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Times of Agriculture

A Resonance in Agriculture

Agriculture Monthly E-Magazine

August-2022

MUSHROOM

A Nutritious Substitute

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A Monthly e-Magazine

About us

"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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Azadi Ka Amrit Mahotsav
AGRICULTURE
UPDATES

NAARM received Sardar Patel Award of ICAR

The **National Academy of Agricultural Research Management (NAARM)** has bagged the **Sardar Patel Outstanding ICAR Institute Award 2021** (in the Large Institute Category) for its overall performance. Ch Srinivasa Rao, Director of NAARM, received the award from the Union Minister of Agriculture. The awards were given away at a function to mark the **94th Foundation Day** of the ICAR.

Sardar Patel Outstanding ICAR Institute Award 2021

Jammu and Kashmir inks pact with Sikkim to boost cultivation of saffron

Jammu and Kashmir has signed an agreement with Sikkim to collaborate on training, technology, capacity building and other activities to boost cultivation of saffron and other temperate crops.

In a historic move to further boost the growth of agriculture and horticulture sector, the agriculture department of J-K, Sikkim government and Sikkim University signed a tripartite agreement for collaboration on training, technology, capacity building and extension activities for saffron and other temperate crops. The agreement was signed in the presence of J-K Lieutenant Governor Manoj Sinha and Governor of Sikkim Ganga Prasad.

11th Agriculture Census 2021-2022

11th Agriculture Census 2021-22 was launched by Union Minister Narendra Singh Tomar on July 28, 2022. It was launched to gather data on several parameters, including operational holdings. This year, data will be collected via smartphones and tablets for the first time.

The fieldwork for the 11th Census will start in August 2022. Agriculture Census is conducted after ***every 5 years****. 11th Agricultural Census 2021-22 is being undertaken in 2022, due to covid-19 pandemic. Main focus of the census is on increasing income of the farmers and empowering them by organizing small farmers.*

Cabinet approved FRP of sugarcane

The Cabinet Committee on Economic Affairs chaired by Prime Minister has approved Fair and Remunerative Price (FRP) of sugarcane for sugar season 2022-23 (October - September) at **Rs. 305/qtl for a basic recovery rate of 10.25%, providing a premium of Rs. 3.05/qtl for each 0.1% increase in recovery over** and above 10.25% and reduction in FRP by Rs. 3.05/qtl for every 0.1% decrease in recovery.

Lowest area under paddy in a decade: Sowing report

According to data released by the Department of Agriculture and Farmers Welfare paddy have been sown with **7.22 million hectares (mha) for the year 2022. This is the lowest area sown till the second week of July when compared to the last 10 years.** The area sown this time is also **24 %** less than the corresponding period of 2021. The primary reason being attributed to the reduced sown area is the failure of the monsoon in the month of June in most parts of the country.

India's first ever Animal Health Summit

Union Minister of Fisheries, Animal Husbandry and Dairying, Parshottam Rupala inaugurating First India Animal Health Summit 2022, he called for greater use of Ayurveda for ensuring better animal health. First India Animal Health Summit 2022 was held at NASC Complex, New Delhi.

'India Animal Health Summit 2022' organized by Indian Chamber of Food and Agriculture (ICFA) and the Agriculture Today Group.

Microbial Encapsulation Technology

The *ICAR-Indian Institute of Spices Research, Kozhikode, Kerala* has been granted the Patent for **Microbial Encapsulation Technology**. It is a novel method of storing and delivering the PGPR / microbes through Biocapsules.

The technology was developed by a team including Dr. M. Anandaraj, Dr. R. Dinesh and Dr. Y. K. Bini.

The technology involves Encapsulation of the microorganisms of interest in a gelatin capsule for delivery to the agricultural crops for the enhanced soil nutrient solubilization, growth and yield. The recently patented product is used for cultivation of spices, vegetable and other crops.

White onion of Alibagh (Maharashtra) get GI tag

The famed white onion of Alibag in Maharashtra's **Raigad district** was given the Geographical Indication (GI) tag bringing worldwide recognition to its ***unique sweet taste, no-tears factor, as well as its medicinal properties.***

The soil of Alibaug taluka has low sulphur content. The NABL-approved lab test report mentions low pungency, sweet taste, 'no tear' factor, low pyruvic acid, high protein, fat & fibre, etc.

Indian, Malaysian bodies ink pact to promote palm oil

The Malaysian Palm Oil Council (MPOC) and the Indian Vegetable Oil Producers' Association (IVPA) have signed a memorandum of understanding (MoU) to expand their cooperation in promoting the usage of palm oil. The MoU is anticipated to increase collaboration in areas of shared interest and to advance the production and consumption of palm oil from Malaysia and palm oil with the MSPO certification.

India to be self sufficient in urea by 2025

Union Fertiliser Minister Mansukh Mandaviya hoped India would eliminate urea import by 2025 through the increased domestic production and enhanced use of nano urea, which cuts the consumption of traditional urea by as much as 30%.

This optimism rests on the commissioning of six new conventional urea plants, each with an annual production capacity of about 1.3 million tonnes. Of these, the Barauni and Sindri plants will be commissioned by September, and the others in the next three-four years. Once all these public sector urea plants start functioning, India's domestic urea output will rise by 7.8-8 million tonnes.

"Jute Mark India" logo

The government of India introduced the certification of authenticity for jute products manufactured in India. The Union Textile Secretary unveiled the logo "Jute Mark India". This project is an initiative to protect and promote Indian jute products.

Jute Mark India (JMI) was implemented during an ongoing scheme for the development and promotion of Jute between FY'22 and FY'26. The total investment of the central government in this project was Rs. 485.58 crore.

COVER STORY

MUSHROOM

A Nutritious Substitute

About the Author

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Since ancient times, people have grown mushrooms for their flavour and nutritional benefits. Mushrooms have substantially more protein, With the exception of iron; they include all significant minerals and have a low fat content, high fibre content, and all essential amino acids. It is a cost-effective crop to grow, needs little space and resources, and can be produced all year long from inexpensive raw materials anywhere.

According to information made public by the National Horticulture Board, overall production of **mushroom was 2,00,350 tonnes in 2021–22 and among this Bihar produced more than 28,000 tonnes of mushrooms,** accounting for 10.82% of all mushrooms produced in the nation. Additionally, it is extremely environmentally friendly because it can turn lignocellulosic waste into food, feed, and fertilizers. However, compared to other crops, mushroom output and consumption are quite low, and the business has received comparatively little investment.

Health Benefits of MUSHROOM

1. Boost the production of vitamin D

2. Enhance immune system function

3. Aid in weight loss

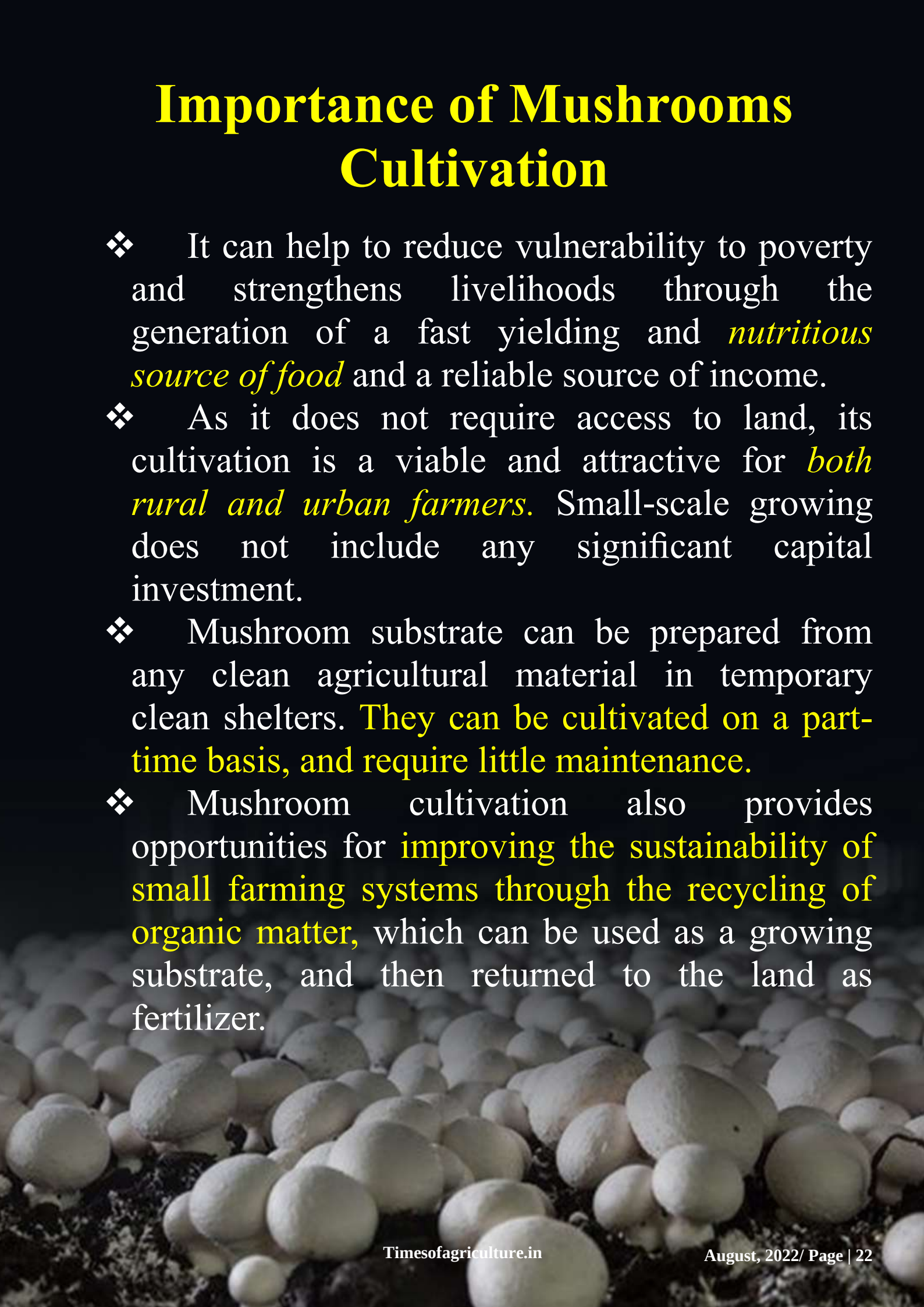
4. Lower cholesterol level and Treat diabetes

6. Fight against free radicals

7. Helps to prevent prostate cancer and breast cancer

Importance of Mushrooms Cultivation

- It can help to reduce vulnerability to poverty and strengthens livelihoods through the generation of a fast yielding and *nutritious source of food* and a reliable source of income.
- As it does not require access to land, its cultivation is a viable and attractive for *both rural and urban farmers.* Small-scale growing does not include any significant capital investment.
- Mushroom substrate can be prepared from any clean agricultural material in temporary clean shelters. They can be cultivated on a part-time basis, and require little maintenance.
- Mushroom cultivation also provides opportunities for improving the sustainability of small farming systems through the recycling of organic matter, which can be used as a growing substrate, and then returned to the land as fertilizer.



Nutritive Value of Mushrooms *(Per 100 gm)*

Calcium (mg)	2.9	**Zinc (mg)**	0.5
Iron (mg)	0.5	**Copper (mcg)**	305
Magnesium (mg)	8.6	**Selenium (mcg)**	8.9
Phosphorus (mg)	82.6	**Vitamin C (mg)**	2.0
Potassium (mg)	305	**Vitamin D (mg)**	0.2
Sodium (mg)	4.8	**Folate (mcg DFE)**	16.3

Common Species of Mushrooms

Button mushroom
Agaricus bisporus

- Most **widely cultivated and eaten mushroom.**
- Contribution of these mushroom in India= **73%.**
- Life cycle - **7-8 weeks**
- Substrate use- **Compost**
- It contains lot of **retene,** which is thought to have an ***antagonistic effect on some types of tumors.***
- **Ergocalciferol (vitamin D2)** in fresh *A. bisporus* (0.2 micrograms); however, when exposed to UV light, the amount of ergocalciferol increases significantly.

Oyster mushroom
Pleurotus ostreatus

- Life cycle- **6-7 week**
- Substrate use- **Agro waste**
- Contribution of these mushroom in India- **16%.**
- It smells benzaldehyde-like, ***sweet and bitter***, which has a delicate texture and a ***delicious, mild flavour.***
- It has antioxidants molecules that lessen cellular deterioration in your body and may also ***aid in blood sugar control*** in addition to heart health promotion.

Paddy straw mushroom
Volvariella volvacea

- Life cycle- **4-5 weeks**
- Substrate use- **Paddy straw**
- Contribution of these mushroom in India- **7%.**
- ***Shorter life cycle***, quick growth, ***easy cultivation*** method, and high customer acceptance due to texture and aroma.

Shiitake mushroom
Lentinus edodes

- Life cycle- **5 weeks**
- Substrate- **Hardwood sawdust blocks and wood chips**
- Shelf life- **10-12 days**
- It contain compounds like ***lentinan*** that may **boost the immune system**
- The organic manure known as **spent mushroom substrate (SMS)** is great for ***vermicomposting.***

White Milky Mushroom
Calocybe indica

- Life cycle- **7-8 weeks.**
- Substrate use- **Wheat/Paddy straw and casing soil.**
- Contribution of these mushroom in India- **3%.**
- It has ***antibiotic, anti-tumor, and anti-cancer*** properties, and to help in regulating **diabetes, lowering bad cholesterol levels**, and to have strong antioxidant properties.

Cultivation of Mushroom

Spawn Production

Spawn is produced from fruiting culture / stocks of selected strains of mushrooms under sterile conditions.

Compost Preparation

The substrate on which button mushroom grows is mainly prepared from a mixture of plant wastes, salts, supplements (rice bran/ wheat bran) and water.

Spawning

The process of mixing spawn with compost is called spawning.

Spawn Running

After the spawning process is over, the compost is filled in polythene bags.

Casing

The compost beds after complete spawn run should be covered with a layer of soil (casing) about 3-4 cm. thick to induce fruiting

Fruiting

The fruit body initials which appear in the form of pin heads start growing and gradually develop into button stage.

Harvesting

Harvesting mushrooms takes place in “flushes”. The first flush is picked in 3 to 5 days and yields 15 to 20 kg/m^2.

CONCLUSION

Compared to most plants, mushrooms have a significant amount of protein, but fewer than animals. They include all key minerals, with the exception of iron, and are high in fibre, low in fat, and contain all nine essential amino acids. It can be produced year-round from cheap raw materials everywhere in the world, requires minimal area and resources to grow, and is an economical crop to do so. It holds great potential and appeal to be able to grow foods that are highly nutritious and have exceptional flavour using easily available, affordable substrates. In India, *button mushrooms account for around 73 percent of all other mushrooms cultivation.* These mushrooms have a variety of therapeutic benefits. Cultivation of these mushrooms involves spawn production, compost preparation, spawning, spawn running, casing, fruiting and ultimately harvesting at proper stage.

FORTIFICATION OF CEREALS

About Author

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Fortification contains added vitamins and minerals that are not naturally present them. Fortification is meant to improve people's levels of particular nutrients and is common for cereals food that adults and children typically eat, such as grains, milk, and juice. Cereal is mostly fortified as foods.

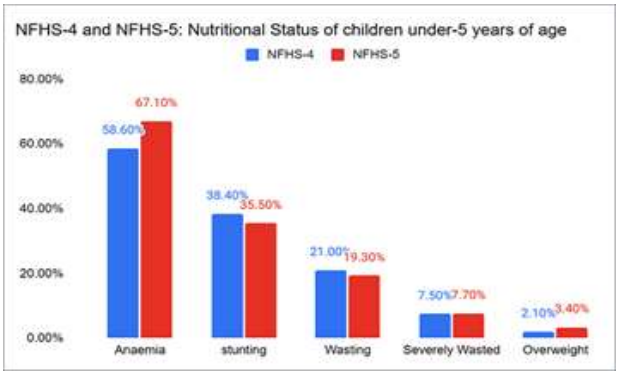
Fortification is necessary mainly for India because in the western countries already the trend for the fortified cereals has increased to greater extent it is due to many reasons as we all know that India is one of the major country leading in production of cereals and it is also seen that it consumes maximum part of the produce for its own consumption most of the cereals such as rice oats, and wheat etc. are produced which lacks in nutrients status naturally we have seen that scientists are working in the field of innovation for the genetic modified crops but it takes much time to carry out the successful experiments in limited time so the need for fortification is felt to great extent.

In western countries like in USA and others already the fortified oats and wheat has taken place some of them says that it is good for young children, breast feeding mothers and vegetarians we as an Indian are also having current crises of malnutrition among our youth and new born babies it is due to less nutrients supplies to new born babies and mothers. Many nutrients are added they are vitamin A, thiamine (vitamin B_1), riboflavin (vitamin B_2), niacin (vitamin B_3), vitamin B_6, vitamin B_{12}, vitamin D, folic acid, zinc, iron, calcium etc.

India is a large country with its population second largest after china and mal nutrients status in India is also so much that many of the children die in India is heading towards meeting its demand for maternal, infant and young ones no progress has been made in reducing anemia but these fortified cereals rich in folic acid can help them in overcoming these problem like over 52.0% of women aged 15 to 49 years now affected low birth weight of infants is also other cause for problem, 58.0% of infants aged 0-5 months are actually breast feeder. But 33.97% of children fewer than 5 years of age are still affected as mentioned in table more clearly.

The 70% of people in India do not consume enough micronutrients vitamins and minerals. About 70% of preschool children suffer from anemia 57% have vitamin a deficiency neural tube defects are most common congenital malformation with an incidence of 0.6 t0 8 per 1000 births. It is estimated that 50-70% of these birth defects are preventable one of major cause if deficiency of iron.

Table- Representing Nutritional status of children less than 5 years of age.



Benefits

1. They are maximum as nutrients are also added to improve health of large section of people.
2. It is the safest the quantity of the nutrients added is small so there are no chances of over dose.
3. It does not require change in food habits of people so it is socially culturally accepted to supply nutrients to people.
4. It do not change the smell, taste, feel and look of food.
5. It is implemented quickly and requires less time to be added.
6. It is cost effective and has minor difference of prices has high b:c ratio.■

MILLETS
A SUPERFOOD FOR HEALTHY LIVING

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Millets are small seed sized harif crops belonging to Poaceae family. It is supposed to be cultivated since before the plough age. Depending upon the size of the seeds, millets can be categorized into major and minor millets. Sorghum *(Jowar)* and pearl millets *(Bajra)* are major millets while finger millets *(Ragi)*, kodo millets *(Kodo)*, proso millets *(Cheena)*, little millets *(Kutki)*, barnyard millets *(Sawa)* are all minor millets. These are drought resistant crops and can grow in lower water requirement (350-500mm). They are C-4 plants which make them physically efficient enabling them to provide higher biomass productivity.

Common name of millets

Crops	Scientific names	Hindi
Sorghum	*Sorghum bicolorata*	*Jowar*
Pearl millets	*Pennisetum glaucum*	*Bajra*
Finger millets	*Eleusine coracana*	*Ragi*
Kodo millets	*Paspalum scrobiculatum*	*Kodo*
Proso millets	*Panicum miliaceum*	*Cheena*
Little millets	*Panicum sumatrense*	*Kutki*
Barnyard millets	*Echinochloa esculenta*	*Sawa*

Agro-climatic regions for millet cultivation

In India, major millets producing states includes Rajasthan, Andhra Pradesh, Telangana, Karnataka, Tamil Nadu, Maharashtra, Gujarat and Haryana.

Nutritional value of millets

It includes protein, essential fatty acids, vitamins and vital minerals like iron, Calcium, Magnesium, Potassium, Zinc. Due to its outstanding nutritional composition, they are considered to be nutritious grain or nutria-cereals.

It has anti-diabetic properties and being gluten free, it can also be used by celiac disease patients. Bajra is a major source of iron and can be used as dietary supplement for anemia patients.

Ragi is rich in Calcium, thus beneficial for all those having bone related problems.

Nutritional composition of millets (for 100g of each millet)

	Protein (g)	Fe (mg)	Ca (mg)
Sorghum	10	2.6	54
Pearl millet	10.6	16.9	38
Finger millet	7.3	3.9	344
Foxtail millet	12.3	2.8	31
Proso millet	12.5	0.8	14
Kodo millet	8.3	0.5	27
Barnyard millet	11.2	15.2	11

(Source: Indian Institute of Millets Research)

Challenges

Despite of providing a wide range of nutritional components, there is still gap in achieving the desired acceptance of millets as well as bringing in diet plan of every individual in the country. There is need to eradicate the challenges which are hampering the acceptance of millets as a main course staple food. One such challenge is the wheat which is used for making rotis/ chapattis have gluten protein, which makes the rotis soft, which is not possible with millets which is gluten free. The Government launched the National Food Security Act of 2013, under which households were provided 5kg of wheat per person per month at the rate of Rs. 2/Kg and rice at the rate of Rs. 3/Kg respectively. This effort of government reduced the demand for millets.

In order to reach every individuals and every plate, the Government of India decided to observe 2018 as National Year of Millets. The Minimum Support Price for millets has been hiked. The government has included millets in the public distribution system along with other cereals. There has been provision to provide inputs to farmers, supporting their marketability by building value chain through Farmers Producer Organization.

Conclusion

Still, there is need to generate mass awareness among people about the health benefits and economic security which millets provides due to its low investment, rain dependent hardy crop and short growing season (70-100 days) and lower requirement (350-500mm). Thus, it can prove to be sustainable income to farmers. Moreover, there is need to provide farmers with relevant inputs for its cultivation, linking them with market and also turning the traditional millets into various value added products such as upma, bheelpori, biscuits, cakes, muffins, etc., providing scope for start-ups.

This is a high time for millets as the people are shifting towards choosing healthier foods. Thus, it is a great opportunities for the farmers to bring economic prosperity as well as an approach for sustainable agriculture and healthy food.■

ROLE OF OMEGA-3 FATTY ACIDS IN HEALTH

About Author

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Omega-3 fatty acids are essential fats that the body cannot produce on its own and must be obtained from food. Fatty acids are important building blocks of cell membranes that also regulate gene transcription, function as cytokine precursors, and supply energy in intricately interwoven systems. Additionally, there have been alarming changes in the proportion of Omega-3 to other fats in the typical human diet during the past century. Our present understanding of the crucial roles that Omega-3 fatty acids and their metabolites play in preserving human health will be presented here.

Introduction

The body is unable to produce omega-3 fatty acids on its own. Since they are an essential fat, they are required for survival. The foods we eat provide us with the omega-3 fatty acids we require. The finest source of omega-3 fatty acids in food is fish. Omega-3 fatty acids are also found in several plants. A significant family of polyunsaturated fats is the omega-3 family. The three primary omega-3s are:

1. Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) come mainly from fish, so they are sometimes called marine omega-3s.
2. Alpha-linolenic acid (ALA), the most common omega-3 fatty acid in most Western diets, is found in vegetable oils and nuts (especially walnuts), flax seeds and flaxseed oil, leafy vegetables, and some animal fat, especially in grass-fed animals.

Heart disease provides the most convincing evidence that omega-3 fats have a positive impact. These lipids seem to support the heart's ability to beat steadily and avoid irregular rhythms that could be harmful or even fatal. Most of the 500,000+ cardiac deaths that take place each year in the United States is brought on by such arrhythmias. Omega-3 fats also improve blood vessel function, lower triglycerides at larger doses, and lower blood pressure and heart rate.

Participants in the more recent Japan EPA Lipid Intervention Study (JELIS) were less likely than statin-only participants to experience a major coronary event, such as

sudden cardiac death, a fatal or nonfatal heart attack, unstable angina, or a procedure to open or bypass a narrowed or blocked coronary artery. The advantages of omega-6 fats for the heart have also been supported by a large number of human research and trials. There is little doubt that many Americans would benefit from increasing their consumption of omega-3 fatty acids, but there is also proof that omega-6 fatty acids have a protective effect on heart disease risk factors and cardiovascular risk factors.

A different kind of balance- that between potential effects of marine and plant omega-3 fats on prostate cancer- is the subject of intense study by researchers. EPA and DHA are mostly found in fish and seafood, and research from the Health Professionals Follow-up Study and other studies has shown that men who consume more of these fats in their diets are less likely to develop advanced prostate cancer than those who consume less of them. Fish or other seafood should be consumed one to two times per week, preferably fatty (dark flesh) fish that are higher in EPA and DHA, given the wide-ranging relevance and advantages of marine omega-3 fatty acids. Because of worries that mercury and other potential contaminants would harm their unborn children, many women avoid eating fish, but the evidence indicating harm from a lack of omega-3 fats is far more consistent, and a balance of benefit vs. risk is easily acquired.

Type of Seafood	Serving Size	Omega-3 Fatty Acids (grams)
Mackerel	3 ounces	2.5–2.6
Salmon (wild)	3 ounces	1.8
Tuna (Bluefin)	3 ounces	1.2
Herring	3 ounces	1.3–2
Lake Trout	3 ounces	2
Lake White fish (fresh water)	3 ounces	1.5
Halibut	3 ounces	0.90
Sea Bass (mixed species)	3 ounces	0.65
Striped Bass	3 ounces	0.80

How much Omega-3 do I need ?

The American Heart Association advises people to consume at least two servings of fish each week even if they have no family history of the condition (a total of 6-8 ounces). The seafood in this should be varied. Omega-3 fatty acids are abundant in cold-water wild fish species like mackerel, tuna, salmon, sardines, and herring. To choose fish with high omega-3 fatty acid content, refer to the list above. Even if you take medicine to lower your triglyceride levels, if you have high levels, you may need to eat additional foods that are rich in omega-3 fatty acids. In general, people with elevated triglyceride levels should take 2-4 grammes of EPA + DHA daily. Studies have indicated that this dose can reduce triglyceride levels by 25 to 35 percent.

What if I'm allergic to fish or don't want to eat fish?

Omega-3 fatty acids are best found in fish, however some plants also contain ALA. Despite being a less abundant source of omega-3 fatty acids, ALA has been linked in certain studies to a decreased risk of cardiovascular disease. Ground or milled flaxseeds, flaxseed oil, chia seeds, walnuts, soy products, and canola oil are all excellent sources of ALA. Algal or algae oil, which is converted to DHA, is another source of ALA. Algal oil is used in several foods that have been enriched with omega-3. These are fantastic choices for vegetarians who avoid fish. There are no suggested serving sizes for foods high in ALA at the moment. However, include these foods regularly in your diet may improve your heart health.

Conclusion

Omega-6 fatty acid consumption has increased dramatically over the last 100 years, but omega-3 fatty acid consumption has dropped by 80%. Omega-3 fatty acids are predominantly cardioprotective due to their favourable effects on arrhythmias, atherosclerosis, inflammation, and thrombosis. There is evidence that they also improve endothelial function, significantly lower cholesterol, and lower blood pressure. There is substantial evidence in the literature that increasing omega-3 fatty acid diet can improve cardiac outcomes. Doctors must incorporate dietary advice for omega-3 fatty acid consumption into daily cardiovascular care.■

Tribulus terrestris

A SUPER MEDICINAL PLANT

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Tribulus terrestris is a plant found in hot and humid parts of the Mediterranean, Europe, Asia, Africa and Australia. This plant has many benefits and is used in traditional medicine to treat a variety of ailments, including kidney stones, lower blood pressure, anti-diabetic properties, heart disease, gastrointestinal issues, and male sexual function. *T. terrestris* is antimicrobial, antibacterial, free radical scavenger and inhibits lipid peroxidation. It is anti-inflammatory and anticancer in nature and since it does not produce any harmful byproducts or side effects, it is being used as a dietary supplement.

Introduction

Tribulus terrestris is a widely distributed annual plant belonging to the caltrop family *Zygophyllaceae*. It is adapted to regions with a dry climate where few other plants can survive. It is indigenous to warm temperate and tropical climates in the southern parts of Eurasia and Africa. It has been brought unintentionally to North America and Australia. *Tribulus terrestris* is widely recognised as a noxious weed due to its small woody fruit, the bur, which has long, sharp, and strong spines that can easily penetrate surfaces, such as the bare feet or thin shoes of crop workers and other pedestrians, the rubber of bicycle tyres, and the mouths and skin of grazing animals.

Description

Tribulus terrestris is an annual herbaceous plant with taproots that grows in temperate areas during the summer. The stems originate from the crown with a diameter of approximately 10 cm to over 1 m and are frequently branched. In the shade or among larger plants, they may grow vertically. The stems that extend from the crown are thickly hairy. The leaves are opposite and pinnately compound, with leaflets up to 3 mm long and densely hairy. The flowers are 4-10 mm broad and have five petals that are lemon-yellow, five sepals, and ten stamens. It blooms from April to October in Southern California, where it is particularly invasive in wastelands and disturbed environments. After the flower blooms, a fruit that easily separates into five burs develops. The burs are firm and have two to four sharp spines measuring 10 mm *Tribulus terrestris* is a plant found in hot and humid parts of the Mediterranean, Europe, Asia, Africa and Australia. This plant has many benefits and is used in traditional medicine to treat a variety of ailments, including kidney stones, lower blood pressure, anti-diabetic properties, heart disease, gastrointestinal issues, and male sexual function. *T. terrestris* is antimicrobial, antibacterial, free radical scavenger and inhibits lipid peroxidation. It is anti-inflammatory and anticancer in nature and since it does not produce any harmful byproducts or side effects, it is being used as a dietary supplement.in length and 4–6 mm in width. These burs have a striking resemblance to the heads of goats or bulls, which gives them their common names in various places. The "horns" are sufficiently sharp to puncture bicycles and other pneumatic tyres. Additionally, they can inflict painful injuries to bare feet and livestock grazing on the plant. Within each bur, the seeds are arranged onto one

another and separated by a tough membrane. As an adaptation to arid regions, the largest seed germinates first, while smaller seeds may wait until more moisture is available before sprouting. The bur spines point upward, where they adhere to the feet and fur of animals to disperse the seeds. This causes harm to domesticated animals and reduces the quality of wool.

Range and habitat

The common name for *Tribulus terrestris* is "shepherd's weed" or "iron thistle." It is a small-leaved plant that grows in many different parts of the world, particularly China and Asia, as well as certain regions of Europe, Africa, and the Middle East. A network of fine rootlets develops from the taproot to exploit soil moisture, allowing the plant to survive in arid environments. It grows in nearly all soil types but thrives in dry, loose, sandy soils, and deserts. It can thrive in heavy soils, particularly if they are fertile or moist, as well as in compacted soils along roadways.

Hosts or species affected

T. terrestris is a weed that can be found in a wide variety of crops, including cereals with large and small grains, legumes, tree crops, vegetable crops, pastures, and ornamental plants. *T. terrestris* poses a significant risk to most crops if they are grown in their natural habitat.

Health benefits and uses

The *Tribulus terrestris* plant has been utilized in traditional Indian and Chinese medicine for a very long time as a tonic, aphrodisiac, and for the treatment of numerous ailments. It is useful for treating kidney stones and other kidney-related problems, such as painful urination and Bright's disease, and as a diuretic, it regulates the production and flow of urine. Gokhru fosters a healthy reproductive system by enhancing male and female fertility. In addition to enhancing vitality, sexual desire, and erectile dysfunction, this herb is also a fantastic libido booster. PCOS, or polycystic ovarian syndrome, is fairly prevalent in women nowadays. Gokhru helps to treat the symptoms of this disorder, which can range from irregular periods and acne to pregnancy difficulties. Gokhru is an excellent natural plant for regulating serotonin levels. This herb is one of the most powerful treatments for psychological imbalances and other neuro-disorders, and it also enhances brain function. Consuming Gokhru at the recommended dosage provides the body with all the nutrients and minerals essential for muscle strength, making it a natural means of building a superb and sculpted physique. *T. terrestris* is antimicrobial, antibacterial, purifies free radicals, and prevents lipid peroxidation via cell and molecular routes. This herb has anti-inflammatory and anti-cancer effects. Because *T. terrestris* does not produce any toxic byproducts or adverse effects, it has being investigated for use as a dietary supplement.

Economics

Gokhru powder extract is in high demand as a dietary supplement for increasing energy, promoting healthy hormone function, enhancing muscle action, and providing athletes with energy during training. It is also commonly employed in numerous Ayurvedic medicines. The pricing of its powder and extract is governed by market demand.

Summary

Tribulus terrestris is a common annual weed native to warm temperate and tropical regions and found in a variety of crops. It is a herbaceous plant with highly branched stems that emerge from the crown. At the proper dosage, it provides the body with all the nutrients and minerals needed for muscle strength and body functions. Gokhru powder extract is a popular dietary supplement because it boosts energy, helps keep hormones functioning well, makes muscles function optimally, and gives athletes energy during training. The price of its powders and extracts is determined by market demand.

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ARTIFICIAL INTELLIGENCE IN FOOD PROCESSING

AN INDUSTRY PERSPECTIVE

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Artificial intelligence is the future of food industry. It can impact most areas of manufacturing and supply chain in food Industry. It would lead ways for the systems that run processing equipment to deal with gradations, subtleties and causations that are too complex or numerous for the human mind. Artificial intelligence is already being used in some food processing applications and has the potential to be used in many more, including maintenance, sanitation and logistics.

There are a lot of uncertainties associated with manufacturing of all kinds of food and beverage products. There are many possible factors causing a process to fail. The decision of what constitutes a good product, and what should the threshold for a product before it must be reworked or discarded comes from a series of data gathered along the process. The difficulty in processing all of these data would adversely impact the final decision. This results in great variability and therefore lack of consistency in decision-making across the organization.

Artificial intelligence is a field in computer science that mimics human thinking, learning and memory. It can discover patterns and correlations that probably wouldn't occur to human observers in applications where there are too many variables for the mind to handle. It can implement solutions around schedule optimization, predictive maintenance and predictive analytics within food from farm, until it reaches to fork.

Artificial intelligence will play a vital role in applications such as sorting, grading and inspecting both ingredients and products. It could set standards and specifications for a product, and doing so could determine a cause if product deviates from the set specifications and also predict correlations its higher accuracy and lower detection limits. For example, in a production line handling different similar products on the same line, there may occur different losses and inefficiencies (waste due to overweight, quality rejects, size and shape variances, colour inconsistencies, unstable yield). An AI could easily do multivariate analysis on all the data, from data on the raw materials, to quality data, and even external data relevant to the production process. Which usually includes all the complex, dynamic interrelationships between the different data tags on the line. Thereby, minimizing the time and effort in finding the cause which usually might go unnoticed by human observers. This safeguards the products and enhances its quality attributes resulting in a superior product.

Artificial intelligence could also be employed for the robust cleaning operation in the food industry, Where Clean-in-place (CIP) is generally done for equipment sanitation. CIP is an efficient and effective way to clean equipment, but it uses harsh chemicals and copious amounts of water. An Artificial intelligence system using ultrasound and ultraviolet sensors to provide feedback can able to reduce water use in this process. Here, UV system is placed inside the top of a tank and feature UV lights and a camera, whereas the ultrasonic sensors are attached to the outside of pipework and equipment. AI determines once all of the fouling has been removed. This model could be integrated with other sensors & data loggers to minimize water use, also optimize flow rates, temperature and chemical concentration to reduce time and resource use leading to an environmental sustainability process.

Conclusion

Artificial intelligence has the potential to be the most powerful tools, employing it more judiciously would move the food processing sector to a sustainable form of industry, which could potentially increase efficiency in some of the most important, and challenging, applications to be found in a food plant.

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DRONE

IN AGRICULTURE SECTOR

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Drones, often called UAVs (Unmanned Aerial Vehicle), are being used for surveillance in several sectors. Self-flying aircraft that can be controlled remotely are known as UAVs, or drones. Information and communication technologies and approaches such as embedded systems, global positioning systems (GPS), and sensors are used to operate UAVs. Smart agriculture not only helps to satisfy the food needs of a rising population, but it also helps with current agricultural trends such as organic farming, enhancing agriculture efficiency, water conservation across the globe (1). UAVs might be utilized to monitor potentially dangerous situations and activities. UAVs have steadily gained effectiveness in agriculture such as precision agriculture, livestock monitoring, irrigation, smart greenhouse, fish farming and several other applications (2). The agriculture community has positively accepted the drone technology as it easy, tremendously helpful in precision agriculture. It is estimated that in the next 10 years the drone technology can create more than $ 127 billion across different global industries (3).

Uses of agricultural drones:

Drones are best suited for large fields. Crop surveillance assists in understanding and preparing for the next season. Drones using infrared cameras may help farmers to monitor crops and improve plant health in real time. They may be used to place sensors that monitor soil moisture, topography, soil conditions, erosion, nutrients, and fertility. Crop surveillance monitors a crop from planting to harvest. This includes applying fertilizer at the appropriate times, inspecting for pests, and monitoring the weather. Seasonal crops need crop monitoring to ensure a timely harvest. Drone may help farmers plant to trees and crops. Drones can monitor and manage vast flocks of animals because their sensors include high-resolution infrared cameras that can discover unhealthy animals rapidly. Agri-drones can spray fertilizers and pesticides since they have reservoirs that can be filled quickly. Weather may be the farmer's friend and foe. Storm drones enhance forecasting accuracy. This may help farmers prepare. Storms or a lack of rain may be used to determine what crops to sow and how to care for them afterwards (2).

Benefits of agricultural drones:

Drones work twice as fast as humans and have no operating delays. Agricultural drones employ ultra-low volume (ULV) spraying, which saves water. Agri drones are durable, low-cost, and low-maintenance. Detachable container,

low-cost frame, precision pesticide spraying are significant advantages. Drone pilots are in charge of the aircraft. As a result, there is no risk of their being misused. Agri drones are durable, inexpensive, and need little maintenance. A removable container, a low-cost frame, and precision pesticide spraying are some of the important characteristics (4,2).

Limitations of agri drones:

In remote places, internet access is often unavailable. In such cases, a farmer would need to invest in internet access, which will become a regular cost. Drones operate at double the speed of humans and have no operating delays. Drones rely greatly on favourable weather conditions. Drones should not be flown in wet or windy weather. Using new technology is a refreshing shift, but doing so on a regular basis need the necessary ability and understanding. Drone functions may be difficult to comprehend for the common farmer. Either he must acquire the necessary expertise or rely on an experienced someone.

Case studies using drone:

The purpose of this case study is to analyse the most common and recent approaches to technological issues employed in autonomous drones used in agricultural applications. Case studies reported here shows agricultural-specific potential of Drones/ Unmanned Aerial Vehicles (UAVs). Three different studies were carried out in Greece by Psirofonia *et al.,* 2017 with the specific applications in crop protection through infestation such as:

A. Detection of infestation symptoms (canopy discoloration) by phytopathogenic bacterium *Xylella fastidiosa* on olive tree. The reported bacterium responsible for the extremely destructive disease also known as named "Olive Quick Decline Syndrome" (OQDS). Early identification and detection of the presence of bacteria is time intensive (area covering 33 million trees). The data recorded shows 26 olive trees with regional dried foliage were found in an olive grove with the use of drones (5).

B. The use of drone was evaluated for palm tree mapping and red palm weevil (*Rhynchophorus ferrugineus)* infestation detection by visual markers in large palm plantations. The infestation caused by the weevil leads to fall of all their leaves and the trunk rots, resulting in the tree's eventual death thus the early detection with the UAV can be helpful for the minimizing the loss. Based on captured photos the palm palms were separated into three groups died, Apparently healthy palm plants, and palm trees with evident evidence of infestation. Once the infested tree located can be destroyed and endangered trees can be treated with insecticides (5).

C. UAV attached with electronic traps that count insects automatically and report counts to a server, which then summons and directs drones to spray in specific locations. Here the e-trap sends the signal to base station when the counts of insects exceeds to threshold of 30 insects. Then UAV gets the mission from the server and perform action such as spray or inspection (5).

D. In a Brazilian soybean field, drones were employed to assist reduce pesticide usage by 52 %. Based on the data generated the herbicide application map can be created that saved farmers on average 52 % of herbicides in the 2018/19 Brazilian season (6).

E. *Cirsium arvense* is widespread weed and to control its growth in specific areas of a field rather than the whole field, DJI partner Planta Drone were used to collect the multispectral data and test a spot spraying solution using drones to reduce chemical glyphosate usage. With the help of drone 67.78% of chemicals were saved with savings of 14.57 EUR per hectare for farmers (7).

Conclusions:

Drone technology will transform agriculture in the future, according to experts. Many Indian businesses are also expressing interest in the market, with plans to invest in low-cost drones that may assist farmers while also providing job possibilities for rural youngsters and improving farmer expertise. However, the business requires mature adjustments that take into account the expanding population, farmer requirements, operational rules, and dwindling acreage. Furthermore, competent pilots are required to propel the drone sector ahead. The harbingers of change are our farmers and drone operators. Overall, it will be fascinating to watch how things progress and how beneficial drone applications become in the future.

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APPLICATION OF GREEN TECHNOLOGIES

FOR SUSTAINABLE DEVELOPMENT

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The term "sustainable development" has been more popular over the past ten years, and current research and the expansion of knowledge in this area have raised interest in it. As suggested by its name, green technology serves a "green" function. We do not refer to green as the color. Green inventions are those that are favorable to the environment and frequently address issues like energy efficiency, recycling, health and safety, and renewable resources. Natural resources are finite and some of them are already exhausted or destroyed. Human health is at serious risk.

The main criteria for green technology are social equity, economic viability, and sustainability. Green energy, organic farming, eco-friendly textiles, green building construction, and the production of related goods and materials to support green business are some of the potential sectors where these developments and growth are anticipated to emerge from.

Principles

Environmental, Ecological, Economic, and Societal Principles make up the systems' basic building blocks (principles) -

Environmental principles:

These concepts are grouped from preventative to control principles and include renewable resources, resource minimization, source reduction (dematerialization), recycling, reuse, repair, regeneration, recovery, remanufacturing, purification, end-of-pipe, and deterioration.

Ecological principles:

Understanding the interactions between natural habitats requires taking into account ecological concepts. For the interplay of multiple systems, these principles are crucial. Through indirect or direct links, every subsystem in nature is connected to every other subsystem.

Economic principles:

Economic principles embrace terms like Environmental Accounting, Eco-efficiency (Factor X, Factor 4, and Factor, and Ethical Investments.

Environmental accounting:

The goal of environmental accounting is to bring environmental costs to the attention of business stakeholders who may be able and motivated to find ways to reduce or avoid such costs while also enhancing the organization's environmental quality and profitability.

Eco-efficiency:

Eco-efficiency is the supply of competitively priced goods and services that meet human requirements and improve quality of life, while gradually reducing ecological impacts and resource

intensity throughout the life cycle, to a level at least consistent with the earth's projected carrying capacity.

Societal principles:

Social responsibility is the growth of individuals in a secure, liberal, equitable, and equal manner while also benefiting both humanity and the environment. The European economic area defined the polluter pays principle as the idea that individuals who produce pollution should be responsible for the expenses it generates.

Sustainable systems:

The maximum level of activity is presented by sustainable systems in order to advance sustainable developments are -

- Sustainable production.
- Sustainable consumption.
- Sustainability policy.
- Sustainable development.

Applications of green technology in our life

- Solar array.
- Reusable water bottle.
- Solar water heater.
- Rainwater harvesting system.
- Building with green technology.
- National benefits for energy generation.
- Benefits to the rural areas.
- Benefit to the urban areas.
- Green nanotechnology.

Challenges to green technology adoption

Since environmental costs are often externalized in conventional manufacturing processes, green technology is typically more expensive than the technology it seeks to replace. It can be more expensive than more established technologies because it is a relatively new technology and because of the accompanying development and training requirements. There may be additional obstacles that prevent the adoption and dissemination of these technologies. Others may be related to technology, finance, politics, culture, or the law. The identification and elimination of these obstacles that prevent the wide-scale transfer of clean technologies to developing nations is necessary to promote green growth.

Conclusions

Product demand from consumers for green technology is rising. The range of products covered by such regulations is expanding, and government customers are being compelled to buy green whenever possible. The R&D phase is where green technology items are being deployed. Products are being redesigned to utilize less hazardous materials, use less shipping material, use less energy, and support recycling at the end of their useful lives. They are making changes to either avoid unfavorable effects, satisfy green demand, or both. Whatever the reason, there is no denying that they are moving in the direction of green. In order to move our society toward sustainable development, it is essential to grasp sustainability words, their definitions, and how they relate to one another.

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AGRICULTURE'S CONNECTED FUTURE:

HOW TECHNOLOGY CAN YIELD MORE

Agriculture plays a crucial role in ensuring food security. Increasing agricultural production through sustainable techniques can help reduce the amount of land required for farming while also slowing environmental degradation and climate change caused by deforestation. Agriculture is the main source of livelihood in developing countries. Two third populations of developing countries are dependent on agriculture for their bread directly or indirectly. Farmers may utilize information and communication technology to adapt cropping patterns to climatic trends, manage inputs and resources in an ecologically and sustainably friendly manner, and deal with productivity risks. Public authorities may alter policy based on ICT data, forecast food supply, focus social programmes, and boost yield technologies.

Over the last 50 years, the agriculture industry has undergone significant changes. Farm equipment has grown in size, speed, and productivity as a result of technological advancements, allowing for more efficient cultivation of more land. Seed, irrigation, and fertilizers have all improved dramatically, allowing farmers to enhance harvests. Agriculture is now in the midst of yet another transformation, with data and connection at its core. Artificial intelligence, analytics, linked sensors, and other developing technologies have the potential to boost yields, enhance water and other input efficiency, and improve sustainability and resilience in crop and animal husbandry.

Food demand is increasing at the same time as land and farming inputs are becoming scarce. By 2050, the world's population is expected to reach 9.7 billion people, necessitating a 70 percent increase in calories available for consumption, even as the cost of the inputs needed to produce those calories rises. Water supplies will fall 40 percent short of satisfying global water needs by 2030, and profit margins are already being pressured by growing energy, labour, and nutrient expenses. Around a fourth of arable land has been damaged and requires extensive restoration before it can be used to grow crops on a large scale again. There are also increasing environmental and social pressures, such as the push for more ethical and sustainable farm practices, such as higher standards for farm animal welfare and reduced use of chemicals and water, as well as social pressures, such as the economic impact of catastrophic weather events.

Agriculture must embrace a digitalization enabled by connectivity to confront these pressures poised to further roil the business. Agriculture, on the other hand, is less digitalized than many other industries around the world. The majority of previous advancements were mechanical in nature, such as more powerful and efficient machinery, and genetic in nature, such as more productive seed and fertilizers. To provide the next productivity jump, significantly

more advanced digital technologies are now required. Some already exist to help farmers use resources more efficiently and sustainably, while others are in the works. These new technologies can upgrade decision making, allowing better risk and variability management to optimize yields and improve economics. They can improve the well-being of livestock when used in animal husbandry, addressing growing concerns about animal welfare.

CURRENT CONNECTIVITY IN AGRICULTURE

In recent years, many farmers have begun to consult data about essential variables like soil, crops, livestock, and weather. However, few, if any, have had access to modern digital technologies that could aid in the transformation of these data into useful, actionable information. Almost all farm work in less-developed areas is done by hand, with little or no technological technology or equipment. Even in the United States, a pioneer in connectivity, only about a quarter of farms use connected equipment or devices to access data, and the technology isn't exactly cutting-edge, running on 2G or 3G networks that Telco's are planning to decommission or very low-band IoT networks that are difficult and expensive to set up. In either scenario, those networks can only support a limited number of devices and lack the real-time data transmission performance required to unleash the value of more advanced and complex use cases.

In many cases, however, current IoT technologies operating on 3G and 4G cellular networks are sufficient to allow simpler use cases, such as sophisticated crop and livestock monitoring. However, because hardware costs were high in the past, the business case for deploying IoT in farming did not hold up. Device and hardware costs are falling rapidly these days, and numerous companies now provide solutions at a price that we feel will pay off in the first year.

WHAT ARE THE USES?

1. Crop monitoring

Connectivity allows for a range of improvements in crop surveillance and maintenance. By more correctly recognising and anticipating shortfalls, integrating meteorological data, irrigation, nutrition, and other systems could optimise resource use and raise yields. Sensors monitoring soil conditions, for example, may communicate through LPWAN to instruct sprinklers to alter water and nutrient application. Sensors may potentially send imagery from far-flung parts of fields, allowing farmers to make more informed and timely decisions and receive early indications of diseases or pests. Farmers may be able to optimise the harvesting window with the use of smart monitoring. Monitoring crops for quality characteristics—say, sugar content and fruit color—could help farmers maximise the revenue from their crops. Most IoT networks today are incapable of supporting picture transfer between devices, let alone autonomous imagery processing, or of supporting big enough device numbers and density to accurately monitor wide fields. Narrowband Internet of Things (NB-IoT) and 5G have the potential to address these bandwidth and connection-density challenges. By 2030, the usage of greater and smoother links between soil, farm equipment, and farm management could unleash a value of $130 billion to $175 billion.

2. Livestock monitoring

In large-scale livestock management, where most animals are kept in close quarters on a regimen that assures they go readily through a highly automated processing system, preventing disease outbreaks and recognizing animals in distress are crucial. Chips and body sensors that monitor temperature, pulse, and blood pressure, among other things, could detect illnesses early, reducing herd infection and enhancing food quality. Farmers are already employing ear-tag technology from firms like Smartbow (part of Zoetis) to track cows' heat, health, and location, as well as equipment from Allflex to conduct comprehensive electronic tracing in the event of disease outbreaks. Similarly, environmental sensors could trigger automatic adjustments in ventilation or heating in barns, lessening distress and improving living conditions that increasingly concern consumers.

3. Farming by drone

Drones have been used in agriculture for nearly two decades, with farmers all over the world relying on pioneers such as Yamaha's RMAX remote-controlled helicopter to assist with crop spraying. Now, the next generation of drones is beginning to make an influence on the industry, with the potential to quickly and efficiently survey crops and herds across large regions, or as a relay system for transferring real-time data to other linked equipment and installations. Drones might potentially employ computer vision to monitor

agricultural conditions and deliver exact fertilizers, nutrients, and pesticides where they're needed most. They might also plant seed in faraway regions, saving money on equipment and labour. Drones might produce between $85 billion and $115 billion in value by lowering costs and enhancing yields.

4. Autonomous farming machinery

The introduction of smart and autonomous farm machinery could be aided by more precise GPS controls combined with computer vision and sensors. Farmers may use a variety of equipment on their field at the same time, without the need for human involvement, saving time and money. Autonomous machines are also more efficient and precise in the field than human-operated machinery, potentially saving fuel and increasing yields. By 2030, increasing the autonomy of machinery through improved connection might contribute $50 billion to $60 billion in value.

5. Implications for the agricultural ecosystem

New pockets of value will most likely be unlocked as the farm business digitizes. Because of their close ties with farmers, their own knowledge of agronomy, and their track record of innovation, input providers selling seed, nutrients, pesticides, and equipment have played a critical role in the data ecosystem to date. One of the world's largest fertilizer distributors, for example, now offers fertilizing agents as well as software that analyses field data to assist farmers in determining where and how much fertilizer to apply. Similarly, to improve the efficiency of field equipment, a large-equipment manufacturer is developing precision controls that use satellite imagery and vehicle-to-vehicle connections.

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ENERGY DRINKS:

UNFERMENTED FRUITS BEVERAGES

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Fruit beverages or drinks are one of the most widely used groups of liquids drink intended for human consumption. Fruit beverage production on a commercial scale was unknown until around 1930, but it has since grown into a significant business. New Zealand and Colombia are the two countries that consume the most fruit juice. Fruit juice consumption rises in tandem with the amount of national GDP. Fruit beverages give a refreshing cold drink in tropical countries like India during the hot summer months. Juice is a beverage made by pressing or extracting the natural liquid contained in fruit. Juice is widely consumed as a beverage or as a flavoring

component in foods and other beverages, such as smoothies. With the introduction of pasteurization technologies, which allowed for the preservation of juice without the use of fermentation, juice became a popular beverage choice. Fruit drinks and beverages are easily digestible, highly pleasant, thirst quenching, delicious, and nutritionally superior to most synthetic and aerated beverages. The use of fruit-based beverages and drinks has risen rapidly in recent years.

Fruit juice

(1) Natural fruit juice (Pure juice)

Natural fruit juices are also considered fresh/pure juice. It can be defined as 100 percent fruit juice produced from ripe and mature fruits. Sugars, acids, vitamins, minerals, and other minor components are mostly present in the juice, which is extracted using various processes. Thermal processing and freezing are used to keep them safe. Apple, pineapple, citrus, grapes, pomegranate, and mango juices are all common fruit beverages.

(2) Sweetened juice

It produces a product that comprises at least 85% juice and 10% total soluble solids (TSS). Sweetened beverage consumption has been connected to weight gain, obesity, and health hazards.

Fruits beverages

Fruit beverages are highly digestible, highly refreshing, appetizing and nutritionally far superior too many synthetic and aerated drink. Fruit beverages are classified into two groups.

(A) Unfermented beverages

Fruit juices which do not undergo alcoholic fermentation are term as unfermented beverages. They include natural fruit juice, sweetened juice, ready to serve (RTS), nectar, cordial, squash crush etc.

(B) Fermented beverages

Fermented juice which have undergone alcoholic fermentation by

yeasts include port, nira, sherry, tokay etc.

Unfermented beverages made from fruit juice or pulp

♣ Ready to Serve (RTS)

This is a type of fruit beverage that comprises at least 10% fruit juice (5% juice in the case of lime drink) and not less than 10% total soluble solids. These drinks must have an acidity of 0.3 percent. RTS beverages are preserved using class second preservatives containing no more than 70 parts per million of SO_2 or 120 parts per million of benzoic acid. It is regarded as ready to serve since it is not diluted before serving (RTS). Mango, guava, orange, papaya, and other fruits are appropriate for RTS.

♣ Squash

Fruit squash is made up of fruit juice or pulp that has been sweetened with cane sugar. The fruit squash must have a minimum of 25% fruit juice or pulp and a maximum of 40% total soluble solids. The amount of acid in squash should be between 1-1.5 percent, but not more than 3.5 percent as citric acid. Before serving, squash is usually diluted in 1:3 ratio with water. Commercially produced lime, mango, orange, guava, and pineapple squash. Squash thrives in a pH range of 5.5-6.5.

♣ Nectar

Nectar is made by adding sugar, acid, and other components to the pulp of tropical fruits such as mango, litchi, guava, papaya, citrus fruits, and pineapple. According to FSSAI guidelines, nectar should have a TSS of no less than 15 percent and a fruit content of not less than 20 percent, with the exception of pineapple and citrus fruits, which should have a fruit content of not less than 40%. As a beginning material, you can utilize fruit pulp, puree, juice, or concentrate. The nectar acidity should not exceed 3.5 percent as anhydrous citric acid.

♣ Cordial

Fruit juice cordial is a sparkling clear sweetened fruit beverage that has been fully free of pulp and other suspended materials. Clarified fruit juice, sugar syrup, acid, and other substances are combined to make cordial. According to FSSAI guidelines, cordial should have at least 25 percent fruit content and at least 30 percent TSS content. The cordial acidity should not exceed 3.5 percent as anhydrous citric acid. The maximum amount of preservative allowed in cordial is 350 parts per million of sulphur dioxide or 600 parts per million of benzoic acid. Cordial is best made by using citrus juices such as lime and lemon.

♣ Crush

This type of fruit beverage contains at least 25% fruit juice or pulp and 55% total soluble solids. It is more or less similar to squash having about 1% acid and diluted before serving.

♣ Carbonated beverage

Fruit juices are used in the preparation of carbonated drinks. Mostly artificially flavored drinks are prepared by this method. The use of fruit juice would increase the nutritive value of carbonated beverages. Carbonated beverages can keep well for about a week without addition of any preservatives. Pineapple, apple, grape, lime, lemon etc. fruits can be prepared are examples of carbonated beverages. They are prepared either by pre mix or post mix method. The liquid is chilled and cascaded down in an enclosure containing carbon dioxide (either as dry ice or a liquid) under pressure. Increasing pressure and lowering temperature maximize gas absorption. Carbonated beverages do not require pasteurization.

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NEUTRAL ELECTROLYZED WATER

A POTENTIAL DISINFECTANT FOR FRESH FRUITS AND VEGETABLES

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Recently, search for chemical free, economically and ecologically sustainable disinfectants for food industry is in increasing trend. Neutral electrolyzed water is one such disinfectant having wide scope for food industry application especially in fresh fruits and vegetable related industry. It has been proven to be effective in reducing many harmful pathogenic micro-organisms present on surface of fruits and vegetables. It is also found fit for use as meat and poultry disinfectant. Neutral electrolyzed water will be more manageable, safer, and can become "in situ" method for ensuring food safety.

Introduction

Occurrence of pandemic made people to realize the importance of surface sterilization in fruits and vegetables for consumption. Chlorine and sodium hypochlorite are the most used chemical for disinfection purpose in food industry especially for fruits and vegetables surface disinfection. From past two years ozonation has become a new trend for home scale as well as industrial scale disinfestation. But high cost of ozone generation makes it a major hindrance for its commercial application. To this the neutral electrolyzed water can become an effective alternative. Neutral Electrolyzed Water (NEW) is one of the types of electrolyzed water but with neutral pH (6.0 - 7.0). It is generated naturally by electrolysis of dilute salt solutions which generates gentle, but extremely potent antimicrobial solution capable of rapid reduction of bacteria, viruses, spores, cysts and scale. It is considered as one of the safe methods, as it does not leave behind any harmful residues. NEW can become a perfect substitute for chlorine fruit and vegetable disinfection in food industries. It is very effective at killing microbes. Apart from surface disinfection of fruits and vegetables it is commercially applied in preservation of meat and poultry. The effectiveness of NEW in eliminating pathogens and spoilage microorganisms has been proved successfully in many fruits like apple, pear, melon, orange, cantaloupe, and mango. New washing is known to bring about 1 log CFU reduction in number of pathogenic microbes. Torlak (2014) reported that the application of NEW washing (pH of 7.76, ACC of 191 mg/L and ORP of 786 mV) for 3 min in apple has resulted in reduction of *Alicyclobacillus acidoterrestris* spores by >4 log CFU/apple. NEW washing is also reported to decrease the *Escherichia coli* O157:H7 population in lettuce (Afari *et al.*, 2016). In 2003, Deza *et al.* demonstrated that the viable counts of four strains of microorganisms were reduced by more than 4 $\log_{10}$ CFU/g on the surface of tomato using NEW containing 89 mg/L of active chlorine without affecting sensory qualities.

Generation of Neutral electrolyzed water

Electrolysis chamber is used to produce electrolyzed water with electrolysis of dilute sodium chloride (NaCl) solution. Upon electrolysis, the NaCl dissociates into Na^+ and Cl^- and water molecule dissociates into OH^- and H^+ ions. Further negative charge ions react with each other resulting in formation of oxygen gas (O_2), chlorine gas (Cl_2), hydrochloric acid (HCl), hypochlorite ion (OCl^-)

and hypochlorous acid (HOCl). Whereas the positive ions produce hydrogen gas (H_2), and sodium hydroxide (NaOH). Finally, electrolysis results in creation of two solutions: an acidic solution in the anode (pH of 2-4) with an oxidation-reduction potential (ORP) of >1000mV, and an active chlorine content (ACC) of 10-90 ppm and an alkaline solution in the cathode (pH of 10-13) with an ORP of 800 to 900mV. The neutral electrolyzed water is generated in similar manner but with neutral pH (7.0 – 8.0) having ORP of 750–1000mV and ACC of 50-500 ppm (Shiroodi & Ovissipour 2018).

Mechanism of action

Hypochlorous Acid (HOCl) is the primary component of NEW having major role in microbial control. The strong sterilizing effect of HOCl is because of disruption in the key metabolic pathways of microbial cell and it also disrupts microbial cell structure leading to leakage of K^+ and Mg^{2+} and eliminating cell viability. Apart from this, Meireles *et al.* (2017) stated that NEW may stimulate the production of reactive oxygen species, which was a factor in its ability to kill microbes.

Pathogens of fruits and vegetables controlled effectively by NEW

- *Alicyclobacillus acidoterrestris*
- *Salmonella*
- *Listeria*
- *Escherichia coli*
- *Yersinia enterocolitica*
- *Cronobacter sakazakii*
- *Pseudomonas.*

Advantages of using NEW as dis infectant

- No harmful effect on humans
- Lethal to harmful bacteria and viruses
- Completely natural
- Easily disposed of
- Environmentally friendly
- Non-corrosive
- Non-flammable.

Conclusion

Neutral electrolyzed water application in fruit and vegetable disinfection will help in diminish the risk of infection or intoxication associated with the consumption of raw fruits and vegetables. It is non-toxic, non-irritant, and environmentally, and ecologically safe. The bactericidal efficacy of NEW is comparable to chlorinated water at lower levels of free chlorine, which encourages the fresh-cut industry to use less chlorine. Additionally, NEW has the advantage of being non-corrosive (unlike acidified EW) and is safer to both product and worker, can be generated "in situ" and is simpler to handle as compared to sodium hypochlorite.

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PROPAGATION TECHNIQUES OF BANANA

About Author

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Banana and plantains are the second largest food-fruit crops of the world produced in the tropical and subtropical regions of mostly the developing countries. The two together are positioned fourth in terms of gross value. During recent years, growth of banana cultivation has witnessed great strides reaching 95.60 million tones in 2009 from 66.84 million tones in 2001. Adoption of Panama disease resistant Cavendish varieties in place of Gross Michel; mechanization in production; efficient water management, harvest and postharvest handlings; and integrated pest and disease management have helped in this growth. Adoption of high quality, disease free planting material developed through tissue culture has been an important addition during recent years.

Need of study

- Commercial banana production has been hinder by scarcity of high quality seedling.
- Farmers mostly rely on Natural regeneration of existing plants for propagation. Which is a slow process and often does not yield adequate amount.
- Pest and Diseases are the most important constraints in banana production.
- In tissue culture plant producing large number of high quality seedling but it required high capital and skills required leading to high cost of seedlings hence not affordable to most farmers.
- All cultivated commercial bananas are tropical and sterile except for a few parthenocarpic AA and AB which are diploid.

Sources of banana planting materials:

Natural regeneration- In India use of conventional suckers cannot be completely avoided because of some regional special varieties tissue culture techniques is yet to be perfected. Further for resources poor small scale growers the cost of tissue culture plants stills a hurdle in adoption. There is Five types of material use for natural regeneration:-

1. Suckers: There are three types of suckers-

A. Sword suckers- Sword sucker with a well-developed base, pointed tip and narrow leaf blades, and water suckers, which are small, less vigorous, broad leaved and emerge in clumps rhizome conical in shape with sound heart best planting material, bearing is early (11 month).

B. Water suckers- Poor developed sucker, Broad leaves spreading with roundish tip, weak narrow pseudo stem, small corms ,lack of vigor and not recommended as planting material, growth slow, bearing late (15 month).

C. Maiden sucker- Maiden sucker, a large non-fruiting pseudo stems 9 with roots and some rhizome.

2. Peepers: peepers (very young suckers) produce late and poor crop.

3. Rhizomes: Four months old suckers produced heavier bunches compared with those obtained from peepers.

4. Bits: Whole or split rhizome can also used when suckers are not available. Bits of rhizome of 2.0kg or more may be planted in the nursery for sprouting or directly sown in the main field for quick multiplication of a variety rhizome bits may be used. Though the plants will requires little longer time to fruit.

Micro propagation- Micro propagation is the practice of rapidly multiplying stock plant material to produce a large number of progeny plants under aseptic conditions, using modern plant tissue culture methods. Micro propagation is the practice of rapidly multiplying stock plant material to produce a large number of progeny plants under aseptic conditions using modern plant tissue culture methods.

Why do micro propagation?

- A single explants can be multiplied into several thousand plants in less than a year. Allows fast commercial propagation of new cultivars.
- Once established a plant tissue culture line can give a continuous supply of young plant throughout the year.
- In plants prone to virus diseases, virus free explants (new meristem tissue is usually virus free) can be cultivated to provide virus free plants,
- Plant 'tissue banks' can be frozen then regeneration through tissue culture.
- Plant culture in approved media are easier to export than are soil-grown plants, as they are pathogen free and take up little space (most current plant export is now done in this manner).
- Save space for early plantation/germination thus reduce cost for land used.

Types of micropropagation:

1. Meristem culture:

In meristem culture the meristem and a few subtending leaf primordial are placed into a suitable growing media. An elongated rooted platelet is produced after some weeks, and is transferred to the soil when it has attained a considerable height. A disease free plant can be produced by this method. Experimental result also suggests that this technique can be successfully utilized for rapid multiplication of various herbaceous plants.

2. Callus culture:

A callus is mass of undifferentiated parenchymatous cells. When a living plant tissue is placed in an artificial growing medium with other conditions favorable, callus is formed. The growth of callus varies with the homogenous levels of auxin and Cyotkininn and can be manipulated by endogenous supply of these growth regulators in the culture medium. The callus growth and its organogenesis or embryogenesis can be referred into three different stages.

3. Suspension culture:

A cell suspension culture refers to cells and or groups of cells dispersed and growing in an aerated liquid culture medium is placed in a liquid medium and shaken vigorously and balanced dose of hormones. Cyotkininn induced adventitious buds in kiwi fruit in a suspension culture sub- culture for about a week.

4. Embryo culture- In embryo culture, the embryo is excised and placed into a culture medium with proper nutrient in aseptic condition. To obtain a quick and optimum growth into plantlets, it is transferred to soil. It is particularly important for the production of interspecific and intergeneric hybrids and to overcome the embryo abortion.

5. Protoplast culture- In protoplast culture, the plant cell can be isolated with the help of wall degrading enzymes and growth in a suitable culture medium in a controlled condition for regeneration of plantlets. Under suitable conditions the protoplast develops a cell wall followed by an increase in cell division and differentiation and grows into a new plant. The protoplast are first cultured in liquid medium at 25 to 28 C with a light intensity of 100 to 500 lux or in dark and after undergoing substantial cell division, they are transferred into solid medium congenial or morphogenesis in many horticultural crops response well to protoplast culture.

Mother nursery block and selection of mother plants:

- Healthy, true to type and free from diseases and pests, especially virus diseases.
- The male flowers buds should be retained to check the presence of virus disease (male flower buds exhibit symptoms of late infection of viruses like BBTV and BBrMV.
- Mother plants should be raised under roofless insect proof shade net with sufficient height.
- Mother nursery must be located away from other banana plantations with an isolation distance of 500 m to maintain purity and to avoid spread of virus diseases.
- Mother plants should be grown under very good management conditions so as to facilitate the true expression of traits.
- Individual plants should be tagged with a master code number so that the plantlets developed could be traced back to the mother plant.
- Pedigree record and source of each mother plant should be maintained and catalogued.
- Once indexed, the mother suckers can be maintained in field or concrete rings with frequent decapitation to facilitate production of more axillary buds. They also serve as explants for culture initiation.

Macro propagation

Macro propagation is an excellent option for producing low cost quality planting material. This is a simple method because of the ease of multiplication, saves cost of producing planting material and has the potential of producing 50-60 shoots per sucker in 4-5 months. Macro propagation is achieved by two methods and could be adopted either in the field conditions (in situ) or in the nursery (*ex situ*). It involves decapitation, decortications and hardening.

Advantages of macro propagation

- It can rapidly multiply plantlets to distribute a new variety or replace plants in disease affected fields.
- It gives relatively healthy plants if source suckers are from healthy mother plants and contamination is minimized during the process.
- It can be done locally at low cost and with little training: a private person or a farmers' organization can launch this activity.
- It can teach awareness of principles of plant health.

■■■

AN OVERVIEW OF INDIAN WETLANDS (KIDNEYS OF THE EARTH)

THREATS AND CONSERVATION MANAGEMENT

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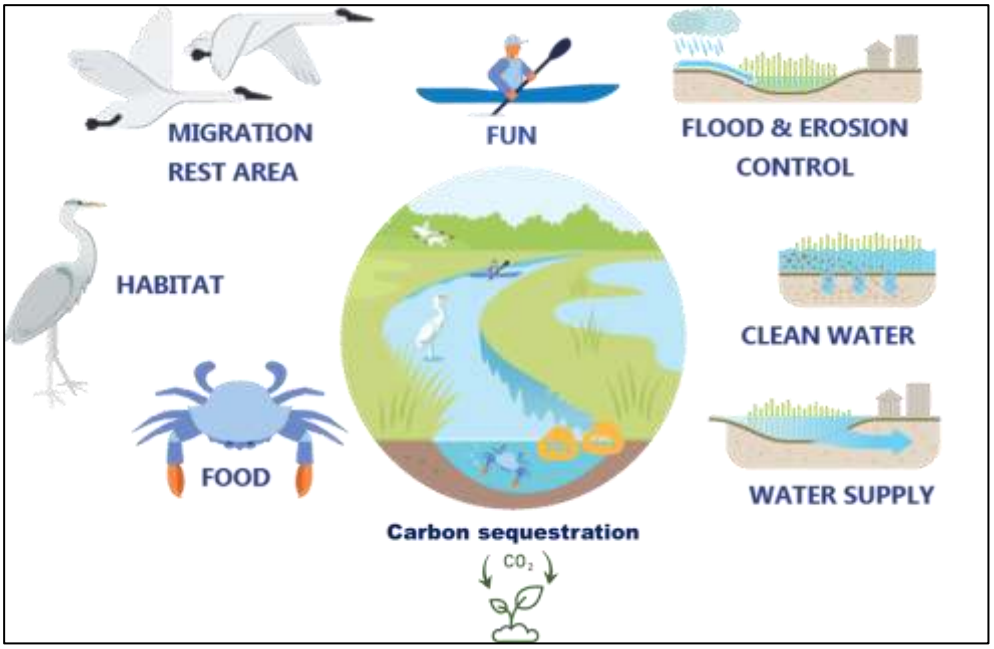

Fig.- 1 A Beautiful unique wetland ecosystem and their

A wetland is a transitional zone between land and water body that is saturated with water either permanently or seasonally. They occupy approximately 6% of the earth's surface. Wetlands are most productive & biologically diverse ecosystems, provide numerous socio-economic & ecosystem services such as shelter or habitat for finfishes & shellfishes, birds, maintenance & conservation of biodiversity, water purification, fisheries & recreation, flood control, water supply, nutrient removal, carbon sequestration & environmental restoration. Due to their unique features scientists often refer to wetlands as the "kidneys" of the earth and forests as the "lungs" of the earth. "Loss of Wetlands = Loss of Biodiversity". According to the SDG-2022 report, over the past 300 years, over 85% of the planet's wetlands have been lost, mainly through drainage & land conversion.

Importance

According to the Ramsar Convention's Global Wetland Outlook (GWO) report, up to 40% of the world's plant and animal species live or breed in wetlands, over 100,000 freshwater species are situated in wetlands, and more than 25% of all wetland plants and animals are currently threatened with extinction.

Ramsar Convention

World Wetlands Day is celebrated worldwide on 2nd February. This Convention was signed in 1971 in the Iranian city of Ramsar. As a result, this convention was titled the Ramsar Convention, on 2nd February 1971 but came into force in 1975.

Current statue of Indian wetland:

India is home to a wide variety and a myriad number of wetlands. India became a party to the 'Convention on Wetlands on 1st February 1982 and has since then designated 54 wetlands covering an area of 10, 98,518 ha under the list of Wetlands of International Importance.

Table 1. List of Indian Wetlands and Area

Sl. No.	Name of Site	State Location	Area (*in Sq. km.*)
1	Kolleru Lake	Andhra Pradesh	901.00
2	Deepor Beel	Assam	40.00
3	Kabartal Wetland	Bihar	26.20
4	Khijadia Wildlife Sanctuary	Gujarat	5.12
5	Nalsarovar Bird Sanctuary	Gujarat	120.00
6	Thol Lake Wildlife Sanctuary	Gujarat	6.99
7	Wadhvana Wetland	Gujarat	6.30
8	Bhindawas Wildlife Sanctuary	Haryana	4.12
9	Sultanpur National Park	Haryana	1.425
10	Chandertal Wetland	Himachal Pradesh	0.49
11	Pong Dam Lake	Himachal Pradesh	156.62
12	Renuka Wetland	Himachal Pradesh	0.20
13	Wular Lake	Jammu & Kashmir	189.00
14	Hokera Wetland	Jammu and Kashmir	13.75
15	Surinsar-Mansar Lakes	Jammu and Kashmir	3.50
16	Tsomoriri Lake	Jammu and Kashmir	120.00
17	Asthamudi Wetland	Kerala	614.00
18	Sasthamkotta Lake	Kerala	3.73
19	Vembanad Kol Wetland	Kerala	1512.50
20	Tso Kar Wetland Complex	Ladakh	95.77
21	Bhoj Wetlands	Madhya Pradesh	32.01
22	Lonar Lake	Maharashtra	4.27
23	Nandur Madhameshwar	Maharashtra	14.37
24	Loktak Lake	Manipur	266.00
25	Bhitarkanika Mangroves	Orissa	650.00
26	Chilka Lake	Orissa	1165.00
27	Beas Conservation Reserve	Punjab	64.289
28	Harike Lake	Punjab	41.00
29	Kanjli Lake	Punjab	1.83
30	Keshopur-Miani Community Reserve	Punjab	3.439
31	Nangal Wildlife Sanctuary	Punjab	1.16
32	Ropar Lake	Punjab	13.65
33	Keoladeo Ghana NP	Rajasthan	28.73
34	Sambhar Lake	Rajasthan	240.00
35	Point Calimere Wildlife & Bird Sanctuary	Tamil Nadu	385.00
36	Rudrasagar Lake	Tripura	2.40
37	Bakhira Wildlife Sanctuary	Uttar Pradesh	28.94
38	Haiderpur Wetland	Uttar Pradesh	69.08
39	Nawabganj Bird Sanctuary	Uttar Pradesh	2.25
40	Parvati Agra Bird Sanctuary	Uttar Pradesh	7.22
41	Saman Bird Sanctuary	Uttar Pradesh	52.63

42	Samaspur Bird Sanctuary	Uttar Pradesh	79.94
43	Sandi Bird Sanctuary	Uttar Pradesh	30.85
44	Sarsai Nawar Jheel	Uttar Pradesh	16.13
45	Sur Sarovar	Uttar Pradesh	4.31
46	Upper Ganga River (Brijghat to Narora Stretch)	Uttar Pradesh	265.90
47	Asan Conservation Reserve	Uttarakhand	4.44
48	East Kolkata Wetlands	West Bengal	125.00
49	Sunderbans Wetland	West Bengal	4230.00
50.	Karikili Bird Sanctuary	Tamil Nadu	61.21
51.	Pallikaranai Marsh Reserve Forest	Tamil Nadu	80.00
52.	Pichavaram Mangrove	Tamil Nadu	11.00
53.	Sakhya Sagar	Madhya Pradesh	18.50
54.	Pala Wetlands	Mizoram	18.50

Threats of wetlands:

Wetlands are one of the world's most threatened ecosystems; the wildlife that calls them home is some of the most endangered. Presently, our wetlands are facing numerous and tremendous threats such as man-made, natural and they are still being disappeared three times faster than forests. Some common threats are habitat destruction, discharge of wastewater, weed infestation, pollution, invasive species, over-harvesting, unregulated tourism and climate change.

Conservation and management:

The Ministry of Environment, Forest and Climate Change (MoEF&CC) has notified Wetlands (Conservation and Management) Rules, 2017 under the provisions of the EPA, 1986 as the regulatory framework for conservation and management of Indian wetlands. Some common state laws regarding the conservation of the wetlands- The Kerala Conservation of Paddy Land & Wetland Act, 2008, Andhra Pradesh Water, Land, & Trees Act, 2002 and East Kolkata Wetlands (Conservation & Management) Act, 2006. Other laws that indirectly help to conserve wetlands such as National Environment Policy, 2006; WPA, 1972; Indian Forest Act, 1927; Forest Act, 1980 and Indian Fisheries Act, 1857. In Uttar Pradesh, there are no rules and regulations for wetland conservation. So, I would like to recommend to the government to implement UP Wetland (Protection) Act.

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CLIMATE CHANGE

IMPACT ON APPLE IN COLD DESERT OF WESTERN HIMALAYAS (SPITI)

About Author

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Spiti valley located in western Himalayan region in India, it is an integral part of Indian cold deserts. The area is characterized by harsh climatic conditions i.e. dry and cold weather, low temperature, heavy snowfall and low annual rainfall. Apple is considered as an important source to increase the economy of farmers of this tribal area. Though very less area is occupied by apple orchards in comparison to other apple producing areas in the state, but these apple orchards are comparatively younger. Due to changing climate scenario and increasing area under apple cultivation in Spiti, the orchardists are facing some problems pertaining to insect and disease attack in their orchards.

Glaciers in Spiti Valley have been retreating at an unprecedented rate for the past decade, due to which agricultural diversity is also changing. In 2014, Jawaharlal Nehru University, New Delhi reported that the annual temperature in the Indian Himalayas has risen to two degrees Celsius in last two decades. Whereas the area under glaciers here decreased by 13 percent in last five decades. According to the Meteorological Department, district Lahaul and Spiti have received 122.8 mm of rain during the monsoon season 2021-22, which is 69 percent less than the normal rainfall (394.7 mm). There has been a reduction of up to 27.81 percent in all the natural water sources of Spiti.

Old crops grown in Spiti valley like black peas, wheat, barley, potato and mustard have seen a decrease in the crop area. The area under these crops was highest in Barley (55.2 percent) and the lowest in Mustard (0.96 percent) two decades ago. Currently, there is a decrease of 31.67 percent in Barley. Green peas (42.66 per cent) and apple (6.93 per cent) are emerging as major cash crops (Fig. 2). Due to climate change, people are turning towards tomato, cabbage and other leafy vegetables and have started growing in the periphery of their house to feed their families.

In the last decade, Spiti has recorded an increase in annual temperature by 1-2°C. The data was recorded by the Meteorological Center located at Krishi Vigyan Kendra, Tabo and the change in annual (maximum and minimum) temperatures are shown in Fig 3 and 4. Representing comparison to the last 10 years, the maximum temperature has increased by 3.2 °C and the minimum temperature rise of

Fig. 1: Location of Spiti in India (H.P.)

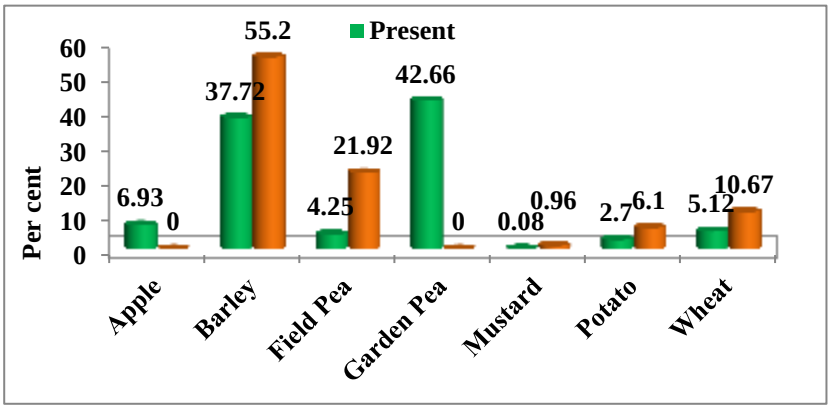

Fig. 2 Comparison of different crops grown during past and present in Spiti

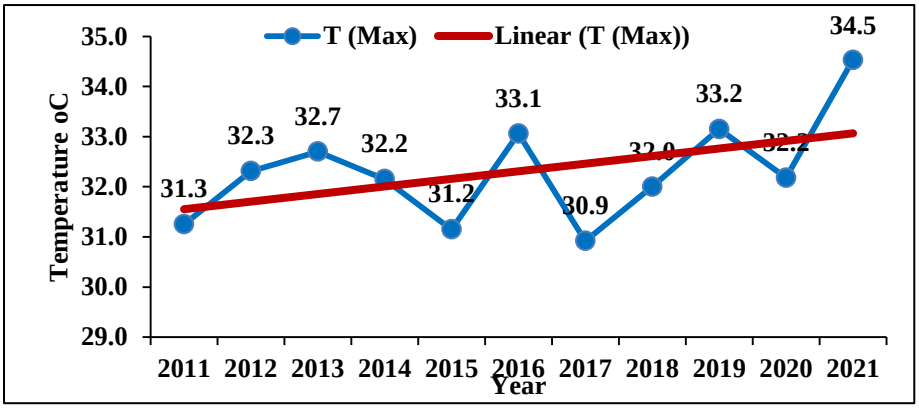

Fig. 4 Min. Temp. (°C) during 2011-2021 at Tabo (Spiti) with linear relationship

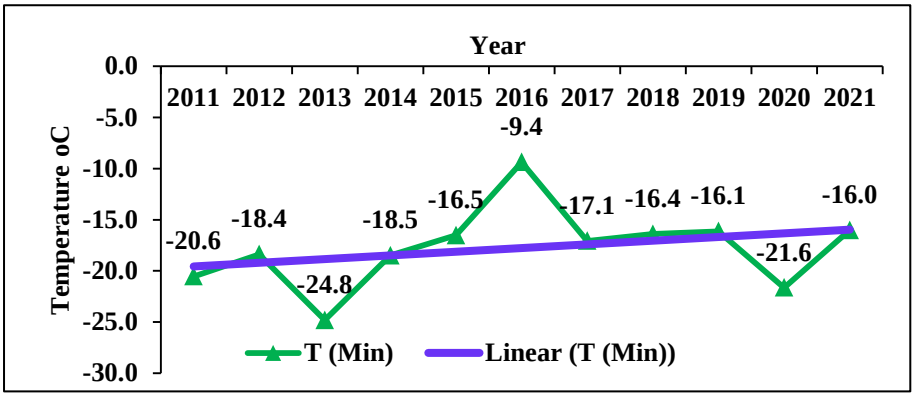

Fig. 3 Max. Temp. (°C) during 2011-2021 at Tabo (Spiti) with linear relationship

7.2 °C has been recorded.

Due to changing climate scenario and increasing area under apple cultivation in Spiti, the orchardists are facing some problems pertaining to insect (Woolly apple aphid, phytophagous mites, Indian Gypsy moth, Shothole borer, Soft scales, beetles, apple fruit moth) and disease (canker, pre-mature leaf fall, root rot, white root rot, hairy roots, leaf blight, flyspeck) attack in their orchards. These pests cause losses both directly and indirectly. The direct losses are fruit damage, quality and quantity of apple fruits and indirect losses are the costs incurred for their management. Reasons for insect-pest infestation and disease occurrence in Spiti:

- Ignorance of improved cultural practices in the orchard
- Lack of basic knowledge about insect-pests and their time of appearance among fruit growers.
- Ignorance as well as poor transfer of technology to farmers on integrated approach of the pest management.
- Indiscriminate use of pesticides.
- Lack of effective bio control agents
- Poor water and nutrient management.
- Lack of well organized, systematic and scientific surveillance system to give advance warning to the farmers.

The Integrated Pest Management is thus a part of agro-ecosystem and one has to manage the plant health rather than the individual pest or pathogen. The strategy thus starts with the host and comprises selection of genetically superior and resistant genotypes, adoption of cultural practices resulting in reduced population of pests and pathogens, preserving and promoting the activities of natural antagonists and predators with minimum use of pesticides and fungicides wherever absolutely necessary.

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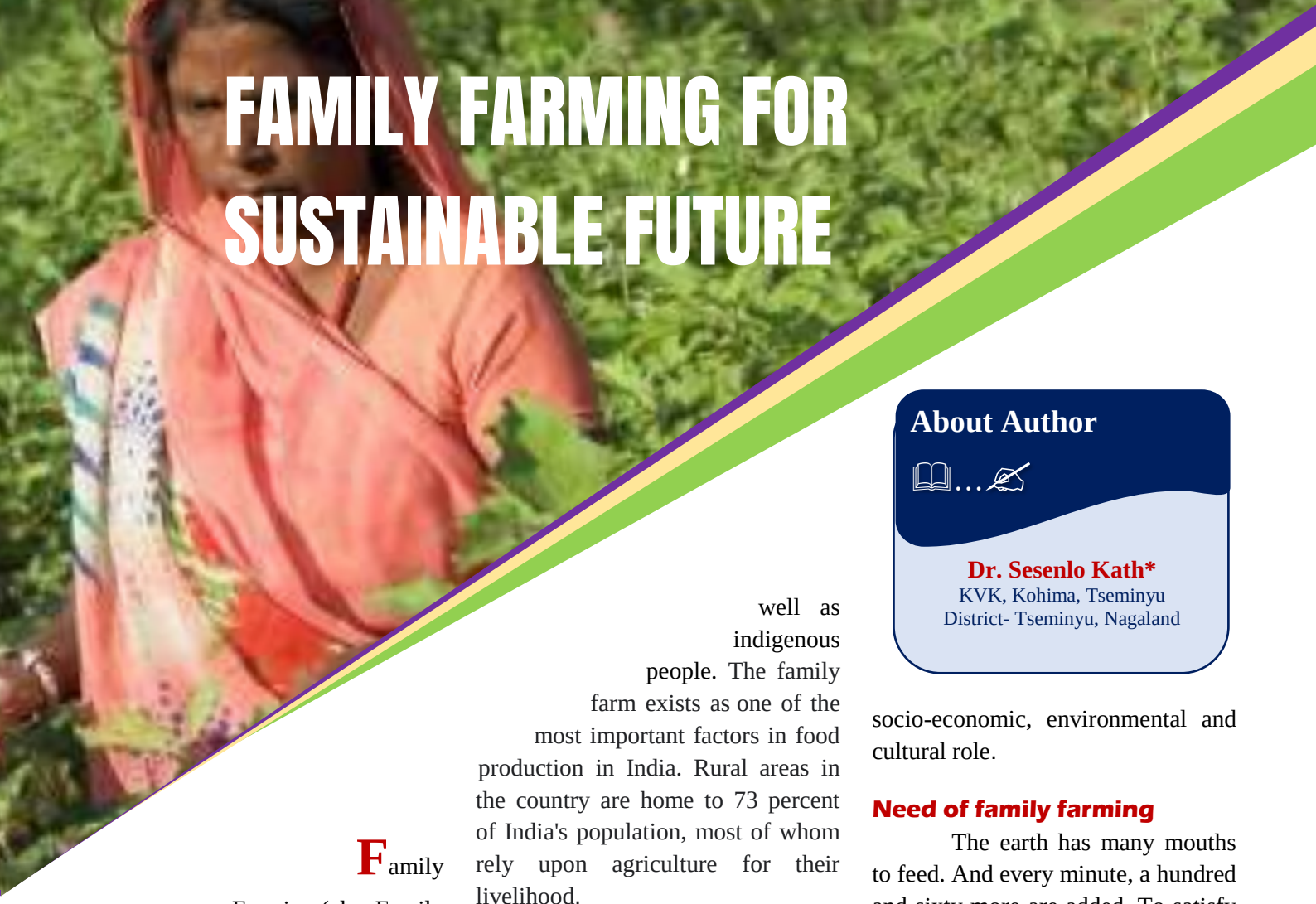

FAMILY FARMING FOR SUSTAINABLE FUTURE

About Author

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Family Farming (also Family Agriculture) is a means of organizing agricultural, forestry, fisheries, pastoral and aquaculture production which is managed and operated by a family and predominantly reliant on non-wage family labor, including both s (FAO, 2014). The family and the farm are linked, co-evolve and combine economic, environmental, reproductive, social and cultural functions. Family Farming considers men and women farmers, artisan fishers (The livelihoods of some 357 million people depend directly on small-scale fisheries, which employ over 90% of capture fishers of the world), pastoralists (Extensive livestock production systems cover about 25% of the Earth's terrestrial surface, produce about 10% of meat used for human consumption and support 20 million households), gatherers and landless peasants, as well as indigenous people. The family farm exists as one of the most important factors in food production in India. Rural areas in the country are home to 73 percent of India's population, most of whom rely upon agriculture for their livelihood.

Family farming sector comprises a wide spectrum of farm sizes and types ranging from very large holdings in high- income economies that are easily by one or two family members with the use of labour-saving machinery and hired labour to the small holdings of a few hectares or less in low-income economies. At national level, there are a number of factors that are key for successful development of family farming, such as: agro-ecological conditions and territorial characteristics; policy environment; access to markets; access to land and natural resources; access to technology and extension services; access to finance; demographic, economic and socio-cultural conditions; and availability of specialized education, among others. Family farming has an important socio-economic, environmental and cultural role.

Need of family farming

The earth has many mouths to feed. And every minute, a hundred and sixty more are added. To satisfy increased demand, global food production will have to increase by more than 50 per cent by 2050. Despite the very real progress since the year 2000, there are still over 1 billion people living in extreme poverty, many of whom live in rural areas, as well as more than 800 million people in the world that are still undernourished. The world 500 million small holder family farms produce four-fifth of food in developing countries. They are also the custodians of much of the world's agro-biodiversity. Yet today, this small scale producer belongs to the "forgotten world".

Family farming is often more than a professional occupation, as it reflects a lifestyle based on beliefs and traditions about living and work. It ensures food security even while meeting rising societal expectations for food safety, quality,

value, origin and diversity of food. It also maintains rural lifestyle and contributes to socio-economic and environmental sustainability of the rural areas.

IFAD initiatives for family farming:

1. Creation of National Committees:

The national level is where governments and organizations of smallholder and family farmers can most effectively reach agreements on measures to improve the conditions of family farming. Smallholder and family farming are mission of reducing poverty and hunger in the rural areas of the developing world. IFAD-supported programmes help poor rural people improve their food and nutrition security, increase their incomes and strengthen their resilience. IFAD is unique in being an international financial institution and a United Nations agency, and is exclusively focused on agricultural and rural development in developing countries. More than 60 National Committees in the five continents have promoted the establishment of National Committees to organise IYFF-2014 in each country so that more than 60 platforms of this type have been Baliwada, H., 2018 25 set up to promote Family Farming in their respective countries. These 60 National Committees, focal points for awareness-building in favour of family farming, bring together under the associations, NGOs, research centres and other entities with the objective of planning goals and activities for the Year in each country. Many of these committees have incorporated governments and international organisations with a view to establishing a dialogue leading to improved public policies affecting men and women family farmers.

2. Increase Investment:

Investing in family farming is investing in a sustainable, food secure future. The IYFF presents a window of opportunity for policymakers to act responsibly to both present and future generations in a way that will reduce poverty and eradicate hunger in their respective countries.

3. Changes at policy level:

Encourage policy changes that will make family farming a more secure, profitable and attractive livelihood, including for rural women and youth. Support programmes that enable smallholder and family farmers to invest in their businesses, link to markets and overcome poverty and vulnerability; Promote incentives to family farmers to manage their land, water, biodiversity and other natural resources in a more sustainable way.

4. Mobilization:

Underlying this were the huge efforts coordinated by the World Rural Forum and supported by more than 360 organisations research centres, institutions etc. In over three increasing support the declaration was finally unanimously adopted by the UN General Assembly -in itself a well-deserved recognition of the silent toil of so many men and women family farmers, peasants.

Challenges Faced by Family Farmers

- Climate change and climate variability.
- Limited access to financial resources, inputs, technology, training, research and advisory services and education.
- Lack of tenure security in a context of increasing competition for land and water and inadequate governance of land tenure.
- Price volatility and limited access to market.

Conclusion

"Feeding the world, caring for the earth" theme of world food day focuses world attention on the significant role of family farming in eradicating hunger and poverty, providing food security and nutrition, improving livelihoods, managing natural resources, protecting the environment, and achieving sustainable development, in particular in rural areas. This is a strong signal that the international community recognizes the important contribution of family farmers to world food security. It also maintains rural lifestyle and contributes to socio economic and environmental sustainability of the rural areas. Family farms have an inherent capacity for quick production expansion and key to sustainable food production, if given an appropriate policy environment.

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ARYA: ATTRACTING AND RETAINING YOUTH IN AGRICULTURE

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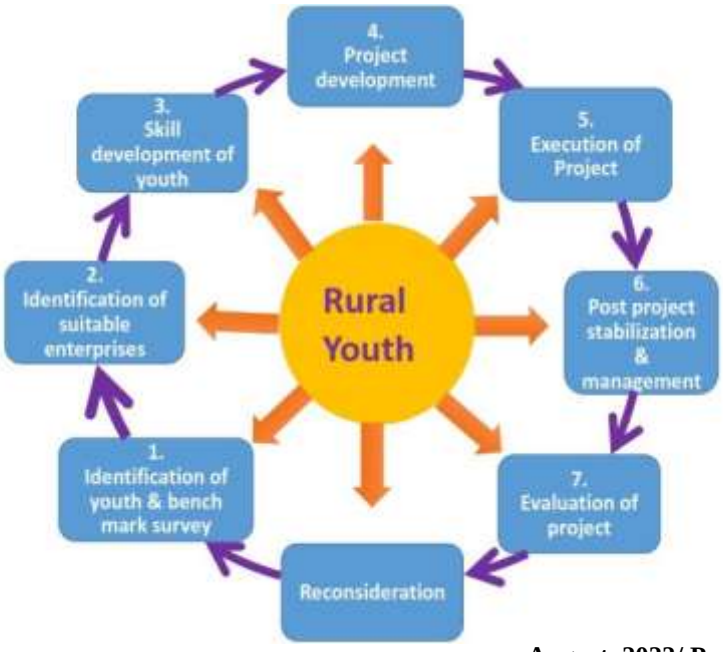
The India economy is mainly dependent on agriculture and the livelihood 54.6% of the total workforce is engaged in agricultural and allied sector activate (Census 2011) given the importance of the agriculture sector, Government of India has taken several steps for its development in a sustainable manner. The primary motive of Project ARYA is to improve the rural economy and attract India's youth to agriculture. Project ARYA was implemented in 2015-16. The Indian Council of Agricultural Research is responsible for implementing project ARYA the Krishi Vigyan Kendra of every district will be responsible for implementing Project ARYA in different districts. Youth have an important role play in bringing about a meaningful and effective change in Indian agriculture. The age group of 18 to 35 years is defined as youth. The youth of this class are going towards private work and government jobs by not adopting agricultural sector and leaving the agricultural land of their village and moving towards cities so by giving motivation and training to the young generation and providing business ideas to the youth. This program was run to generate interest in the agriculture sector.

The youth can be attracted to and relined in farming only if it become economically rewarding and intellectually satisfying.

M.S. Swaminathan

"ARYA" a pilot project launched by ICAR, is finding out many ways to attract and retain youth in agriculture, by identifying their reasons for drawback such as giving no part in policy formation, Land & credit accessibility and mainly support from the parents and the society. Also, he mentioned about reasons for the success of youth, if considered for involving in policy making by taking their collective feedbacks and facilitating them with good Communication reach, Advocacy and Networks. Pointing out the differences other nations



have made to bring their youth into agriculture such as, Philippines - institutionalizing, promoting and protecting the youth rights; Vietnam - prioritizing the great respect for farmers of their country; Taiwan - by supporting the young and professional to take up agriculture; Korea – reducing its interest in all agriculture related finances to support youth to take up agriculture in their countries. He added that, key role of India is to support youth in agriculture by bringing real changes such like these to the village level will help youth to take up agriculture.

Objective of ARYA Project:

1. To attract and empower the Youth in Rural Areas to take up various Agriculture, allied and service sector enterprises for sustainable income and gainful employment in selected districts.
2. To enable the Farm Youth to establish network groups to take up resource and capita intensive activities like processing, value addition and marketing.
3. To demonstrate functional linkage with different institutions and stakeholders for convergence of opportunities available under various schemes/program for sustainable development of youth.

Benefits of Project ARYA

- It will generate a regular stream of income for the youth in rural areas.
- It will provide employment opportunities and absorb underemployed and unemployed rural youth in secondary agriculture and service related activities in rural areas.
- It will encourage the rural youth to pursue farming as a profession.
- It will help in agricultural development and improve the overall economic situation in rural areas.
- It can reduce migration of youth from rural areas, if sufficient employment opportunities are available in the villages.
- It can solve the food security problem associated with small holdings and rising population in the country.

Facts about project ARYA

- Project ARYA is operational in 25 States through Krishi Vikas Kendras (KVKs). One district from each state is selected for the project.
- Technical partners for the project include ICAR Institutes and Agricultural Universities.
- 200-300 rural youths (in one district) are identified and provided entrepreneurial and skill development training so that they can set up micro-enterprise units in the areas like apiary, mushroom, seed processing, dairy, goatry, poultry, carp-hatchery, vermi-compost etc.
- One or two enterprise units will be set up at Krishi Vikas Kendras (KVKs) so that they can serve as entrepreneurial training units for farmers.

Number of youths oriented and entrepreneurial units established

S. No.	Major Enterprises	No of youths oriented	No. of youths established their own entrepreneurial units	Oriented/Established (Col. 4/Col. 3)
1	Nursery Management	72	13	18%
2	Mushroom Production	847	291	34%
3	Poultry	792	280	35%
4	Lac Cultivation	230	100	43%
5	Pig Farming	387	91	31%
6	Bee keeping	406	82	20%
7	Fishery	80	80	100%
8	Goat Farming	221	69	31%
9	Broiler duck farming	55	46	83%
10	Value Addition	40	40	100%

There is a need of ARYA in agriculture in India, for this urgent need is realized to develop attractive strategy and policy by government for attracting rural youths towards agriculture. ICAR has initiated ARYA programme however more critical efforts are expected to attract youths towards agriculture as profession not only to feed stomachs of largest population of world but also for the sustainable development of rural India.

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GEOENGINEERING:

TO MITIGATE CATASTROPHIC CLIMATE CHANGE

About Author

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With record-breaking heatwaves hitting many parts of the world over the last few months, scientific circles have been hotly debating whether countries should prepare to deploy geoengineering technologies to deal with such climate emergencies. Should these technologies be deployed by an international body or by individual countries? Geoengineering is an umbrella term for various experimental technologies designed to deliberately alter the climate system to reduce the impacts of global warming. They are slowly but steadily gaining salience and broadly fall under two categories: Solar Radiation Modification (SRM) and Carbon Dioxide Removal (CDR) technologies.

How would these technologies cool the planet?

As the name suggests, CDR is about removing carbon from the atmosphere, either by massive deployment of machines to extract CO2 from the air or by more natural methods like planting trees. On the other hand, SRM technologies, which are attracting the most attention, aim to reduce the amount of solar radiation reaching Earth by reflecting sunlight back into space, thereby reducing surface temperatures. Scientists are proposing to do this by a variety of techniques such as making clouds brighter, thereby reflecting sunlight like a mirror. Or by thinning/ removing the 'cirrus clouds' that absorb solar radiations and warm the earth.

Cloud engineering is not new. Countries have been seeding clouds to force more rainfall for years. China has been implementing an extensive cloud seeding Programme, with plans to cover more than half of the country by 2025. In India, cloud seeding has been tried in states such as Tamil Nadu, Karnataka and Maharashtra during droughts.

These practices have encouraged scientists to propose cloud engineering of the planet to reduce warming. But these geoengineering technologies are at an ideation stage; the one that has reached the experimentation stage is Stratospheric Aerosol Injection (SAI). SAI aims to mimic large volcanic eruptions that have a cooling effect on the globe. During large eruptions, millions of tonnes of sulphur particles (called aerosols) are injected into the upper atmosphere, where they reflect back the incoming solar radiations, thereby cooling the planet. For example, the eruption of Mount Pinatubo in the Philippines in 1991 caused global cooling of 0.6°C for the following two years. Scientists are now proposing to send aeroplanes and balloons to the stratosphere to release millions of tonnes of aerosols to mimica smaller version of Mount Pinatubo.

Several modelling studies indicate that SAI might reduce some of the worst effects of climate change, such as lowering warming and reducing the frequency of heatwaves and high-intensity storms. Also, the price is so affordable that a few dozen countries can easily deploy this technology unilaterally. But there are risks.

What are the dangers of their use?

SAI's unintended consequences could include an adverse impact on rainfall, crop production and ocean acidification. Large-scale spraying of aerosols into the atmosphere could also deplete the ozone layer enlarging the ozone hole. Another big risk is that when the aerosol injection is terminated abruptly this will cause rapid warming, disrupting the water cycle and leading to massive biodiversity loss. Lastly, the impacts will not be limited to national borders. Unilateral use of SAI could lead to significant adverse effects in other countries, leading to conflicts. Because of these risks, there is massive opposition to advancing research on SAI. It is also feared that such research would move the focus away from cutting emissions, which is the best way to solve the climate crisis. None of this has deterred countries from investing in the research. Premier universities such as Cambridge and Harvard have set up specialised geoengineering research centres. Research is also picking up in the global South. There

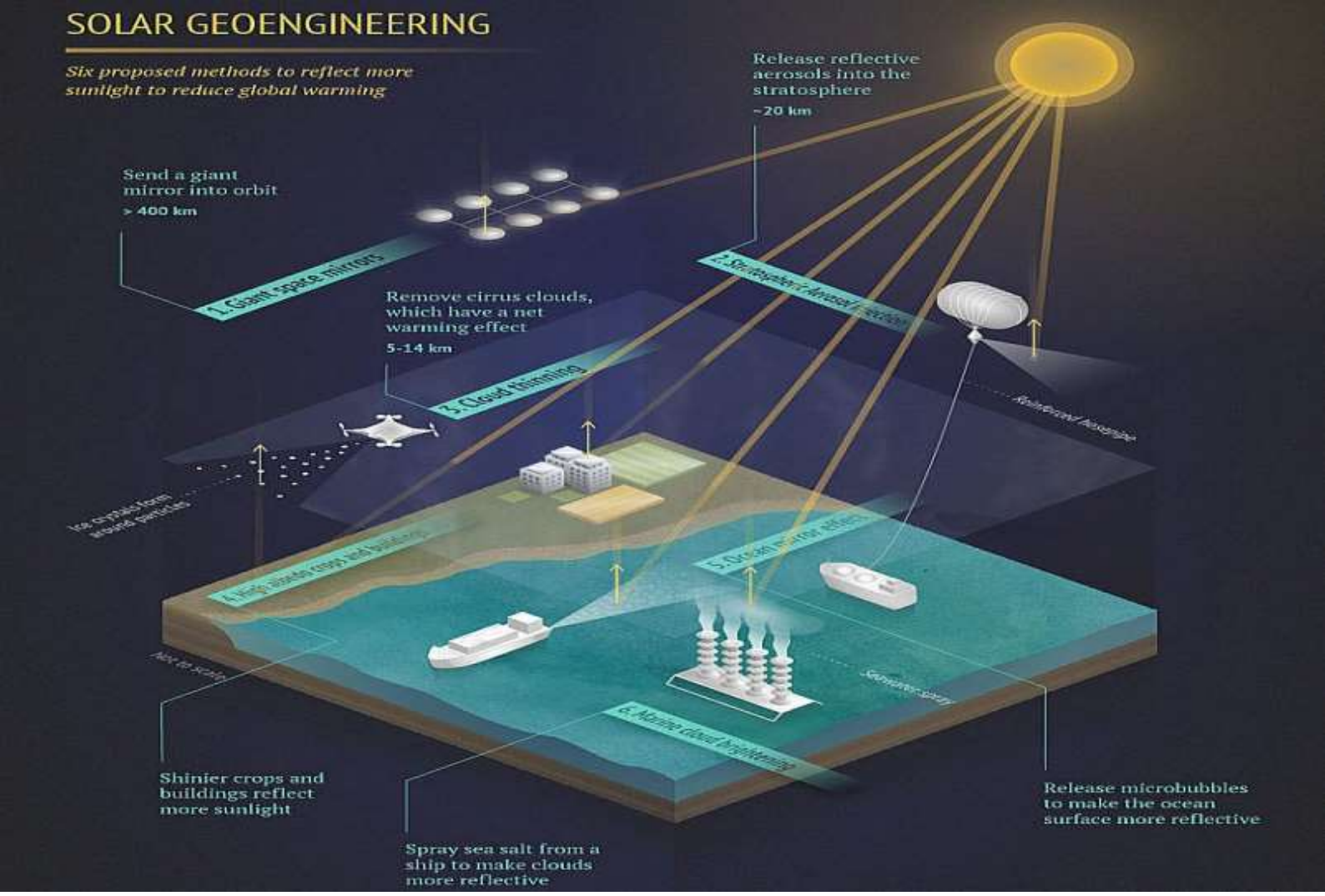

Fig:- Geoengineering techniques to lower down global temperatures.

are a few geoengineering modelling programmes in India as well.

But a lot more research is required to understand the regional impacts of SAI in our part of the world. In fact, India should take the lead from the global South in developing scientific knowledge on the subject. Similarly India will have a major role in framing global governance around the use of geoengineering technologies. These technologies have global ramifications and must be governed by an international rules-based system.

Conclusion

While geoengineering is highly risky, countries will deploy it if they fear large-scale casualties or economic disruptions due to extreme climatic events. In fact, considering the current trajectory of Earth's warming, countries will have to make these choices within a decade or two. Therefore, enough research must be done about the safety and effectiveness of these technologies. Likewise, a global governance mechanism must be established to deter the unilateral deployment of these technologies, In the end, it is better to be prepared for the consequences than to be blindsided by a lack of knowledge.

INTEGRATED FISH-HORTICULTURE FARMING

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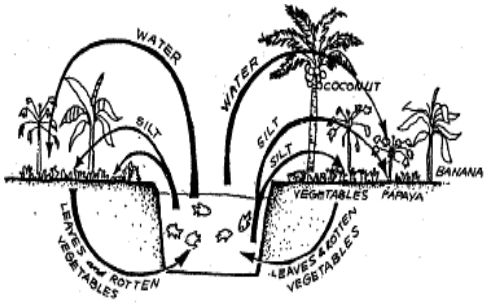
Integration of fruit and vegetable farming on the fishpond embankment has been tested in India, and has several advantages:

- The farmer gets additional income from growing fruits and vegetables on the pond embankment that normally lies fallow.
- The nutrient-rich pond mud is used as fertilizer for growing crops, eliminating the cost of organic manures.
- Manured pond water is used for irrigation of plants.
- Fruit and vegetable residues are used as feed for the fish.
- The plants on the embankment strengthen the dikes.

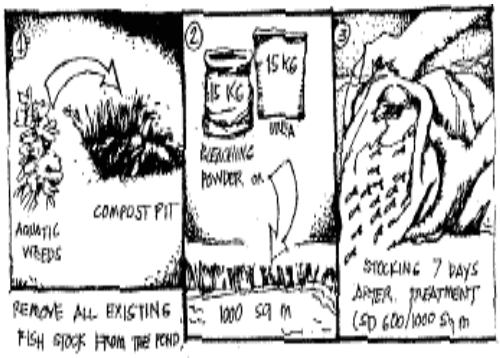
Fish-crop farming material flow



Establishment of the system

Select ponds near to your house. This helps in easy management of the pond and in discouraging poachers. Check and repair the dikes and guard the inlets and outlets with meshed screens to avoid escape of stocked fish and entry of unwanted fish. The pond should be deep enough so that it retains more than 1 m water during the dry period. Strengthen the dikes and terrace them for planting crops and fruit plants.

Fish culture



Pond preparation

Remove aquatic weeds. Compost and use them later as manure for the pond. Remove all existing fish stock from the pond by repeated netting and draining the pond water. If it is not possible to drain the pond, kill the fishes by adding to the water 15 kg bleaching powder and 15 kg urea (for 1000m^2 pond). Bleaching powder may be applied one day after urea application. Application of 250 kg Mahua oil cake (*Basia latifolia*) can also be done for the eradication of fish. Mix it thoroughly with the pond water and net all the fishes. Manure the pond with the compost (made out of aquatic weeds). Apply 500 kg basally; the rest (500 kg) may be applied in two equal installments at 4 months interval but more frequent doses (e.g. fortnightly) are better. Stock the pond with fingerlings 7 days after poisoning as the toxicity of bleaching powder lasts for about 1 week. The recommended rates (at stocking density of 600/1000 m^2) are: Some alterations can be made on the stocking density and species ratio depending upon the pond conditions and availability of fish seed.

Harvesting

The fish that attain marketable size should be harvested and the rest allowed growing further. Final harvesting may be done 10-12 months after stocking.

Horticulture

- The dikes are strengthened, terraced, prepared and fertilized by application of pond silt.
- Bananas, papayas, pumpkins, gourds, spinach, brinjals, tomatoes, cucumbers and leafy vegetables are grown on the dikes.
- Inorganic fertilizer is also applied to the plants in addition to pond silt at 10 kg/year divided into installments.
- Water the crops with manure pond water.
- Planting of papaya is done in June/July and banana in October/November and harvesting starts after 6 and 8 months following planting, respectively. The farmer consumes a portion of the harvested fruits and the rest are sold in the market.
- The vegetable crops are grown and harvested twice in a year--once during August/September and another in March/April. After meeting the requirements of the farm family, the vegetables are sold. Below is a list of some crops that can be grown on the pond embankment:

♣ **Fruit plants:-** Papaya, Banana, Coconut etc.

♣ **Vegetable plants:-** Brinjal, Cabbage, Tomato, Cucumber, Pumpkin, Radish etc.

■■■

Calendar of activities for fish-horticulture farming

S. No.	Month	Activities
1.	August	Pond preparation. Dike preparation and planting of fruits and vegetables.
2.	September	Stocking of Fish. Application of inorganic fertilizers to plants.
3.	October	Pest control if necessary.
4.	November	Harvesting of vegetables, inorganic fertilizer application.
5.	December	Harvesting of vegetables.
6.	January	Harvesting of vegetables. Harvesting of papaya.
7.	February	Preparation of dike for second crop of vegetables. Harvesting of papaya. Plantation of second crop of vegetables.
8.	March	Partial harvesting of fish. Harvesting of Papaya & Banana.
9.	April	Harvesting of Papaya & Banana.
10.	May	Harvesting of vegetables.
11.	June	Harvesting of vegetables.
12.	July	Final harvesting of seeds. Harvesting of vegetables, Papaya & Banana.

BLACK RICE
CULTIVATION IN INDIA

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Black rice (also known as purple rice) is a range of rice varieties of the *Oryza sativa* L. species some of which are glutinous rice. Indonesian black rice and Thai Jasmine black rice are two varieties. It is also known as purple rice, heaven rice, forbidden rice (Chinese), king's rice, imperial rice, and prized rice. Black rice is a rare and ancient variety of rice that has been growing in India for centuries. It is primarily grown in India's north-east region (known as ChakHao) and southern region (known as Kavuni in Tamil). The black rice becomes black in color due to presence of purple color powerful pigment anthocyanin on the outer covering of rice grain. Anthocyanin components in black rice are about 26.3 percent. Anthocyanins are a type of flavonoid pigment and a major source of antioxidant that protection against free radicals that cause cancer, ageing and disease. Black rice contains 18 essential amino acids, mainly lysine and tryptophan. Black rice is a whole grain, super nutritious type of rice that has higher levels of protein, fibers, vitamins B1 & B2, minerals such as iron, zinc, phosphorus, calcium and selenium. It's high in anti-oxidants, especially anthocyanin which is beneficial for heart patients, diabetics patients and helps brain activity. It's beneficial for skin and hair due to its Vitamin E content. It is also high in fibre, so it does not spike blood sugar levels. Its rich in iron, hence a good source for vegetarians."

Prospects of Black Rice in India:

Growing black rice, which has its origins in north-east India, is becoming increasingly popular in other regions as well, among farmers. It's widely grown in West Bengal, Odisha, Puducherry, Tamil Nadu and Jharkhand and it's a popular food in Manipur. Because of its superior nutritional quality due to the presence of antioxidants and phenolic compounds, black rice has been increasing popular in today's world. It is also rich in beneficial amino acids such as lysine and tryptophan, which possesses health advantages. Phenolic donate free radicle hydrogen act as singlet oxygen quenchers, protecting cell constituents against oxidative damage caused by free radical molecules. Due to the presence of anthocyanin, black rice is usually consumed along with the bran and is sold as unmilled rice.

These days, black rice is found in larger supermarkets around the country at a very high market price. Due to its high nutritional value and market pricing, there are great prospects to promote the

cultivation of black rice in major rice-growing states in the country. Many States Agricultural Universities (SAUs) have begun work to assess the performance of black rice varieties grown in Manipur and other of north-eastern states with suitable production technologies. Initiatives should be taken to identify the potential areas of black rice cultivation and adequate awareness about its nutritional values and market price to the farmers of that region to promote black rice farming in the country.

Constraints in black rice production:

- The utilization of black rice as a product is still minimal in India.
- The black rice's potential has not yet optimally utilized, which is one of the inhibiting factors for its low productivity.
- It is less popular among farmers due to its inherent unfavorable traits, such as low yield, highly photo insensitive, a prolonged vegetative phase, and tall stature that causes its loading which are the major reason for its non-adoption among farmers.
- Lower productivity and higher prices are the reason behind in accessibility of nutrient enriched black rice by common people.

Future perspectives

- More research needs to be done in black rice to ensure sustainability by preserving the local black rice species and can improving desirable traits in best rice varieties.
- Introducing special rice (black rice, red rice etc.) as main crop and raising awareness among the people can eradicate the malnutrition to some extent.
- To developed varieties with desirable agronomic and marketing traits can increase its wide adoption for cultivation in different regions in India.
- To produce superior varieties, improvement of phenotype and genotype is necessary.
- The Indian black rice 'Chakhao' is drought tolerant and insect pest resistance. Hence, it can be used to developed rice lines with improved grain quality, yield potential and antioxidant properties.
- Black rice productivity needs to be increased to compensate its long harvest time. As a result, it is necessary to develop varieties that can give early and higher yield.

Conclusion:

Black rice is a higher nutritious rice species i.e., *Oryza sativa* which is black in colour, glutinous, nutty in flavored, high levels of nutrients. It has recently been referred to as a "Super Food", which it truly deserves. Super Foods are food that provide a wide range of health benefits in addition to their inherent calorie and nutritive value. Promoting black rice cultivation and its consumption will improve the nutritional status of poor farming communities. The black rice fetches higher price ranging from $150 to $200 per Kg in the local market due to its nutrition value.

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NORMALIZED DIFFERENCE VEGETATION INDEX

IN CROP HEALTH MONITORING

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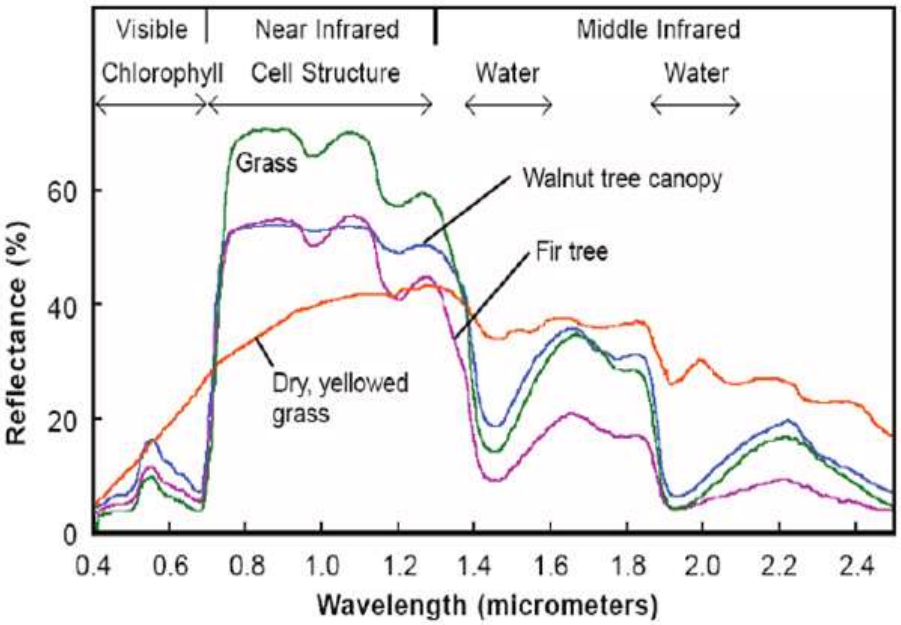

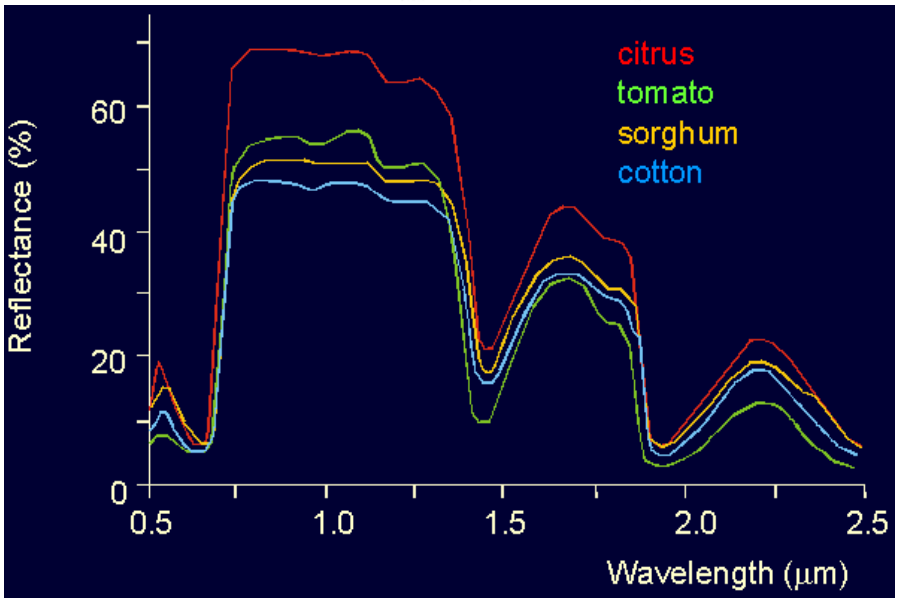

Plants absorbs solar radiation in the range of 0.4 – 0.7 µm in electromagnetic spectrum. This range of wavelength is involved in the process of photosynthesis, and it is known as Photosynthetically Active Radiation (PAR). As chlorophyll absorbs radiation in the region of Blue (0.45 µm) and Red (0.67 µm) and reflects in green region, the healthy vegetation appears green in colour. If a plant is under stress it affects normal growth and productivity, hence it decreases the chlorophyll production. This results in less absorption by chlorophyll in the blue and red region. The crop canopy reflects more in NIR region (0.7 – 1.3 µm) than green. About 40 to 50 per cent of the incident energy is reflected, and its reflectance is varied based on leaf cellular structure. As this structure is highly variable between plants species, reflectance in this range helps to discriminate between species, even if they look same in entire visible wavelength. Dips in reflectance occur at 1.4, 1.9 and 2.7 µm because water in the leaf absorbs strongly at these wavelengths. Accordingly, wavelengths in these spectral regions are referred to as water absorption bands.

Spectral indices:

Spectral vegetation indices are the representative of photosynthetic activity and quantity of biomass in the crop canopy. Based on the visible and near-infrared reflectance, computed vegetation indices indicate the amount of chlorophyll content in the plants. Spectral reflectance of a crop also depends on their health, phenology and crop stage. Vegetation indices act as a valuable tool in crop monitoring, biomass estimation and yield forecasting.

Several vegetation indices such as Soil Adjusted Vegetation Index, Transformed Soil Adjusted

Plant absorption and reflectance in various spectrum:

Wavelength (μm)	Spectral Region	Absorption and reflectance by plant
0.7 – 1.3	Near Infrared	A greater reflection bands of chlorophyll.
0.62 – 0.7	Red	A greater absorption bands of chlorophyll.
0.51 – 0.62	Orange, yellow - green	Low photosynthetic activity.
0.38 – 0.51	Purple, blue and green	The most energetic and strong absorption by chlorophyll.
< 0.38	Ultraviolet	Germicides effects

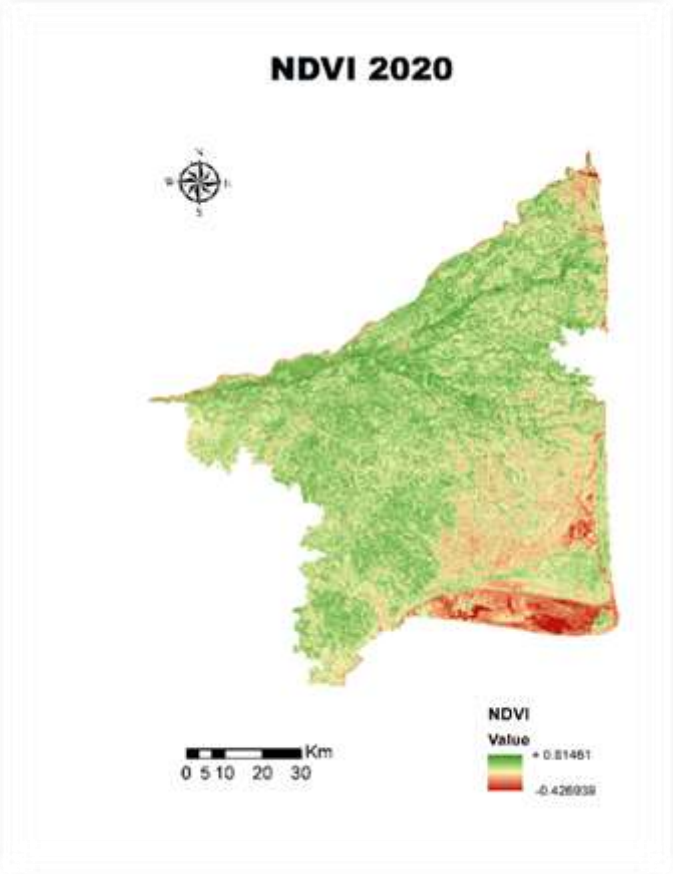

Fig 1. NDVI of Cauvery delta zone in Tamil Nadu

Vegetation Index, Modified Soil Adjusted Vegetation Index, Difference Vegetation Index, Green Normalized Difference Vegetation Index, Chlorophyll Index Green, Chlorophyll vegetation index, Enhanced Vegetation Index, Leaf Chlorophyll Index, Leaf Water Content Index, Land Surface Water Index and Normalized Difference Water Index are used for crop health monitoring, crop inventory and productivity estimation.

Normalized Difference Vegetation Index:

Normalized Difference Vegetation Index (NDVI) has been the representative of plant photosynthetic capacity and efficiency. NDVI is an effective tool for crop monitoring and crop yield based on which yields of many crops are estimated. Rouse *et al.* (1974) reported the earliest use of NDVI in the Great Plains. However, Kriegler *et al.* (1969) preceded them in formulating a normalized difference spectral index.

NDVI is the most widely used in the estimation of vegetation greenness and potential yield. NDVI represents plant photosynthetic capacity, efficiency and vegetation vigour. NDVI is the normalized difference between the reflectance in the ρNIR (0.785 – 0.899 μm) and ρRed (0.65 – 0.68 μm) region, and the values range from -1 to +1. Higher values indicate vigorous and healthy vegetation cover.

$$NDVI = \frac{\rho NIR - \rho Red}{\rho NIR + \rho Red}$$

During the vegetative phase to reproductive phase, NDVI increases to a maximum value, and once the crop attains its maturity, it starts to decline. The mathematical definition of NDVI of an area containing a dense vegetation canopy will tend to positive values (0.3 to 0.8) while clouds and snow fields will be characterized by negative values. Water bodies have a low reflectance in both spectral bands resulting in very low positive or even slightly negative NDVI values. Soils exhibit a near-infrared spectral reflectance somewhat larger than red, and has positive NDVI values (0.1 to 0.2).

Conclusion

Surface reflectance derived from satellite datasets are helpful in the estimation of NDVI. Based on the NDVI values crop health, growth, development and yield can be monitored.

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BENEFITS AND RISKS OF QoI (STROBILURIN) FUNGICIDES

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The QoI family of fungicides includes several of the most recent and significant disease-control compounds. The earliest fungicides in this class, including one called *Strobilurus tenacellus*, were derived from wood-rotting mushroom fungus. This chemical family of fungicides was given the name "*strobilurin*" after the source of the first components of this class. (These fungicides were more correctly known as QoI fungicides, as detailed in the fungicide resistance section.) These natural fungicides were considered to support the fungus in defending itself against bacteria found in rotting wood. These chemicals represent a lower risk to human health and/or the ecosystem than other pesticides on the market at the time of their commercial release.

Commercially available chemicals-

S. No	Chemical trade name	Chemical Active Ingredient
1	Reason™ 500SC	Fenamidone
2	Disarm™ 480SC, Evito™ 480SC	Fluoxastrobin
3	Abound™ 2.08F, Amistar™, Heritage™, Quadris™	Azoxystrobin
4	Sovran™ 50WG	Kresoxim methyl
5	Cabrio™ 20EG, Headline™ 2.08EC, Insignia™ 20WG,	Pyraclostrobin
6	Compass™ 50WG, Flint™ 50WG, Gem™ 500SC	Trifloxystrobin

Mode of Action-

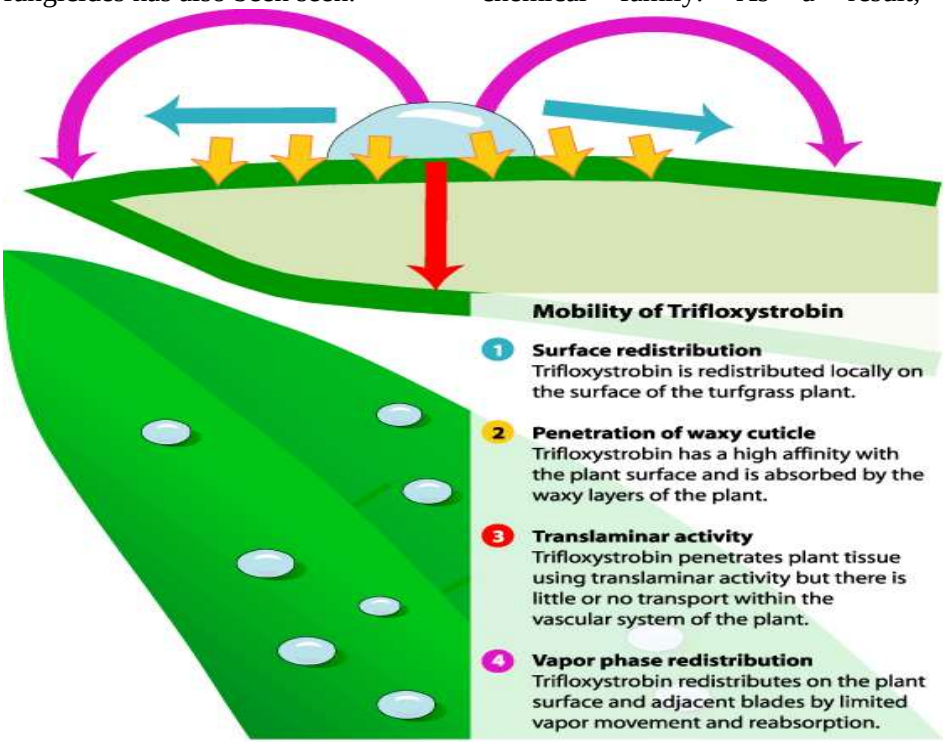
Translaminar movement is seen in all QoI fungicides (which means "across the lamina", or leaf blade). The majority of the active component in these fungicides is first kept on or inside the waxy cuticle of plant surfaces when they are sprayed. Some of the active substances "leaks" into the plant cells under the surface. The active component in fungicides with a waxy cuticle affinity (such as trifloxystrobin and kresoxim methyl) that "leaks" through the lamina quickly rebinds to the cuticle on the far side of the leaf blade. Even if only one leaf surface was treated, the fungicide can be present on both leaf surfaces. It might take one to several days for the translaminar movement to become completely effective.

Azoxystrobin is a fungicide that works both translaminar and systemically (in the plant's vascular system, or "plumbing"). Kresoxim methyl and trifloxystrobin are fungicides that travel translaminar but not systemically. Fungicides like kresoxim methyl and trifloxystrobin are referred to as "mesostemics," "quasi-systemics," or "surface systemics" since they are not genuine systemics but redistribute through these other methods. Curative disease control is concerned with the dynamics of translaminar migration. Because they all successfully destroy germinating spores, QoI fungicides are good as preventative fungicides.

Risk of resistance-

Fungicide resistance can be classified into two categories: quantitative and qualitative. Resistant strains are less susceptible to the fungicide than the wild type with quantitative resistance, but they can still be managed with greater rates and/or more frequent administrations (within labeled limits, of course). Strains resistant to DMI (demethylation-inhibitor) fungicides, such as propiconazole or triadimefon, are an excellent example of this sort of resistance. Resistance to benzimidazole fungicides like benomyl or thiophanate methyl is an excellent example of this form of resistance. Natural occurrences of resistance to QoI fungicides show that the majority of control failures are due to qualitative resistance, but that

quantitative resistance to several QoI fungicides has also been seen.



The fungus recognizes them all as the same active component biochemically. When a fungus becomes resistant to one fungicide in a chemical family, it typically becomes resistant to all of the fungicides in that family. Cross resistance is the term for this. Fungal strains resistant to QoI fungicides frequently show cross-resistance to other QoI fungicides. Cross-resistance is limited to a single chemical family. As a result, different fungicides not in the QoI family can be used to manage QoI-resistant subpopulations.

Guidelines for Reducing the Risk of resistance-

- Limit the number of applications of QoI fungicides
- Limit the number of consecutive applications of a Q_oI fungicide
- When QoI fungicides are used with other fungicides, the selection pressure for resistance is reduced.
- In terms of fungicide resistance, the best time to employ QoI fungicides is during the early phases of disease development.

Effects on Plant Health-

- **Enhancement of Growth-** Several QoI fungicides have been shown to promote plant growth in some species. For example, kresoxim methyl has been demonstrated to alter the hormonal balance of wheat, resulting in higher grain yields due to delayed leaf senescence and water-saving benefits.
- **Phytotoxicity-** The likelihood that tank mixes of QoI fungicides with ingredients that solubilize the cuticle-oils, surfactants, and some liquid insecticide formulations-could raise their phytotoxicity potential is known as phytotoxicity risk.

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ZERO BUDGET NATURAL FARMING (ZBNF)

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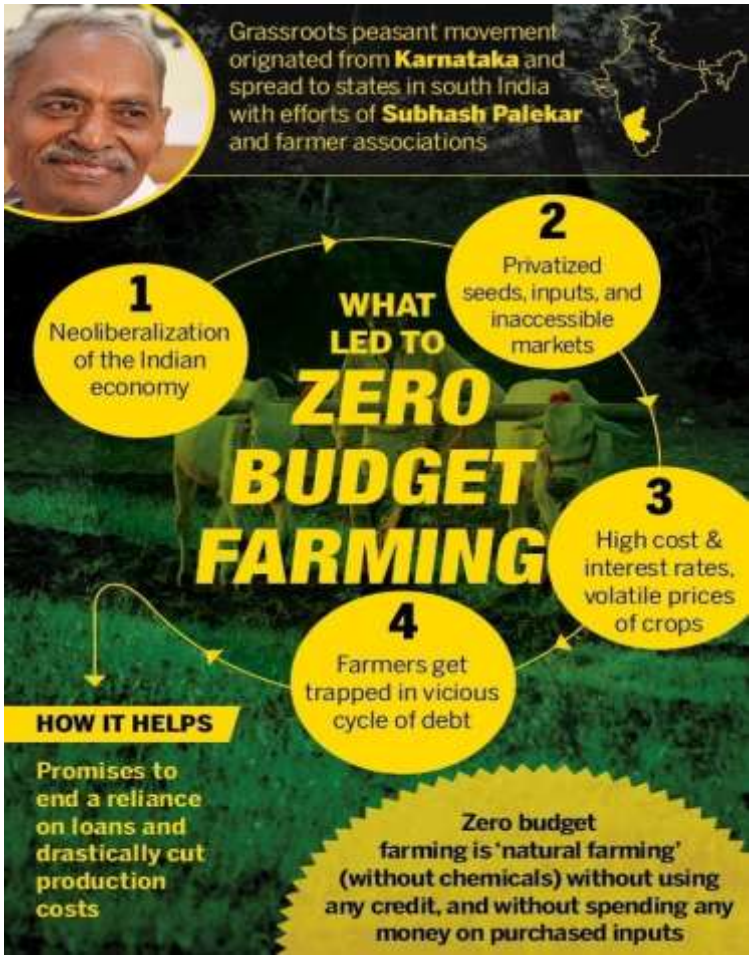
The neoliberalization of the Indian economy has resulted in a severe agrarian crisis, rendering small-scale farming unprofitable. For peasants, privatised seeds, inputs, and markets are inaccessible and expensive. Because of high production costs, high interest rates on credit, uncertain market prices for commodities, rising expenses of fossil fuel-based inputs, and private seeds, Indian farmers are increasingly trapped in a debt trap. In India, debt is an issue for farmers of all sizes. In such circumstances, 'zero budget' farming has the potential to eliminate reliance on loans and substantially reduce production expenses, effectively breaking the debt cycle for desperate farmers. The term 'budget' refers to credit and expenses, hence a 'Zero Budget' signifies that no credit is used and no money is spent on purchased inputs. 'Natural farming' refers to farming that is done in harmony with nature and without the use of chemicals.

Zero Budget Natural Farming (ZBNF) is a set of farming methods and also a grassroots peasant movement, which has spread to different states in India. It has achieved wide success in southern India, especially the southern Indian state of Karnataka where it was first evolved. The movement in Karnataka state was born out of collaboration between Mr Subhash Palekar in the mid-1990s as an alternative to the Green Revolution methods such as the adoption of high yielding variety seeds and use of chemical based fertilisers and pesticides, who put together the ZBNF practices, and the state farmers association Karnataka Rajya Raitha Sangha (KRRS), a member of La Via Campesina (LVC). He said that the rising expense of these external inputs was a leading source of farmer indebtedness and suicide, while the impact of chemicals on the environment and long-term fertility was disastrous. The cost of production might be cut and farming could be turned into a "zero budget" exercise, breaking the debt cycle for many small farmers.

Addressing the United Nations conference on desertification (COP-14), Indian PM told the global community that India is focusing on Zero-Budget Natural Farming (ZBNF). ZBNF was also highlighted in budget 2019 in the bid to double farmer's income by 2022.



Thus, zero budget natural farming is a unique model relying on Agro-ecology which aims at chemical-free agriculture drawing from traditional Indian practices. The main objective of ZBNF is to minimise the cost of production to nearly zero and output to be at least equal to the traditional farming of old India i.e. Pre-green revolution period. In this practice there will be no requirements of expensive inputs such as fertilisers, pesticides and intensive irrigation.

Four principles of ZBNF:

There are four basic principles of ZBNF which must have been followed during this method.

- **Jeevamrutha:** It is a mixture of cow dung, cow urine, jaggery, pulse flour, water and soil and this mixture is applied in the field.
- **Bijamrita**: A composition of neem leaves and pulp, tobacco and green chillies, which is prepared for management of insect and pests. Seed treatment can be done with this mixture.
- **Acchadana (Mulching):** It is used to protect the topsoil during cultivation and it saves the topsoil from tilling.
- **Whapasa:** It is the condition where air molecules and water molecules both are present in the soil. Thus, providing water to maintain the required moisture-air balance is necessary.

Benefits of ZBNF:

- The rising cost of external inputs *i.e.* chemical based fertilizers and pesticides, which is the main reason behind the indebtedness and suicide among farmers can be controlled and minimised. According to the National Sample Survey Office (NSSO) data, almost 70% of agricultural household's expenditure is more than their income.
- As we know that in ZBNF there is no need to spend money or take loans for external inputs thus, the cost of production is reduced which make farming a "zero budget" exercise. This as a result would break the debt cycle for many small farmers and help to increase their income.
- It is a zero-cost environment-friendly farming method since no chemical is used in it while, chemical-intensive farming is resulting in soil and environmental degradation.
- The ZBNF method increases soil aeration, minimal watering, intercropping, bunds and topsoil mulching while; it discourages the extensive irrigation and deep ploughing.
- It is suitable for all crops of different agro-climatic zones.

Issues Related to ZBNF:

- In some states like Sikkim (India's first organic state), a decline in yield comparison to normal practices is reported.
- Many farmers have reverted to conventional farming after seeing their ZBNF returns drop after a few years.
- No conclusive evidences have been reported for preserving the soil fertility by ZBNF and its role in boosting productivity and farmers' income.
- For the Jeevamrutha, an essential constituent of ZBNF, an Indian breed cow is needed whose numbers are declining at a very fast pace.

Way Forward

There are several structural marketing issues which need to be resolved first before expecting the targets of ZBNF. Some of them are discussed below:

- The agricultural market infrastructure needs to be strengthened.
- The procurement mechanism for all type of crops to all states will have to be expended.
- The price deficiency payment system for selected crops must be implemented.
- The minimum support prices (MSP) must have fixed in consonance with the cost of cultivation.
- The minimum export price for agricultural commodities should be abolished.
- The legislation on 'right to sell at MSP' should be enacted.

Government initiatives

The government of India is promoting the organic farming through two schemes *viz.* Paramparagat Krishi Vikas Yojana (PKVY) since 2015-16 and Rashtriya Krishi Vikas Yojana (RKVY). The objective of Paramparagat Krishi Vikas Yojana (PKVY) is to produce agricultural products free from chemicals and pesticides residues by adopting eco-friendly, low- cost technologies. Under this scheme, Organic farming, organic food is promoted while, use of chemical fertilizers and pesticides is discouraged. As per the RKVY scheme, organic farming or natural farming model components are promoted by the respective State Level Sanctioning Committee (SLSC). Citing the positives of ZBNF, in June 2018, Andhra Pradesh rolled out an ambitious plan to become first Indian state to perform 100% natural farming by 2024. However, scientists from the National Academy of Agricultural Sciences had suggested that there is no need for the government to promote ZBNF till its proper scientific approval.

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POTENTIAL OF HERBAL TOURISM IN INDIA

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Tourism is a social, cultural and economic phenomenon which entails the movement of people to countries or places outside their usual environment for personal or business/ professional purpose. Herbal tourism is a form of tourism that connects tourists with herbal plants. This a new concept which is very much helpful for enhancing the income to farmers and people associated with the agribusiness. Not only is it an opportunity for agriculture businesses to expand their reach and revenue, but it also allows for direct marketing to customers and the general public. By providing tours, experiences, and education around agriculture, farms can create a more direct connection with people.

Herbal tourism has been important in education which provides an avenue of information for tourists to understand the land, crops, medicinal plants and where their food comes from. Herbal garden walk, making herbal drink, tea and soaps, cooking herbal dishes as well as education and interpretation centre that feature local herbs medicinal and health values. Through Herbal tourism, farms can also preserve their lands, and the state can help develop business enterprises around it for the betterment of the area and the public. Nature-based tourism activities respond to people's desire to participate in tours with different aims such as relaxation, discovery, learning and escaping to nature, and getting away from the routine of everyday life. Herbal tourism has remarkable potential for employment generation, conservation of valuable medicinal plants and preservation of traditional medicine practices. Demand of plant based medicine increasing every year in worldwide. The growing demand for medicinal plants is met partially by over-exploitation of forest resources and partially by adulteration. Over-exploitation results in the extinction of some important species and causes serious damage to the forest eco-system.

There are various estimates and guesstimates of the total number of plant species in medicinal use in India. More than 7000 plants species have known used as medicinal plants out of 17000-18000 flowering plants species in India. About 22% of the production sourced through cultivation. The annual per capita consumption of drugs in the country is around US$ 3, which is the lowest in the world, mainly because traditional medicines based on sound ancient system of medicine are still prevalent in the country. Market value of medicinal plants in India according to estimate in 2016 was 72 billion USD and by 2050 this is estimated to reached about USD 5 Trillion.

The potential main market segments include the special interest group and researchers who are interested to explore and learn about herbal plants and tourists who are seeking for relaxation and an escape from busy work life or urban cities. Herbal tourism is not only a tourist attraction, but it also generates a range of economic opportunities, income and employment at the rural site. Key issues and challenges faced in developing herbal tourism relate to financial, labour, environmental and climate changes. Hence, support from local government agencies and a tourism promotion board is crucial in ensuring sustainability of herbal tourism.

Importance of Herbal tourism

- At present man works very hard to earn money and want to rest far away from crowded hotels and popular holiday resorts. The need for silence is often associated with coming back to nature, admiring its beauty and harmony as well as discovering its enormous role it has in human life, it implies the creation of an extensive agri- and ecotourism offer.
- Herbal tourism can be conducted at agri- and ecotourism farms, educational farms, open-air museums and educational centres.
- Classes can be held in the form of workshops, presentations,

field trips and workshops with use of herbs and cosmetic workshops.

- Herbal tourism is the possibility of using herbal products to improve health and beauty or to recover.
- Herbs are widely used in food preparation, and branded product. Example: herbal tinctures, teas, spice mixes, cosmetics.

Benefits of herbal tourism

- Herbal tourism will create various types of job in rural area.
- Acts as a secondary source of income for farmers, improving their living standards.
- Helps in making the tourists or visitors aware of the lifestyle of the rural people and gain insight into the locally produced agricultural goods.
- The spirit of starting a business will be generated in the rural youth of the villagers
- Generating employment opportunities will strengthen the rural economy.
- Locally produced agricultural goods and services can be promoted.
- Provides opportunities to the communities to enhance their local tax bases.
- Traditional knowledge and wisdom of India can be preserved and promoted.
- An improvement would be there, in terms of protection and aesthetic value, in the sites which are supposed to serve as agritourism areas for attracting the tourists.
- Tourism sector can be strengthened in the rural areas.
- It will provide an opportunity for the flow of non-local currency in the rural economy.
- It will provide a first-hand experience about the various farming activities carried on the farm.
- It will also provide an opportunity to the visitors to interact directly with the nature and know about the importance of the environment in which they are living.

Scope of Herbal tourism in India

- Herbal tourism is a low cost business limited to urban and elite people, constituting only a small portion of the population. However tourism has the potential to widen the tourist base due to its cost-effectiveness as the cost of food, accommodation.
- Herbal tourism provides scope to satisfy the curiosity about the farming community as it centres on the lifestyle of rural people, their tradition and culture.
- Human life has become very busy these days, that all they want is an escape from such routine and finding solace to make life more peaceful. Being closer to the nature, peace and tranquillity are two in-built factors in Herbal tourism.
- Due to urbanization, rural people are migrating to urban areas in search of jobs. Thus cities and growing at the cost of villages and yesterday's villagers are today's urbanites. But deep down in their hearts, lies love and respect for their villages.
- Industry estimates put the market for herbal products at Rs 50,000 crore, growing at 10% annually,
- Patanjali's helping farmers for enhancing their income through cultivating medicinal herbs on 40,000 acre". Kutki, shatavari, and chirayata are on top of his list of best earners.
- Dabur developing Bio-Resources of medicinal plants and working with 2,400 farmer families and cultivating more than 5,000 acres across 19 states.
- Himalaya Drug Company promoting medicinal plant cultivation and working with over 1000 farmers families.

Keeping the above facts we can say that Herbal tourism has very much potential in India and generates wide range of economic opportunities, income and employment at rural site. Thus, the time has come for the policy-makers to successfully harness the potential of Herbal tourism to boost up the rural economy of the nation. However, just like any other new concept, Herbal tourism is also not without challenges, the major ones being lack of proper credit facilities, lower literacy rate and lack of proper market orientation on the part of the farmers, lack of awareness about the concept, fragmented and small land-holdings and lack of Government support. Thus, initiatives on the part of the Government along with promoting and making the people aware about this new concept are the need of the hour to harness the immense potential that lies in it.

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STRENGTHENING FARMERS

THROUGH BACKWARD AND FORWARD INTEGRATION IN DAIRY COOPERATIVES

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The majority of the population in India lives in villages where agriculture is the main economic activity. Besides crop farming, the domestication of animals has been an integral part of the farming system from time immemorial. It is a centuries-old tradition for millions of Indian rural households. Milk has the highest value in the Indian agriculture and food sector, more than the combined value of wheat and rice. Milk contributes close to one-third of the gross income of rural households. Dairy is an important sub-sector of Indian agriculture, accounting for nearly 17% of the value of output from agriculture and allied activities. Dairying has emerged as an important source of income and employment in rural areas, especially for marginal and small farmers. India continues to be the largest milk producer in the world since 1998 with an annual production of 198 million tons recorded in 2019-20. Which is around 20% of the world. The livestock sector contributes 4.11% GDP and 25.6% of total Agriculture GDP.

Dairying in India

The Indian dairy sector plays a very important role in the Indian economy. It is an undeniable fact that the role and contribution of dairy professionals in the growth and development of the Indian dairy sector are enormous. The agriculture is seasonal but the dairying provides all season work to the people who are engaged in dairy-related activities. It gives steady income and keeps them employed throughout the year. Dairying in India is an occupation of small farmers. Over 60 percent of close to 11 million farmer members in about 1,00,000 village milk cooperatives all over the country are small, marginal, and even landless producers. Dairying has provided livelihoods to millions of the poor in our country. It is the sole source of livelihood bringing cash into their hands, twice a day every day of the year. Livestock, therefore, plays an extremely critical role in supporting and sustaining the livelihoods of a large number of poor. Livestock is often the only livelihood option available to the landless.

Dairying is an important part of the Indian agricultural economy. It provides nutrition, drafts animal power, organic manure, supplementary employment, cash income, and a 'cushion' for 'drought proofing' in India. The sector involves millions of resource-poor farmers, for whom animal ownership ensures critical livelihood, sustainable farming, and economic stability. Dairying in the recent decades has been considered a vital component in the diversification of Indian agriculture, where crop farming is beset with stagnating growth and low absorption of unskilled agricultural laborers. In order to alleviate the problem of unemployment/under-employment and to maintain domestic tranquility, diversification of crop production into non-crop enterprises like dairy farming is of vital importance.

Role of Dairy cooperatives in India

Today 1.90 lakhs dairy cooperative societies are present across India. They are under 27 state federations in India, with 223 district-level unions' having172.63 lakh Dairy farmers' members. These co-operatives collect an average of 2.76 lakhs liters of milk per day. Fresh liquid milk, packed and branded product marketed in major cities and towns in India by these co-operatives. The annual sales turnover exceeds Rs. 4661 crores in 2021. Most of the dairy co-operatives in India are based on the principle of maximization of farmer profit and productivity through cooperative effort. The Anand Pattern of cooperatives is an integrated cooperative structure that procures, processes, and markets produce. Supported by professional management, producers decide their own business policies, adopt modern

production and marketing techniques, and receive services that individually they can neither afford nor manage.

Dairy development in India has been acclaimed as one of the most successful development programs in the world. The co-operatives were conceived as the main vehicle for implementing dairy development programmes in India. Much of the success of the 'White Revolution' in India is attributed to the cooperative framework of the dairy development strategies. The network of dairy co-operatives expanded considerably, especially after the launch of Operation Flood in 1970. The functioning of the dairy co-operatives is based on collective action, which is supposed to be inclusive and participatory. It is assumed for assisting smallholders' engagement in milk markets, contribute to improvement in production and productivity, and finally enhance the farmers' income and welfare. The major problem with small and marginal dairy farmers is that these farmers do not involve in activities beyond production such as processing, value addition, and marketing of products by themselves. Due to these issues, farmers are exploited by the intermediaries and have fewer shares in consumer prices. Dairy cooperatives are collectivization of producers, especially low and marginal farmers, into a producer organization and came out as one of the most efficient pathways to address these challenges of the agriculture sector. A dairy cooperative gives a robust framework for small producers to organize themselves for effective linkage with markets. It gives bargaining power to the small farmers, enables cost-effective delivery of extension services, and empowers the members to influence the policies that affect their livelihoods. Dairy cooperatives help to overcome the constraints imposed by the small size of individual farms, members of Dairy cooperatives can leverage collective strength and bargaining power to access financial and non-financial inputs, services, and appropriate technologies, the leads to a reduction in transaction costs, tap high-value markets and enter into partnerships with private entities on more equitable terms.

Backward Integration through Dairy Cooperatives

Backward integration is a process in which a supply of raw materials is needed in the production of its finished product. Dairy cooperatives pursue backward integration with the expectation that the process will result in cost savings, increased revenues, and improved efficiency in the production process. Major activities done by dairy cooperatives includes

- Cattle feed supply.
- Vaccination.
- Breed improvement programmers
- Subsidies for the purchase of animals.
- Atomization in production.
- Shed construction.
- Veterinary healthcare services.
- Livestock insurance.
- Artificial insemination.
- Trainings the farmers.
- Financial and technical advice.

Forward Integration through Dairy Cooperatives

Forward integration is a strategy in which an organization owns and manages commercial activities that are ahead of its market value chain, such as direct distribution or supply of the organization's products. Forward integration is carried out to move up the supply chain. A dairy cooperative uses a forward integration strategy for lowering manufacturing costs and increasing efficiency by acquiring suppliers, thereby replacing third-party channels and consolidating activities. By eliminating intermediaries, the cooperatives gain ownership of the distribution operations and get more control over the product flow. This way, forward integration meaning has a lot of variety attached to it. There are various value-added products of milk directly sold through their own marketing channels by dairy cooperatives. Small farmer organizations such as co-operatives are expected to enhance incomes, reduce costs of input purchase along with transaction costs, create opportunities for involvement in value addition, enhance bargaining power and provide access to formal credit.

Conclusion

The Anand Pattern succeeds because it involves people in their own development through co-operatives where professionals are accountable to leaders elected by producers. The institutional infrastructure—village co-operatives, dairy, and cattle feed plants, and state and national marketing—is owned and controlled by farmers. The model is most successful in Gujarat, but there is a need to strengthen in other state. Any form of collective shown focus on backward and forward integration. So the farmer's income can be increase.■

THURPU CATTLE

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Poda thurpu female

Poda thurpu male

Telangana, youngest state of the country, does not have any registered cattle breeds of its own. Nevertheless, the state is rich in both indigenous domestic livestock and agro-biodiversity. In this background, the livestock node of Watershed Support Services and Activity Network (WASSAN), under Revitalizing Rainfed Agriculture (RRA) programme have initiated field surveys to identify any yet undefined livestock populations in the state for further systemic characterization and registration. The present project was funded by the Telangana State Biodiversity Board and the Global Environment Facility (GEF). One such population that has been identified was PodaThurpu Cattle which had been maintained mainly by the local Lambada/Banjara and Golla/Yadava communities. The population of this cattle had been identified in and around Amrabad Forest areas of Achampet, Amrabad, and Mannanur Mandals of now Nagarkurnool district of the former undivided Mahbubnagar district of Telangana State.

The NABGR, under Indian Council for Agricultural Research (ICAR), is the nodal agency for registering the newly-identified germplasm of livestock and poultry in India. The newly-identified breeds are approved by the Breed Registration Committee (BRC), headed by Deputy Director General (Animal Sciences), ICAR. The BRC, at its meeting held on 2020 January 24 in New Delhi, approved the registration of thirteen new breeds of livestock and poultry, which include Poda Thurpu and PD2 (Vanaraja female).Currently, the NBAGR has 202 indigenous breeds, including 50 cattle, 19 buffalo, 34 goats, 44 sheep,7 horses and ponies, 9 camels, 10 pigs, 3 donkeys, 1 yak, 19 chicken, 2 ducks and 1 goose and 3dogs.

Breed characterization:

Poda Thurpu are found in western parts of Telangana, a state in southern part of India. It is commonly known as Thurpu Edlu. Local communities call it as Poda Edlu (Poda locally means spotted/speckles/blotches), the cattle usually have brown spots on its skin. The breeding area of this breed is in Nagarkurnool district of Telangana, mainly bred inside Nallamalla forest of Amrabad and the adjoining areas, including Achampet, Lingal and Padra. There are an estimated 15,076 Poda Thurpu cattle in the state. They graze inside the dry deciduous Nallamalla forest, making it a strong breed that requires less water and fodder. At the same time, they have good draft power.

They are medium-sized cattle with compact body. They have

straight upward or forward pointing horns. They have speckled/blotched coat, which are brown in color. In most of the cases, forehead is convex with deep groove at the center. Bullocks are used for their draught capacity in terms of their speed, endurance and stamina. They are good for heavy ploughing and carting heavy loads. They are tolerant to heat and dry conditions. They can survive droughts and can stay alive with less fodder and water availability. Their wild and aggressive nature may be attributed to their lives spent inside the forest. Lambadi, Golla and Madiga are some of the communities seen maintaining large herds of these cattle for generations. The cattle's strong and developed hoof helps them to work tirelessly for long durations on the fields, helping the farmers in a substantial manner. They are used in both dry land and wetland agriculture. They have good migration capacity over undulated forest topography, and they are grazed on open fields. When used for milk, the daily yield can vary from 2 to 3 kg and lactation milk yield from 494 to 646 kg. Herd size ranges from 23 to 75. Population is approximately 15,000, which can grow in future due to programs by the state for cattle welfare.

a. Strong/Hard Hooves:

Strong/hard hooves are one of the unique characteristics of Poda Thurpu breed. Like wild animals these animals also wear down their hooves, as they grow continuously. The strong hooves make these animals suitable for draught purpose, both in dry land and wetland agriculture. With a single break in a day, they can work for 8 hrs.

b. Wild/Aggressive:

Another typical character of PodaThurpu breed is its wild and aggressive nature. The aggressive nature helps the animal to ward-off predators, especially wild dogs and wolfs. As these animals stay very close to wildlife and nature, shows wild and natural behavior.

c. Water Consumption:

The average water consumption of these animals in summer is 13.49 litres which is very less when compared to other draught breeds which consume on an average 25 litres. This makes the breed to increase the withholding water capacity during summer and effective utilization for physiological operations.

d. Economics:

The local market price of a breeding bull (usually 4 years old) could be anywhere between INR 90,000 – 1,50,000. The average income of breeders through sale of male calves of Poda thurpu is INR 2.05 lakhs, which accounts to major source of the household income.

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MANAGEMENT PRACTICES FOR POULTRY DURING HOT WEATHER

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Hot weather can severely impact poultry performance. Summer stress not only affects birds' performance, but it is an important stress factor which is responsible for immunosuppression, leading to disease outbreaks affecting the economics of poultry farming. Heat stress in poultry typically begins when the ambient temperature climbs above 80 degrees Fahrenheit and becomes very apparent at temperatures around 85 degrees Fahrenheit. When a bird begins to pant, physiological changes have already taken place within its body to help eliminate excess heat. Practising proper heat management to help keep birds comfortable will help maintain optimum growth, hatchability, egg size, egg shell quality, and egg production.

When temperatures reach the mid-to-upper 90s, birds need to be able to dissipate body heat to maintain a body temperature of about 105 degrees Fahrenheit. However, poultry does not sweat. Therefore, body heat is dissipated from wattles, shanks, and unfeathered areas under the wings. Birds do not need to drastically alter normal behaviour, feed intake, or metabolism to maintain body temperature by heat loss. The purpose of ventilation in poultry housing is to maintain an environment that allows birds to sustain body temperature by sensible heat loss. Sensible heat loss methods include radiation, conduction, and convection which are effective when temperatures range from 55 to 75 degrees Fahrenheit. Once temperatures reach 77 degrees Fahrenheit, the method for heat loss shifts to evaporative heat loss. Evaporative heat loss requires birds to dissipate body heat by panting, which begins to occur at about 80 degrees Fahrenheit.

Techniques for managing heat stress include maintaining a grass cover on the ground surrounding the poultry house to reduce the reflection of sunlight onto the house. Vegetation should also be trimmed to avoid blocking air movement. Shade trees should be located in areas that do not restrict air movement.

Also, make sure to keep a reliable, clean, cool source of water for birds. Electrolytes can be added to the water to replace those lost during periods of heat stress. For layers, be sure to provide adequate ventilation and air circulation for nesting boxes.

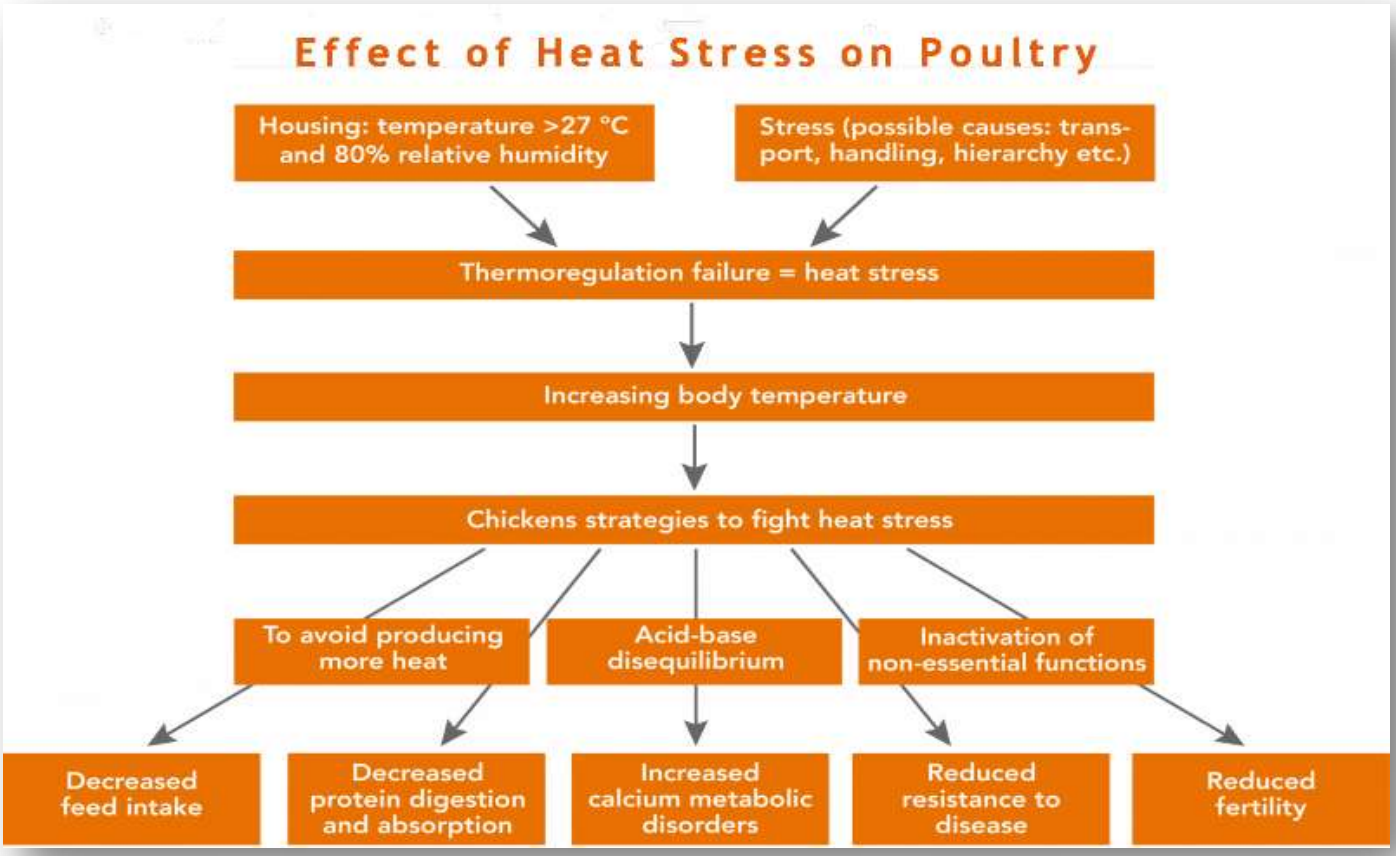
The importance of proper hot weather management for poultry should not be underestimated. Please keep your feathered animals in mind this summer!

Management practices in summer

Chickens prefer a laying house temperature of about 23.8°C and are comfortable up to 29.4°C. When the laying house temperature is above 32.3°C, birds are uncomfortable and the feed consumption is greatly reduced with low egg production. Over 37.8°C, the mortality rate is rather high. Coupled with these, the farmer often faces low egg prices also. Therefore, adequate protection of laying birds during hot weather is emphasized.

The following tips are recommended to keep the birds comfortable and curtail deaths during the summer months.

- Provide plenty of clean, cool drinking water at all times. Crushed ice may be provided in water if possible.
- Plant shade trees around the poultry house.
- Use a hosepipe sprinkler on the roof. Sprinkling can reduce the temperature inside the house.
- Clean the wire netting regularly to maintain perfect ventilation.
- Reduce the thickness of old built-up litter. Two inches of fresh litter may be provided in the place of old litter.
- Preferable to give artificial light in the early morning hours so that birds eat and drink more during the cooler hours of the day.
- Provide plenty of soluble grit so that the hens can adjust their



calcium intake. This will save a lot of cracked and broken eggs.

- The addition of electrolytes, Vitamin C, and probiotics in drinking water helps to alleviate heat stress.
- Provide fan ventilation during summer.
- Feed during cool hours of the day. The addition of vitamins and minerals in the feed is advantageous.
- Hang wet gunny bags on the sides.
- Keep water in mud pots.
- Provide sprinklers in the pen.

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USE OF BIOCHAR IN AGRICULTURE

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The concentration of atmospheric CO_2 is currently 417 mg kg^{-1} and this concentration has increased continuously as a result of human activities, such as industrial processes and changes in land use and agricultural practices. Atmospheric CO_2 along with other gases, cause a warming effect of the planet, negatively affecting the soil's chemical, physical and biological properties. Biochar (BC) is a viable option to face global warming because it helps carbon sequestration, which improves crop yield. BC has also shown the potential to improve conventional agricultural productivity and profitability of farmers by favouring the plant nutritional status.

Biochar can bring significant benefits when applied to agricultural soils in combination with some fertilizers. An increase in crop yield from 45 to 250 % has been reported, when BC is used in mineral nutrition plans of crops, such as radish, rice, corn and wheat. The water retention properties of the soil, saturated hydraulic conductivity, and nutrient availability have also been optimized with BC application also reported that the supply of sawdust BC reduced CO_2 production. Finally concludes that the biochar influences the structure, porosity, as well as the density and the specific surface of BC, which favours the availability of nutrients to be subsequently absorbed by plants.

General aspects of biochar production

Biochar is obtained by the decomposition of organic matter exposed to temperatures between 200-900 °C in an inert atmosphere with low / no oxygen concentration. This process, known as pyrolysis, is generally divided into fast, intermediate and slow depending on the residence time (time required to complete the pyrolysis process) and the exposure temperature of the biomass. The first is characterized by a concise residence time and high temperatures (less than 2 seconds, > 800 °C) and is often used to produce bio-oil from biomass obtaining approximately 75 % yield. The processes of slow and intermediate pyrolysis occur with a residence time of a few minutes to several hours or even days under temperatures between 300 and 800 °C, with BC yields between 25-35 %.

How to apply biochar to soil

Biochar takes between three to six months to show its effects in the soil, so the best time to apply it would be in autumn and winter before getting ready to plant in spring. There are several ways to add biochar in the soil.

1. Hand mixing is an easy way to apply biochar to flower beds and indoor pots by mixing it with the soil using your hands or a rake.
2. Tilling requires mixing it with the soil using a tiller.
3. Top-dressing is the process of sprinkling charged biochar on top of the soil and wetting it. It can also be mixed with compost for better results.

Effect of biochar

BC incorporation into the soil can alter water retention because BC porosity and high specific surface area reduce the apparent density of the soil. Additionally, it was found that the use of BC may favour the increase in soil temperature because it confers a dark colour which is associated with the capture of solar energy. This increase in soil temperature may benefit microbial communities and germination of seeds in soils with low temperatures. BC can also modify the chemical properties of the soil, increasing the cation exchange capacity and improving soil fertility through the availability of essential and beneficial nutrients for the plant.

Conclusions

In general terms, BC is a valuable tool that can be used in soils as a mitigation strategy for environmental pollution. It also serves as a carbon sink substance, improves the physical and chemical characteristics of the soil and has been proven to have high potential in agricultural use, increasing the yield and quality of cultivated plants. Additionally, it is an exciting alternative in the management of solid residues of vegetable (cherries obtained from coffee plants, rice husks, or pruning residues) or animal (poultry, cattle, and pig manure) origin.■

CARBON FARMING

A METHOD OF CAPTURING AND STORING CARBON

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ANDUAT, Kumarganj

Carbon

It is widely acknowledged as a vital source of energy in biological processes, including agriculture. Agricultural production is reliant on plant photosynthesis to transport CO from the atmosphere to the plant, where it is converted into agricultural goods such as food, flora, fuel, and fibre.

Agriculture and Carbon Emissions

Agriculture provides nearly one-third of global GHG emissions and covers more than half of the Earth's terrestrial surface. The livestock industry (54.6 percent) and the use of nitrogenous fertilisers account for the majority of agricultural emissions in India (19 percent).

Carbon farming

Carbon farming (also known as carbon sequestration) is a type of agricultural management that allows the land to store more carbon and release less GHG into the environment. It entails methods that have been shown to increase the rate at which CO is taken from the atmosphere and transformed to plant matter and soil organic matter. When carbon gains from improved land management or conservation efforts outweigh carbon losses, carbon farming is successful.

Methods for carbon farming

a) Forest management:

CO emissions from other sources are absorbed and stored by healthy forests. Avoiding deforestation is one way to generate carbon offsets. Reforestation and replanting initiatives. Permanent land conservation. More effective forest management.

b) Grasslands conservation:

It entails preserving native plant life through long-term land conservation and avoiding the transfer of grasslands to commercial development or intensive agriculture.

c) Mixed farming

A climate-friendly livestock-crops-livestock-crops-livestock-crops-livestock-crops-live. Grazing grasses recover from grazing by rotating cows among pastures, and the animals' excrement and grazing impacts renew carbon in soils.

d) Using cover crops

These crops are mostly planted to cover the land rather than to be harvested. They are sown after the main crop has been harvested. They return more carbon to the soil and keep soil bacteria alive, which are important for carbon storage.

e) Reduction of soil tillage:

Tillage is usually done to loosen and aerate the soil as well as to get rid of the first weeds. Tillage, on the other hand, stimulates carbon mineralization (the breakdown of chemical molecules in organic matter), which results in CO emissions from the soil. Soil disturbance reduction is an important method for preserving soil organic matter.

f. Wetland restoration:

Wetland soil is an important natural carbon pool or sink, as it conserves around 14.5 percent of the world's soil carbon.

Significance of carbon farming

a. Multidimensional benefits:

Increasing soil organic carbon (SOC) through a variety of approaches can increase soil health, agricultural productivity, food security, water quality, and pesticide

use.

It would not only address carbon reduction, but also other planetary boundaries that are in jeopardy, such as fresh water, biodiversity, land use, and nitrogen use.

b. Offsets carbon emissions:

A global programme known as "4 per 1000" discovered that raising soil carbon by just 0.4 percent per year may offset the year's additional CO emissions from fossil fuel emissions. In 2015, the French government established the "4 per 1,000" project at the COP21 Paris climate summit. The initiative's goal is to show that agriculture, specifically agricultural soils, can play a critical role in addressing food security and climate change.

c. Acts as an intermediate mitigation strategy:

Increasing soil carbon has a number of co-benefits, including purchasing time until other technologies can assist the globe in transitioning to a zero-carbon lifestyle.

d. Helps restoring carbon cycle:

Soils are thought to contain roughly ten times the amount of carbon in the atmosphere, significantly more than normal plants. Carbon farming is viewed as a technique to assist restore the carbon cycle's balance. It also aids in the natural development of drought resistance in soil and boosts agricultural productivity.

Way forward

a. Direct farmer incentives:

Because land can trap CO from the atmosphere, it is critical for achieving a climate-neutral economy.

However, in order to encourage the agriculture and forestry sectors to adopt climate-friendly practises, direct incentives must be created, as there is currently no particular policy tool to significantly incentivize the increase and conservation of carbon sinks.

b. Carbon credits and carbon banks:

Farmers can be compensated through globally marketable carbon credits, and 'carbon banks' that buy and sell carbon credits from farmers can also be established. These credits might subsequently be offered to companies who need to reduce their carbon footprint.Paying farmers to replenish carbon-depleted soils is a terrific way to achieve a natural climate solution and keep global warming below 2 degrees Celsius.

Organic-Carbon-Rich Fertilizers:

Fertilizers with a high C:N (carbon:nitrogen) ratio, such as compost and solid manure, will have a slower carbon turnover than other materials. They should be included in the agricultural system.

Biofuels *vs.* fossil fuels:

Almost all biofuel systems (mostly biodiesel and bioethanol) emit fewer greenhouse gases than fossil fuels. Farmers may diversify their income, cut costs, and help reduce global GHG emissions – primarily carbon dioxide (CO), methane (CH), and nitrous oxide (NOx) – by using biofuel as a replacement for fossil fuels (NO).

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FERTILIZER APPLICATION IN DRYLAND CROPS

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No Agricultural system can persist, if it fails to maintain soil fertility. In dryland soils Nitrogen is universally deficient, 'P' is low and 'K' status is medium to high. The organic matter content of dryland soils is usually less than one per cent and hence is of low fertility status.

Low rates of fertilizer application

Vagaries of rainfall and the consequent uncertainty of crop performance make farmers of dryland agriculture avoid fertilizer application. However, the results of experiments demonstrated yield advantage due to fertilizer use in dryland crop production. If the fertilizers are applied to meet the needs of the dryland crops, there may be prolonged breaks in the monsoon in *kharif* or limited available moisture in the root zone of *rabi* crops may be exhausted before the plants reach the reproductive stage resulting in poor yields. On the other hand, if fertilizers are applied at rates below the optimum, the yields will be poor. This has to be avoided by assessing the yield potential of different regions and regulating the soil fertility levels by adding only such quantities of fertilizers as required for realizing the potential to the maximum extent possible. Hence fertilizer usage is more in irrigated agriculture than dryland agriculture.

Response to nitrogen

Fertilizer use and loss will be more sensitive in shallow soils; hence response to applied fertilizer will be less stable on shallow soils. Response to 'N' was low and the influence of rainfall was inconsistent among shallow *vertisols* and *alfisols*. With decreasing rainfall, *vertisols* produced more responses to applied fertilizer. Results indicated that with 40 kg N/ha many crops responded to 'N' in dryland areas by giving about 20 kg extra grain or yield for every kg of N applied. However, the magnitude of response decreased with higher rates except for the maize crop. Results of experiments for five years indicated that the response of *rabi* sorghum to 25 kg N/ha on soils with low moisture storage, whereas on soil depth up to 60 cm sorghum grain yield increased up to 75 kg N/ha.

Response to phosphorus

The deficiency of phosphorus is less extensive than that of nitrogen. Though several crops respond to 'P' the response is not conspicuous and universal as that of 'N'. Dryland vertisols possess high

Fig. 1 Fertilizer use in drylands farming system

Table 1: Recommended dose of fertilizers for rainfed crops of TN

Crop	Dose (kg/ha)		
	N	P_2O_5	K_2O
Groundnut	20	40	40
Sorghum	40-80	40	0
Pearl millet	40-80	40	0
Setaria	40	40	0
Redgram	20	40	0
Greengram	20	40	0
Horsegram	10	30	0
Sunflower	30-40	30-40	0

phosphorus fixation capacity, ranging from 300 to 450 mg /kg of soil, hence there will be less amount of 'P' in the soil solution to be available for the crop plants. This explains the lack of response to 'P' in vertisols since the amount of the 'P' added seldom exceeds 25-35 kg P_2O_5/ha which is inadequate to meet the 'P' fixing capacity of the soil and crop requirement. Response of dryland crops to 'P' will continue to remain small and marginal as long as the poor yields of crops are not increased through efficient soil and moisture conservation measures and balanced crop nutrition.

Response to potassium

On a large scale, potassium has failed to produce a distinct response in dryland cereals and millets as is common with irrigated crops. Dryland soils particularly, the sandy loam and red soils which are deficient in 'K' may respond to moderate levels of 'K' when the monsoon is normal. The recommended dose of NPK for different crops of Tamil Nadu is furnished in table 1.

Response to secondary and micronutrients

Among secondary nutrients, oilseeds and pulses respond to sulphur and calcium. Response to 'Ca' and 'S' is typical of rainfed groundnut. Among the micronutrients deficiency of 'Fe' and response to its application have been observed in crops like chickpea and groundnut. Zinc is deficient in many areas and many crops respond to Zinc. Eg: groundnut, maize, pearl millet, etc.

Response to NPK (Balanced fertilization)

Balanced fertilizer application increases the efficiency of added fertilizers. Response to universally deficient 'N' could be low if other nutrients are limiting. More frequently 'P' limits the response of 'N'. If N+P is applied the yield response is increased. In dryland areas receiving less than 750 mm annual rainfall where prolonged dry spells are common during the crop period, economical responses were obtained with low levels of 'N' only.

Conclusion

In the conclusion that fertilizers are applied to meet the needs of the dryland crops, there may be prolonged breaks in the monsoon in *kharif* or limited available moisture in the root zone of *rabi* crops may be exhausted before the plants reach the reproductive stage resulting in poor yields. This has to be avoided by assessing the yield potential of different regions and regulating the soil fertility levels by adding only such quantities of fertilizers as required for realizing the potential to the maximum extent possible. Hence fertilizer usage is more in irrigated agriculture than dryland agriculture.

■■■

PRADHAN MANTRI KRISHI SINCHAYEE YOJANA (PMKSY)

IRRIGATION TO EVERY VILLAGE

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Indian farmers usually rely on rainfall in an unhealthy way for the production of crops. This forces them to take a tremendous chance since there is zero absolute guarantees on the incidence and magnitude of rainfall. With an emphasis on water conservation and irrigation, the Indian government has developed numerous initiatives, and PMKSY is one of them. Water conservation and management are top priorities for the Indian government. Extending irrigation coverage (Har khet ko pani) and utilising water more effectively were the main goals of the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) (More Crop Per Drop). Source generation, distribution, administration, field application and other extension operations will all be addressed under this plan. PMKSY was launched by the Indian government in 2015 with an investment of 50,000 crores (US$ 7.7 billion) in an effort to find long-term solutions to the country's drought problem with a motto 'Har Khet Ko Paani'. Improving water efficiency and decreasing water waste are the primary objectives of this mission's execution. By harvesting rainfall at the micro-level via "Jal Sinchan" and "Jal Sanchay," the PM Krishi Sinchai Yojana aims to provide sources of guaranteed irrigation and create protective irrigation. Subsidies for "Per Drop-More Crop" also help to encourage micro-irrigation. The PMKSY Yojana was created by combining several existing programmes. These are: Accelerated Irrigation Benefit Programme (AIBP) of the Ministry of Water Resources; River Development & Ganga Rejuvenation (MoWR, RD&GR); Integrated Watershed Management Programme (IWMP) of Department of Land Resources; On Farm Water Management of Department of Agriculture and Cooperation.

The primary purpose of the PMKSY is to merge investments in irrigation at the field level. Other objectives are:

1. Expansion of irrigated farmland and increased accessibility to irrigation infrastructure (Har Khet ko Pani).
2. Reducing water waste on the farm through increasing efficiency in the usage of water.
3. Using relevant technology to integrate water supply, delivery, and efficiency.
4. Promoting the use of water-saving methods such as precision irrigation and other innovative approaches (More crop per drop).
5. Investigating if peri-urban farming might benefit from recycling treated water from a nearby city can help replenish aquifers and maintain the water supply.
6. A watershed strategy to water and soil conservation, such as regeneration of groundwater, watershed approach for conserving water and soil, arresting runoff, providing livelihood and other NRM activities.
7. Extension programmes for farmers and field workers, such as water harvesting, water management and crop alignment.
8. Increasing the amount of private money invested in precision irrigation system framework. This will lead to a rise in agricultural revenue as a consequence of greater output and productivity.

Functions of PMKSY

The goal is to bring together relevant Ministries, Departments, Agencies, Research Institutes, and Financial Institutions that are involved in the creation, use, reusing, or potential reusing of water, in a typical stage so that a comprehensive and all-encompassing perspective of the entire "water cycle" can be considered and water budgeting can be completed for all areas specifically, families, horticulture, and businesses.

A 'decentralised State level planning and implementation' structure is the purpose of the PMKSY programme design, which aims to help States develop their own District Irrigation Plan and State Irrigation Plan. Under the proposals, all buildings built will be geotagged.

Scheme Components of PMKSY Accelerated Irrigation Benefit Program (AIBP):

Priority will be given to completing current medium and major irrigation projects.

PMKSY(Per drop more crop):

1. Improved/ Innovative operations, such as a controlled outlet pipe and box system, have been implemented to increase water efficiency.
2. The holding of conferences and seminars, the production of documentaries and advertising, the printing of booklets and pamphlets and the sharing of success stories are all ways to raise awareness of water conservation methods, programmes and technology.
3. An emphasis on agronomic, technical and managerial approaches, including community irrigation, to stimulate the use of viable water sources.
4. Extension efforts to promote scientific water conservation and agronomic strategies such as cropping alignment for maximising water use are underway. Included in this is rain and reducing the amount of irrigation needed (Jal sarankchan)
5. Electric, solar, and diesel pump sets are examples of water raising technologies. Pipes used to transport water are included in this.
6. When water is in plentiful supply, such as during the rainy season or from perennial sources, secondary storage buildings at the end of a canal system are used to store it. Streams, for example, may be tapped during seasons of low rainfall via careful control of on-farm water use.
7. Micro-irrigation structures, such as dug wells and tube wells, that are not covered by MGNREGS, PMKSY and PMKSY (Watershed). Groundwater that is not critical, semi-critical, or overexploited is not included in this category.
8. Extrapolating MGNREGS' permitted 40 percent increase in civil construction input costs. This is used for tasks such as silt traps, lining the intake, and so on.
9. In the farm, use pivots, rain-guns, drips, sprinklers, and other precision water application equipment to ensure efficient water flow and precise water application (Jal Sinchan).
10. Monitoring, approving the yearly action plan, preparing the District/State Irrigation Plan, etc. are all part of programme management.

PMKSY (Watershed):

Structures such as nala bunds, agricultural ponds, check dams, tanks, and other water collecting structures. Staggered trenching, land levelling/ mulching, field bundling/contour trenching /bundling, etc. are all examples of effective rainfall management. Enabling activities, such as nursery-raising, afforestation and the ridge area treatment, horticulture and the development of pastures, as well as livelihood and micro-enterprises for marginal and small farmers, are included in this category.

PMKSY (Har Khet Ko Paani):

Constructing a small water system to provide fresh sources of water (both surface and groundwater). Fixing up and redesigning existing water bodies and a dvancement of the charge range. Organizing the strengthening and generation of dispersion at the ranch. Reviving and re-creating historic water storage systems like Jal Mandir (Gujarat), Khatri, Kuhl (H.P.); Zabo (Nagaland); Eri, Ooranis (T.N.); Dongs (Assam); Katas, Bandhas (Odisha and M.P.) and so on in suitable sites throughout India.

Committees involved in implementation

- **National Steering Committee (NSC):** The Prime Minister chairs this inter-ministerial committee, which includes Union Ministers from all relevant departments. As a national agency, it will oversee and monitor the programme.
- **National Executive Committee (NEC):** The Vice-Chairman of NITI Aayog will preside over the group's formation. Interministerial coordination, resource allocation, performance evaluation, and administrative concerns will all be handled by this agency.
- **State Level Sanctioning Committee (SLSC):** The Chief Secretary of each State will preside over the SLSC, which will oversee the implementation of the programme at the state level. It will have the ability to approve and supervise the project's development, as well.
- **District Level Implementation Committee:** In order to make sure that the last mile coordination is in place at the district level.

Krishi Sinchai Yojana has benefited a number of farmers. Before this, farmers had to contend with a shortage of irrigation infrastructure. Because PMKSY focuses on resolving problems at the local level, all communities affected by these concerns will benefit from this important project.■

WATER CONSERVATION

FOR POTENTIAL USE OF RAINFALL WATER

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Water conservation is the use and management of water for the good of all users. Water is abundant throughout the earth, yet only three present of all water is fresh water, and less than seven-tenths of freshwater is usable. Much of the usable water is utilized for irrigation. Detailed analysis will show that in about fifteen years, about two-thirds of the world's population will be living in some sort of water shortage. Water is used in nearly every aspect of life. There are multiple domestic, industrial and agricultural uses. Water conservation is rapidly becoming a hot topic, yet many people do not realize the importance of soil conservation.

Water is prime life sustaining natural resource which cannot be created like other commodities. It is a nature's gift to all living beings on the earth. Water is the elixir of life. Unfortunately for our planet, supplies are now running dry at an alarming rate. The world's population continues to soar but that rise in numbers has not been matched by an accompanying increase in supplies of fresh water. In India, the increasing stress on the availability of water is due to population explosion and improved standard of living. The scarcity is compounded further because of massive agricultural and industrial development coupled with improper and indiscriminate exploitation of groundwater resources

Conservation techniques Primary source of water in India is south-west and north-east monsoons. Monsoon, however, is erratic and as you have already studied the duration and the amount of rain fall is highly variable in different parts of our country. Hence, surface runoff needs be conserved. The techniques for conservation of surface water are:

1. Surface water storage:

Storage of water by construction of various water reservoirs have been one of the oldest measures of water conservation. The scope of storage varies from region to region depending on water availability and topographic condition. The environmental impact of such storage also needs to be examined for developing environment friendly strategies.

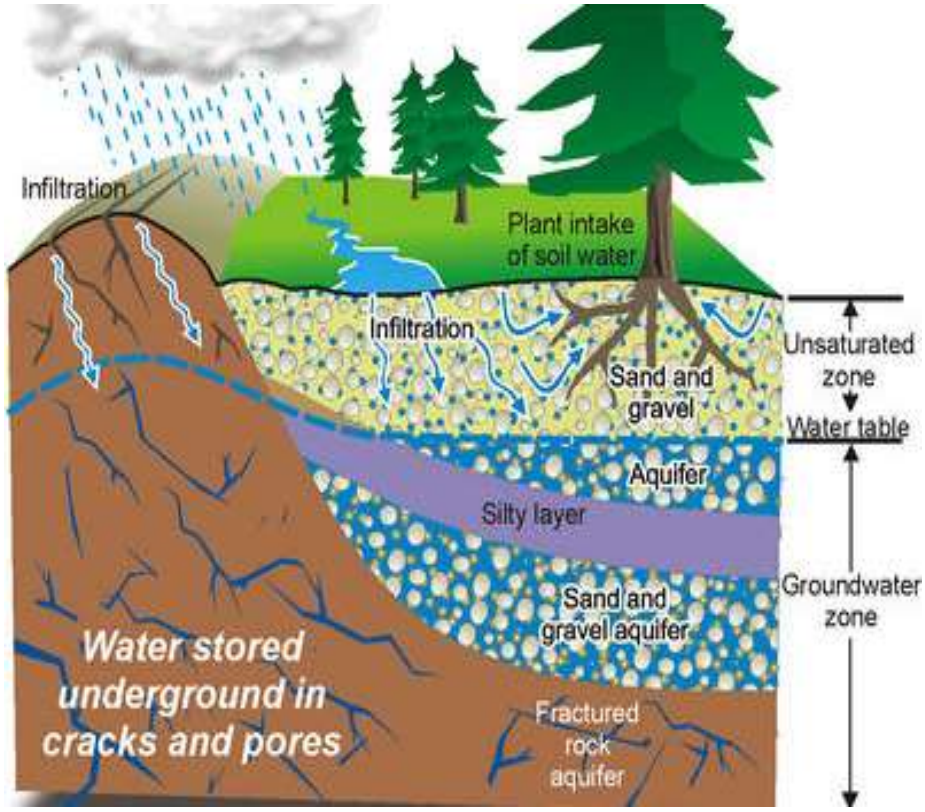
2. Rain water:

Rain water has been conserved and used for agriculture in several parts of our country since ancient times. The infrequent rain if harvested over a large area can yield considerable amount of water. Contour farming is an example of such harvesting technique involving water and moisture control at a very simple level. It often consists of rows of rocks placed along the contour of steps. Runoff captured by these barriers also allows for retention of soil, thereby serving as erosion control measure on gentle slopes. This technique is especially suitable for areas having rainfall of considerable intensity, spread over

large part i.e. in Himalayan area, north east states and Andaman and Nicobar Islands. In areas where rainfall is scanty and for a short duration, it is worth attempting these techniques, which will induce surface runoff, which can then be stored.

3. Ground water conservea-tion

- There is more groundwater than surface water.
- Groundwater is less expensive and economic resource and available almost everywhere.
- Groundwater is sustainable and reliable source of water supply.



- Groundwater is relatively less vulnerable to pollution.
- Groundwater is a free of pathogenic organisms.
- Groundwater needs little treatment before use.
- There are no conveyance losses in underground based water supplies.
- Groundwater has low vulnerability to drought.
- Groundwater is the key to life in arid and semi -arid regions.
- Groundwater is source of dry weather flow in some rivers and streams.

Techniques of ground water conservation

(i) Artificial recharge

(ii) Percolation tank method

4. Catchment area protection (CAP):

Catchment protection plans are usually called watershed protection or management plans. These forms are an important measure to conserve and protect the quality of water in a watershed. It helps in withholding runoff water albeit temporarily by a check bund constructed across the streams in hilly terrains to delay the run off so that greater time is available for water to seep underground. Such methods are in use in north-east states, in hilly areas of tribal belts. This technique also helps in soil conservation. Afforestation in the catchment area is also adopted for water and soil conservation.

5. Inter-basin transfer of water:

A broad analysis of water and land resources and population statistics of various river basins in our country reveals that areas in western and peninsular regions have comparatively low water resources/cultivable land ratio. Northern and eastern region which are drained by Ganga and Brahmaputra have substantial water resources. Hence, the scheme of diverting water from region with surplus water to water defecit region can be adopted GangaCauveri link would enable to transfer of vast quantities of Ganga basin flood water running out to sea, to west and south west India. The transfer of the surplus Ganga water would make up for the periodical shortage in Sone, Narmada, Godaveri, Krishna and Cauveri. The National Grid Commission envisages diversion of part of the surplus discharge in the Ganga near Patna during the high flood period.

6. Adoption of drip sprinkler irrigation.

7. Reducing evapotranspiration.

8. Reducing evaporation from various water bodies

9. Recycling of water.

10. Conservation of water in domestic use.

11. Reduce the loss of water.

12. Reuse of wastewater.

13. Water shed management.

The most important step in the direction of finding solutions to issues of water and environmental conservation is to change people's attitudes and habits this includes each one of us. Conserve water because it is right thing to do. we can follow some of the simple things listed below for water conservation:

1. Use only the amount you actually need.
2. See that there are no leaks in the toilet tank. You can check this by adding colour to the tank. If there is a leak, colour will appear in the toilet bowl within 30 minutes. (Flush as soon as the test is done, since food colouring may stain the tank).
3. Do not leave the tap running while you are brushing your teeth or soaping you is your face.

Avoid flushing the toilet unnecessarily.

4. Put a brick or any other device that occupies space to cut down on the amount of water needed for each flush.
5. When washing the car, use water from a bucket and not a hosepipe.
6. Do not throw away water that has been used for washing vegetables, rice use it to water plants or to clean the floors, etc.
7. Make sure that your home is leak of water free. Many homes have leaking pipes that go unnoticed. Encourage your family to keep looking for new ways to conserve water in and around your home.
8. Try to do one thing each day that will result in saving water. Don't worry if the savings are minimal every drop counts'! You can make a difference.
9. Form a group of water conscious people and encourage your friends and neighbours to be part of this group. Promote water conservation in community newsletters and on bulletin boards. Encourage yours friends, neighbours and co-workers to also contribute.
10. You can store water in a variety of ways. a simple method is to place a drum on a raised platform directly under the rainwater collection source.

Future stand points for soil and water conservation

The burgeoning world population, natural resource degradation especially soil and water and food in-security are the big challenge in the present and Future era of climate change. Because the rapid growth of industrial and intensive farming practices are expected to raise the pressure on natural resources (soil and water).

Therefore, a paradigm shift in soil and water conservation and its management in vital for achieving agriculture sustainability and eliminates the pressure of nature resources.

Few tips for magnificent soil and water conservation

1. Create and implement the adaptive policies for productive soil and water conservation.
2. Existing soil and water conservation practices should be improved and development base on location.
3. Development cost effective soil and water conservation practices to restore the degradable land.
4. Demonstration of efficient technology on farmers' field.
5. Emphasis on research, education and extension of effective resource management technology to the stakeholder.
6. Adaptation and judicious use practices.

Government's efforts on water conservation following main efforts can be noted.

1. National Water Policy 2002 strongly emphasizes conservation of water.
2. Efforts to retain rain water on land through various schemes.
3. Construction of large number of dams on various river systems.
4. Interlinking of rivers (proposed).
5. Promotion of bunds at village level.
6. Promotion of rain water harvesting.
7. Promotion of reuse and recycling of wastewater.
8. Steps to protect water quality.
9. Drought-proofing the future.

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FARM LEVEL WATER HARVESTING STRUCTURES

TO SUSTAIN RAINFED FARMING THROUGH WATERSHED DEVELOPMENT

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Conserving water resources and consuming it efficiently has turn out to be the need of the hour under stressing situation of growing population and water scarcity. In India, about 85.3 per cent of the total water was consumed for agriculture (Central Water Commission, 2021). Hence, there is a requisite for management of water resources scientifically at farm level which is energetic to agricultural development and ecosystem sustainability. Rainwater harvesting is the only viable option to achieve water security, recharge of ground water, to prevent evaporation and to promote prolonged utilization. Farm level harvesting was performed highly effective for irrigation in rainfed farming and made a multiplier effect on farm income (Kumar *et.al.*, 2016). Watershed development programs are implemented by government widely to establish a symbiotic relationship between all the communities in large scale to ensure that all people have access to water resources and other amenities.

Water harvesting structures- Farm level

Contour Bunds:

The bunds are constructed on the contour of the catchment area and these hold the surface runoff in the area located between the two adjacent bunds. Generally the length and height of contour bund ranges from 0.3m to 1.0m and from 10m to a few 100m respectively. The side slope of the bund should be based on the requirement. Contour bunding is a proven sustainable soil and water conservation practice for sloping, marginal and hilly area where soil productivity is very low. It is built to control soil erosion, promote water retention, and increase.

Contour Bund

Farm ponds:

Farm ponds are constructed for attaining multi-purpose objectives such as irrigation, maintenance of live-stock, water supply to fodder, fish production, etc. They are used to store water during rainy season and using the same for irrigation purpose subsequently. The location of farm pond should be fixed in such a way that all requirements are easily met. The capacity is determined by a contour survey of the site at which the pond is to be located.

Farm Pond

Percolation tanks:

Percolation tanks are usually earthen embankments which are constructed across stream submerging a land area with adequate permeability to facilitate sufficient percolation. This is one of the effective methods of recharging groundwater table. Percolation tanks are designed with storage capacity of 0.1 MCM to 0.5 MCM and a stored water column should be generally between 3m and 4.5m. The optimal size of the percolation tank must be determined by its capacity of strata in the tank bed.

Percolation tanks

Check dams:

Check dams are concrete structures constructed across small streams for the purpose of surface

storage. It can be used where temporary channels or permanent channels without vegetation, infeasible channel line and velocity checks are required. The design are based on the volume of water that can be stored in the channel upstream, the evacuation of surplus flood discharge, stability of the structure and ground water recharge. This dam should be used with drainage areas of 2 acres or less and used as a temporary and emergency measure to control erosion by reducing flow in small channels.

Check Dams

Graded bunds:

Graded bunds consist of earthen or stone embankments constructed on the land area having slope of 0.5% to 2%. The design and construction of graded bunds are diverse from the contour bunds. They are optional where rainfall intensity and soils are such that the runoff water discharged from the field can be easily intercepted. The height of these graded bund ranges from 0.3m to 0.6 m. The downstream bunds consist of wings to interrupt the overflowing water from the upstream bunds.

Permeable rock dams:

Rock dams are long low but broad permeable dams across valleys intended to slow and spread floodwater as well as gullies. It has the dimension of between 50m and 300m in length and between 80cm and 150 cm in height. The dam wall is also flatter on the downslope side than on the upslope side to give better stability to the structure. A shallow trench is used for the foundation which improves stability and reduces the risk of undermining. Usually, large stones are used on the outer wall and smaller stones internally. They are site-specific and require loose stone as well as the provision of transport.

Permeable rock dams

Recharge pit:

Recharge pit is most suitable for plains or alluvial areas where permeable strata are not below than 2m to 2.5 m deeper from the ground surface. The pit is constructed with the width of 1m to 2m and depth of 1.5m to 2m or based on the availability of permeable strata. The pit is filled with layers of the boulders of 5mm to 20mm placed on bed of the pit, gravels of 5mm to 10mm in middle, thick sand is filled on top so that the silt coming in with

Recharge Pit

run off is deposited above thick sand which can be removed later. Recharge pits for the roves comparatively of smaller size can be filled in with brick pieces or pebbles etc. A mesh should be put at the drainage point on the roof. A desilting or collection chamber can also be constructed on the surface to stop silt which can further prevent the flow of small molecules towards the pit.

Conclusion

The potential of using rainwater for agriculture and allied activities exist where demand is high and presence of large catchment area and pressure from groundwater. It is suggested that training in water harvesting structures through watershed development programmes need to be provided to community based organizations to promote the scheme. Extending such programmes and post maintenance of the same will overcome the problems of water scarcity which ultimately help communities to adapt to climate change as a whole.

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ERICULTURE

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Ericulture is an agro-based small scale industry of North Eastern India consisting of activities like host plant cultivation, silkworm rearing, and spinning of yarn and weaving. Ericulture i.e., rearing of eri cocoon and spinning as well as weaving of clothes has been an integral part of the rural economic activities especially of the rural women in North Eastern India. The name eri derives from the Assamese word 'era', which means castor-oil plant, the main food plant of this silkworm. *Samia cynthia ricini* a multivoltine silkworm commonly called as 'eri silkworm' is known for its white or brick-red eri silk. The primary food plant of this polyphagous insect is castor (*Ricinus communis L.*), but it also feeds on a wide range of food plants. 19 species of eri silk moth were recorded in the tropical Asia out of which three species of eri silkworm, namely, *Samia ricini*, *Samia canningie* and *Samia fulva* are found exclusively in India.

Ericulture is mostly confined to the Brahmaputra valley of Assam in the tribal inhabited districts. It is also practiced in few districts of the neighbouring states mainly Meghalaya, Nagaland, Manipur and Arunachal Pradesh. A small quantity of eri cultivation is also practiced in Bihar, West Bengal, Orissa, Jharkhand, Chhattisgarh, Uttranchal, Gujarat, Andhra Pradesh etc. The eri silkworm is multivoltine and polyphagous in nature.

Bio diversity of Eri flora

The primary food plant of this polyphagous insect is castor (*Ricinus communis L.*), but it also feeds on a wide range of food plants such as-

Tapioca – *Manihot utilissima*
Kesseru – *Heteropanax fragrans*
Barkesseru – *Ailanthus excelsa*
Payam – *Evodia flaxinifolia*
Papaya – *Carica papaya*
Jatropa – *Jatropa curcas*
Gulanchaphool /champa – *Plumeria acutifolia*
Korha – *Sapium ellgeniafoliu*

Eri silkworm - diversity

Exploited eri silkworm species	Geographical distribution
Samia ricini (Donovan) , *Samia cynthia* (Drury), *Samia canningie* (Hutton)	North Eastern India, China, Japan
Eri silkworm ecoraces	North Eastern India
Borduar, Sille, Titabar, Nongpoh, Dhanubhanga, Mendiathar, Kokrajhar	
Eri silkworm strains	North Eastern India
Yellow plain, Yellow zebra, Yellow spotted, Greenish Blue Plain, Greenish Blue Spotted, Greenish Blue Zebra	

Morphology

Eri egg

i) Medium sized and oval, very tough smooth shell
ii) Freshly laid eggs - slight white in colour.
iii) As embryo develops inside the egg, egg shell changes from whitish to yellowish, yellowish to ashy and ashy to blackish just before hatching.

Larva

i) On hatching, the larva is greenish yellow in colour.
ii) Size: 5 x 1 mm
iii) Weight: 1.5 mg.
iv) Colour changes gradually to pure yellow by end of third day.
v) Later the body colour segregates into yellow, cream, green blue or white.
vi) The mature larvae measures about 7.0 x 1.5 cm and weights 8 g.
vii) It is translucent and is covered with a white powdery substance.

Pupa

i) Obtect pupa
ii) Size : 2.8 x 1.5 cm
iii) Weight : 2.6 g

Cocoon

i) Elongated, soft, wolly, peduncle less, open mouthed and unreelable.

ii) Size : 4.0 x 2.5 cm
iii) Weight : 3 g
iv) Colour : brick red and creamy white.
v) Shell wt: 0.4 g
vi) Shell ratio : 13%.

Adult

i) Moth colour is variable,but always solidly white on the dorsal surface of the abdomen.

ii) Wing pattern was heavily marked whiter in ante median and post median lines.
iii) Forewings are brownish, blackish or chocolate coloured with antemedian line and postmedian line.
iv) Antenna: Bipectinate type.

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PLANT BIO REGULATORS

FOR SUSTAINABLE AGRICULTURE

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The continuous increase in human population together with loss of agricultural land, decrease in soil and soil-water quality and changing climatic condition is posing serious threat to agriculture and food security. The FAO reported that to feed a total of 9 billion people by 2050, significant grain yield increase of approximately 44 million metric tons per year will have to be achieved. To meet this scale is a great challenge especially in the light of projected scenario of different abiotic stresses such as salt, drought, high temperature, cold and heavy metals. Thus, in order to provide solution to farmers, the concept of sustainable agriculture is introduced. LEISA based agriculture system is based upon the options which are ecologically sound, economically feasible, and culturally acceptable. This is generally achieved through the exogenous application of low concentration of chemicals termed as "Plant Bio-Regulators (PBRs)". Their successful implementation is dependent upon the interaction between scientists and farmers so that the knowledge accrued from plant responses toward different environmental factors at molecular, cellular and whole plant level can be utilized to develop an effective PBR. The LEISA is slightly different than that of priming. In LEISA, low level of PBRs are applied to the crop as foliar application to modulate the signaling associated with plant growth and yield; while, priming is mainly given during seed soaking stage to activate stress tolerance mechanism so that plants perform better upon subsequent stress exposure.

Plant bio-regulators (PBRs)

These are both endogenous and exogenous substances can be regarded as bioregulators if, in low concentrations and without having any biocidal or nutritive action, they exert an influence on the growth, development and composition of the plant.

a. In LEISA, low level PBR'S are applied to the crops as foliar application to modulate the signaling associated with plant growth and yield.
b. While priming is mainly giving during seed soaking stage to activate stress tolerance mechanisms so that plant performs better upon subsequent stress exposure.
c. PBR'S have the ability to modulate the redox mediated signaling.
d. Most of PBR'S function by modulating cellular redox homeostasis.
e. All these PBR'S which provides the structural constituents modulate ROS levels and they involve in biology of the plant.
f. PBR'S they provide the tolerance to the drought and cold to the plants.

The common categories of bioregulators include auxins, ABA, cytokinins, GAs and ethylene. However, other more recently discovered compounds that can regulate plant growth and development include brassinosteroids, jasmonates, oligosaccharins, polyamines, strigalactones and salicylates. The action and efficacy of a PBR is dependent on a range of factors, including product concentration, time of application, species and cultivar. Environmental conditions can also influence the physiological response of the plant to a PBR. With increasing labour costs impacting production costs, application of PBRs can be more cost effective than labour intensive cultural methods.

Advantages of PBRs

1. PBRs have the ability to activate redox mediated signaling to facilitate rooting.
2. Maintaining high photosynthesis efficiency.
3. Helps to increase the source-sink translocation for enhanced yield.
4. They provide the tolerance to drought and cold to the plant.
5. PBRs helps to develop the stress tolerance.

Limitations of PBRs

- Most of the PBRs study limited to the seedling level.

- Large scale research on PBR'S on different agro-climatic zones is not done.
- The basic research on the PBRs is required on plant redox signaling.
- The exact dosage of the PBR'S for different crops is not properly standardized.
- The knowledge of PBRs and educating the farmers about PBRs is lacking.

Sustainable agriculture

It is the form of agriculture aimed at meeting the food, fibre and fuel needs of present generation without endangering the resource base for the future generations.

In simplest terms, sustainable agriculture is the production of food, fiber, or other plant or animal products using farming techniques that protect the environment, public health, human communities, and animal welfare.

a. Satisfy human food and fiber needs.

b. Enhance environmental quality and the natural resource base upon which the agricultural economy depends.

c. Make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls.

d. Sustain the economic viability of farm operations

e. Enhance the quality of life for farmers and society as a whole.

Sustainable agriculture integrates three main goals:

1. Environmental health.
2. Economic profitability.
3. Social and economic equity.

Conclusion

1. Combined application of SA and mepiquat chloride will enhance the stress alleviating characters and yield of a crop.
2. Application of SA to the saline soils will enhance the nutrient concentration in rice seeds.
3. Application SA and mepiquat chloride will reduce the leaf spot infestation in groundnut.
4. The net returns and benefit cost ratio will be higher with the application of cycocel @ 500 ppm ha^{-1}.

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STRATEGIES FOR MINIMIZING FARM RISKS IN INDIA

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The excessive price volatility, climatic abnormalities and indebtedness are the major challenges in Indian agriculture. Its uncertainties become fulfill to them also extra vulnerable or risk-prone due to the maximum numbers of farmers under small and marginal which is about 86 % with decreasing and partitioning the farmer's field for their future generation. The two pro-agriculture Indian government schemes were:

- First is the Imbalance of use of resources for agriculture.
- Another is a range concerning programs which were initiated by expanding area under irrigation, improving soil fertility and productivity, and developing the post-harvest technologies with minimizing the production risks.

However, such appears as agronomical immanency is silently outpouring across everywhere and it appears like functioning individually without any link between each other. So it is very important for defending against these uncertainties and challenges by adopting some steps in one way in Indian agriculture. Which are as follows:

1. Enhancing the farmer's income:

The process of transforming India into Agricultural is very gradual and slow due to the traditional dependency of farmers. Therefore, the procedure regarding producing greater earnings through agriculture is additionally slow. The essential goal, then rising incomes, is to increase production, which may stand for the expectation of our Prime Minister Narendra Modi's proposes of doubling the farmer's income by the end of 2022. The requirement for this procedure will be:

- Improved technologies for dissemination system under seed sector.
- Agricultural diversification into the favour of excessive cost commodities yet the improvement over price chains by using linking manufacturing and marketing centres.
- Assurance towards minimum support price under concerning crash in farm prices. Its favourable outcome will depend interlinkage between the farm production and their marketing under strengthening contract farming, cluster farming, self-help groups and farmer's organizations.

2. Raising employment:

The current report of Situation Assessment about India referred to like more than forty per cent regarding would like in imitation of cease agriculture salvo alternative opportunities were available. Agriculture is turning into pos yet does no longer provide ordinary employment opportunities. The rural youth population, due to the absence of required employment for their livelihood, is migrating in conformity to higher possibilities for income. In India, more than 70 per cent of its rural households still depend primarily on agriculture for their livelihood. So, it is very important to make their energies in the right and useful direction towards transforming agriculture and rural economics. However, only agriculture is not sufficient for increasing the income another incentives may also be includedlike: Aggregating uncooked and processed merchandise (one example: Lijjat Papad, which generates the employment for more than 43,000 women); self-employment of agro- processing, agro-advisory, agricultural transport, etc.; private sector application in custom-hire services, petty or tertiary processing; location-specific non- farm service into micro, little then medium enterprises, composite with the enormous technical sector; or appointment into government programs, schools, yet agriculture extension.

3. Decreasing distress in agriculture:

The continuous agrarian distress is developing for years due to both uncertainties under production and price which have been faced, b farmers. The uncertain climatic and environmental factors such as

droughts, floods, heat waves, hailstorms, and uneven and unseasonal rainfall are adversely creating production risks. However, in normal conditions, the farm prices after harvesting, fall steeply, adversely affecting the farmers' incomes. Now in some areas, some production losses are covered by the Prime Minister's National Agricultural Insurance Scheme (PMs-NAIS). Though its intention is good it is inadequate forassurance under falling prices and doesn't cover these risks. The rule must think about launching a "Prime Minister's Climate Resilience Scheme"(PMs-CRS) up to expectation covering each manufacturing and charge risk. Such a strategy should also interlink the climate together with smart farming via improved advisory services under environmental circumstances for better implementation regarding insurance and assisting MSP (Minimum Support Prices).

4. Improving agri-infrastructure:

Agri-infrastructure such as agricultural markets, warehouses, agro-processing, cold storage and agro-based industries, has not been raised at the same level of increasing farm produces. The pace concerning agri-infrastructure is some distance in the back of such as that is wantedin conformity with enhancing the standard agri-food system. The main objective in agriculture was the production of agricultural produces, in the past and the development of agri-infrastructure was partially neglected. In the non-existence of sufficient agri- infrastructure, the grant chains on agri-food supply hand to hand are broken and now are within the palms of individually unorganized inefficient sectors. With the absence of business viability, private organizations are rising slowly and adversely affecting the agri-infrastructure. The function of public-private partnerships (PPP) is broad within increasing agri-infrastructure because of high economic yet convivial gains. There should be a proper scheme for the proposals of modalities under public-private partnerships in the agri-infrastructure sector which is shaped by the government of India. Many classes execute stand learned by PPP's previous results like under the building construction, national highways, the construction and functioning on airports, the allocation of power, or ignoble areas. These do be applied in improving and constructing various Agri-infrastructures. There should be various initiatives to be performed individually by different states to maintain the PPP's viabilities.

5. Enhancing the standards of rural living:

Some basic and simple amenities are still missing in rural India such as sanitation, hygiene, ingesting water, drainage, schooling, and health care centres). In past, our PM Narendra Modi made government assemblies according to undertake one village and then work in imitation of transforms such into a model village. The predominant goal was to facilitate all basic needs for enhancing the lifestyles of rural peoples. The late respected President A. P. J. Abdul Kalam produced a comparable concept, Provision of Urban Amenities to Rural Areas (PURA), aiming to offer urban infrastructure or create employment opportunities for rural ones. The design stays revived in conformity with enhancing the attribute over lifestyles of peasant areas. In addition, the various packages of schemes for constructing social and economic infrastructure need to lie in joint because of the larger impact.

So, after a long time, it is time for India's agriculture sector to enhance its economy for rural growth and livelihood and this can be achieved through performing by planning these strategies in a systematic way in one line.

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APPLICATION OF STATISTICAL METHODS IN AGRICULTURE SCIENCES

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Statistics provides scientific tools for collecting, classifying, analyzing, and inferencing data. Agricultural researchers and statisticians play a vital part in a country's agricultural productivity and development. Statistical science is concerned with the fundamental aspects of experimental design and sample surveys, as well as drawing valid inferences therefrom using various statistical methods. The art of drawing valid conclusions depends on how the data has been collected and analyzed. This article describes the basic concept of statistical research design and the techniques used for analysis and interpretation of investigations into agriculture-related data.

Introduction

Statistics plays an important role in practically all sciences, including social, biological, and psychological sciences, agricultural sciences, and information technology. Because of the variability inherent in biological and agricultural data, statistical knowledge is necessary for their understanding and interpretation. Many scientific problems that arise in various sectors of agricultural activities can be solved using various statistical procedures such as determining and estimating the amount of irrigation required by a crop each day, per base period. In determining the required pesticide and fertilizer doses for a specific crop. Forecasting procedures are used by agricultural economists to estimate food demand and supply, as well as export and import output. Classification of soils based on Ph content, and texture. Estimating yield losses caused by a certain pest, insect, bird, rodent, etc. statistical approaches in a variety of applications, including irrigation studies, cultivation modes, and the design of harvesting and cultivating machinery and equipment.

Statistical techniques and their applications

Modern agricultural production is characterized by some particularities and many different activities. Different nature of agricultural materials data requires different approaches to the use of statistical methods. Statistics is a branch of mathematics that focuses on data quantification. Even when dealing with non-numerical data, statistical approaches employ transformations to convert it into numerical data.

Statistical Science is concerned with the fundamental aspect of the theory of design of experiments and sample surveys. A sample is drawn from a population using various probability and non-probability approaches dependent on the purpose of the research and also the nature of the population. The most common sampling methods include simple, stratified, systematic random sampling, and cluster random sampling. Non-probability sampling approaches include purposeful, judgmental, and convenience sampling.

In agricultural research, analysis of variance (ANOVA) is a more useful technique for comparing more than two group means. The Design of Experimental Techniques in Agricultural Research is concerned with the study of methods for comparing treatments, and varieties, by agricultural researchers. The experimental design provides a maximum amount of information at a minimum cost. Completely Randomized Design (CRD), Randomized Complete Block Design

(RCBD), Latin Square Design (LSD), Split-Plot Designs, Strip Plot Design, Augmented design, Lattice Design, etc., most commonly used experimental designs.

When dealing with more than two variables at the same time, multivariate analysis comes in helps a lot. Principal component analysis, Path analysis, discriminate analysis, Cluster analysis, Factor analysis, and Correspondence analysis are some of the multivariate approaches used in agricultural experiments. Inferential statistics used different methods to estimate population parameters using sample data and hypothesis testing. Time series analysis is used ARIMA, ANN, and SVR methods to forecast the future of any agricultural commodity price, production, etc.

Statistical testing examines the population hypothesis based on sample data. Most large and small sample tests, such as Z, t, and F tests, are based on the assumption that the parent population has a specific distribution, such as normal. When data does not conform to normal distribution properties, non-parametric methods are used to analyze the data. Nonparametric statistics are typically applied to nominal or ordinal data. Non-parametric techniques include the Mann-Whitney U test, the sign test, the Wilcoxon signed-rank test, the Kruskal Wallis test, etc.

Sources of agricultural data

Major data sources for agriculture statistics are. The directorate of economics and statistics (DES) in the department of agriculture does a great job to generate and publish data collected from states. FAI (Fertilizer Association of India), FHPPI (Farm Harvest Prices of Principal crops in India), GOI (Government of India), SAS (Statistical Abstracts of India), AGMARKET (Agricultural Marketing Information Network), APEDA (Agricultural and processed Food Product Export Development Authority).

Conclusion

Statistics is the backbone of agriculture and other research fields. There is a need to devise strategies for data generation based on statistical principles. In the advance, agricultural research with the help of appropriate statistical tools and research designs provides an unbiased estimate, conclusions, and appropriate interpretation.

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MAINTENANCE OF GENETIC PURITY DURING SEED PRODUCTION

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The success of seed production and hybrid seed production is dependent on the genetic purity of parental lines. Both out crossing and the inadvertent mixing of seed can compromise seed quality, therefore genetic purity tests are critical tools for seed producers and plant breeders. A genetic purity test serves as an important quality check point to make sure that the cross happened as expected and that a seed lot does not have contamination in the form of self-pollination or out crossing.

The various steps to maintain varietal purity:

1. Use of approved seed only in seed multiplication.
2. Inspection and approval of fields prior to planting.
3. Field inspection and approval of growing crops at critical stages for verification of genetic purity, detection of mixtures, weeds and for freedom from noxious weeds and seed borne diseases etc.
4. Sampling and sealing of cleaned lots.
5. Growing of samples of potentially approved stocks for comparison with authentic stocks.

The various steps to maintaining genetic purity:

1. Providing adequate isolation to prevent contamination by natural crossing or mechanical mixtures.
2. Rouging of seed fields prior to the stage at which they could contaminate the seed crop.
3. Periodic testing of varieties for genetic purity.
4. Avoiding genetic shifts by growing crops in areas in their adaptation only.
5. Certification of seed crops to maintain genetic purity and quality of seed.
6. Adopting the generation system.
7. Grow out tests.

Genetic purity maintenance in hybrid seeds:

Maintenance of the genetic purity of hybrid seeds is a complicated one requiring elaborate procedures.

Nucleus seed of inbred lines

The nucleus seed of inbred lines can be maintained by self-pollination, sib-pollination, or a combination of the two procedures (hand pollination). Some breeders prefer 'sibbing" because it maintains vigour."Selfing" is used to stabilize inbred lines if a change in breeding behavior is noticed. Some parental material is preferably maintained by alternate selfing and sibbing from one generation to other. Individually selfed or sibbed ears should be examined critically, discarding off types or inferior characteristics (texture, colour, seed size, chaff color and shape of earhead).

The uniform ears are then threshed separately and planted in ear to row method to easily detect and discard off types from individual ears if any. Alternatively all of the ears from an individual inbred line may be composited for bulk planting in the next season. The hand pollination seed is sown on clean, fertile soil having no previous crop of the same kind or variety during the previous year (bearing maize). It is rather important to ensure that the crop is well isolated, with the requirement varying from crop to crop and depending upon the nature of the material to be protected by isolation, the nature of the contaminant, and the direction of the prevailing wind. The isolation can be achieved either by distance or by time (maize). The inbred line may be composited for bulk planting in the next season. Maintenance of genetic purity in inbred lines through hand pollination and adequate isolation alone is not enough to achieve perfection. The isolated fields must be critically rogued for off types and other impure types prior to the shedding of pollen.

The nucleus seed crop is harvested after physiological maturity if artificial drying facilities exist. Ear to harvest lines are harvested separately and piled; these are again critically examined for ear characteristics, sorting out of all off-coloured, diseased, or otherwise undesirable ears. If the overall percentage of off types exceeds 0.1%, hand pollination should be repeated to produce the second year's breeders seed. The uniform ears are bulked, dried in a clean dry bin at temperatures not exceeding 430C, shelled, cleaned, treated with pesticides, and stored under ideal storage conditions as breeder stock

seed. This seed may be increased during the following season by paying adequate attention to isolation, roguing, etc., to maintain high genetic purity of the seed.

Nucleus seed of non-inbred lines:

To maintain in the genetic purity of the nucleus seed of non-inbred lines, the number of plants for hand pollination should be large enough to preserve genetic makeup of the variety, narrowing the genetic base by sibbing only a few plants (about 5000 plants or more). The sibbed ears are examined critically, discarding of colour, texture, or diseased ones. Uniform ears are bulked, dried, shelled, cleaned, treated and stored as usual. Other practices of seeding sibbed nucleus seeds are similar to those described earlier for inbred lines. Roguing however, needs to be observed more critically by individuals with good knowledge of the material. The breeder's stock seed thus produced from the nucleus seed can be utilized to increase the breeder's stock of non-inbred lines, paying adequate attention to land requirements, isolation, roguing, harvesting and handling of seed to achieve maximum genetic purity.

The breeder's seed of the established varieties of cross-pollinated crops can be maintained by raising breeder's seed crop in isolation and roguing the crop thoroughly at various stages. It is often purified by mass selection. The crop is grown in isolation and rogued carefully as described earlier. At maturity about 20000 - 25000 true to type plants are selected, harvested separately, and bulked after careful examination. This constitutes the breeder's stock seed. The seed may be carried over to ensure against possible failures or unforeseen shortages.

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LED LIGHTS ON GERMINATION OF SEED

A NOVELISTIC APPROACH IN MODERN AGRICULTURE

Seed is the basic input in any kind of cultivation practices, which plays the major role in production of crops. In recent days various methods have been developed to improve the quality of the seed material. Seed treatment provides uniform, disease- free seeds. Nature has produced a number of light absorbing molecules in the environment that enable the organism to respond to changes in their original habitat. Among various methods, here we describe the Light Emitting Diode (LED) treatment on seeds. LED have a numerous positive impact over traditional forms of lighting; their small size, durability, long lifetime, cool emitting temperature and the option to select specific wavelength for a targeted plant response make LED's make suitable for plant-based uses than many other light sources.

Led treatment on seeds

H. Mangon, E. Prilleux and few others documented the earliest reports on artificial light treatment on plant growth. Electric lamps, which mimic the spectrum and energy of sunlight, were used to grow the plants since 150 years. Carbon arcs (lamps) were the first lamps used for plant growth conducted by (Simens 1880). They provided an intense broad bluish spectrum which stimulated plant growth, but as it required frequent replacement of carbons, it was replaced by incandescent filament lamps. It emits the far-red and infra-red radiation which enhances stem elongation in plants. Later replaced by fluorescent followed by metal halides and then high pressure sodium lamps due to their respective drawbacks. Later in the 1990's LED treatments were tested for plant growth at the University of Wisconsin. According to Dr. Ray Wheeler, the idea of growing plants by LED originated in NASA during the late 1980s on wheat using only red LEDs, resulting in leggy and bleached out plants which was rectified by blue fluorescent lamps. LED represents the maximum photosynthetically active radiation (PAR) efficiency of 400 to 700nm, which is the part of visible spectrum light that contributes the most of photosynthetic process. In photosynthetic plants photoreceptors harvest the photons which get transferred to photosystem reaction centers, where electrons generate and transfer, resulting in production of ATP and NADPH, which were ultimately consumed in assembly of carbon atoms in organic molecules. In germinating seeds light plays the major role along with other environmental factors, may not involve directly but breaks the dormancy of seed and induces germination, which is exclusively mediated by phytochrome B along with other phytochromes. Photosensitive seeds utilizes the large spectrum of visible light in breaking the dormancy and helps in the germination. It is maximally triggered by a saturating pulse of monochromatic red light (RL), first shown in lettuce seeds. In a germinating seed along with light, hormones such as ABA (Abscisic acid) and GA (giberllins) get involved. Where GA promotes the germination and ABA induces the dormancy until the favourable conditions are available for the seed to germinate. Phytochromes with its

molecular switch behavior converts Pr (red light absorbing state) to Pfr (far redlight absorbing state) which is the active form for stimulating germination. This process is reversible by far-red irradiation, which inhibits germination.

When seeds get treated with red light, phytochromes regulate the endogenous levels of GA1, which induces germination. White light induces dormancy is shown in cereals. In green house cultivation, pulsed LED lightning is the innovative method to flow the sufficient amount of photons in a period of time which conserve the energy in a controlled system. In lettuce, seeds treated with LED light of four wavelengths (blue, red, green, white) with the frequency of 25, 50 Hz resulted that the red and green LED light had a maximum germination percent. 50Hz showed better results compared to 25Hz. By treating with pulsed LED lightning in seeds improves the growth and development in plants. Red light activates the photochromes, whereas blue light is responsible for the cryptochromes. Blue LED light is important for phototropism, but it reduces the germination percent in crops; it regulates the elongation in stem and increases the plant height showing (shade avoidance response). Wang, 2013 reported that green LED lightning inactivates the cryptochromes and maintains hypocotyl growth in seeds.

Advantages

- LED treatment with specific light intensity improves the germination percent of seeds.
- Seed dormancy can be broken with the help of LED treatment on seeds by activation of GA biosynthesis.
- It increases the rate of germination in crops with the supply of optimum frequency and wavelength of light.
- It promotes organic agriculture because in the whole process of seed treatment inorganic chemicals were not used.
- LED's are easily available and also cost effective.

Conclusion

Quality seedlings can be obtained by using LED light technology and it is one of the newly emerging techniques in treating the seeds. It is mainly used in controlled environment cultivation such as green house and poly-houses. Among all other artificial light treatments on seeds, LED has the more potential to raise good quality seedlings and improves the germination efficiency with low power consumption. This technology is mainly adopted in the horticultural crop seeds, there has been a great evolution from carbon arc to high intensity discharge lamps (HID) based on need and it can be believed that the versatile operational control and the user together will result in a high beneficial outcome to the farmer's society.

■■■

SEED CERTIFICATION STANDARD FOR VEGETABLE CROPS

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Seed certification is a legally controlled system whose aim is checking quality status of seed production and its multiplication techniques. It is a very crucial step in seed production and marketing which is generally done to maintain high-quality seeds standards and making them available to farmers at right time, right place, right price for maintaining quality and yield. These certification standards laid down are applicable to all crops which are eligible for certification, shall constitute the Minimum Seed Certification Standards.

Criteria followed in seed certification:

The main criteria for seed certification are followed only for those suitable varieties of crops which are registered under seed act 1966 under section 8. The seeds which are sown in field should have certification. The seed utilized for sowing to get the certification must have pedigree record and under the chain of production. Field where seed certification is being taken should have good site selection, proper isolation distance, proper spacing between plant to plant and row to row, planting ratio and border rows should be maintained. Objectionable weed, dead and disease off type plant must be roughed off from field in order to main the physical and genetic purity. The minimum seed certification standard should be developed in field.

Steps of seed certification:

The whole seed certification required or completed in six phases:

1. Receipt and scrutiny of application.
2. Verification of seed source, class and other requirements of the seed used for raising the seed crop.
3. Field inspections to verify conformity to the prescribed field standards.
4. Supervision at post-harvest stages including processing and packing.
5. Seed sampling and analysis, including genetic purity test and/or seed health test, if any, in order to verity conformity to the prescribed standards.
6. Grant of certificate and certification tags, tagging and sealing.

Field inspection:

This is necessary to check the field condition, plant population, spacing in confounding areas, isolation distance etc. it must physically verified.

1. The field inspection must be followed by trained person, he should be technical sound, and person must be authorized by certification agency.
2. The field inspection consist those factors which can affect the genetic and physical purity or seed health and shall be carryout without prior notice to seed grower.
3. As inspection over, a copy of inspected report shall be hand over to seed grower and one copy must be handled by him.

If seed plot do not meet out the entire standard as per laid down the certification agency than the certification agency, upon the request of seed grower, can go for re inspection twice or thrice after meet out the all standard.

Harvesting of seed:

Soon after final inspection by certification agency if it meets the entire standard as per certified agency than seed crop shall be harvested, threshed and transported to the seed processing plant in accordance with the guidelines issued by the Certification Agency. At the time of transportation of the seed, seed producer will take all precautions to safeguard the seed from admixture and other causes of

seed deterioration. Seed processing include mainly cleaning, drying, treating, grading and operation which will improve the quality of seeds.

Seed treatment is essential step of seed processing. When a variety, seed of which is under certification is susceptible to a seed borne disease organism or when seed under certification is carrying a seed borne pathogen and a seed treatment is available which may control the disease or pathogen when properly applied, the Certification Agency may require such seed to undergo such treatment before Certification. After seed certification, seeds are made in to a lot which should be homogeneous and easily identifiable. The lot size varies and depends upon the size of seed. Generally seed which are similar in shape of rice consist of 20,000 kg/lot and the seed which are similar in size of maize lot consist of 40,000 kg/lot. Each lot of grain consists of specific lot number.

Various classes of seeds:

The basis of seed multiplication of all notified varieties/hybrids is the Nucleus seed. Generally, 4-5 classes of seeds are seen which are mentioned below:

1. **Nuclear seed:** Nucleus seeds are cent percent pure seed on genetic basis with no physical impurity as well as full genetic purity which are generally originated or developed by the eminent indigenous breeders/Agricultural Institute/State Agriculture University (SAU) from raising primary nucleus seed stock. In this a pedigree record certificate is taken by the producing breeder.
2. **Breeder seed:** Breeder seed is also a hundred percent physically and genetically pure seed for foundation seed production. For breeder seed, golden yellow color certificate is provided for this class of seed by the producing breeder or workers.
3. **Foundation seed:** Foundation seeds are the offspring of breeder seeds which are build and admitted by seed producing agencies in public and private sector, under management of seed certification agencies in such a way that its quality standards is continued according to prescribed field ad seed standards. A white coloured certificate is provided for foundation seed by the concerned seed certification agencies.
4. **Registered seed**: This seed is the offspring of the foundation seed that is so made as to continue its genetic recognition of seed and purity according to specified standard for the specific crop being certified. A purple colour certificate is given for this stage of seed.
5. **Certified seed:** It is the offspring of foundation seed which is made by certified seed growers under seed certification agencies management system to constant the seed quality as per minimum seed certification standards. A blue colour certificate is given by seed certification agency for the certified seed category.

Isolation Distance of different vegetable crops (M)

S. No.	Crop name	Foundation seed	Certified seed
1	Tomato	50	25
2	Cluster beans	10	5
3	French beans	10	5
4	Peas	10	5
5	Lettuce	50	25
6	Potato	5	5
7	Brinjal	200	100
8	Chilli	400	200
9	Bhendi	400	200
10	Cabbage	1600	1000
11	Raddish	1600	1000
12	Cauliflower	1000	500
13	Onion	1000	800
14	Carrot	400	200
15	Amaranthus	1000	500

Conclusion:

Seed certification is essential and legal step in order to produce authentic seed. Different classes of seed can be obtained after certification which are physically and genetic pure. These seed gives high percentage of germination. These seed fetches high prices from market so seed growers can earn profit by seed certification.

■■■

THE SURPRISING WORLD OF INSECTS

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Insects are powerful natural environmental cleansers. We are aware of their ability to feed on any type of vegetal or animal waste and thus reproduce at an unrivalled rate. A few years ago, insect biorefinery was almost unthinkable. Nonetheless, it is under full development. Its products will be available soon. In the near future, the insect world will reveal numerous unexpected applications.

Insect biorefinery using exoskeleton

The insect exoskeleton is currently the most important by-product. Chitin, a polymer that resembles cellulose and is the second most prevalent chemical in living nature, is the major component of exoskeletons. Unlike cellulose, which is a polymer of glucose, chitin is a polymer of glucosamine. It can be found in a variety of forms, including pure (caterpillar skins), very thin layers (butterfly wings with stunning colour effects), combined with proteins to form sclerotin (the major material in insect exoskeletons), and in a powerful mixture with calcium carbonate (shrimp and crab shells).

Chitin as industrial applications

As a food film, a dye binder, an industrial membrane, a biodegradable surgical thread, or a paper strengthening agent. Its most important application may be the creation of self-healing coatings, which have numerous applications in the automobile, aerospace, and pipe industries.

Chitosan - Product of insect biorefinery

Deacetylation easily produces from chitin. Chitosan has an active amino group and can be dissolved in acid solutions up to quite high molecular weights.

Uses

- Winemaking,
- Settling contaminants
- Bioplastic that degrades.

Medical applications

It easily clots blood and has inherent antimicrobial qualities; thus, it has been created for high-value bandages.

Chitosan in agriculture

It boosts plants' inherent innate resistance to insects, pathogens, and soil-borne illnesses. It supports and boosts plant development by increasing photosynthesis.

Chitosan-coated seeds are more resistant to parasitic cyst nematodes and do not affect beneficial nematodes or organisms.

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POPULAR APPROACHES FOR IMPROVEMENT OF NATURAL ENEMIES

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Biological control has been accepted as an effective, technically appropriate, economically viable and socially acceptable method of pest management. It aims at suppression of insect pests by using their natural enemies and constitutes a deliberate attempt to use natural enemies, either by introducing new species or by increasing the effectiveness of the same those present already in the environment. Integrated Pest Management (IPM) tactics employing living entities and chemical control measures need to be adopted in such a manner that the biological control agents are least affected by chemical pesticides, environmental vagaries and other factors hindering their progress Genetic improvement projects of natural enemies have been conducted to achieve either of the following: Improve adaptation to climatic conditions, Improve the host finding behaviour, Change in host tolerance, Improve synchronization with the host, Resistance to Insecticides, Induction of Non-diapause and Production of the lytokous. Global climate change has affected the physiology and performance of natural enemies. Indiscriminate usage of pesticides reduced the survival of natural enemies. Hostile, fragile and resource deficit ecosystem reduced the efficacy of biocontrol agents. Traditional tactics *viz*. classical, augmentation and conservation have been vital and valuable tools but there is an urgent need of better and novel techniques for improving the performance of the bio agents. The emerging techniques aimed the genetic improvement of natural enemies are – 1) Artificial selection, 2) Hybridization or use of Heterosis and 3) Use of Biotechnology (recombinant DNA (rDNA) techniques).

1. Different conventional breeding approaches

a. Artificial selection

Artificial selection or selective breeding refers to a process whereby the breeder chooses to perpetuate only those strains with selected desirable inheritable attributes. The procedure of artificial selection as explained by Hoy (1985) is as follows: **i.** Determination of traits that need improvement in a potentially effective natural enemy, **ii.** Population sampling of natural enemy, **iii.** Rearing and maintenance of natural enemy, **iv.** Selection of natural enemy, **v.** Assessment of fitness of natural enemy through lab, green house or field cage studies and genetic analysis and **vi.** Determination of field release strategy, followed by release of natural enemies and evaluation of their efficacy. If found effective, the technology is implemented.

i. Some examples of improved bio-agents through selective breeding are as follows –

- At National Bureau of Agricultural Insect Resources (NBAIR), Bangalore, endosulfan-tolerant strain of *Trichogramma chilonis* has been developed. NBAIR has also developed superior strains of *T. chilonis* such as Bio Sc1 for graminaceous tissue borers, Bio H3 for *Helicoverpa armigera* and Bio C1 and Bio C6 for cotton bollworm. Some of these strains are 60–100 percent more fecund than the strains used till now. An endosulfan tolerant strain of *T. chilonis* was developed and transferred to a private industry, which is marketing it under the name of 'Endogram'.
- Recently, strains of *T. chilonis* namely TcUPI and TcUP2, were identified as tolerant to high temperatures of 32-40^{o}C and with high biotic potential. Such strains could be used against sugarcane borers in hot weather conditions.
- Green lace wing strain of PTS-8 with tolerance to different pesticides (monocrotophos, fenvalerate, acephate and endosulfan) has been developed.
- B. bassiana can tolerate upto 32 times the field dose of imidacloprid, 16 times the dose of carbendazim and carbosulfan and eight times the dose of chlorpyriphos, lambda cyhalothrin, malathion and mancozeb after 10 passages through respective poisoned media.
- Host searching range of genetically improved high temperature tolerant strain and local Ludhiana strain of T.

chilonis was up to 10 and 8 m from the release point.

- Carbaryl resistant parasitoid *Aphytis melinus*: Carbaryl resistant strain of *A. melinus* from Valencia orange groves was reported in California.

b. Hybridization

Hybridization refers to the process of crossing two genetically different individuals of different species (interspecific hybridization) or same species (intraspecific hybridization).

i. Some popular examples are as follows-

- Interspecific hybrids of Chrysoperla with increased fertility were developed by Naka *et al.* (2005) by crossing between green lacewings of indigenous origin, *C. carnea* and that introduced from Germany, *Chrysoperla nipponensis* (Okamato).
- Mukuka *et al.* (2010) developed intraspecific hybrid strains of *H. bacteriophora* which were heat-tolerant (40-420C) and desiccation tolerant (water activity – 0.65 aw).
- Venkatesan and Jalali (2015) developed *T. chilonis* (strain MITS) which can tolerate high temperature (32-38^{o}C) and chemical insecticides *viz*., endosulfan, monocrotophos and fenvalerate.

There are certain limitations for the adoption of conventional breeding techniques. Due to inherent complexity of the natural environment, the exact factor to which a beneficial organism is susceptible is difficult to determine ex situ, and therefore cannot be dealt with in the laboratory. Furthermore, lack of knowledge concerning the genetic basis for inheritance of desirable characteristics in beneficial organisms makes selective breeding a difficult and lengthy proposition. It is also necessary to obtain a sufficiently broad genetic diversity to assure the availability of suitable characters on which selection can be adopted.

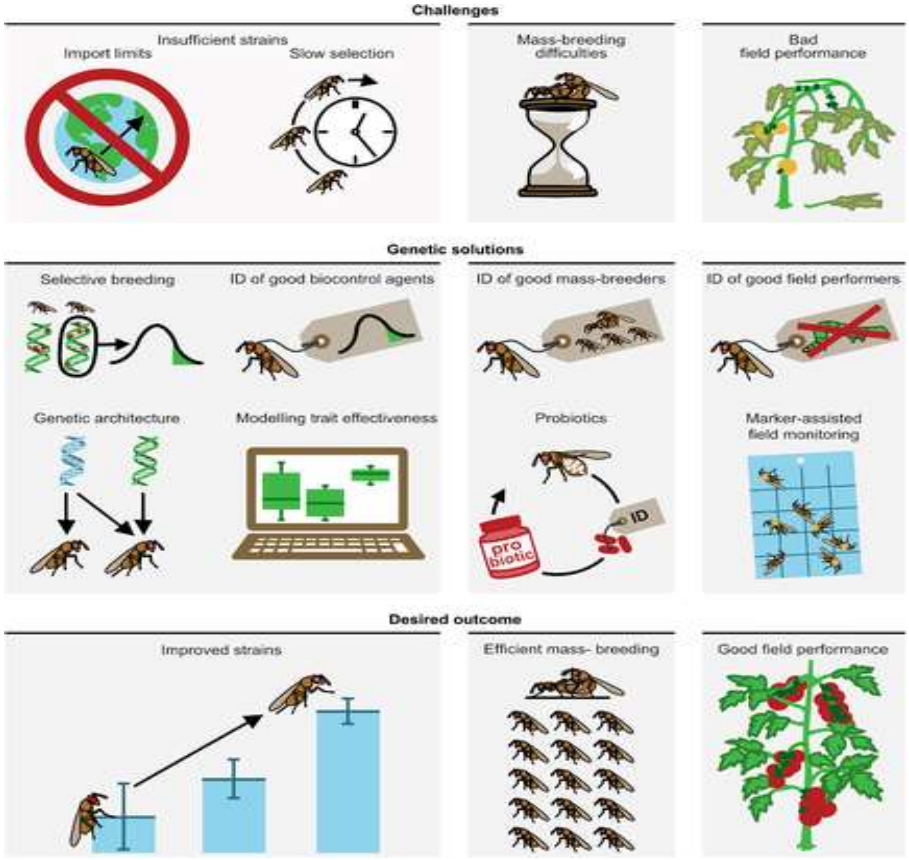

Fig 2- Overview of the Next Generation Biological Control

2) Novel approaches

Novel methods results in rapid achievement without conventional rearing for many generation. The novel approaches include mutagenesis, microinjection method, protoplast fusion, micro projectile method, electroporation, recombinant DNA technology and many more. The most economic and popular method employed for the genetic improvement of natural enemies is R- DNA technology.

a. Recombinant DNA technology

Recombinant DNA (rDNA) technology or genetic engineering refers to the artificial synthesis or isolation of specific genes or Deoxyribose Nucleic Acid (DNA) fragments and introducing these into the genome of host organism. The steps in recombinant DNA technology involve isolation of DNA, fragmentation, amplification of gene of interest and insertion of recombinant DNA into the host. Recombinant DNA can be introduced into the host by means of vector mediated or vector less methods. Genetic transformations can be deployed in natural enemies to modify the genome of natural enemies, to change the sex ratio, for cryopreservation, to develop genetic linkage maps, to identify biotypes, to improve artificial diets, to monitor establishment and dispersal and for parentage analysis and genetic changes.

i. Some common examples include

- St. Leger *et al.* (1996) developed the first recombinant fungi gene encoding insect cuticle degrading protease PR1A into M. anisopliae, resulting in 25 per cent reduction in time of kill in *M. sexta*.
- Incorporation of tyrosinase gene in *B. bassiana* using Agrobacterium tumefaciens Smith & Townsend resulted in development of UV tolerant strains of *B. bassiana.*
- Recombinant viruses of Autographa californica nucleopolyhedrovirus (AcMNPV) and *Helicoverpa zea* NPV (HzSNPV) have been engineered to express the insect-selective toxin genes of the scorpion *Leiurus quinquestriatus* (abbreviated as LqhIT2). These viruses naturally infect *Helicoverpa zea* (Lepidoptera: Noctuidae) and *Heliothis virescens* (F.) (Lepidoptera: Noctuidae), key pests of cotton, *Gossypium hirsutum*, non-target species, such as predators and parasitoids of the heliothine pest complex, are not able to support viral replication; thus, they should not be directly affected by these toxin-producing viruses.

Conclusion

We should have a definite and distinct knowledge on various factors affecting the sustenance of natural enemies, which act in the ecosystem. Various molecular methods can be used for the manipulation of natural enemies with recombinant DNA technology standing in the forefront. Development of 'lab creatures' with improved traits through molecular methods can enhance their efficiency thereby providing assured rates of pest control. Hence, we should utilize the emerging techniques in the field of molecular biology so that 'farmers' friends' can be successfully manipulated.

BIOTECHNOLOGY IN AGRICULTURE

RISK OR BENEFIT?

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Biotechnology is the application of scientific techniques to modify and improve plants, animals, and micro-organisms to enhance their value. It is widely employed in different fields and agriculture is one of them. Starting from the ability to identify genes that may confer advantages on certain crops, and the ability to work with such characteristics very precisely, biotechnology enhances breeder ability to improvements in crops and livestock.

Why biotechnology is needed?

From past centuries, the selection and breeding of desirable characteristics is most common or traditional method to improve wild plants and animals. This method resulted in breeds of plants and animals which are commonly used in agriculture and livestock production i.e., domestic purpose. But in modern world, farmers want not only domestic animals and plants but selection include diseases and pest resistance, increase yield, drought resistance, dual purpose breeds and enhanced flavors. Hence, biotechnology became most important tool in agriculture to improve farmers need. Today, technology reached a stage where scientist take that specific gene from desired organism, like plants, animals, fungi, virus, and bacteria, and transfer into another organisms. This is called Genetic engineering techniques. Organism which is transform by this technique is called genetic modified organisms.

Benefits of biotechnology in Agriculture

1. Increase in yield

Characters like disease and pest resistance are introduced in crop plants which increases the crop production and productivity. Many crops like corn, soybean, cotton, papaya, rice, beets etc. are genetically modified to incorporate desired gene into their genome so that they become disease and pest resistance crops which resultant into improvement in crop production as well as productivity.

2. Vaccines

Biotechnology derived vaccine of humans and livestock. They may be cheaper, better and safer, stable at room temperature and do not need to store in refrigerator than traditional vaccines.

3. Improved nutrition content

With new technologies, many factors like nutrition content, texture, color and flavor are improved. For example, golden rice produces beta-carotene, a precursor of vitamin-A, which deficiency cause night blindness in humans. Development of soybean varieties with high content of protein and oil. Potatoes with high starch and amino acid content.

4. Tissue culture

Tissue culture refers biological research in which fragments of tissue from plants or animals are transferred to an artificial environment in which they can continue to survive and function. Tissue culture has contributing in enhancing the agriculture biotechnology by showing variations in yield, growth, disease resistance, stress and many more.

Risk associated with using transgenic crops

Everything in life has its benefits and risks. As above said in this article biotechnology improved characters in crops like nutrition, flavor, color etc. some people are allergic to some sort of food but not all. Hence, genetic engineering is at a risk of introducing allergens and toxins. Another concern on environment involves in which some insects also develop resistance to crop-protection features of genetic modified crops.

Conclusion

Scientists, farmers should consider very carefully use of transgenic crops so that no environment and health risk will pose by crop. Modern biotechnology follows unique application that can be used for betterment of crops. Biotechnology is a science that can provide benefits if used very carefully and ethically. So, knowledge of process, best genetic material and benefits and risk of new technology is very important.

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SELF-INCOMPATIBILITY:

A MECHANISM FOR POLLINATION CONTROL IN PLANTS

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Self-incompatibility is the mechanism in which the prevention of self-fertilization and inbreeding occurs. The prevention of self-fertilization occurs by inhibition of the pollen germination or the pollen tube growth when pollen from same / another flower of same plant falls on the stigmatic surface. Here the pollen grains fail to germinate on the stigma of the flower producing them. If some of the pollen grains do germinate, the failure of the pollen tube to enter the stigma occurs. Sometimes, pollen tube enters the style, but before the flower drops, their growth is too slow to effect fertilization and if the fertilization is effected, the degeneration of embryo occurs at early stage. Different types of self-incompatibilities are heteromorphic type and other is homomorphic types. There are several mechanisms also on molecular basis for self-incompatibility in different crops.

Introduction:

In plant breeding, mode of pollination holds important role in determining the genetic constitution, ease in pollination control, nature of gene action and after release, stability of varieties. Various mechanisms are there that encourage the cross pollination and out of these self-incompatibility (SI) holds a great significance because of its utilization in hybrid seed production. Self-incompatibility (SI) is the mechanism involves the prevention of fusion of fertile (functional) male and female gametes after self-pollination. Self-incompatibility (SI) is a mechanism in which self-recognition and then rejection occur. It is first reported by Koelreuter in the middle of eighteenth century. It leads to the prevention of inbreeding depression. Inbreeding depression is the loss of vigor as a result of inbreeding. In this article, we will discuss in brief about the different self-incompatibility classifications and its molecular models.

Classification of self-incompatibility

Lewis (1954) gave the classical classification of self-incompatibility. He classified self-incompatibility (SI) into two main groups, i.e. homomorphic and heteromorphic system. The homomorphic system is sub classified again into gametophytic and sporophytic system of incompatibility.

Heteromorphic self-incompatibility:

In this, flowers of different incompatibility groups are different in morphology. The example for this system is in Primula having two different types of flowers namely pin and thrum. Long style and short stamens describes the pin type while short styles and long stamens describe the thrum flowers. This type of situation is termed as distyly. These both pin and thrum flowers are developed on different plants. Pin and thrum flowers have the only compatible mating. Single locus s governs this character. Thrum is produced by Ss, while pin flower is produced by ss. The pin flowers produce the pollen grains would be all s both in genotypes and in incompatibility reaction. On the other hand, the pollen grain produced by thrum flowers would be of genotypically two types i.e. S and s, but phenotypically all of them would be S.

Homomorphic self-incompatibility :

The morphology of the flower does not have a role with incompatibility reaction. The incompatibility reaction is controlled either by genotype of the pollen (gametophytic self-incompatibility) or by genotype of the plant on which it is produced i.e., sporophytic self-incompatibility.

Gametophytic self-incompatibility:

Pollen parent is having the genetic constitution (S1 S2) produce two gametes S1and S2 and two alleles are co-dominant in female parent and expressed of both will be there. Therefore, when pollen grains having S1 or S2 genetic constitution falls on a S1 S2 female plant, both will not germinate since there is co-dominance reaction in stigma. When it falls on the S1 S3 stigma of a

female plant, S2 can only germinate and results in partial incompatibility and it is completely compatible occurs when falls on a S3 S4 female.

Sporophytic self-incompatibility:

In this, pollen parent with male gametes have both S1 and S2 developed from S1 S2 will behave as S1 and also in stigma as S1. Hence, a cross in between S1 S2 x S1S2 results in incompatibility and S1S2 x S1S3 results in incompatibility also while S1 S2 x S3 S4 results in compatibility.

Molecular models of self-incompatibility

Molecular model of self-incompatibility in Brassicaceae:

There are two genes namely, SP11/ SCR are present, SP11 acts as a male determinant and SRK acts as a female determinant. The promoter of incompatibility reaction is SLG. SRK acts in stigma i.e. in the plasma membrane of papilla cells while in the anther tapetum, expression of SP11 occur during pollen grain maturation. In a self-incompatibility (SI) reaction, when landing of pollen grain on stigma, SP11 will tend to bind with SRK and results in auto-phosphorylation and leads to pollen tube growth prevention. But in case of a compatible reaction, activation of SP11 does not occur and therefore, germination of pollen and fertilization takes place normally.

Molecular model of self-incompatibility in Solanaceae:

In case of Solanaceae family, the male determinant is SLF/ SFB and the female determinant is SRNase. When pollen grains falls on stigmatic surface, the production of SRNase occur and then enter into the stigmatic surface. They will lead to the degradation of the RNA which encodes the enzyme for pollen tube growth and result in pollen tube death. In case of incompatible reaction, production of RNase also occurs and it enters the stigmatic surface and it will lead to formation of complex with SLF. Therefore, there is no disturbance in RNA encoding enzyme for growth of pollen tube and pollen tube growth and fertilization occurs normally.

Molecular model of self-incompatibility in Papaveraceae:

In Papaveraceae family, identification of only female determinant is there which is called as S-protein. Male determinant on the other hand is unknown. Here, S protein will tend to bind with SBP (S-protein binding protein) and results in increasing the concentration of Ca^{++}. This will start different reaction mainly actin depolymerisation which results in pollen tube death but in compatible reaction, S protein will not tend to bind with SBP. So, there is no fluctuation in Ca^{++} concentration and hence results in growth of pollen tube normally.

Conclusion:

Self-incompatibility (SI) is among the most important systems used by various flowering plants for the prevention of self-fertilization and hence, generation and maintenance of genetic diversity occur within a species. Moreover, there are two genes present in S-locus which control self-incompatibility. The nature of genes which are responsible for self-incompatibility are multi-allelic. For determination of self-incompatibility, there are different methods which varies with the type of self-incompatibility as well as the crop. Self-incompatibility will tend to prevent self-pollination effectively. Therefore, it has great effect on the breeding approaches and also on the objectives.

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IMPORTANCE OF INCLUSION OF LEGUMES IN CEREAL CROPPING SYSTEMS

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Legume plants have a probably important role to play in growing indigenous nitrogen production besides meeting human demands for protein and energy. Some legumes have the capability to solubilize in any other case unavailable phosphate by excreting organic acids from their roots, in addition to improving soil fertility. Legumes also assist to restoration of soil natural matter and limit pest and disease issues when used in rotation with nonleguminous crops. Research has shown that the organic nitrogen fixation procedure is the most environment friendly way to grant the giant amounts of nitrogen wished through legumes to produce high-yielding crops with an excessive protein content. For the fixation technique to occur, legume vegetation must enter into a "symbiotic" or collectively beneficial partnership with sure microorganism known as rhizobia. Soon after legume seeds germinate, rhizobia current in the soil or delivered as seed inoculum invade the root hairs and go through an infection thread toward the root. The bacteria multiply rapidly in the root, causing the swelling of root cells to structure nodules.

Increased cultivation of legumes is essential for the regeneration of nutrient- deficient soils and for providing needed protein, minerals, and vitamins to humans and livestock. Legumes can be a means of improving the livelihoods of smallholder farmers around the world.

Legumes in human nutrition

As a source of protein:

Grain legumes (such as pigeon pea, chickpea, soybean or mungbean) are a good source of protein, with a protein content ranging from 17-40%. By combining cereal and grain consumption, farmers and their families can achieve protein balance and nutritional improvement.

As a source of important vitamins and minerals:

Legume seeds contain significant amounts of minerals (calcium, zinc, iron) and vitamins (folic acid and vitamin B).

As a way of reducing cholesterol and blood sugar.

Legumes for crop and soil improvement:

For optimum yield, crops require a supply of mineral nutrients, the most important of which is nitrogen. Exhausted soils are often low in nitrogen, meaning that farmers are normally applying inorganic fertilizers. However, as fertilizer costs increase, farmers struggle to obtain good yields. This problem can be addressed by incorporating legumes into the cropping system.

Leguminous plants have a special relationship with nitrogen-fixing bacteria called R*hizobium*. By biologically fixing nitrogen levels in the soil, legumes provide a relatively low-cost method of replacing nitrogen in the soil, enhancing soil fertility and boosting subsequent crop yields.

Legumes can be incorporated into cereal cropping systems in a variety of ways:

- Green manuring
- Intercropping
- Grain- legume rotations
- Leguminous shrubs

Legumes can be used as a green manure, a general term used for plants that enrich soil fertility. Green manuring with legumes involves growing the plants, then slashing the crop and leaving it on the soil surface. Leaving the crop on the soil surface has additional benefits, as it also reduces soil erosion and conserves soil moisture.

A drawback with green manuring is that it involves the loss of a growing season, especially in areas where there is only one short growing season, since the grain is not harvested from the legume and it displaces the cereal crop. Also, because the grain is not harvested, growing legumes as green manures does not provide the benefits to human diets. However, when soil quality is low and fertilizer prices are high, green manuring is an option for farmers to consider, especially in regions with longer growing seasons. To overcome the loss of a full growing season, intercropping or relay intercropping with legumes is a good alternative. With intercropping, alternating rows of the cereal crop and legumes are planted at the same time. However, in some cases the legume may compete with the cereal crop for water and nutrients, reducing the yield of both crops. With relay intercropping, this competition for resources is reduced: the cereal crop is sown first, followed by the legume a few weeks later. In this scenario, both the grain yield and the nitrogen content have been found to improve.

Legumes can also be grown in rotation with cereal crops. This system is intended to provide the farmer with a useful harvest while at the same time improving the fertility of the soil. However, since part of the legume crop is harvested (and thus removed from the field), the effect on soil fertility, equivalent to 5-15 kg/ha of nitrogen fertilizer, is not as high as when the entire legume crop is left on the soil surface, as with green manuring. In order to benefit fully from cereal-legume rotations, farmers need to maximize the productivity of the legume crop in addition to the cereal crop.Figure.1. (a) Maize + Soybean (b) Maize + Urd bean

Source: agrocrops.com

Constraints to legume production

- Legume production presents new diseases, pests, and weeds, which farmers will need to learn how to control.
- Low soil pH, high salinity, flooding, and nutrient deficiencies can negatively impactthe nitrogen fixation process, preventing the legumes from improving soil fertility to their full potential.
- Legumes are often expected to grow in existing soil moisture conditions. Reduced or non-existent irrigation may lead to drought stress.

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EPIGENETIC BREEDING
AS A COMPLEMENTARY TOOL FOR CROP IMPROVEMENT

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According to the 2015 study published in the Journal of Health Psychology; people with less physical activity, in other words lazy, tend to be brainier than their counterparts who intend activity. A whimsical description of 'laziness' as 'need for cognition' where such kinds crave well-reasoned, planned and structured ways of perceiving the world. And hence they often pursue mentally stimulating activities such as brainstorming, puzzles and debates. But, could that be a justification of 'laziness' or, the brainy, having peculiar ways of conserving energy. While many of us take genetics as an 'excuse', to laze around and find it difficult to change our behaviours towards productivity; Dr Bruce Lipton, a cell biologist whose research on cloned human stem cells augured the present-day *Epigenetics*; quoted that we do not have to be at the mercy of our "genes". The convoluted relationship between genetics (DNA) and the environment holds primacy in controlling biology. Way back in the 19th century a foretime central dogma logic; the Lamarckian theory of inheritance explained the use or disuse of organs as the prerequisite for acquiring characteristics that are passed on to their offspring.

Genome and epigenome: As determinants of phenotype in response to the environment

Genome, the primary long-term memory storage is a single set of an organism's DNA. The epigenome is the heritable modifications in DNA or proteins (histones) that coil DNA. The Greek word 'epi' means above the genome, the genome is modified or marked by chemical molecules, which moderate the expression of the genome. These epigenetic markers can be transmitted from one generation to the next as cells divide. In epigenetics, certain biochemical signatures (like DNA methylation, and chromatin modification) act as secondary storage and diverse biomolecules (or proteins) thus generating and coordinating multiple actions in response to the environmental cues needed for the development/defence.

To elucidate the communication route (signal transduction) that starts with an environmental signal traced to the cell nucleus of an organism and then back again. The primary exchange of information starts at the plasma membrane (the brain of the plant cell) which determines whether to allow the particular signal or information received to be sent inside the cell or not. The signal shall then be communicated to the cell with the help of key messengers such as enzymes and secondary metabolites. These molecules decode the message and activate specific key regulators of gene expression or repression based on the specific necessity in the system. The response is then communicated back by other members of the cell which take respective biochemical pathways.

Thus, it could be inferred that one could not rely on a 'yes' or a 'no' to the question stated; as the order of the flow of regulatory routes are bi-directional and case-specific. For example, in the case of two identical plant genotypes that give different nutrient composition, the result could be an altered growth pattern. Similarly, different genotypes with the same nutrient composition, confer differential growth patterns. This observation revealed that not just the genome or the environment alone, is affecting the overall biology but the *constant interaction* of both genes and the environment that is responsible for a particular phenotype (Biology).

Method of epigenetic breeding in crop improvement

Plants are sessile and constantly perturbed by the environment. Their perception is transduced into cellular signalling cascades and gene transcription networks. It has been recorded that the plants can memorize past events and then act upon the present condition epigenetically. The epi-information could be used in developmental gene regulation and environmental response. Thus, epigenetics, on the whole, play a significant role in crop improvement strategies, including-

1. The selection for favourable epigenetic states.
2. Introducing novel epialleles.
3. Regulation of transgene expression and identifying variations.

However, it is indispensable to understand the causative factor for variations and the newly formed epigenetic variants over the generations for crop improvement. In an instance, Kim *et al*. (2018) introgressed the functional epigenetic *OsSPL14* WFP (SQUAMOSA promoter binding protein-like 14, WEALTHY FARMER'S PANICLE*)* allele into the elite Indica rice genome and it greatly improved panicle traits and grain yield. Xanthopoulou *et al*. (2019) reported the graft-induced effects on fruit morphology (alterations in fruit size and shape) in intra-species (*Cucurbita pepo* L.) grafting. Their results, further, may help in understanding the role of epigenetic molecular mechanisms on the phenotypic changes.

Conclusion

Though it is hard science to study the chromatin hardware in which the genome is embedded within histones and nucleosomes, recent studies have yielded evidence that epigenetic mechanisms are indeed essential for stress memories and adaptation in plants. Therefore using it as a soft tool by developing the methods for widespread epigenome profiling and engineering may generate new avenues for using the full potential of epigenetics in crop improvement.

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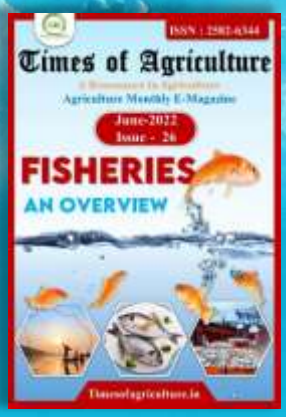

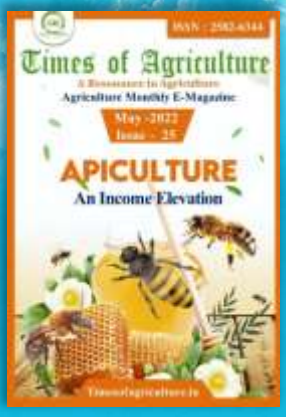

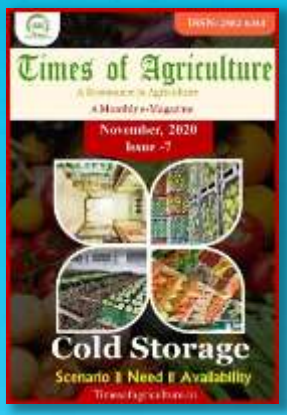

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