body weight are collected in a dry pan and kept dry, improving fertilization. Males are stripped in the same way as females, collecting milt in a bowl, avoiding water and urine contamination. It is recommended that milt from three or four males is mixed prior to fertilization to reduce inbreeding. Water is added to activate the sperm and cause the eggs to increase in size by about 20 percent by filling the perivitelline space between the shell and yoke; a process known as "water-hardening". Fertilized eggs can be transported after 20 minutes, and up to 48 hours after fertilization, but then not until the eyed stage (eyes are visible through the shell). Direct exposure to light should be avoided during all development stages, as it will kill embryos. One advantage of this technique is that only the brood stock is sex-reversed, and they can be grown separately, while the marketed fish are not exposed to hormonal treatment.

### Feed

Commercial Trout feed manufactured at Govt./Pvt. is

available. Feeding @ 4-6 % of body weight is necessary for the fingerlings for better growth but due consideration should be given to the water temperature for following the feeding schedule. At the water temperature range of 10-12 °C, feeding schedule of 6% is optimum but when it increases to 15 °C, the feeding schedule to be lowered to 4%. The optimum growth rate per month is 30-40 g.

### Market and trade

There are many commercial outputs from rainbow trout culture, which include sale of fresh fish to consumers, of fingerlings for restocking of rivers and lakes, and products from hatcheries like eggs and juveniles are sold to other farms. Supply of formulated aqua feed to growers is another important upcoming activity.

Presently, the sale of fish is confined to local markets. For example, Himachal Pradesh supplies fish to the two nearby cities of Chandigarh and New Delhi. New trade channels are expected to develop soon, once production expands with upcoming additional infrastructure. No processing or value addition is done yet, as the significant demand for unprocessed product absorbs production.

### Conclusion

The trout culture is one of the best farming systems under cold water. It is traditionally practiced for hatchery production of fish, where a flow-through system is maintained to provide the required level of water quality. Trout culture feeding habitat was optimum at 6% and optimum growth rate per month is 30-40 g. Because of optimal temperature trout farming is common in the states of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh and Ladakh.



# WHETHER CLIMATE CHANGE IS BOON TO AGRICULTURE ?

## About Author



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Climate is changing in recent decades due to the erratic variation of weather and intensified human activities like burning of fossil fuels, soot particle emission by coal, that emission and ground water depletion by intrusion of sea water into the land and deep bore wells by placing inside the land at several meters depth. Since 1995, the UN Climate Change Conference, also known as the Conference of the Parties, has taken place annually. The two-week summits provide a crucial forum for stakeholders to tackle the global climate challenge. The United Nations Framework Convention on Climate Change (UNFCCC), an international environmental treaty addressing climate change, is the subject of these yearly conferences, known as "COPs." Representatives from all parties meet there to debate climate change action. The COVID-19 epidemic forced the postponement of

the 26<sup>th</sup> COP (link is external), which was originally scheduled to take place in Glasgow, UK, in November.

### Impact of human behavior on climate change

In order to achieve net zero, citizens must actively participate and use low-carbon technologies, alter their behaviour (such as installing solar water heaters), demand governmental changes, and invest in the necessary infrastructure. Governments, however, do not feel the political pressure to urgently enhance their goal in reducing emissions without public support. As long as businesses can encourage high-carbon behaviours, they will also lack motivation to commit to the drastic emissions reductions required.

### Climate's impact on agriculture

There are many ways that agriculture may be impacted by climate change. Warming tends to decrease yields above a certain temperature range because crops develop more quickly

and produce less grain as a result. Additionally, rising temperatures hinder plants' capacity to absorb and use rainfall. When temperatures rise, plants increase transpiration, or the loss of more moisture from their leaves, which speeds up soil evaporation. The overall result is referred to as "evapotranspiration." The overall effect of rising temperatures on water availability is a race between more evapotranspiration and higher precipitation because global warming is anticipated to increase rainfall. Higher evapotranspiration typically wins that competition.

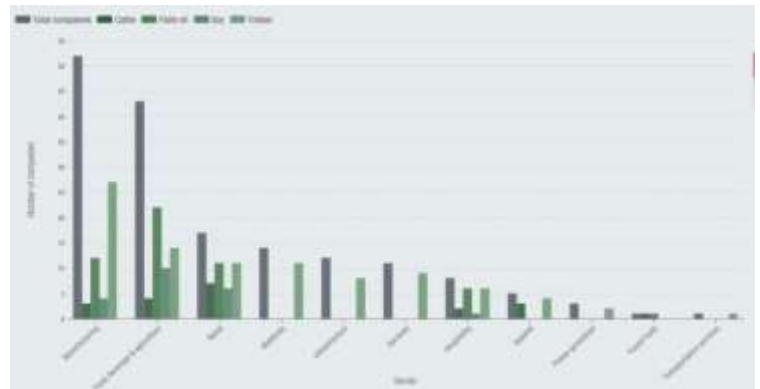


Fig. 1. Human behavior on climate change

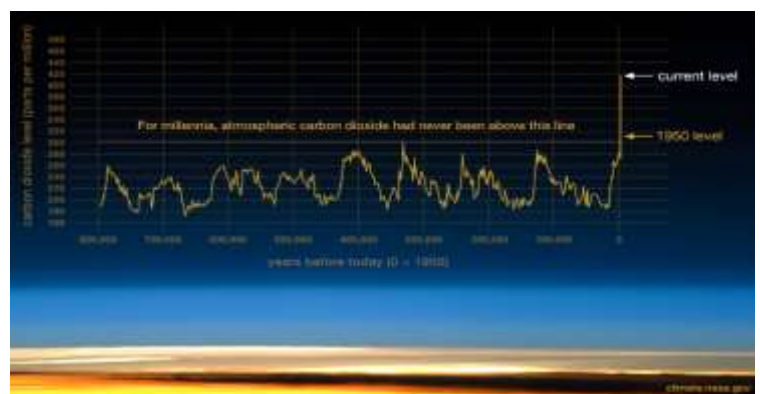


Fig. 2. Report of NASA on climate change



# INDIA BAN ON SELECTED SINGLE-USE PLASTIC ITEMS

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From July 1, 2022, certain single-use plastic items will no longer be sold in India. On August 15, 2019, the Honorable Prime Minister Shri Narendra Modi first declared a ban on single-use plastics. In 2002, the nation of Bangladesh became the first to do this by banning all light-weight plastic bags. Sikkim was one of the first states in India to outlaw single-use plastic bottles and disposable plastic bags in 1998. A notification for the ban was subsequently released in August 2021, requiring the establishment of task groups in the states and at the Centre to monitor its implementation across all of India. This is due to the fact that even after July 1st, a variety of single-use plastic products will still be offered in the Indian market, including soft drink and mineral water bottles that are all packaged with many layers. According to the definition India has chosen, these plastic objects are a perfect fit for single-use plastic.

## What is the plastic ban ?

The Indian government currently only bans 21 "low-utility and high litter potential" goods, not all single-use plastics. It alludes to single-use, disposable plastic goods.

One of the largest percentages of plastic produced and used is single-use plastic, which includes plastic straws, ear-buds with plastic sticks, balloon sticks made of plastic, plastic flags, candy and ice cream sticks made of plastic, plates, cups, glasses, and cutlery made of plastic, as well as polythene bags, face masks, coffee cups, cling film, trash bags, and food packaging. Even if the prohibition does not apply to all plastic bags, it does mandate that manufacturers produce bags that are 75 microns or thicker, up from the previously accepted minimum of 50 microns. The notification further mandates that non-woven plastic (polypropylene) must be thicker than 60 GSM and that plastic or PVC banners and hoardings must have a thickness of at least 100 microns (grams per square meter). Despite having a texture similar to fabric, nonwoven plastic bags are classified as plastics. According to a 2021 research by one of Australia's charitable organizations, the Minderoo Foundation, single-use

plastics make up 33% of all plastic produced worldwide, with 98% of that plastic coming from fossil fuels. The majority of plastic that is thrown away, approximately 130 million

metric tons worldwide in 2019, is single-use plastic, which is "all burned, buried in landfills, or thrown straight into the environment," according to the research. By 2050, it has been predicted that single-use plastic might be responsible for 5–10% of greenhouse gas emissions, depending on the production trajectory currently in place. According to the survey, India ranks 94<sup>th</sup> out of the top 100 nations for producing the most single-use plastic garbage, behind Singapore, Australia, and Oman.

## Why these items?

According to ministry representatives, the decision to ban the initial batch of single-use plastic products was made due to their "difficulty of collection, and consequently recycling." "Plastic in the environment is the adversary, not the facts that it exists. Micro-plastics are created when plastic is left in the environment for a very long time without decomposing and then enters our food supply before eventually making its way into our bodies. This



is extremely harmful. We chose these items because they are challenging to collect, especially since many of them, like ice-cream sticks, are either small or dumped into the environment. In contrast to the much larger objects, it then becomes challenging to gather for recycling, according to a Ministry official.

With up to 95 per cent of single-use items falling into this category, including everything from toothpaste to shaving cream to frozen foods, packaging makes up the greatest portion of single-use plastic. A contributing factor can be the low value, low turnover, and little likelihood of significant economic impact of the things selected.

### **Plastic waste pollution**

In India, the second-most populated nation in the world, plastic trash has grown to be a substantial cause of pollution, and the country's rapid economic development has increased consumer demand for goods that include single-use plastic items like straws and disposable cutlery. The restriction does not apply to thousands of other plastic products, including plastic bottles. However, the federal government has set goals for producers to follow regarding recycling or disposal after use. Single-use plastic items (SUPs) are utilized only once or for a brief time before being discarded. Global and sometimes severe effects of this plastic trash on the ecosystem and our health. Reusable alternatives are less likely to enter our seas than single-use plastic products. India ranks as the fifth-highest country in the generation of plastic waste with an annual discharge of 3.5 million

tons in fiscal year 2020 (Kotak Institutional Equities).

### **Bad effects of plastic pollution**

Every year, a million tonnes of plastic are dumped into bodies of water like rivers, lakes, ponds, and seas. Throwing away plastic wrappers, bottles, and bags made of polythene is a grave error for which the entire planet will pay a price. When it comes to plastic pollution, the entire natural world is contaminated. Due to its non-dissolving nature, it continues to float or settle on the surface of water. These have a serious negative impact on aquatic life, birds, animals, and humans.

Apart from it remains on the water surface for an endless time which is responsible for hampering the purity of water. The areas surrounding plastics which dumped in to the water body creates several diseases including diseases and insects which are causing deadly illness. These hazardous insects also contribute to a number of human ailments.

Breathing becomes extremely challenging for aquatic species. Small fish and dolphins are among the aquatic creatures that swallow this plastic, which becomes lodged in their throats. It then becomes accountable for their demise. Moreover, millions of tons of plastic are dumped on land as well. The birds, animals like dogs, cows, and other domestic animals reach there for eating food.

### **Future alternatives to plastics**

As we can see, many single-use plastic items can now be

replaced with paper, wood, agricultural waste, food crops, and several plants. But we require more eco-friendly options. Given the limited amount of land available, it is not particularly sustainable to grow trees and food crops for packaging. Additionally, there are a variety of disposable plastic products that still need to be replaced, including plastic packets for dairy and FMCG food products, plastic bottles for liquids, food delivery containers, plastic wrappers and polystyrene (thermocool) used in white goods, and plastic covers used by e-commerce companies, to name a few.

### **Conclusion**

The Plastic pollution is caused by the accumulation of contaminated plastic material in the environment. We can also use of plastic wastes for construction applications will increase the sustainability of the environment significantly, and also serve as a reliable source of materials for construction purposes. Plastic is a non-bio-degradable substance. Plastic is a material that cannot be biodegraded. Plastic garbage pollutes our water severely when it reaches bodies of water like rivers, seas, and even the ocean. According to experts, it is a significant step in India's fight against waste, air, and marine pollution and is consistent with its larger environmental goal. In March 2021, India said that it was on target to achieve its PACC or Paris Agreement Climate Change targets, and added that it has voluntarily committed to lessening greenhouse gas emission intensity of its GDP by 33-35 per cent by 2030.

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# EFFECTS ON THE ENVIRONMENT DUE TO BURNING OF CROP RESIDUES

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After harvesting a large part of it remains unusable as residue which is a source of renewable energy. The quantity of such crop residue in India is about 62 million tonnes. Half of it is used for roofing of houses and huts, animals, food, fuel and packing and the remaining half is burnt in the fields itself. It is estimated that burning of crop residues such as dry wood, leaves, and weeds produces 40 percent CO<sub>2</sub>, 32 percent CO particulate matter 2.5 and 50 percent hydrocarbons in the atmosphere. The process of burning crop residues in the fields pollutes the environment. Soil erosion increases and respiratory diseases increase. The process of direct incorporation of crop residue into the soil is simple, but it also has some difficulties. Like reducing the gap between two crops. It also involves additional less irrigation and other activities, which increases the cost of burning stubble, increasing pollution.

According to the study, mixing paddy straw in the soil releases methane gas, which

increases global warming. By removing these difficulties through a simple process, the ill-effects of burning crop residue can be reduced. Therefore, renewal of crop residues is very important for a healthy environment and from an economic point of view.

## Chemical diavasin

Due to the residue of pesticides in crop residues, the toxic chemical diavasin dissolves in the air by burning it. By burning the residue at the time of harvesting and after harvesting, the amount of toxic diavasin in the air increases by 33-270 times. The effect of diavasin remains in the environment for a long time, which gets deposited on the skin of humans and animals, and it causes dangerous diseases.

## Options and diagnostics

- The government should implement rules for not burning crop residues so that pollution can be reduced.
- Soil health can be increased by re-plowing the crop residue in the field.
- The residue can be collected and used for fuel, compost, animal feed, house roof and mushroom production etc.
- Biofuels can also be prepared from these residues.
- A simple solution is to decompose these residues by micro-organisms, which can



increase both the physical structure and fertility of the soil by preparing fertile compost.

## Concern for clean environment

- This air pollution collects on the lower surface of the atmosphere, which has a direct effect on the population.
- This type of pollution is spread by the wind in far-flung areas and wide areas, whose control
- is not in our control.
- This type of pollution causes global climate change by producing greenhouse gas.
- Burning crop residues releases hazardous chemicals into the atmosphere, which is a carcinogenic pollutant.

## Health problems due to burning of crop residues

- Changes in thyroid hormone level.
- During pregnancy there is an adverse effect on the brain level of the child.
- This pollution reduces the level of testosterone hormone in men.
- Reproductive diseases increase in women.
- Immunity decreases.

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# HEAT WAVE-2022

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## What is a heatwave?

A Heat wave is an extended period of unusually of hot weather relative to the expected conditions of the area at that time of year. It can be fatal for the human body and scientifically defined as the occurrence of temperature greater than normal in a certain reason.

## IMD declares a heatwave when...

The temperature of a place's crosses 40°C in the plains, 37°C in coastal areas, and 30°C in the hills. Temperature of a place is 4.5 to 6.4°C more than the normal temperature for the region on that day. If the increase is over 6.4°C, it is a 'severe' heat wave. Temperature of a place crosses the 45°C mark. When the temperature crosses 47°C a severe heat wave is declared.

## Why is March and April sweltered ?

Northwest India recorded more than four western disturbances in March and April but were not strong enough to cause a significant change in the weather. The reason also did not receive any significant pre monsoon rainfall in March and April who compounded the severity of the successive heat waves spells.

## Heat wave days

An ongoing study by the IMD showed the number of heatwave days in India increasing  
1981-90 – 413  
2001-10 – 575  
2011-20 – 600

Heat waves are not uncommon to Indian subcontinent during March to May. However, what made heatwave of 2022 deadliest is that started very early and extended for a longer period. A combination of low rainfall and high temperature has a more serious impact on agriculture than when there occurs separately. The yield of wheat crops decreases substantially when high temperature and low rainfall occurs together (sharma and majumdar, 2017). By Indian Council of Agricultural Research has shed light on extent and kind of crop damage that happened due to the scorching heat wave in the months of March and April 2022. The heat wave had infected wheat yield and subsequently, a shortage of grain. But it also resulted in poor vegetative and retarded growth, pest infestations like fall Army and whitefly attacks and viral infections in crops and live stocks. The abnormal increase in maximum and minimum temperature during 2022 impacted crops, vegetables, and animals in the 9 States of Punjab, Haryana, Rajasthan, Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Bihar, and Maharashtra. Poor pod setting, wilting and force maturity, flower drop, poor pollination and prematurity were observed in *Rabi*

crops like green gram, maize, chickpea, wheat, mustard. They were also seen important horticulture crops like citrus, apple, cabbage, cauliflower cucumber etc. The hot weather also increased the body temperature of livestock and milch animal by 0.5 to 3.5°C which reduced milk yields by 15% animals faced the problem of increased calf mortality and skin infection. Rise temperature also reduced egg production by up to 10% during the initial two days of the heat wave. Northwest and Central India experienced their hottest April in 122 years, with average maximum temperature reaching 35.9°C and 38.7°C respectively. During this period the extreme temperatures were found to be higher by 8°C to 10.8 degree Celsius and their rainfall over by 60 to 99% compared to normal in 10 out of 36 metrological subdivisions.

As a result, a reduction of vegetable yield up to 40 to 50 percent compared to normal was observed in a few areas, especially in Himachal Pradesh and Jammu and Kashmir. A reduction of 23% was observed in kinnow yield in Punjab. chickpea in Haryana also experienced a yield reduction up to 19%. In Uttar Pradesh temperature increase of 5°C in March from the normal resulted on flower drop and lots of Jhumka (a fruiting disorder) in mango trees. Similarly in Rajasthan experienced heat wave and recorded yield losses up to 4 to 5 q/ha in wheat and 2 to 3 q/ha in mustard compared to normal.



# QUANTIFICATION OF CLIMATE CHANGE IMPACT ON CROPPING SYSTEMS

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Crop growth, in reality, is influenced by a number of interconnected processes. Crop yields are affected by management factors such as crop variety, fertilizer application, tillage, irrigation, and the consequences of climate change such as temperature, precipitation, solar radiation, and extreme disaster (flood, drought, dry hot wind, etc.) should be considered. The interactions of climate and non-climate factors increase the need to investigate the impact of climate variables on crop development, as well as the difficulty of predicting crop yield responses to climate change. The key methods for evaluating the impact of climate change on crop yields are statistical models and crop models. Crop models may incorporate physiology, agronomy, soil science and agrometeorology information into the models, which use mathematical equations to explain physiological, physical, and chemical processes in order to simulate crop growth and development over time.

## Statistical models

Statistical models include three main types i.e., time-series models based on time series data from a single point or region, cross-section models based on spatial variations data and panel models based on spatiotemporal variation data. Some stationary assumptions are made in time-series models, such as the relationship between crop yields and environment in the past will not change in the future. In cross-section

models, different location conditions are compared, considering all of the adaptations in different regions and climate conditions. Panel models, which incorporate time series from multiple locations into a single study, should have the same number of adaptations as the other two methods. Regression models are the easiest way to study the impact of climate change on crop growth and yield. They are simple and require very less data to construct. But it does not show the cause-effect relationship as it is not process based and only based on statistical relation.

## Process based models (Crop simulation models)

Eco-physiological models are extensively used to assess the impacts of environmental factors (and their changes, thereof) on crops/cropping systems. Since they are process-based and explicitly explains the mechanisms of processes mainly on a day-to-day temporal scale, it is very convenient to understand the individual as well as interaction effects of various environmental factors on crop production. In the ecophysiological modeling, the input for model includes daily weather and CO<sub>2</sub> data corresponding to historic, current or future scenarios of interest, initial field conditions (soil physicochemical properties, moisture and N status etc.), crop information (information on cultivar, crop management data like sowing date, method of sowing, fertilizer and irrigation application details etc.). The simulation is run and the outputs are compared to other simulations with different initial conditions or management practices or weather files used. In this way, the impact of projected changes in climate/CO<sub>2</sub> on growth and yield of various crops/cropping systems are explored and various adaptation options are optimized.

## Measuring the impact of projected climate on crop growth and yield

The researchers around the world have used different structures to

conduct field experiment for studying the impact of projected climate on crop growth and yield. These include growth chambers, greenhouses, phytotrons, open top chambers (OTCs) and free air CO<sub>2</sub> enrichment (FACE) facility etc. OTC consists of basic metal frame fitted in the field, which is covered with highly transparent poly vinyl chloride sheet to permit natural light. It is open at the top to avoid building up of temperature and humidity inside the structure. Inside the structure, arrangement is made to maintain CO<sub>2</sub> concentration or temperature of interest. One criticism regarding OTCs is that the plants grown in these systems are not subjected to changing environmental conditions such as wind or temperature and humidity fluctuations.

A standard large-scale FACE apparatus consists of a range of 15- to 30-meter-diameter plots within a crop area, where CO<sub>2</sub> is re-released just above the crop surface on the plot's upwind side. A drawback of FACE is the under-estimation of fertilization impact of enriched CO<sub>2</sub> on plant growth due to the rapidly fluctuating CO<sub>2</sub> inside FACE rings. Another drawback is the huge amount of monetary investment required to establish and maintain the experiment set up.

## Conclusion

This article has described various approaches used globally to estimate and measure the impact of projected climate on growth and yield of cropping systems. Each approach has its own advantages and disadvantages. Measurement approaches will always have more accuracy and better quantification of the impact of projected climate on growth and yield of cropping systems compared to estimation techniques. However, if we want to conduct the study over a large region, the latter will be the better choice.

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# BIOREMEDIATION

## A SOLUTION FOR POLLUTION

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**B**ioremediation is the use of microorganism (bacteria and fungi) to decompose the environmental pollutant into less toxic forms. This technique is used to clean up polluted soil and ground water. Microorganism can be specifically designed for bioremediation using genetic engineering technique. Bioremediation stimulates the growth of certain microbes that use pollutant as source of food and energy. Pollutant treated using bioremediation includes oil and other petroleum products, solvents pesticides and fertilizers. The process of bioremediation can be monitored indirectly by measuring the oxidation reduction potential in soil and groundwater.

### Factors of bioremediation

Bioremediation is the complex process of many factors. These factors are:

- The presence of a microbial population capable of degradation.
- The availability of contaminants to the microbial population for degradation.
- The environmental factors ( type of soil, temperature, pH, presence of oxygen and nutrient).

### Microorganism for bioremediation:

- **Aerobic:** In the presence of oxygen. Examples of aerobic bacteria recognized for their degradative abilities are *Pseudomonas*, *Alcaligenes*, *Sphingomonas*, *Rhodococcus*, and *Mycobacterium*. These microbes have often been reported to degrade pesticides and hydrocarbons.
- **Anaerobic:** In the absence of oxygen. Anaerobic bacteria are not as frequently used as aerobic bacteria. There is an increasing interest in anaerobic bacteria used for bioremediation of polychlorinated biphenyls (PCBs) in river sediments, dechlorination of the solvent trichloroethylene (TCE), and chloroform.
- **Ligninolytic fungi:** Fungi such as the white rot fungus *Phanaerochaete chrysosporium* have the ability to degrade an extremely diverse range of persistent or toxic environmental pollutants. Common substrates used include straw, saw dust, or corn cobs.
- **Methylotrophs:** Aerobic bacteria that grow utilizing methane for carbon and energy.

### Bioremediation technologies

#### In-situ technology

- **Bioventing-** Supply of air and nutrients through wells to contaminated soil to stimulates the growth of indigenous bacteria.

- **Biosparging-** Injection of air under pressure below the water table to increase groundwater oxygen concentrations and enhance the rate of biological degradation of pollutant by naturally occurring bacteria.
- **Bioaugmentation:** Microorganisms are imported to a contaminated site to enhance the degradation process.

#### Ex situ technology

- **Land farming-** Contaminated soil is excavated and spread over a prepared bed and periodically tilled until pollutants are degraded.
- **Composting-** Composting is a nature's process of recycling decomposed organic materials into a rich soil is known as compost.
- **Bioreactors-** It involves the processing of contaminated solid material or water through an engineered contaminated system.

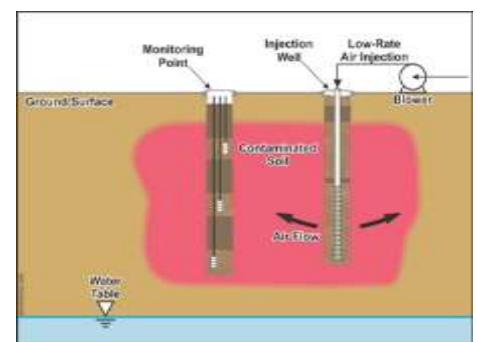


Fig.1 Bio-venting

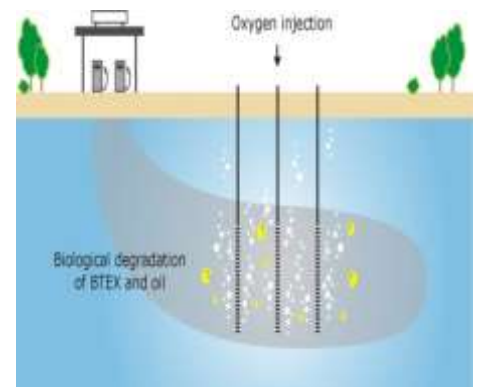


Fig.2 Bio-sparging



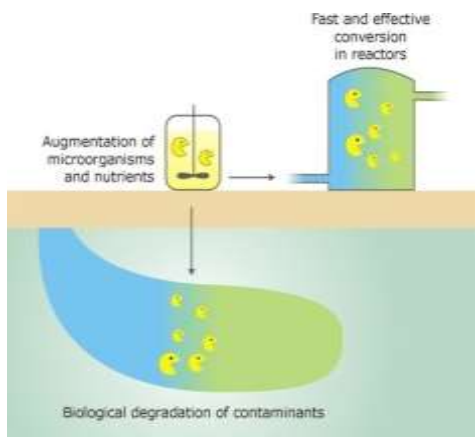


Fig.3 Bio-remediation

### Advantages of bioremediation

- Bioremediation is a natural process and is useful for the complete destruction of a wide variety of contaminants.
- The residues for the treatment are usually harmless products and include carbon dioxide, water, and cell biomass.
- Many compounds that are legally considered to be hazardous can be transformed to harmless products.

- Instead of transferring contaminants from one environmental medium to another, for example, from land to water or air, the complete destruction of target pollutants is possible.
- Bioremediation can often be carried out on site, often without causing a major disruption of normal activities. This also eliminates the need to transport quantities of waste off site and the potential threats to human health and the environment that can arise during transportation.

- Bioremediation is less expensive than other technologies that are used for clean-up of polluted soil and water.

### Disadvantages of bioremediation

- Bioremediation is limited only to biodegradable compounds.

- Not all compounds are susceptible to rapid and complete degradation.
- Bioremediation often takes longer time than other treatment process.
- Important factors required for success include the presence of metabolically capable microbial populations, suitable environmental growth conditions, and appropriate levels of nutrients and contaminants.
- It is difficult to extrapolate from bench and pilot-scale studies to full-scale field operations.

### Conclusion

On the basis of above discussion it is clear that the bioremediation has a potential to clean up the polluted soil and water. But Research is needed to develop fast and engineer bioremediation technologies that are appropriate for sites with complex mixtures of contaminants that are not evenly dispersed in the environment.



# IMPORTANCE OF DIETARY FIBER IN DAIRY FOODS

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**D**ietary fiber (DF) is the indigestible portion of food which helps in fighting against several diseases mainly associated with the modern life-style. However, milk is a concentrated source of life-sustaining nutrients with high digestibility and is purely devoid of DF. These dietary fibers can be added in milk and milk products either for health or for technological benefits or for sensory reasons. Dietary fiber (DF) was originally defined in 1972 by Trowell as, that portion of food which is derived from cellular walls of plants which are digested very poorly by human. Intake of fiber through various foods such as nuts, whole-grain flour, fruits, and vegetables is now associated with decreased low-density lipoprotein (LDL)-cholesterol, lower insulin demand, increased stool bulk, softening of fecal contents, and improved laxative properties. Epidemiological studies have correlated high consumption of DF with lower incidence of certain diseases such as cardiovascular and cancer of colon and rectum. Such findings boosted searches for DF. Several conditions such as diabetes, atherosclerosis, breast cancer,

diverticulitis, hemorrhoids have been connected to a low intake of fiber. Fiber of various sources is added to dairy products because of its water-holding capacity, reduce the lipid retention, improve textural properties and reduce caloric content by acting as a bulking agent to increase its product yield.

Consumption of products containing high fiber may decrease hypertension, hypercholesterolemia, obesity, gastrointestinal disorders, coronary heart disease, diabetes, and cancer. Therefore, in this paper the recently innovated dairy products that are developed using varied sources of DF have been reviewed. There is growing interest among consumers about the nutritional and therapeutic aspects of the food they eat. This has led to new inquiries about the linkage between food and health. The basic tendency of human beings has always been to procure and consume "natural foods". However, the fast pace of modern life has placed a great burden on such past activities and consequently canned, packaged, and ready-to-eat foods have now moved into a central position and onto the tables of modern consumers. Many of them have become aware that they are being deprived of some food components, which may be of immense importance to health. Milling of grain to white flour, ready-made squeezed juices, and many canned vegetables have clearly



cut down the supply of fiber from the diet. Fiber not only increases the bulk of the food and moves it through the gastrointestinal tract

**Table 1. Dietary intakes of dietary fiber in human beings**

Life stage group	Total DF intake (USDA) g/day <sup>a</sup>	Total DF intake (EFSA) g/day <sup>b</sup>
<b>Infants</b>		
0–6 month	ND	ND
7–12 month	ND	ND
<b>Children</b>		
1–3 year	19	12–15
4–8 year	25	11–20
<b>Males</b>		
9–13 year	31	13–27
14–18 year	38	15–33
19–34 year	38	16–26
35–64 year	30	17–27
<b>Females</b>		
9–13 year	26	13–25
14–18 year	26	14–27
19–34 year	25	15–24
35–64 year	21	15–26

more rapidly, but also helps in preventing constipation and possible colon and rectal cancer. These Fiber rich products can fortify dairy foods, increase their dietary fiber content and result in healthy products, low in calories, cholesterol and fat.

The Indian Council of Medical Research (ICMR) and National Institute of Nutrition (NIN) have published the amount of fiber is recommended based on energy intake. Fiber intake of 30 g/2000 kcal is considered to be safe.



# PROMOTION OF ORGANIC FARMING IN ODISHA



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Organic farming is better path towards sustainable agriculture. Most of the state adopting Organic farming day by day. Government of Odisha providing better market opportunity in organic farming. Also initiating different policies and scheme for promoting organic farming. The article discussed about various steps taken by the Odisha Government to spread awareness among the local peoples about the benefits of organic products and thus helping in marketing.

## Introduction

Odisha is a farming-oriented state. About 70% of the people in Odisha depend on Farming because of the availability of proper resources. But now day farmers are using pesticides or agro chemical to get maximum yield easily. Many Agrochemicals companies are marketing their products in Odisha. Their sales increases day by day but these use of chemical affects the health of the peoples. So, in focus to this situation Government of Odisha is promoting organic farming through different policies and schemes.

## Discussion

According to Department of Agriculture & Farmers' Empowerment, about 95740 hectares area under organic farming in Odisha. The better reasons of the organic farming are, most of them are small and marginal farmers and suitable environmental

conditions and rainfalls. Also, Government of Odisha initiating a greater number of policies and scheme for promotion of Organic farming. Such as Odisha Organic Mission (OOM), Paramparagat Krishi Vikas Yojana etc. and some others policies are National Food Security Mission which is for the promotion of biofertilizer of cost Rs. 300 per hectare, financial support is providing by Government.

OOM is initiative for developing programs for implementing policies under organic farming. In this program necessary administrative structure will be developed with appropriate monitoring ways at the state and district level. It is funding through PKVY (Paramparagat Krishi Vikas Yojana), RKVY (Rashtriya Krishi Vikas Yojana), MNREGS (Mahatma Gandhi National Rural Employment Guarantee Act) and the state plans. The objective of this mission is adoption of organic farming in 2 lakh hectares of land within 5 years by the combination of agriculture, horticulture, pasture and forest land.

Through Paramparagat Krishi Vikas Yojana the Government of Odisha selected 8 districts (i.e., Kandhamal, Kalahandi, Rayagada, Gajapati, Nayagarh, Koraput, Mayurbhanj and Keonjhar) in which 250 hectares will be allocated for organic farming. These areas are chosen as this is tribal, hilly and rain-fed areas and main aim to increase the farmer's income. The cluster formation for organic farming group, training and exposure visit will be promoted through the service provider, as per the modalities the PKVY policy. The service provider also responsible for packaging and licensing of organic produce and advertisement &

marketing of organic products. According to official, each group (20ha cluster) will be provided 10 lakh and it will be released in 3 phases. 1500 ha area will be considered for organic farming in 2019 and 3 crores will be spent during 2019-20 as per the budget provision. The Government has introduced Odisha Organic Farming Policy, to make farming climate resilient, reduce farmer's risks and enhance their income.

Most of the farmers adopting organic farming for healthy foods. There is better market availability for organic farming also. Farmers getting good profit from organic products by selling in the market. Organic Products are having high values as compared to inorganic products. The educated people are farming organically in their home garden for fulfilled their family needs. Farmers of hilly areas are using traditional organic method in seed treatment, Pest control etc. They are using Panchakavya, Beejamrut, Jeevamrut, FYM and other fertilizer made without chemicals. Also, these fertilizers used for marketing purpose online and offline mode.

## Conclusion

There will be better future in farming can be possible with the help of organic farming. Also, it helps in conservation of natural resources and maintaining the pleasurable environment. This generation of peoples innovating new agricultural practices for getting maximum yield. Around 2.38% of agricultural land is used for organic farming in Odisha and it is increasing day by day as the Government provides incentives and subsidies. Also Government, Non-Government Organization and Private companies initiating awareness programmes and activities. The organic fruit, vegetables and organic related products are mostly acceptable by the customers. There is huge demand for the organic product.■



# SUSTAINABLE AGRICULTURE



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**S**ustainable agriculture refers to the set of all agronomic activities that help in maintaining an economically viable, environmentally safe, and socially efficient environment. It is the system of raising crops with the utilization of resources for better efficiency without disturbing and polluting the environment. It is mainly a production system that emphasizes food security, environmental protection, and economic and social needs with the involvement of farm management, agricultural policies, and independent factors such as climate conditions, terrain, soil type, and gas emissions from animals. The buffering capacity of agriculture helps to adapt to the change in resource demand over time, which qualifies as sustainable. Agricultural sustainability focuses on both genotype improvement and improved ecological and agronomic management. Sustainable agriculture provides something much alternative to standard input-intensive agriculture, which has long-term consequences such as degraded topsoil, diminishing groundwater levels, and decreased biodiversity. In a climate-constrained environment, ensuring India's nutrition security is important. It refers to less resource-intensive agricultural methods, higher crop and livestock diversification, and farmers' flexibility to adapt to local conditions. In India, barely 5 percent of farmers practice sustainable agriculture (crop

rotation, agroforestry, rainwater harvesting, mulching, precision farming). Sustainable agriculture operates within the bounds of physical and biological resources as well as socio-economic viability and quality. Sustainability is based on the principle that we must meet the needs of the present without affecting the ability of future generations. Agricultural sustainability focuses on both genotype improvement and improved ecological and agronomic management. Sustainable agriculture operates within the bounds of physical and biological resources as well as socio-economic viability and quality. Sustainability is based on the principle that we must meet the needs of the present without affecting the ability of future generations. The agricultural sustainability systems to develop technologies do not have adverse effects on environmental goods and services and are accessible to farmers, which leads to improvements in food productivity. Agricultural sustainability refers to an ecological sustainability that plays an important role in the transformation of agriculture from 'farming for subsistence' to 'farming for profits' with the use of technological advancements for improved crop and animal varieties, fertilizers, pesticides, irrigation, and irrigation with negative impacts on the resource base both in quantity and quality. The agricultural growth which relies sufficiently on external inputs caused a remarkable improvement in productivity but led to a decline in sustenance in the long term and showed trends of declining soil quality and environmental issues. Due to such an impact, the need for

agricultural sustainability is a new approach in the twentieth century for technological developments in agriculture, industry, and infrastructure for systems and resources to match the steep increase in human population for enhanced life expectancy and economic growth. A new approach is needed to integrate biological and ecological processes into food production and minimize the use of non-renewable inputs that can cause harm to the environment and the health of farmers and consumers. The concept of sustainable agriculture is essential to making productive use of the knowledge and skills of farmers by substituting human capital for costly external inputs and making productive use of people's collective capacities to work together to solve common agricultural and natural resource problems such as pest, watershed, irrigation, forest and credit management. Sustainable agriculture is an important discipline and rapidly emerging concept that aims at producing food and energy in a sustainable way for the human population's growth and development. The ecological management of agroecosystems for energy flows and nutrient cycling can be helpful for redesigning agriculture. The outcomes of sustainable agriculture can be positive for food production, reduced pesticide use, and carbon balances. The guiding principles for the development of sustainable agricultural technologies are the principles of conservation, complementarities, and rejuvenation of resources on the demand of society and the environment. A significant challenge to developing a national and international framework for the emergence of more sustainable agricultural production across both industrialized and developing countries is needed. ■





# ORGANIC CERTIFICATION



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Organic certification is a certification process including registration, inspection, evaluation and even the issuing of certificates as per NPOP norms for producers, processors and traders/ handlers. It is based on a system of farm design and management which creates an ecosystem that leads to sustainable productivity without using artificial external inputs including chemicals. The organic certification involves a set of production standards for cultivating the crops, storage, processing, packaging and transport for which a written assurance is given by a certification body.

## **NPOP (National Programme for Organic Production)**

The Government of India has implemented the National Programme for Organic Production (NPOP). The government of India has developed the NPOP. It involves the accreditation programme for certification bodies, standards for organic production, promoting of organic farming etc. The main aim of NPOP was:

1. To evaluate certification programmes,
2. To accredit certification,
3. Facilitate certification,
4. Encourage the development of organic farming and organic processing.

## **Organic certification**

Organic certification is the certification process for producers of organic food and other organic agricultural products. Organic certification requirements vary from country to country. The conversion period is the time between the start



of organic management (the date of the first inspection) and the certification of crops as organic. Generally, it is 3 years. Certain standards were developed for growing, storage, processing, packaging, and shipping. The major standards are listed below:

- ✓ Avoidance of synthetic chemicals.
- ✓ Avoidance of genetically modified organisms.
- ✓ The farm should be free from chemicals free upto >3 years.
- ✓ Keeping detailed written production and sales records.
- ✓ Physical separation in the field.
- ✓ Periodic on-site inspection.

## **Organic certification process**

We have to obtain organic farming certification for agricultural produce. We must submit an application in the requisite format along with the fee and complete field verification. Before submission of the application, the applicant or farmer needs to ensure that his/her farm conforms to the standard laid out by the National Programme for Organic Production (NPOP) for organic crop production.

## **Guidelines for organic certification**

1. General Requirements for Certification
2. Application for Certification
3. Review of Application
4. Scheduling of Inspections
5. Verification during Inspection Standards
6. Continuation of Certification
7. Example: Tamil Nadu Organic Certification Department (TNOCD) Standards for Organic Certification.

## **Organic farming accreditation agencies**

- ❖ APEDA (Agricultural and Processed food products Export Development Authority).
- ❖ Coffee board.
- ❖ Tea board.
- ❖ Spices board.
- ❖ Coconut development board.
- ❖ Directorate of cashew and cocoa board.

## **Conclusion**

Organic certification allows a farm or processing facility to sell, label, and represent its products as organic. The organic brand provides consumers with more choices in the marketplace.



# IMPORTANCE OF SOWING DATES

## FOR THE MAXIMIZATION OF CROP GROWTH AND YIELD



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**D**ate of sowing is one of the prime most important factors affecting the cultivation of any crop. Traditionally farmers have adopted the optimum date of sowing based on the appearance of stars on sky. Even today farmers in many regions start to sow the seeds based on the appearance of specific stars in specific direction. Though many climate smart and multi season varieties have been emerged in the world, sowing of seeds at correct time is the first precautionary measure to prevent crop failure and to increase the production. Hence, let us discuss the importance of sowing dates for maximization of crop growth and yield in this article.

### **Why sowing date is to be necessarily considered for crop production ?**

Sowing date is an important determinant of crop yield. Optimum sowing date is one the most imperative agronomic factors to achieve higher production and to enhance resource use efficiency. Optimum sowing date is different in various agro-ecological conditions

based on the various factors. Sowing at right time under changing climatic condition is necessary to suppress the shrink in critical development stages of crop due to various biotic and abiotic stresses. Sowing date can enhance the qualitative and quantitative traits of crops, when determined accurately and sown at right time.

### **Factors determining the sowing date**

The various factors that determines the sowing date are

#### **I. Crop factors**

1. Crop
2. Variety
3. Duration
4. Photoperiod requirement
5. Method of planting

#### **II. Environmental factors**

1. Location.
2. Season.
3. Rainfall.
4. Water availability.
5. Solar radiation.
6. Pest and disease occurrence.
7. Growing degree days.
8. Photo and helio thermal units.

#### **III. Edaphic factors**

1. Soil temperature.
2. Soil moisture.
3. Topography.
4. Soil aeration.

#### **IV. Socio-economic factors**

1. Availability of good quality seeds.
2. Availability of labour.
3. Economy of farmer.
4. Demand and supply.

### **Optimum date of sowing**

Optimum date of sowing varies from region to region based on various factors. First of all,



optimum date of sowing is determined by the onset of monsoon and timely recipient of rainfall. Optimum soil moisture is necessary for ploughing, sowing and germination of seeds. This optimum soil moisture is provided by rainfall. Once the seeds are sown, they can germinate with the available soil moisture. But subsequent rain or irrigation is necessary for crop emergence and development. Hence the crop growth stages and phenological phases should coincide with the optimum environmental conditions required for crop growth. There should be a regular rainfall in a specific interval of time. Receiving low intensity of rainfall with more number of days is better than receiving high intensity of rainfall in short period of time. If a continuous dry spell or dry weather prevails for a certain period of time especially during the critical growth stage may lead to crop failure. Each crop requires a specific photoperiod such as short and long days for flowering which should coincide with the flowering season. Weather conditions during the crop growth should favour for intercultural operations and pesticide sprays. There should not be heavy rain and weather fluctuation during the maturity stage. High rainfall with heavy wind may cause lodging of crops which act as a major threat for harvesting. Weather conditions should be favourable for postharvest management practices such as threshing, winnowing and drying. By considering all these factors the

optimum date of sowing should be planned and take place. For e.g. In the middle areas of Punjab, the maximum attainable grain yield is generally highest at the sowing date of 20 November narrowly followed by a sowing date of 10 November. Delayed sowing of wheat causes negative impact due to high temperature stress on phenological stages of wheat resulting in the reduction of grain yield. However if the late sown variety is of short duration, it can withstand the stress as it has shorter period of vegetative growth. Hence the varieties of crop play a major role in the choice of optimum sowing date.

### **Adjusted sowing date**

Adjustment in sowing dates is a simple, but powerful tool to ensure increase in agricultural productivity by adapting to the effects of climate change and global warming. Global warming shortens the crop growth duration by accelerating its development. Heat and cold stress are the two emerging abiotic stresses that affect crop production at global level. Physiological processes like photosynthesis rate, starch conversion rate and nutrient metabolism are highly affected by these stresses. In addition to abiotic stresses, various biotic stresses such as insect pests and diseases causes damage to crops. Adjustment in time of sowing is one of the preventive measures in components of Integrated Pest Management to escape from peak season pest attack. Hence there is a need for the change

in sowing date, as it can reduce or prevent the harmful effect of these stresses. Crop simulation studies by various scientists have indicated that adjustment in date of sowing can ensure global food security by preventing the ill effects of climate change. The synchronization of critical phenological stages with favorable weather circumstances ensures promising crop productivity that is merely probable through adjustment of planting dates. Adjusting sowing date to the starting of rainy season ensures optimum growing environment and reduces the danger of water shortage at later crop development stages, thus allowing the greater use of rainwater to potentially enhance agriculture production.

### **Conclusion**

Either optimum or adjusted sowing date should make crop growth and development stages to coincide with possible environmental conditions which are favourable for maximum yield. Sowing date is the most crucial factor that affects the productivity of crops to the foremost extent. Hence, the optimum sowing date should be adjusted according to the prevailing environmental conditions based on the need and necessity, not only in order to increase yield but also to reduce the farmer's expenditure on stress management.



# RURAL ENTREPRENEURSHIP DEVELOPMENT PROGRAMME (REDP)



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A rural entrepreneur is the one who stays in rural areas and contributes to the creation of local wealth by using local resources. And rural entrepreneurship refers to the development of new enterprises which produce new products and create new markets and also create job opportunities in rural areas. Rural Entrepreneurship Development Programme (REDP) is a programme that aims to promote entrepreneurship and self-employment in rural areas. It also provides gainful employment to view to supplement their income.

## Objectives of Rural Entrepreneurship Development Programme (REDP)

1. To develop entrepreneurial and activity-oriented skills among the educated employed rural youth.
2. To set up small/micro enterprises for creation of employment and income opportunities in rural areas.
3. Rural entrepreneurship also focuses to reduce migration of villagers and also protect and promote creative heritage.

4. Rural entrepreneurship also balances the regional development and also removes the income disparity.

## Types of rural entrepreneurship:



## Constraints faced by rural entrepreneurship:

### A. Socio personal constraints:

- Lack of consumer awareness and motivation.
- Low level of education.
- Poor investment due to poor savings.

### B. Technological constraints:

- Lack of regular and effective training.
- Lack of scientific processing, storage and marketing facilities.
- Poor access to inputs.

### C. Economic constraints:

- Lack of finance.
- Non-availability of loan facilities for purchase of inputs.
- High cost of inputs.
- Difficulty and costly maintenance / management of new practices.



### D. Communicational constraints:

- Inadequate access to training programmes.
- Poor infrastructure, particularly transport and communication facilities.
- Poor report of extension agencies.



# CRISPR-Cas9

## A PROMISING TECHNIQUE FOR INSECT PEST MANAGEMENT

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A family of DNA sequences known as CRISPR, or clustered regularly interspaced short palindromic repeats, is present in the genomes of prokaryotes like bacteria and archaea. An enzyme called Cas9 (CRISPR-associated protein 9), uses CRISPR sequences as a guide to detect and cut particular DNA strands which are complementary to the CRISPR sequence. Cas9 enzymes along with CRISPR sequences are the core of CRISPR-Cas9 technique, which can be used to edit genes within organisms.

### Outline of CRISPR

This gene-editing technique CRISPR-Cas9 consists of two basic elements:

- A single guide RNA (gRNA) that matches specified target gene.
- Cas9 is an endonuclease that makes a double-stranded DNA (160kDa) split, enabling the genome to be modified.

### Key findings related to CRISPR

The CRISPR clustered repeats were first described in 1987 by Ishino *et al.* Mojica *et al.* (2000) were the first to report that CRISPR is present in most of the prokaryotes. Jansen *et al.* (2002) coined the term CRISPR. The first evidence that CRISPR acts on DNA was reported by Marraffini in 2008. Hale *et al.* (2009) discovered CRISPR type-III, which cleaves RNA. In 2010, Garneau *et al.* reported that Cas9 causing double strand breaks

with the aid of gRNA. CRISPR-Cas9 as a method for genome editing was experimentally verified in 2012 by Jinek *et al.* Cong *et al.* (2013) made the first discovery of eukaryotic cell genome engineering. Using gRNA, Nishimasu *et al.* (2014) revealed the first crystal structure of Cas9.

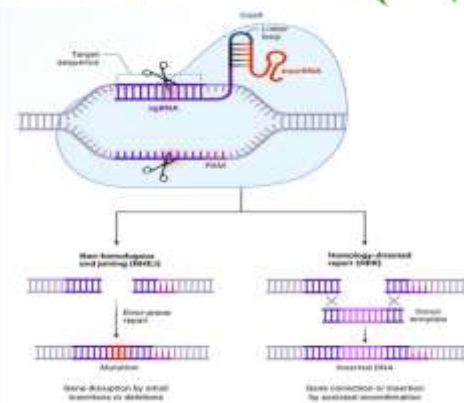
### Mechanism of CRISPR/Cas9 Genome Editing

A gRNA is made up of two noncoding RNA components that have been merged together: a crRNA (CRISPR RNA), which provides Cas9 with target specificity, as well as a Cas9-binding transactivating CRISPR RNA (tracrRNA). It consists of three steps: recognition, cleavage and repair. CRISPR-Cas9 causes precise double-strand cuts at the target region, activating DNA repair processes.

This repairing process led to two distinct kinds of genomic modifications: Constitutive Knock-outs (KO) is formed via non-homologous end joining (NHEJ), whereas Knockins (KI) is produced by homologous directed recombination (HDR).

### Various delivery methods of the CRISPR-Cas9 system in insects

1. Electroporation.



**Figure 1. Flowchart of mechanism of CRISPR-Cas9 technique**

2. Microinjection.
3. Induced transduction .
4. DNA nanoparticles.
5. Lipofection.
6. Cell Penetrating Peptides (CPP).

### Conclusion

The targeted gene of interest can be altered using CRISPR gene editing. Cas9-based gene drives are

**Table 1. A number of insect genes successfully edited using the CRISPR-Cas9 approach is presented below**

Insect	Target genes	Delivery Method	References
<i>Plutella xylostella</i>	Pxabd-A	mRNA+ DNA	Huang <i>et al.</i> , 2016
<i>Helicoverpa armigera</i>	HaCad	mRNA+ DNA	Wang <i>et al.</i> , 2016
<i>Spodoptera litura</i>	Abdominal-A	Microinjection	Bi <i>et al.</i> , 2016
<i>Locusta migratoria</i>	Odorant Receptor Co-Receptor (Orco)	Microinjection	Li <i>et al.</i> , 2016
<i>Anopheles gambiae</i>	AGAP011377 and AGAP007280	Microinjection	Andrew <i>et al.</i> , 2016

perhaps utilised for reducing the pest population. Similarly, vectors can be manipulated to prevent them from carrying and spreading pathogens or to eradicate their population entirely. Indeed, CRISPR-Cas9 can also be used to overexpress or knockdown certain target genes that are responsible for insecticide resistance in insect pests. Therefore, the CRISPR-Cas9 technology has enormous potential for the efficient and sustainable management of insect pests. ■



# GREEN TECHNOLOGY PESTICIDES NECESSARY TO ALL FARMERS



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**A**grochemicals, particularly pesticides, are essential firefighting equipment and the sole way to manage pest outbreaks. One approach to ensure their welfare is through the use of appropriate technology, farmer-friendly policies, and fair prices for the farmers.

Crop protection systems play an important role in protecting a farmer's investment in other inputs. Additionally, it guarantees the security of the nation's food, nutrition, health, prosperity, and environment. We need to support our farmers by giving them the newest technologies, such as environmentally friendly herbicides that are only used in small amounts per hectare. The environment, people, and animals are all much safer when using modern pesticides. They reduce the impact of pesticides on the environment and on agriculture. Recently, our government took a historic step by allowing drones to survey about 70% of India's geographical area. Drone agrochemical spraying can help the vast Indian farming population combat the recurring threat of insects, pests, fungus, weeds, etc.

The goal of the government is to ensure that even the most

marginal farmers have access to the most recent technology. We require these technologies as soon as possible to realise our vision of an agri-led, \$5 trillion US economy for India.

## Significant obstacles

The genuine crop protection industry is serving the country and the world admirably. Realizing India's crop protection industry's full potential is hampered by significant obstacles, some of which are briefly listed below:

- India's need for novel molecules, which is now being hindered by laws and implementation delays;
- The Pesticides Management Bill 2020 must take into account scientific suggestions and be written to address the demands of the post-Covid situation.
- The problem of fake, illegal, imported, bio pesticides that are loaded with chemical pesticides, and a sizable grey market. Even though the GOI took action back in 2010 (notifying the public that such players would be eliminated), nothing more has been done on the ground since then.
- A thorough revamp of the state government's licensing programme, the CIB&RC (Registration authority and Quality Control Systems), and the wholly unnecessary quality control systems.
- Modernizing the Central Insecticides Laboratory, as well as state, regional, and local pesticide testing facilities, which serve as the last line of defence before a pesticide is applied to a

crop. Accreditation by the NABL must be required.

The fourth-largest producer of pesticides in the world right now is India. In India, the domestic pesticides market had a 19–20 value of around 214 billion. I will support Database Research & Markets' forecast that the domestic Indian pesticides market will reach Rs. 316 billion by 2024–25 at an 8.1 percent CAGR if GOI takes decisive action to address the sector's issues.

Indian pesticide exports currently total \$3 billion USD, or 50% of total exports. By creating the appropriate policies, our export may rise to 60–65 percent and reach US\$ 6 billion by 2025. As chairman of the FICCI subcommittee on crop protection chemicals, I directly advocate for the creation of these policies on a daily basis. Although our farmers use the fewest pesticides globally, they are nevertheless accused of indiscriminate use. Agriculture yields have a big potential for increase as long as real new pesticide compounds are utilized correctly and according to protocol.

## Farmer empowerment is a result of new agricultural laws

The productivity of many industries must be increased for Indian agriculture. Our corn, pulse crops, and oil seeds require attention. The three new agriculture laws and the reforms put forth by the prime minister will greatly increase the power of Indian farmers. The most crucial reform is making sure that farmers have stronger marketing resources. The Government of India (GOI) has launched a number of efforts to carry out and monitor the expansion of technologies, the soil



health card programme, the simplification of agriculture credit, the PM Sinchayee Yojna, the Paramparagat Krishi Vikas Yojna, and strengthened credit facilities. The National Agricultural Market (eNAM) platform was developed to give farmers direct market access by connecting them to all of the major mandis in the nation for higher profits. Major crops like rice, sugarcane, cotton, legumes, and oilseeds all have yield gaps that need to be closed. These gaps can be closed by using high yielding varieties, periodically demonstrating stress-tolerant cultivars on farmers' fields based on agro-climatic zone, and adopting prompt measures. Growing concern some methods to ensure their welfare include using the appropriate technology, farmer-friendly policies, and providing them with the appropriate price. Operations for pest management in agriculture today January 2021 with technologies relevant to their locales, extension staff must reach farmers at their doorsteps. Micro irrigation using sprinklers and drippers has proven to be efficient in terms of both cost and results.

### **Infrastructure facilities revisited**

Exports will rise as a result of improved infrastructure. The initiative for lease-lined laws will aid

in the growth of horticultural crop exports. Horticulture is a key industry that helps farmers quadruple their revenue. Following Covid, the demand for horticultural crops, spices, sauces, medicinal plants, and different herbs has grown and will continue to expand. As a result, the farmers will earn more money and have access to work and wholesome food.

### **Agriculture produces marketing**

In order to develop an agriculture market infrastructure, a programme that benefits co-operatives, Panchayati raj institutions, individual farmers, and farmer organizations must be implemented. The popularity of e-NAM (National Agriculture Market) is increasing, which guarantees openness in weighing and eventually helps the farmers. Bright young minds with technological aptitude are entering the agricultural industry thanks to agri-entrepreneurs.

### **Smart Water Use: More Crops Per Drop Smart Water Use: More Crops Per Drop**

There are numerous methods that can boost water efficiency by 30% to 40%. Water is not used effectively because it is not valued as an economic good. Use of sprinkler and drip irrigation can maximize

water use efficiency for rice and sugarcane, respectively. Most likely it's time to set a water pricing. When drinking water is in short supply, wise water management is essential. It is not justifiable to grow groundnuts in the summer in desert regions like Jodhpur with 30 sprays and to draw water from elevations of 1000 or 1500 feet when there is no access to drinking water. For inclusive growth, not just for one criteria, agriculture must be viewed as an industry as a whole.

### **Current credit flow to the farm sector: Banking sector**

In the farming industry, credit is king. The SBI website lists roughly 20–25 different types of loans for farmers. Everything is available, from "Kisaan Credit Cards" to "agricultural term loans" to gold loans, as well as loans for agri-business, clinics, and technology, among other things. However, there aren't enough business owners or new companies in the agricultural industry. The bankers can arrange for safe finance and investments, and this is a crucial part of their job. Farmer wellbeing can be ensured by the use of appropriate technologies, farmer-friendly regulations, and fair prices. The answer is not subsidies.



# MAJOR INSECT PEST OF SPINY GOURD

## (KOKODA) AND THEIR MANAGEMENT

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**Research Scholar**

ANDUAT, Kumargan j, Ayodhya

Spiny gourd *Momordica dioica* Roxb. belongs to the family Cucurbitaceae and under the genus *Momordica*, a genus of annual or perennial climbers that contains about 80 species. A rather common climber, *Momordica dioica*, also known as teasle gourd, kakrol, kankro, kartoli, kantola, kantroli, ban Karola, or small bitter gourd tiny veggie, ovoid to oval. It also goes by the name jangle karela. It is frequently grown for its fruits because they can be used as vegetables. The teasle gourd is a common summertime cucurbitaceous vegetable. This plant's fruits, young twigs, and leaves can be eaten raw or cooked like vegetables. It comes in male and female variations as well as fruited and unproductive varieties. Roxb. *Momordica dioica* tuberous roots are used for vegetative, dioecious reproduction. It has tuberous roots and is a perennial with two sexes. The green fruit is frequently cooked or fried and consumed as a vegetable. lengths between 1.5 and 4 inches, cordate, acute, roughly 3-5 lobed; big, dioecious, and golden flowers; Fruit 1-3 inches long, has a short beak and is heavily covered with soft spines. This climbing creeper is typically found in Ceylon, the Himalayas, Bangladesh, Pakistan, and India. as high as 1200 metres in Assam and the Garo hills of Meghalaya.

### 1. Cucurbit fruit fly (*Bactrocera cucurbitae*)

#### Damage symptoms

Only the maggots cause damage by feeding on near-ripe fruits, riddling them and polluting the pulp. Damage by the maggots of this pest causes oozing of brown, resinous fluid

from fruits and the fruits become distorted and malformed. The maggots feed on the pulp of fruits and cause premature dropping. The attacked fruits decay because of secondary bacterial infection. After the first shower of the monsoon, the infestation often reaches 100 per cent. Damage from fruit flies begins in March and lasts until August or September. Inside the fruit, female flies lay their eggs. When the eggs hatch, the fruit is harmed by the maggots. Infected fruits may contain a lot of maggots. The maggot will drop onto the earth and pupate after 7 to 10 days.

#### Management

- Gather diseased fruits and dried leaves, and then throw them in large pits.
- Change the sowing dates in endemic areas because the fly population is low in hot, dry weather and at its highest during the rainy season.
- To kill pupae, often scrape the soil beneath the vine or till the affected land after the crop.
- Use ribbed gourd as a trap crop and spray adult flies that are congregating on the underside of leaves with flonicamid 50 wg/ha of water.
- To use as a fly trap, place 5 g of wet fishmeal two cm from the bottom of a plastic bag with six holes that are 3 mm in diameter.

### 2. Hadda/spotted beetle

*Henosepilachna dodecastigma* (7-14 spots on each elytra), *H. vigintioctopunctata*; *H. demurille*, *H. implicata* [Coccinellidae (Epilachna = Henosepilachna): Coleoptera].

#### Damage symptoms

In a distinctive fashion, both adults and grubs scrape the lower epidermis of leaves, leaving stripes of uneaten portions behind. A strangled effect is created by the leaves. In cases of severe infestation, plants may

wither when all of the leaves are eaten away, leaving only the veins.

#### Management

- Take adult beetles, grubs, and pupae and eliminate them.
- Early in the morning, shake plants to agitate grubs, pupae, and adults into a pail of kerosene-infused water, or mechanically gather and destroy them.
- Emulsify one litre of Neem oil mixed with 60 g of soap dissolved in half a litre of water, 20 litres of water added to thin the emulsion, 400 g of finely chopped garlic mixed in, and then sprayed.
- Spraying on the crop after dhatura oil and 5% kaner powder.

### 3. Leaf eating caterpillar (*Diaphania indica*)

#### Damage symptoms

A young larva scrapes the amount of chlorophyll. Later, it webs and folds the leaves, feeding inside. Additionally, it consumes blooms and bores into forming fruits.

#### Management

- Gather and eliminate young caterpillars.
- Encourage parasitoid activity with *Apanteles spp.*
- spray any of the pesticides below.
- Garlic extract 5% in spray.
- Azadirachtin 0.15% EC spray.
- Dasparni ark 5% in spray.

### Red pumpkin beetle (*Aulacophora foveicollis*)

#### Damage symptoms

Grubs eat the roots, stems, and fruits that are in contact with the soil. The adult eats leaves and flowers.

#### Management

- Always maintain a tidy field.
- If you plant early, the plant will have passed the cotyledon stage before the beetles become active.
- When you plough the fields right after harvest, you kill the adults that are hibernating.
- Gather and eliminate adult beetles.
- Spray dimethoate 30 EC@ 500 ml, or flonicamid 50 wg.■





# MODELING AND SIMULATION OF PEST INCIDENCE FOR FOREWARNING



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From the 1960s, the scientists started using computers for scheduling the spray, exploring control strategies and managing pest monitoring data. Recently, utilization of computer application is explored in pest management delivery systems and decision support systems (DSS) designed to enhance decision making. In the area of plant protection, computers are useful in myriad ways:

- Storing, retrieving and analyzing data such as survey, surveillance and maintenance of pest incidences.
- Modeling and simulation of pest incidence/forewarning.
- Developing, Decision Support Systems/Expert systems to pest problems leading to decision making.

Simulation is the imitation of the operation of a real-world process or system over time. The act of simulating something initially requires that a model be developed; model represents the key characteristics or behaviors/functions of the selected physical or abstract system or process. The model represents the system itself, whereas the simulation represents

the operation of the system over time. Severity of infestations of the insect pests and diseases differs b/w seasons, regions and individual crops within a region. In the absence of stable, desirable and diverse sources of resistance to the biotic menace, pesticides remain the only effective means to manage them.

Knowledge about the timing of start of infestation of these pests and their gradual progress in advance could enable plan necessary pesticide schedule for the season, region on the particular crop against the specific menace expected. This could be enabled by development of region, crop and pest-specific prediction models to forewarn these menaces. Since these biotic menaces are weather-dependent, weather-based prediction models could be developed to enable manage these pests. Forecast model devising consumes a lot of resources viz., manpower, time etc. Hence, it is important that such resources are provided only to an important crop. The candidate pest should be sporadic and its occurrence, severity, progression should be influenced by weather factors and hence should vary accordingly, should cause economically significant yield losses over large area and availability of timely and quality forecast could enable mitigate the risks due to the occurrence of the same by application of effective economic prophylactic measure. Pest must be potential to cause damage.

## Types of models

If data is available at periodic interval for 15-20 years, the

detailed study can be carried out for different variables of interest. However, depending upon the data availability, different types of models can be utilized for developing forewarning system. The models could be of two types- Between year model and within year model.

## 1. Between year models

These models were developed using previous year's data. An assumption is made that the present year is a part of the composite pop of the previous years and accordingly the relationships developed on the basis of previous data will be applicable for the present year. The forecast for pests are obtained by substituting the current year data into the model developed upon the previous years.

## 1.2 Within year model

Sometimes, past data on pests are not available but the pest status at different points of time during the crop season is available for the current season only. In such situations, within years growth model can be used for forewarning max pest pop, provided there are 10-12 data points b/w time of first appearance of pest and max or most damaging stage.

## Some popular application of successful models in pest monitoring and control

- **Wireless sensor network based forewarning models for pests and diseases in agriculture in groundnut-** Calculated DDs serve as the base to predict whether the pest is in egg or larval stage and thus assists in timing pesticide sprays.
- **CLIMEX simulated predictions of oriental fruit fly, *Bactrocera dorsalis* (Hendel) (Diptera:**



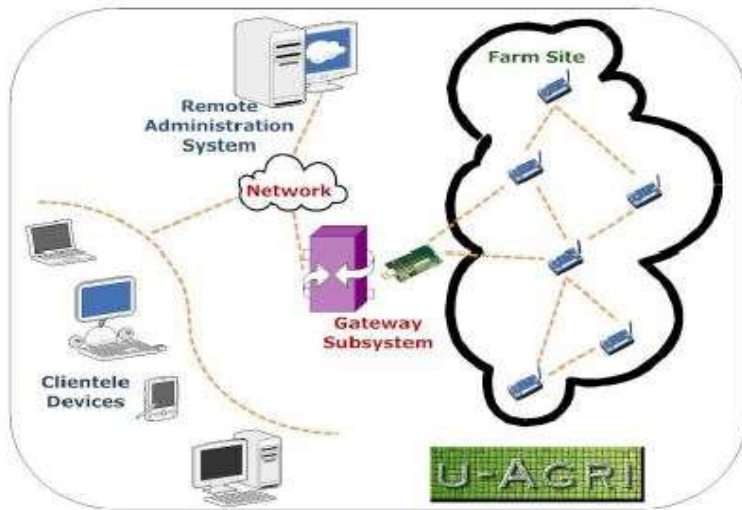


Fig. 1: u-Agri System Architecture

**Tephritidae) geographical distribution under climate change situations in India-** CLIMEX uses two constraints to estimate the potential growth and survival of a population at a given location, i.e. growth (mainly temperature and soil moisture) and stress indices (cold, heat, wet and dry stress). The values of these two indices are clubbed to generate the eco-climatic index (EI), generally scaled between 0 and 20. An EI close to 0 indicates location not favourable for long-

term survival of a species and EI nearer to 20 as highly suitable.

- Assessing aphid infestation in Indian mustard under present and future climate scenarios.
- Spatial dynamics of *Helicoverpa* populations in Australia: simulation modelling and empirical studies of adult movement.
- **Simulation model of *Rhyzopertha dominica* population dynamics in**

### 3) Some other models

Model	Insect pests
Spatially-explicit	Cereal aphid
Pest-Weather Regression	Rice BPH
PENNA	<i>Aphis gossypii</i> & parasitoid ( <i>Lysiphlebus testaceipes</i> )
Med -fly	Mediterranean fruit fly
FENOVITIS	European grapevine moth
Insect Life Cycle Model (ILCYM)	Potato tuber moth
PHENIPS	Bark beetles on spruce trees

**concrete grain bins-** Population density was predicted to be highest in the top center of the bin. The reasons for this are: (1) immigration rates are highest in the top layers of the grain and decrease exponentially in subsequent layers. (2) the periphery of the grain mass cools faster than the center, so pop growth is slower in the periphery.

### Conclusion

Forecasting the peak abundance of pest and diseases in advance helps in timely management of crop pests. The correlation and multiple regression analysis clearly showed the importance of weather factors in predicting the pest and diseases incidence. Bioeconomic, process-level simulation models are effective tools for integrating multiple crop stresses and for evaluating management strategies.

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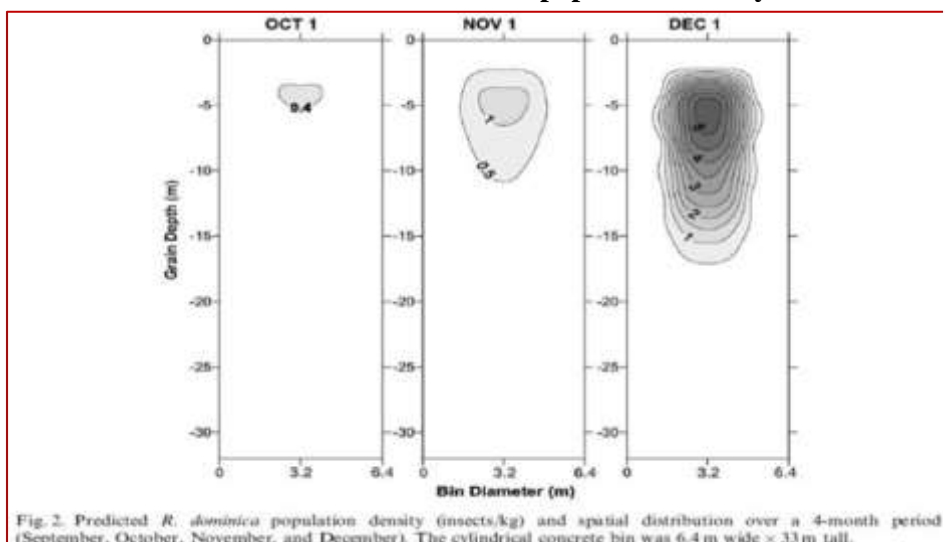


Fig. 2. Predicted *R. dominica* population density (insects/kg) and spatial distribution over a 4-month period (September, October, November, and December). The cylindrical concrete bin was 6.4 m wide × 33 m tall.



# JACKFRUIT

## THE UNDERUTILIZED TREASURE

### OF HEALTH BENEFITS



raw, fragile, and ripened fruits and seeds. Ripe fruit bulbs (without seed) and rind of ripe fruit (along with perianth and unfertilized flowers) have been utilized in a wide range of items.



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The Jackfruit (*Artocarpus heterophyllus*) is the largest tree-borne fruit in the world. It belongs to the family Moraceae. *Artocarpus* is the third largest genus in the Moraceae family. Some of the economically important species, such as breadfruit (*A. altilis*) and Jackfruit (*A. heterophyllus*), are planted across the tropics and it's thought to have originated in the Western Ghats jungles. Jackfruit is the national fruit of Bangladesh and Sri Lanka, as well as the state fruit of the Indian states of Kerala and Tamil Nadu. Kerala is the world's greatest producer of jackfruit, which is an essential staple food for specific groups of people in these areas. Various by-products have been prepared at different places either by traditional methods or scientific methods.

#### Introduction

Jackfruit is a dicotyledonous complex fruit of the jack tree (*Artocarpus heterophyllus* L.). People consume it largely as a fruit when ripe, but also as a vegetable at unripe stage. As a source of vitamins, minerals, and calories, it

considerably contributes to the nourishment of the human body. Jackfruit is high in dietary fiber, making it an excellent bulk laxative. The fibre content protects the colon mucous membrane by reducing the exposure time and binding to cancer-causing toxins in the colon. Fresh fruit contains trace levels of vitamin A in addition to flavonoid pigments like carotene- $\beta$ , xanthin, lutein, and cryptoxanthin- $\beta$ . These chemicals combine & play an important role in antioxidant and cognitive functions. However, because of its innate compositional and textural features, the fruit is perishable and cannot be preserved for an extended period of time. Every year, a significant portion of jackfruit, particularly during the bumper season (June-July), goes to waste due to insufficient post-harvest knowledge during harvesting, shipping, and storing in both quality and quantity. Proper post-harvest technology is thus required to extend its shelf life. Besides, alternate ways of using jackfruits in on-season plays significant roles in reducing postharvest losses. One of the most crucial is processing. It offers diverse and appealing food items to the nutritional menu while also fostering the growth of earnings and employment.

A variety of products have been produced from

Ripe jackfruit bulbs are canned in syrup and used to prepare jams that are either pure or blended with dehydrated bulbs, chutney, jellies, candy, concentrate, and flour. Ripe fruit rinds are processed into jelly. Fruit preservation by processing has been the focus of study in many developed and developing countries, yielding a plethora of technologies.

#### Value-added products from Jackfruit

##### Dehydrated raw jackfruit slices

These can also be called jackfruit chips (Fig 1). Dehydrated Sun-drying or mechanical drying can be used to obtain raw jackfruit slices. Solar drying is a simple, low-cost, and ancient preservation technique. It comes with some drawbacks in comparison to mechanical drying. By using mechanical drying methods, the product's quality can be preserved for an extended period of time. Fresh raw jackfruit bulbs were selected, cleaned, and sliced to make dehydrated jackfruit slices. The slices are dried with or without sulphur. Blanching is then done to



Fig 1: Dehydrated raw jackfruit slices



the bulbs. It is done by soaking the slices in hot, boiling water for 3 minutes. Afterwards, they are dried, chilled, and packed.

### Jackfruit jam

Jam is made by boiling the fruit pulp with sugar until it acquires a thick consistency ( Fig 2). The extracted pulp is mixed with sugar, acid, and pectin and heated at 68.5° brix. A hand refractometer can be used to determine the product's endpoint. When the endpoint is reached jam is packed hot in sterile bottles. Place the jars in a cold, dry location.



Fig 2: Jackfruit Jam

### Jackfruit jelly

Jelly preparation is similar to jam making, with the key distinction here is that jelly (Fig. 3) is produced from strained or clarified fruit extract. To produce a clear, transparent, well-set jelly, the clear extract is boiled with sugar and pectin. Jelly has a TSS of 65° brix.



Fig 3: Jackfruit jelly

### Jackfruit muffins & cakes

It is a baked item made from all-purpose flour, sugar, egg, fat, milk, jackfruit pulp, and baking powder. Jackfruit preserves and cake jeera can be added to the recipe for decorative purposes and flavouring (Fig 4). This same method of



Fig 4 : Jackfruit cake

preparation is almost the same as that of a cake. Following the proper beating, the batter is transferred to muffin pans and baked for 15-20 minutes in a preheated oven at 180°C. Cool and pack properly.

### Jackfruit candy

Candied fruit is a fruit which has been soaked in cane sugar or glucose and then drained and dried. The manufacturing principle of jackfruit candy is osmotic dehydration. Osmotic dehydration is a barrier technology that combines the effect of high sugar content preservation with a high-temperature drying technique. Jackfruit candy is made from slightly ripe jackfruit bulbs (Fig 5). Avoid eating overripe fruits. The bulbs are first cleaned and dipped in a sugar solution of 65-700 brix before being drained and dried in a mechanical drier at 60-62°C until completely dry. It is a food product with intermediate moisture



Fig.5: Jackfruit candy

levels. It should be properly packed and stored.

### Jackfruit wine

Wine is a fermented drink. The fruit is boiled till it becomes soft and once it is boiled, grinds it to a fine paste. The fruit is mixed with water, sugar, and yeast for fermentation after preliminary processing. Cloves & cinnamon are added for flavoring.

### Conclusion

There are a number of by products which can be obtained from jackfruit which are yet to be discovered. These by-products are highly nutritious and can be a healthy alternative to many other processed products. Several studies have been conducted research into the possibility of processing jackfruit into long-lasting and nutritious food products as a result; it is now a pressing issue to reduce losses by developing jackfruit processing techniques. It is anticipated that with the continued growth of agro-based companies, unemployed people would be able to find jobs through auxiliary and beneficial services, making rural living more prosperous in the near future.

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## MIRACLE FOOD

# DRAGON FRUIT



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**D**ragon fruit or pitaya (*Hylocerus undatus*) is a tropical fruit that belongs to the climbing cacti (*Cactaceae*) family. Although the pitaya is a native to the tropical areas of the north, central and south America, it is now cultivated worldwide due to its commercial interest, not demanding cultivation requirement i.e., high drought tolerance, easy adaptation to light intensity and high temperature, a wide range of tolerance to different soil salinities and wide nutritional and medicinal properties which benefits to human health. Dragon fruit is a rich source of vitamin C, calcium and phosphorous. The fruits are used as hypo cholesterolaemic, anti-microbial, antioxidant in constipation, anti-cancer, boost immune system in diabetes, maintain cholesterol level, to promote healthy hair and skin, to prevent anaemia, to improve appetite, vision and brain function.

The plant's name comes from the Greek word "hyle," which means "woody," and the Latin word "cereus," which means "waxen." It also called dragon pearl fruit, strawberry pear, night blooming cereus, belle of the night and cindrella plant.

It grows best in soil with a high level of organic materials. Its

flowers bloom

only at night; hence the plant is sometimes also called the "moon flower" or "Lady of the Night". The flowers, which bloom for only one night, are white and large, measuring 20 cm long or more. They are bell-shaped and are fragrant when in bloom. *Pitahaya* plants can have between four to six fruiting cycles in one year. It can be propagated by seed or by stem cuttings.

The dragon fruit has a dramatic appearance, with bright red, purple or yellow skinned varieties and prominent scales. The fruit is oval, elliptical or pear-shaped. The flesh has a subtly flavoured sweet taste or sometimes slightly sourish taste. The flesh is either white or red, with edible black seeds dotted all over.

### Nutritional and medicinal benefit of the dragon fruit

#### Nutritional composition of dragon fruit (100gm)

Nutrients	Amount
Carbohydrates	11 gm
Protein	1.1 gm
Fat	0.4 gm
Fiber	3.0 gm
Iron	1.9 gm
Vitamin C	9.0 mg
Vitamin B	0.04gm
Calcium	107 mg

Dragon fruit is rich in antioxidants like flavonoids, phenolic acid, and betacyanin. These natural substances protect cells from damage by free radicals -molecules that can lead to diseases like cancer and premature aging.

Dragon fruit was naturally fat-free and high in fibre. It makes for a good snack as it helps to keep full for longer between meals.

Dragon fruit may help lower blood sugar. This might be partly because it replaces damaged cells in pancreas that make insulin, the hormone that helps body break down sugar.

Dragon fruit contains prebiotics, which are foods that feed the healthy bacteria called probiotics in gut. Having more prebiotics in system can improve the balance of good to bad bacteria in intestines. Specifically, dragon fruit encourages the growth of the probiotic's lactobacilli and bifidobacteria. In gut, these and other helpful bacteria can kill disease-causing viruses and bacteria. They also help digest food.

Dragon fruit can strengthen immune system. Dragon fruit is high in vitamin C and other antioxidants, which are good for immune system.

Dragon fruit can boost iron levels. Iron is important for moving oxygen through body and giving energy, and dragon fruit has iron. And the vitamin C in dragon fruit helps body take in and use the iron.

The fruit is commonly eaten raw and is thought to taste better chilled. It is also served as a juice or made into a fruit sorbet. The fruit can be used to flavour drinks, while syrup made of the whole fruit is used to colour pastries and candy. Unopened flower buds can be cooked like vegetables.

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**HYBRID SEED  
PRODUCTION  
TECHNOLOGY IN  
PEARL MILLET**

  
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Pearl millet is a highly cross-pollinated crop due to its protogyny condition of flower. In this condition stigma of the flower emerges first and mature before pollen shedding this condition of flower promote cross pollination. This nature of flowering facilitates the breeding of hybrids and open-pollinated varieties (OPVs).

**Hybrid seed production of pearl millet**  
**Isolation distance**

As pearl millet is a highly cross pollinated crop-recommended isolation distance should be followed strictly. The seed crop must be sufficiently isolated from nearby fields of the same crop as per the requirements of certification standards. Seed village approach is commonly followed for certified seed production to avoid isolation problem. Even after the seed crop is harvested, effective isolation of seed

S. No.	Contaminants (Field standards before harvesting)	Minimum distance (m)	
		Foundation	Certified
1	Fields of other varieties including commercial hybrid of the same variety	1000	200
2	Field of same hybrid (code designation) not conforming to varietal purity requirement for certification	1000	200
3	Field of other hybrids having common male parent and conforming to varietal purity requirement for certification	-	5
4	Field of other hybrids having common male parent but not conforming to varietal purity requirement for certification	-	200
5	Field inspection	3-4	3-4
6	Seed rate (kg/hectare)	Female- 1.5 Male- 0.75	Female-1.5 Male- 0.75
7	Spacing (cm)	75x20	75x20
8	Planting ratio (Female: Male)	6:2	6:2
9	Off types	0.05	0.10
10	Pollen shedders	0.05	0.10
11	Downey mildew diseased plants	0.05	0.10
12	Ear heads affected by ergot	0.02	0.40

from different varieties is essential to avoid mechanical contamination.

**Planting method**

Planting is done either by direct sowing of seed or transplanting the seedlings raised in nursery. Generally, tractor or bullock-drawn seed drills or bullock

plough is used for sowing. A-lines are planted by machine-drawn seed drill and R-lines are planted manually by hand dibbling in rows marked with stakes. Sowing equipment needs to be thoroughly cleaned to avoid contamination during sowing.



## Male-female flowering synchronization

Synchronization of flowering of A-line with R-line in certified seed production plots is essential in order to ensure pollen availability in the R-line when stigmas emerge in the A-line. Synchronized flowering results in good seed set in A-line and higher yields in production plots. The A- and R-line may differ for flowering. Synchronization of flowering of A- and R-lines can also be enhanced by:

- Spray of urea- Hastening of flowering time by 6-8 days can be achieved by 3-4 sprays of 4% urea at 2-3 days interval at boot leaf stage.
- Staggered planting - If the difference in flowering time of parental lines is more, a practice of staggered sowing is followed. In which male parental line planted at different dates.

## Rouging

The process of removal of pollen shedders from A-lines and off-types from parental lines in seed production field is called rouging. Pollen shedders are male fertile plants in an A-line with similar morphology. Pollen shedders in A-line are results of mutations or

## Seed standards for pearl millet

S. No.	Parameters (After harvesting)	Permitted (%)	
		Foundation seed	Certified seed
1.	Physical purity (minimum)	98	98
2.	Inert matter (maximum)	2	2
3.	Other crop seed by number (maximum)	10/kg	10/kg
4.	Weed seed by number (maximum)	10/kg	10/kg
5.	Ergot effected seed by number maximum)	0.020%	0.040%
6.	Germination (%)	75	75
7.	Moisture content (%)	12	12

mechanical mixtures. Off-type plants clearly deviate from the norm in terms of height, flowering season, foliage colour, leaf size, shape, and orientation, tillering, panicle size, or any other morphological feature, as well as plants with diseases.

It may arise through mechanical mixture or out crossing and rarely as mutants. Adequate and timely rouging constitutes the most important operation in seed production. In order to prevent genetic contamination, rogue plants with phenotypes that are different from those of normal plants should be removed and eliminated as early in the plant's development as feasible, before flowering.

Rouging at maturity is also necessary to remove off-types not distinguishable earlier, and contaminants affecting the physical purity of seed. Rouging and sorting out of harvested panicles may be necessary in case of diseased panicles.

## Seed certification

Seed certification consists of several quality control measures that ensure supply of quality seeds to farmers. For this different following test were conducted:

- For Genetic purity- Grow out test
- Germination test.
- Physical purity test.



# AQUATIC VEGETABLES

## WATER GARDEN AS A NUTRITIONAL GARDEN



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The farming of aquatic organisms is called as aquaculture. Vegetables being rich in nutrients can be cultivated in wide range of environments. The vegetables growing in water or marshes are called as aquatic vegetables. They possess numerous health benefits and grown commercially for its edible part. Some of the important vegetables are discussed below and photographically depicted in Fig. 1.

**Water cress (*Nasturtium officinale*, *N. microphyllum*, formerly *Rorippa nasturtium-aquaticum*, *R. microphylla*): Brassicaceae**

It is fast-growing, aquatic/semi-aquatic perennial plants native from Europe to central Asia. It is one of the oldest known leaf vegetables consumed by human beings. The plants are members of the family Brassicaceae, or cabbage, family, botanically related to garden cress and mustard with a peppery, tangy flavour. The hollow stems of watercress are floating and the leaves

are pinnately-compound. Watercresses produce small white and green flowers in clusters. Being semi-aquatic, watercress is well-suited to hydroponic cultivation, thriving best in water that is slightly alkaline. If unharvested, watercress can grow to a height of 50-120 cm. Also sold as sprouts, the edible shoots are harvested days after germination. The foliage of watercress becomes bitter when the plants begin producing flowers. Watercress contains significant amounts of iron, calcium and folic acid, in addition to vitamins A and C. In some regions, watercress is regarded as a weed, in other regions as an aquatic vegetable or herb. From health point, it acts as a mild stimulant, being a source of phytochemicals and antioxidants, a diuretic, an expectorant, and a digestive aid. It also appears to have cancer-suppressing properties, and is widely believed to help defend against lung cancer.

**Water spinach (*Ipomoea aquatica*): Convolvulaceae**

*Ipomoea aquatica* is a semi-aquatic tropical plant grown as a leaf vegetable. Common names include water spinach, swamp cabbage, water convolvulus, water morning-glory, kangkung, etc. *Ipomoea aquatica* grows in water or on moist soil. Its stems are 2-3 m or more in length, hollow, allowing them to float and root at the nodes. The leaves vary from sagittate (typical) to lanceolate, 5-15 cm long and 2-8 cm broad. The flowers are trumpet-shaped, 3-5 cm diameter, usually

white in color. It is most commonly grown in East and Southeast Asia. The vegetable is a common ingredient in Southeast Asian dishes, with the leaves often stir fried with chilli, pepper, garlic, ginger, dried shrimp paste, and other spices.

**Wasabi (*Wasabia japonica*): Brassicaceae**

It is known as "Japanese horseradish" and its root is used as a spice and has an extremely strong flavor. Its hotness is more like that of a hot mustard than the capsaicin in a chilli pepper, producing vapors that irritate the nasal passages more than the tongue. The plant grows naturally along stream beds in mountain river valleys in Japan. The two main cultivars in the marketplace are *W. japonica* cv. 'Daruma' and cv. 'Mazuma'. Recent studies have shown that wasabi contains a natural chemical that can be used against certain cancer cells. This unique root can also be used for oral hygiene and infections. It has been suggested that Wasabi can help prevent cardiovascular diseases like stroke, heart attack, and hypertension. The root can help with diarrhoea, osteoporosis, asthma, arthritis, and allergies as well.

**Chinese water chestnut (*Eleocharis dulcis*): Cyperaceae**

The Chinese water chestnut (*Eleocharis dulcis*; synonyms *E. equisetina*, *E. indica*, *E. plantaginea*, *E. plantaginoides*, *E. tuberosa*, *E. tumida*), more often simply called the water chestnut, is a grass-like sedge grown for its edible corms. It has tube-shaped, leafless green stems that grow to about 1.5 metres. The Chinese water chestnut is native to China and is widely cultivated in flooded paddy fields in southern







**Water cress**



**Water spinach**



**Wasabi**



**Chinese water chestnut**



**Lotus**

**Fig. 1- Different aquatic vegetables**

China and parts of the Philippines. The small, rounded corms have a crisp white flesh and can be eaten raw, slightly boiled, grilled, pickled, or tinned. They are unusual among vegetables for remaining crisp even after being cooked or canned. Because their cell walls are cross-linked and strengthened by certain phenolic compounds, a property shared by other vegetables that remain crisp in this manner, including the tiger nut and lotus root. The corms are rich in carbohydrates (about 90 percent by dry weight), especially starch (about 60 percent by dry weight), and are also a good source of dietary fiber, riboflavin,

vitamin B<sub>6</sub>, potassium, copper, and manganese.

**Lotus (*Nelumbo nucifera Gaertn*): Nelumbonaceae**

Lotus is an aquatic perennial but, if its seeds are preserved under favourable conditions, they can remain viable for many years. The flowers, seeds, young leaves and roots (rhizomes) are all edible. In Asia, the petals are sometimes used for garnish, while the large leaves are used as a wrap for food. The rhizome is used as a vegetable in soups and stir-fried dishes. Petals, leaves, and rhizome can also all be eaten raw, but there is a risk of parasite transmission (e.g.

*Fasciolopsis buski*), so it is recommended they be cooked before eating. Recent studies have shown Lotus roots to be rich in dietary fiber, vitamin C, potassium, thiamin, riboflavin, vitamin B<sub>6</sub>, phosphorus, copper, and manganese, while very low in saturated fat. The stamens can be dried and made into a fragrant herbal tea, or used to impart a scent to tea leaves. The lotus seeds or nuts are quite versatile, and can be eaten raw or dried and popped like popcorn.

They can also be boiled until soft and made into a paste, or boiled with dried longans and rock sugar to made a tong sui (sweet soup).

**Conclusion**

Aquatic vegetables have numerous environmental benefits. Wetlands could be conserved and used by the cultivation of aquatic vegetables. They are also known to involve in the phytoremediation. But some of these plants are pernicious weeds, so they should never be introduced to new locations.



# ROOT KNOT NEMATODE OF GUAVA

## AN EMERGING DISEASE IN WESTERN UTTAR PRADESH



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**G**uava (*Psidium guajava* L.) is an important fruit crop in India. It is native of Mexico or Central America and later spread to Asia, Africa and Europe. Guava occupied fourth position in the world in fruit crops. It is also called as 'poor man's apple' for being nutritionally rich in vitamins and minerals. Guava is tolerant to a wide range of climate and is well adapted to tropical and subtropical climate; hence it is called as 'apple of tropics'. Guava is a good source of vitamin C, carotene, calcium, phosphorus, iron, and carbohydrates. The nutrients can effectively manage diabetes, promote digestive health, and protect the heart. India is the leading producer of guava in the world, shares 44.4 per cent of world production and China is in second place. In India, guava is grown in an area of 2.65 lakh hectares with the production of 40.54 lakh MT and an average productivity of 15.3 MT/ha. Uttar Pradesh ranks first in both area (0.49 lakh ha) and production (9.28 lakh MT).

Guava crop is affected by many biotic and abiotic stresses. Among them, plant-parasitic nematodes viz., root-knot nematodes (*Meloidogyne* sp.), Spiral nematode

(*Helicotylenchus dihystra*), Lance nematode (*Hoplolaimus indicus*) and Lesion nematode (*Pratylenchus coffeae*) are major constraints for profitable guava production. Among plant-parasitic nematodes, root-knot nematode is wide spread and infects more than 2000 plant species. Root-knot nematode is most problematic in horticultural crops, particularly in fruit crops such as pomegranate, guava, papaya, grapes etc. and cause the average annual losses of 10-69 % in India. The guava root knot nematode, *M. enterolobii* was first reported in Ayakudi (Dindigul district) of Tamil Nadu in India. This nematode is spreading very fast in the western UP and became a serious concern in guava orchards.

### Distribution

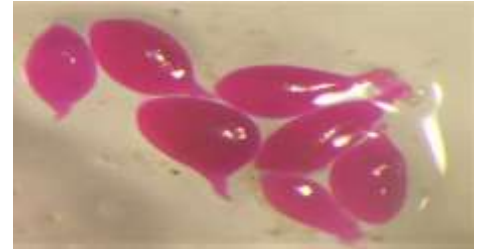
The guava root-knot nematode is found in tropical to subtropical areas of the world, including Central and South America, Africa and Asia. In India, the nematode was reported from Tamil Nadu, Karnataka, Uttar Pradesh, Rajasthan, Madhya Pradesh, Uttarakhand, Delhi, Andhra Pradesh, Telangana, Gujarat, Kerala, Haryana and West Bengal (reported from AICRP Nematodes centres).

### Biology and movement

The young juveniles of the nematode hatch from eggs in the soil and migrate toward root tips of susceptible plants. The nematode enters the roots, sets up a permanent feeding site and begins developing into a mature female. During this process, large galls, or swellings, of the root tissue may form in



Male



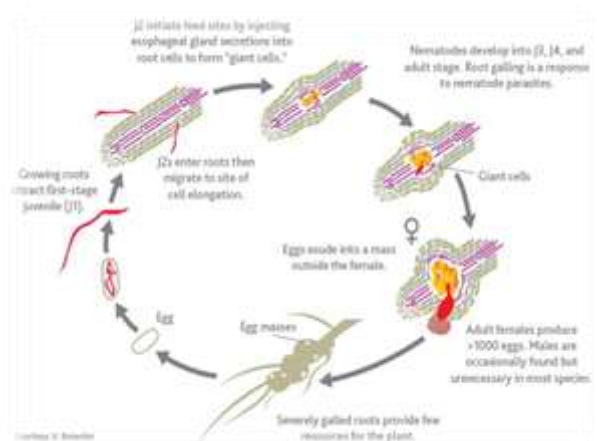
Female

association with the developing female. Although the nematode itself cannot move very far in the soil, it can easily spread by any outside force that moves soil, such as farm equipment, irrigation or heavy rainfall. Nematode problems in fruit crops originate at two stages. First, through infected planting materials from nurseries and secondly, from the main field soil; the former inflicts more damage.

### Life cycle

Root-knot nematodes are sedentary endoparasites. Saccate females are completely embedded inside the root galls, with heads located near the vascular tissues and terminal portions near the root epidermis. Reproduction is generally parthenogenetic. Males are vermiform, wander in soil and are non-parasitic. The rectal glands of the females secrete a gelatinous substance on the root surface in which eggs are deposited. Oviposition continues for 10-12 days, each female lays about 200-400 eggs held together in an egg-mass or egg-sac. Occasionally, egg-masses may be formed inside roots, particularly in compound galls. Embryogenesis takes about 10-15 days and each egg-mass contains





**Healthy seedling**



**Infected seedling**

eggs at different stages of development.

### Symptoms

#### A. In nursery

- The severely infected plants exhibit general symptoms of yellowing/bronzing in leaves.
- The diagnostic symptom is root galls which are not visible because these are concealed inside the polybags. (Neither the nurserymen nor the orchardists are aware of the inception).

In order to confirm root-knot nematode infestation, one has to tear open the polythene cover, remove the soil gently, wash the roots and look for conspicuous galls or minute bulges that may be microscopic.

#### B. In field

Severely infected plants may remain stunted and the leaves turn into yellow and dry up. The plants defoliate showing bare twigs. However, diagnostic symptoms can be seen on the roots. The whole root system may be variously galled. With time, such galled roots start showing rotting symptoms. Guava wilt or guava decline manifests itself in two ways. First the plants dry up partially or completely within a couple of weeks, the guava wilt, which is typically caused by *Fusarium* spp. with or without the

involvement of nematodes. Second, the plants start drying up slowly with leaves turning yellow, shedding of leaves, and plant mortality occurs gradually over a period of a few months, the slow wilt or decline, that is typically caused by the root-knot nematode.

### Management

- Use nematode free nursery plants to prevent the spread or entry of nematodes
- Don't allow irrigation water from infested orchard to healthy plants to prevent the spread of nematodes.
- Solarization can reduce nematode populations in the top 12 inches of soil. For effective solarization, moisten the soil, then cover it with a clear, plastic tarp. Leave the tarp in place for 4 to 6 weeks during the hottest part of summer. Root knot nematodes, including eggs, die when soil temperature exceeds 125°F for 30 minutes or 130°F for 5 minutes.
- Application of organic amendments to the soil can reduce the nematode losses in crop plants.
- Grow trap crops such as marigold (*Tagetes* spp.) which produces allelochemicals like  $\alpha$ -terthienyl and bithinyl, suppress plant parasitic nematodes. Allyl-



**Close view of infected root**

isothiocyanate is another allelochemical derived from the roots of mustard, which reduces the population of plant parasitic nematodes.

- Biological control of nematodes can be achieved by application of microorganisms like *Trichoderma harzianum*, *Paecilomyces lilacinus* and *Pasteuria penetrans* etc. (@10 gm/plant at the time of planting).
- Use nematicides such as Nimitz @ 25 g/plant at the time of planting for the management of nematode. These chemicals can be applied prior to planting, at planting, or after planting through soil drenching, or drip irrigation, to reduce population densities of nematodes and protect crops from damage.
- For already established orchard, the doses of the bioagent as @40-50g/plant and Nimitz @ 50-60g/plant.

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# ABA METABOLISM IN SEED DEVELOPMENT



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Plant physiologists suspected that the phenomena of seed and bud dormancy were caused by inhibitory compounds, and they attempted to extract and isolate such compounds from a variety of plant tissues, especially dormant buds. From early experiments led to the identification of a group of growth-inhibiting compounds, including a substance known as *dormin* purified from sycamore leaves collected in early autumn, when the trees were entering dormancy. Upon discovery that *dormin* was chemically identical to a substance that promotes the abscission of cotton fruits, *abscisin II*, the compound was renamed abscisic acid (ABA), to reflect its supposed involvement in the abscission process.

## ABA metabolism

The seed is an important organ in higher plants; it is an important organ for plant survival and species dispersion. The transition between seed dormancy and germination represents a critical stage in the plant life cycle and it is an important ecological and commercial trait. A dynamic balance

of synthesis and catabolism of two antagonistic hormones, abscisic acid (ABA) and gibberellins (GAs) controls the equilibrium between seed dormancy and germination. Embryonic ABA plays a central role in induction and maintenance of seed dormancy and also inhibits the transition from embryonic to germination growth. Therefore, the ABA metabolism must be highly regulated at both temporal and spatial levels during phase of desiccation tolerance.

Seed dormancy, a temporary quiescent state that is observed in seeds from many plants species, prevents untimely germination and ensures plant survival by adjusting vegetative development to seasonal changes in the environment. ABA metabolism in seeds gives information about the transition between seed dormancy to seed germination.

## Biosynthesis of ABA

In developing seeds, ABA is necessary for inducing the synthesis of reserve proteins and lipids as well as for the onset of seed dormancy and the acquisition of desiccation tolerance. Endogenous ABA levels peak during seed maturation and the onset of primary dormancy. ABA also plays important roles in vegetative development in response to various environmental stresses such as drought and high salinity conditions.

ABA is a sesquiterpene derived from oxidative cleavage of

phytoene, a C<sub>40</sub> common precursor of all plant carotenoids which are synthesized in plastids by nuclear-encoded enzymes. The phytoene is synthesized by phytoene-synthase after condensation of two molecules of geranylgeranyl diphosphate (GGPP), a C<sub>20</sub> formed from isopentenyl diphosphate (IPP) and its isomer dimethylallyl diphosphate (DMAPP). The IPP can be synthesized from mevalonic acid (MVA), via the cytosolic MVA pathway and subsequently sent to the plastid, or alternatively formed from 1-deoxy-D-xylulose 5-phosphate (DXP) which is synthesized in plastid from pyruvate and glyceraldehyde 3-phosphate, via the methylerythritol phosphate pathway. The all-trans-lycopene synthesized from phytoene is successively converted in  $\beta$ -carotene and zeaxanthin, the first oxygenated carotenoid precursor of ABA, which produces successively antheraxanthin and trans-violaxanthin mediated by ZEP. The all-trans-violaxanthin is either converted to 9-cis-violoxanthin or to 9'-cis-neoxanthin, both C<sub>40</sub> carotenoids being cleaved in the plastid to the C<sub>15</sub> aldehyde xanthosine and a C<sub>25</sub> compound.

The 9-cis-epoxycarotenoid dioxygenase (NCED) catalyzes the oxidative cleavage of the 9-cis-violoxanthin or 9-cis-neoxanthin, synthesized from all-trans-violoxanthin to produce 9-cis-xanthoxin. It is suggested that 9-cis-neoxanthin might be the major substrate in vivo of NCED to produce cis-xanthosin, the first cytoplasmic precursor for the catalytic conversion to ABA. NCED expression in response to environmental stresses is so rapid that NCED activity is considered the



rate-limiting step in ABA biosynthesis.

### Catabolism of ABA

ABA catabolism is categorized into two types of reactions: hydroxylation and conjugation. Normally, the ABA is converted into a compound hormonally inactive and unstable (i.e. 8'-hydroxy ABA) through the intervention of the ABA 8'-hydroxylase, which is a cytochrome P450 monooxygenase (P450), whose family has four members in Arabidopsis (*AtCYP707A1-4*;44). Alternatively, ABA can also be hydroxylated at position C-7'. The 8'-hydroxy ABA isomerizes spontaneously to phaseic acid (PA) and is further catabolized to dihydrophaseic acid (DPA) by an unknown soluble reductase enzyme. Both PA and DPA as ABA can be conjugated to compounds of low molecular weight (i.e. UDP-glucose to ABA by means a glycosyl transferase activity). The decrease in ABA during both barley and Arabidopsis seed imbibition is associated with increase in PA. It is likely that the ABA hydroxylation is involved in seed dormancy. *CYP707A1* and *CYP707A2* genes have been shown, respectively, to play roles in the reduction of ABA

content in the embryo at mid-maturation and in both the embryo and endosperm during late maturation. The high abundance of *CYP707A2*-Mrna in the dry seeds, and its transient expression pattern during early imbibition (6 h), suggests that ABA degradation in seeds is mainly achieved by the *CYP707A2* isoform.44,53 *CYP707A2* is a single copy gene that displays only subtle phenotypes during other developmental stages outside the seed which makes it ideal for genetic manipulation. The *CYP707A2*-mRNA is localized in the radicle tip and the micropylar endosperm during early imbibition, suggesting that the ABA degradation is mediated by the *CYP707A2* enzyme expressed in these tissues. It is speculated that endosperm weakening is delayed in the Arabidopsis *cyp707a2* mutant due to impaired ABA degradation and that is, at least in part, the reason for the higher ABA sensitivity of the *cyp707a2* endosperm rupture.

### Genes involved in ABA biosynthesis and catabolism

Genes involved in ABA biosynthesis	Genes involved in ABA catabolism
ABA 1	OH- ABA FAMILY GENES
ABA 2	At- CYP707A1
ABA 3	At- CYP707A2
ZEP	At- CYP707A3
NCED	At- CYP707A4
AAO 3	Os- ABA 8ox 1-3

Free ABA is also inactivated by covalent conjugation to another molecule, such as a monosaccharide. A common example of an ABA conjugate is ABA-b-D-glucosyl ester (ABA-GE). Conjugation not only renders ABA inactive as a hormone; it also alters its polarity and cellular distribution. Whereas free ABA is localized in the cytosol, ABA-GE accumulates in vacuoles and thus could theoretically serve as a storage form of the hormone. Finally, the glucose-induced delay of seed germination is a consequence of an increase in the expression of ABA biosynthesis genes (v.e. *AtABA2* and *AtNCED3*)58 or suppression of ABA catabolism genes (v.e. *OsABA8ox2* and *OsABA8ox3*)59 by glucose signaling.



# PROTECTION OF CROP GENETIC RESOURCES

## INDIAN SCENARIO



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Climate variability highly demands the development of new crop varieties for sustainable economic and social development, since crop varieties are the sole producers of food for all human beings. The plant genetic resources (PGR) provide the valuable genes to develop new crop varieties to cope with the production challenges in the changing climatic situations. The conservation, protection and sustainable use of genetic resources have become a major concern in countries due to the depletion of biological resources as a result of climate change and anthropogenic activities. By protecting Intellectual Property Rights (IPR) over genetic resources, each country can ensure sovereign rights over its biological resources and crop varieties.

Recognizing the need for the conservation and protection of IP rights over genetic resources and in compliance with several international treaties and agreements like World Trade Organization (WTO), International Treaty on Plant Genetic Resources on Food and Agriculture (ITPGRFA) and Convention on Biological Diversity (CBD), several legislations have been enacted in our country. India has implemented the Biological

Diversity Act, 2002 to protect the rights of the country over its biological resources, to regulate its access and to ensure the equitable sharing of benefits arising out of its utilization. Protection of Plant Varieties and Farmers' Rights (PPV & FR) Act, 2001 is a unique law for encouraging the development of new varieties and the protection of IP rights over new and traditional crop varieties while ensuring the plant breeders, farmers and researchers rights. The provisions of these Acts for conservation and IP protection of PGR and their implications in crop development are discussed below.

### Protection of biological diversity

Modern techniques of genetic engineering, allele mining and bioprospecting have added an increased pressure over dwindling biological resources. This led to enhanced awareness about the significance of conservation, IP protection and sustainable use of valuable genetic resources available in each country. Indian subcontinent is a mega diversity centre of the world with a rich and varied heritage of crop genetic resources including four biodiversity hotspots namely, Himalayas, Indo-Burmese region, Western Ghats and Sunderland. In accordance with CBD, the valuable PGRs in India are protected by implementing Biological Diversity Act, 2002 (GOI, 2003) and Biological Diversity Rules in 2004. The key objectives of this Act are the conservation and sustainable use of biological diversity as well as fair and equitable sharing of the benefits of using genetic resources. In addition to protecting the interests of Indian researchers, the Act also

safeguards the interests of the local people, farmers and cultivators of biological diversity. In-depth knowledge of the provisions of this Act is a must for the protection and sustainable use of our genetic resources.

The Act is implemented through a three-tiered institutional framework. The National Biodiversity Authority (NBA) at national level, supported by State Biodiversity Board (SBB) at state level and Biodiversity Management Committee (BMC) at local level regulate access to PGRs. The NBA keeps a watch over the biological diversity of the country by protecting the IP rights over the genetic resources, checking biopiracy, advising Government on endangered and endemic species, regularizing equitable sharing of benefits arising out of access to bio-resources and sustainable use of biodiversity. NBA deals with accessing and obtaining IP rights over inventions developed from biological resources and traditional knowledge. SBBs regulate the access to bio-resources by Indians for commercial purposes and impose restrictions on activities that violate the conservation, sustainable use and equitable sharing of benefits. India Biodiversity Awards is given every year since 2012 to recognize and encourage individuals and institutions for their efforts in conservation and sustainable use of biological resources along with fair and equitable sharing of benefits.

### Protection of crop varieties

The presently cultivated crop varieties are evolved by plant breeders from the conserved crop genetic resources applying traditional plant breeding tools and



modern genetic engineering techniques. IP rights over new, extant and traditional varieties are protected through the grant of Plant Breeders' Rights (PBR) and farmers' rights. PBR is an IP right that confers exclusive rights to the breeder for a specific period of time, to multiply, market, export, import and stock the propagating material of the protected variety. This right is granted to plant breeders to encourage the development of new varieties of plants to meet the challenges of the future and to ensure high quality seeds for the farming communities. India accepted Farmers' Rights to recognize the efforts made by the farmers for the conservation and sustainable use of PGRs for future generations. India has ensured Farmers' Rights under the Act, making it the first country to ensure the rights of farmers. Farmers are recognized as the cultivator, conservator and breeder of crop varieties. Farmers can register their own varieties and have the right to save, use, sow, re-sow, exchange, share or sell the seeds of registered varieties. Researchers' Rights are granted to use the protected crop varieties for conducting experiments and in the development of new crop varieties. But, the authorization of the breeder is necessary if the registered variety is repeatedly used for developing a new variety.

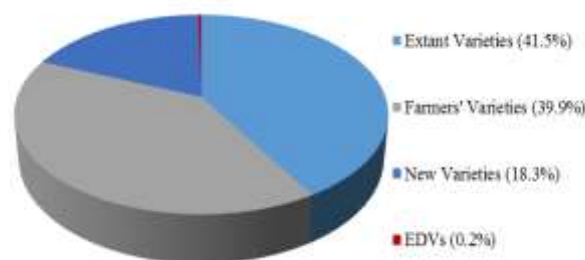
Merging the rights of Plant Breeders, Farmers and Researchers, India developed 'Protection of Plant Varieties and Farmers' Rights (PPV & FR) Act', 2001 (GOI, 2001) to ensure a *sui generis* system for plant variety protection in line with Article 27.3(b) of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs) under WTO. The Act came into force in 2005 and led to the establishment of the Plant Varieties and Farmers' Rights Authority (PPV & FRA) at

New Delhi for the effective implementation of the Act. The protection of plant varieties in India is ensured through registration.

PPV & FR Act ensures the IP protection of different classes of crop varieties like new varieties, extant varieties, farmers' varieties and Essentially Derived Varieties (EDVs). The PPV & FR Act allows the registration of new plant varieties that fulfil the conditions of novelty, distinctiveness, uniformity and stability (DUS). The rights over a variety are for a period of 15 years for both annuals and extant varieties and 18 years for trees and vines. Provision for benefit sharing to the local communities or farmers for their contribution in sharing PGR for the development of new improved varieties is also included in this Act. The Act also provides for compulsory licensing of a protected variety in case the seeds or the propagating material are not readily available to the public at an affordable price or in sufficient quantity. To encourage and reward the farmers or farming communities for their contribution in agrobiodiversity conservation, the Authority established the Plant Genome Saviour Community Award, Farmer Reward and Recognition certificates. A National Gene fund has been established for these and a National Register of Plant Variety is also maintained by the Authority.

PPV & FR Authority commenced the registration of crop varieties developed in India in 2007. At present, a total of 172 crop species are open for registration in cereals, millets, pulses, vegetables, oil seeds, plantation crops, fiber crops, sugar crops, spices, fruit

crops, flowers medicinal and aromatic crops. Also, the DUS centers are also established across the country to verify the varieties applied for registration and to develop crop specific DUS guidelines. Till October 2022 a total of 5034 certificates were issued under various categories of crops. This includes 1409 extant notified varieties, 679 extant varieties of common knowledge, 927 new varieties, 2005 farmers' varieties and 14 EDVs were registered under different classes of varieties (PPVFRA, 2022). Among the different categories of crop varieties, cereals (3347) mainly rice varieties were registered followed by maize and sorghum.



## Conclusion

In India, the protection of crop genetic resources is of major concern as these are the basics for crop improvement for sustainability in the era of changing climatic situations and degradation of the ecosystem. To protect IP Rights over genetic resources, India has successfully explored several legislations like the Biological Diversity Act, 2002 and the Protection of Plant Varieties and Farmers' Rights (PPV & FR) Act, 2001. These Acts have made a major shift in the area of biodiversity and crop genetic resource protection and provide the IP rights over these genetic resources.

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# IMPACT OF ENDOCRINE DISRUPTING CHEMICALS IN PLANTS



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Diverse compounds known as endocrine disruptive chemicals (EDCs) can harm human health by influencing any physiological body system that is sensitive to hormonal fluctuations. Concern has been raised about a plant's capacity to absorb, transport, and destroy EDCs. EDC exposure in people, as well as other animals that eat the plants, can be influenced by degradation pathways connected to plants. EDCs may be present in a plant without having any obvious effects on growth, but they may still have harmful effects on critical plant systems and physiology that are not immediately obvious. Processes including photosynthesis, plant metabolism, hormone production and responses, etc. are responsible for these impacts.

## Importance of study of EDC

One of the most common issues that farmers encounter globally is contamination from EDCs and other chemicals, and this issue has many different facets. The present study clearly implies that EDCs have a considerable potential to damage plants, but a literature

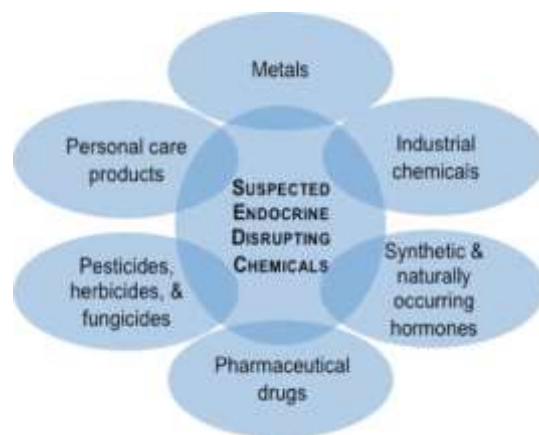
analysis also reveals another crucial component of the issue: many plants cultivated for human consumption have the capacity to absorb and translocate EDCs into plant tissues being farmed.

## Effect of EDCs on plant

- The assembly of cell wall components and actin filaments, as well as calcium efflux and diminished phosphatase activity, were all effectively suppressed when *Picea meyeri* was exposed to various concentrations of BPA. These effects all contributed to the constricted development of pollen tubes.

- In *A. thaliana*, it was found that hydroxy atrazine, altered a number of other pesticide-responsive genes. The genes in question were suspected to be involved in pesticide metabolism, pesticide metabolism response, and developmental stress signaling.

The endocrine system is thought to be affected negatively by tens of thousands of substances, which might affect both humans and wildlife.



Source: Xu *et al.*, (2018). Rapid, High-Throughput Detection of Endocrine Disrupting Chemicals Using Auto Bioluminescent Cellular Bioreporters

**Table 1: Different important sources of EDCs**

S. No.	Use	Example EDCs
1.	Pesticides	DDT, chlorpyrifos, atrazine, 2,4-D, glyphosate
2.	Children's products	Lead, phthalates, cadmium
3.	Food contact materials	BPA, phthalates, phenol
4.	Electronics and Building materials	Brominated flame retardants, PCBs
5.	Personal care products, medical tubing	Phthalates
6.	Antibacterial	Triclosan
7.	Textiles, clothing	Perfluorochemicals

## The case of pesticides

A number of pesticides are suspected or proved to act as endocrine disruptor compounds (EDCs). Although these compounds are chosen to impact specific stages in the target organism(s) that are absent in non-target creatures, they are poisonous since they are meant to kill live things. Acute eradication of undesirable species is also their intended application, and most toxicity evaluations are conducted in real-world settings rather than in long-term studies. Additionally, xenogeneic compounds often have the potential to be endocrine disruptors under long-term conditions.





## Regulatory matters

Concern over the possible negative impacts of endocrine-disrupting chemicals on both human health and the environment peaked to the point that the US Congress was forced to act in 1996. The Federal Food, Drug, and Cosmetic Act (FFDCA) was amended to

include language directing the US EPA to "determine whether certain substances may have an effect in humans that is similar to an effect produced by a naturally occurring oestrogen, or such other effects as the Administrator may designate."

The US EPA established the Endocrine Disruptor Screening

Program (EDSP) in response to the law in 1996, and the Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC) was established to offer guidance on the implementation of the screening programme.



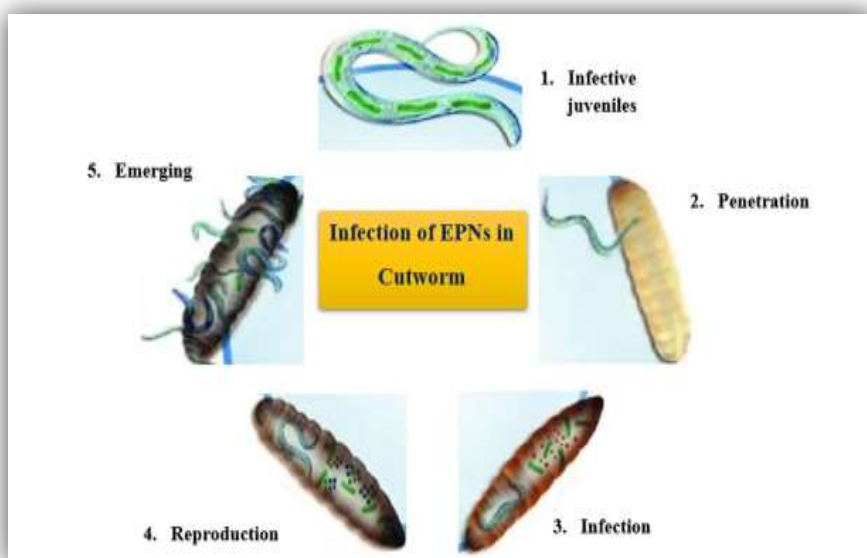
# ENTOMOPATHOGENIC NEMATODES

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Entomopathogenic nematodes are tiny, soil-dwelling worms that are scrounging to pest insects. Some species of *Heterorhabditis* and *Steinernema* are on hand in numerous trade formulations, above all for controlling soil insect pests. Steiner found the first insect-killing nematode *Aplectana kraussei* in 1923, which is now regarded as *Steinernema kraussei*. These discoveries are not gaining people's attention toward the pathogenicity in insects until *Neoaplectana carpocapsae* and DD-136 strain were isolated from the larvae of codling moth (Dutky and Hough 1955).

Nematodes have a symbiotic association with bacteria, families Steinernematidae are symbiotically associated with *Xenorhabdus* genus of bacteria and bacterial genus *Photorhabdus* is symbiotically associated with family Heterorhabditidae. Due to this mutualistic association, nematodes are regarded as effective biocontrol agents.

## Mode of action of entomopathogenic nematodes

Infective young one of nematodes vigorously search for their specific host and go through natural openings such as the mouth

(Food pipe), spiracles (Tracheal pipe), and anus (Excretory pipe) or the intersegmental membrane (between). On one occasion within the host corpse, these nematodes discharge symbiotic bacteria which slaughter the host throughout bacterial septicemia. *Heterorhabditis* species carry *Photorhabdus* species bacteria and *Steinernema* species carry *Xenorhabdus* species bacteria.





# CHANGE IN DECISION MAKING OF FARMERS THROUGH WEATHER BASED AGRO ADVISORIES

## A STUDY OF DAMU PROJECT



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Weather is the most important factors determining success or failure of agricultural production in any region. It effects on every stage of growth of crop. Any variability in the weather during the crop season, such as delay in the monsoon, excessive rains, flood, droughts, spells of too-high or too-low temperatures would affect the crop growth and finally the quality and quantity of the yield. The losses in crop can be reduced by proper crop management by timely weather forecasts. Weather forecast also provides scope for selection of crops best suited to the anticipated climatic conditions. The objective of the weather forecasting is to advice the farmers on the actual and expected weather and its impact on the various day-to-day farming operations like sowing, weeding, time of pesticides

spray, irrigation scheduling, fertilizer application etc. and overall crop management. Weather forecast helps to increase agriculture production, reduce losses, risks, reduce costs of inputs, improve quality of yield, increase efficiency in the use of water, labor and energy and reduce pollution with judicious use of agricultural chemicals. The benefit by the farmers using agromet advisory bulletin and weather forecast for making farm level decisions by farmers from different village have been.

### DAMU

The District Agromet Unit (DAMU) located at KVK, in each district has been serving the farming community in respective district of India. The major objective of this programme is to advise timely and need-based crop management practices. Weather forecast on rainfall, maximum and minimum temperature, wind speed, wind direction, cloud cover, maximum and minimum humidity are being received on every Tuesday and Friday from IMD, New Delhi. Once the forecast was received, the

experts' opinion from different disciplines was obtained. Based on the advice, the agro advisories are being prepared on every Tuesday and Friday in Telugu as well as in English. These advisories are sent to IMD for preparation of national bulletins and are uploaded on the IMD website ([www.imdagri-met.gov.in](http://www.imdagri-met.gov.in)) in both telugu and English. Bulletins are regularly disseminated to the farmers on real time basis through telephone/ E-mail/SMS, majorly by Whatsapp. Agro-met advisory bulletins are also sent to local Telugu newspapers for publication. The bulletins are also sent to NGO, FPO, ATMA, State Agriculture and All India Radio through E-mails. Progressive farmers have been taking keen interest in the agro-advisories and are the foremost beneficiaries and spread of bulletin by sharing and add other farmers in the group. The weather forecast based agro-advisory bulletin contains a summary of previous weeks' weather, deviation of weather from the normal value, weather forecast information for the next five days, crop management, which is based on weather forecast and giving warning



to the farmers well in advance, regarding rainfall variation, its amount and other weather variables including pest/disease problems. Thus, farmers can decide on crop management options, application of nutrients and strategies to overcome other problems.

Weather forecast and weather based agromet advisories help in increasing the economic benefit to the farmers by suggesting them the suitable management practices according to the weather conditions.

**Farmer awareness programmes**

Under DAMU project, the farmer awareness programmes were conducted at each sub division level and at KVK as and when on-campus trainings going on. The DAMU staff will explain about the importance of weather based forecast on daily agricultural activities, convince the farmers about knowing of forecast before every farm operation.

The farmers were trained to install and use of Meghdoot app in their smart phones to regularly check the current, past weather data, forecast for next five days and real time agro advisories for different crops in the location and allied sectors like animal husbandry and fisheries. Damini app to get notifications about lightning and thunder storms for the specific location.

**Impact of weather based agro advisories on rice cultivating farmers**

The adaptation of agromet advisory bulletin and economic impact of agromet advisory services for Rice during Kharif 2020-21 and 2021-22. For assessing the impacts

of agromet advisory services, users of agromet advisory services (DAMU farmers) and non-users of agromet advisory services (non DAMU farmers) were selected for rice crop. The study was conducted in 38 mandals of Srikakulam district, at KVK, Amadalavalasa, Andhra Pradesh.

Results showed that the farmers who followed the agromet advisories (DAMU farmers) are able to reduce the input cost up to Rs.1950 and increases the net profit by Rs. 3775 in rice as compared to the non DAMU farmers, who did not follow the weather based information. DAMU farmers were able to reduce the input cost up to Rs. 1950/acre in rice. Increases in the net profit were Rs. 3775/ acre in rice compared to the non DAMU farmers. More net returns of DAMU farmers over non-DAMU farmers can be due to low input cost, following weather based management practices and timely management of pests and diseases. This profit was due to the crop management done by the farmers such as timely land preparation and sowing, adoption of recommended seed rate and suitable varieties, timely weeding, harvesting and irrigation and pesticide applications, according to agromet advisory bulletins.



Installation of Mghdhoot, Damini apps in farmer mobile



Timely advisory to Rice-farmers

The application of agromet advisory bulletin, based on current and forecasted weather is a useful tool for enhancing the production and income. DAMU farmers received weather forecast based agro-advisories, including optimum use of inputs for different farm operations. Due to judicious and timely utilization of inputs, production cost for the DAMU farmers reduced. The increased yield level and reduced cost of cultivation led to increased net returns.

Based on the above success story of DAMU farmers, the farmers are habituated to knowing of weather forecast before every farm operations and reduce the cost of farming and yield loss and damage by the unexpected weather.



# REVITALISING NORTH EAST INDIA THROUGH AGRI-BUSINESS INTERVENTIONS



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Agriculture plays a vital role in India, provide highest employment (directly or indirect) than on any other sector, addresses malnutrition and provides food security, augmenting economic growth (4%). Similarly, in north east region of India, share of processing, distribution and trade has improved over the years due to tireless efforts of incubation centres, agri-business departments of state and central institutes, government policies on food processing, infrastructure and capacity building.

## Government initiatives to revitalize Agri-business in the North Eastern Region

In this article, the authors shall discuss few Government schemes which have boosted agribusiness in North East region.

### 1. PM Formalization of Micro Food Processing Scheme

The Ministry of Food Processing Industries (MoFPI) has launched the PM Formalization of

Micro Food Processing Scheme on 29<sup>th</sup> June 2020. The PM FME scheme intends to provide financial, technical and business support to upgrade existing micro food processing enterprises. It is a part of India's self-reliant scheme called *Atmanirbhar Bharat Abhiyan*; and 'Vocal for Local' Campaign.

### 2. Mega Food Parks Scheme

Mega Food Parks Scheme launched by the government in 2008 provides financial assistance up to 50 crores to set up modern infrastructure facilities for food processing called Mega Food Parks. It establishes a mechanism to bring together farmers, processors and retailers and link agriculture production to the market to ensure maximization of value addition, minimization of wastage and improving farmers' income. The primary objective of the Scheme is to provide modern infrastructure

### MEGA FOOD PARK MODEL



facilities for the food processing along the value chain from the farm to the market with a cluster-based approach based on a hub and spokes-model. It includes the creation of infrastructure for primary processing and storage near the farm in the form of Primary Processing Centres (PPCs) and Collection Centres (CCs) and common facilities and enabling infrastructure like roads, electricity, water, ETP facilities etc. at Central Processing Centre (CPC).

The Mega Food Parks in North Eastern Region of India are

1. North East Mega Food Park, Nalbari, Assam.

Beneficiaries/Components under PM-FME	Benefits
Existing unorganized food processing units	A maximum grant of up to Rs.10 lakhs.
SHGs/FPOs/Cooperatives	Credit linked grant at 35 percent of the project cost for capital expenditure with maximum limit as prescribed.
Person engaged in food processing	Rs.40000 as seed capital provided as working capital.
Common infrastructure	Credit linked grant at 35 percent of the project cost with a prescribed maximum limit.
Marketing and branding	Upto 50 percent of expenditure with a prescribed maximum limit.



2. Zoram Mega Food Park, Kolasib, Mizoram.
3. Tripura Mega Food Park, West Tripura, Tripura.
4. Mega Food Park' at Mendipathar in North Garo Hills and at Barnyhat in Ri-Bhoi.
5. Mega Food Park' at Sikkim.
6. Mega Food Park' at Arunachal Pradesh.

These food parks have benefitted farmers and created jobs. They have boosted the North-East Region's potential to become the organic destination of the world due to its rich agricultural and horticultural produce.

### 3. Pradhan Mantri Matsya Sampada Yojana (PMMSY)

Pradhan Mantri Matsya Sampada Yojana (PMMSY) was launched on 10<sup>th</sup> September 2020. The aim of the scheme is to bring about Blue Revolution through the sustainable development of the fisheries sector over a period of five years (2020-2025.) The main objective of the PMMSY is to develop fisheries and aquaculture sectors. The scheme has equal importance in North Eastern Region of India to become self-sufficient in fish production, empowerment of

**₹20,000 crores for Fishermen through Pradhan Mantri Matsya Sampada Yojana (PMMSY)**

- Critical gaps in fisheries value chain
- Government will launch the PMMSY for integrated, sustainable, inclusive development of marine and inland fisheries.
- ₹11,000 Cr for activities in Marine, Inland fisheries and Aquaculture
- ₹9000 Cr for Infrastructure - Fishing Harbours, Cold chain, Markets etc.
- Cage Culture, Seaweed farming, Ornamental Fisheries as well as New Fishing Vessels, Traceability, Laboratory Network etc. will be key activities.
- Provisions of Ban Period Support to fishermen (during the period fishing is not permitted), Personal & Boat Insurance
- Will lead to Additional Fish Production of 70 lakh tonnes over 5 years.
- Employment to over 55 lakh persons; double exports to ₹1,00,000 Cr.
- Focus on Islands, Himalayan States, North-east and Aspirational Districts.

Source: Government of India

fisheries farmer producer organization and inclusive growth.

### 4. National Livestock Mission (NLM)

National Livestock Mission (NLM) was launched in the financial year 2014-15. It seeks to ensure quantitative and qualitative improvement in livestock production systems and capacity building of all stakeholders. There are four sub-missions under National Livestock Mission:

- Sub-Mission on Fodder and Feed Development.
- Sub-Mission on Livestock Development.

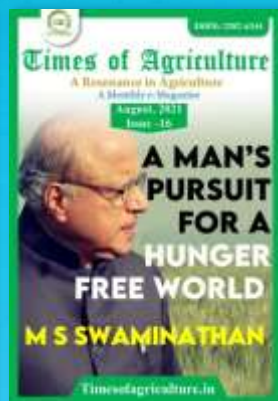
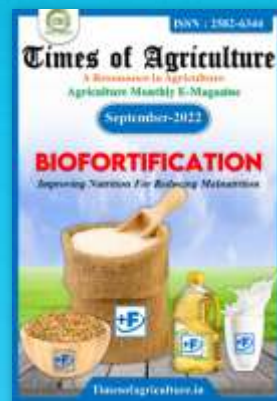
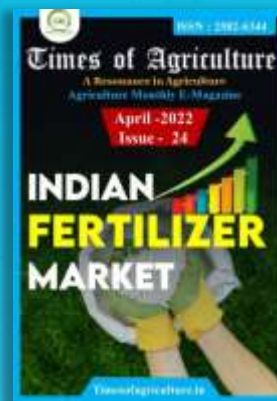
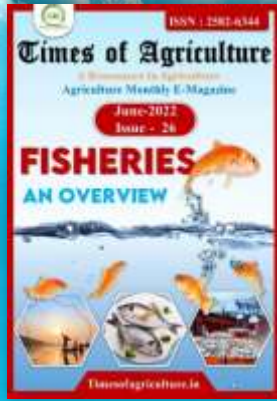
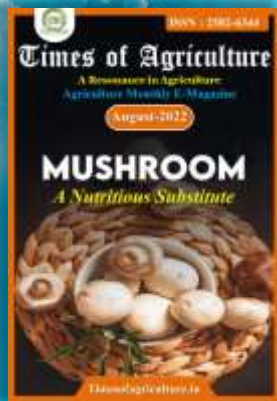
- Sub-Mission on Pig Development in North-Eastern Region.
- Sub-Mission on Skill Development, Technology Transfer and Extension.

### Conclusion

The region has significant potential in agriculture and allied to boost the economy. The central government has initiated many path breaking ways to promote agri-business; however, it needs proper implementation and monitoring at grass-root level.

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