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Times of Agriculture

A Resonance in Agriculture

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June-2022
Issue - 26

FISHERIES

AN OVERVIEW

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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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AGRICULTURE UPDATES

INDIA BANNED WHEAT EXPORTS

On 14th May 2022, **India banned wheat exports** with some exceptions. This announcement came days after the central government had announced that this year record shipments of wheat are being targeted this year. The government's move came after a day when it was reported that over 4,000 wheat-laden trucks were stuck in a queue outside Kandla port and four ships were also stranded at the port.

A quantity of more than 1.6 lakh tonnes was to be loaded on these ships but as soon the ban came into force, the loading was stopped.

AMMONIA POWERED TRACTOR

An startup sponsored by **Amazon's Climate Pledge Fund**, has achieved a huge milestone by powering the **world's first tractor using ammonia**. The tractor runs on **ammonia as fuel**, which is split on demand to power a **100kW hydrogen fuel cell**.

These energy-intensive applications demand a power source that is dense in energy, and Amogy Inc. believes that ammonia meets this requirement precisely.

MAHARASHTRA 'GENE BANK PROJECT'

Maharashtra Cabinet approved the ***'Maharashtra Gene Bank', a first-of-its-kind project in India***. To conserve genetic resources in Maharashtra including marine diversity, seeds of local crops, and animal diversity.

'Maharashtra Gene Bank Project' will work on seven themes:

1. ***Marine biodiversity.***
2. ***Local crop/seed varieties.***
3. ***Indigenous cattle breeds.***
4. ***Freshwater biodiversity.***
5. ***Grassland, scrubland, and animal grazing land biodiversity.***
6. ***Conservation and management plans for areas under forest right.***
7. ***Rejuvenation of forest areas.***

FIRST SOFT WHEAT VARIETY, PUSA SOFT WHEAT-1 (HD 3443)

Indian bakery makers, who import wheat at double the price of domestic rates, will soon become Atmanirbhar as scientists at ***Indian Agricultural Research Institute (IARI) has developed the country's first soft wheat variety named*** **Pusa Soft Wheat -1 (HD 3443),** which is suitable for growing in all producing States.

"While **Pusa Soft Wheat -1 (HD 3443)** is already registered with Protection of Plant Varieties and Farmers' Rights Authority, the next line is also ready.

INDIA'S FIRST 'LAVENDAR FESTIVAL'

Union Minister **Dr. Jitendra Singh** has inaugurated the country's first ***'Lavendar festival'*** at **Jammu's Bhaderwah** where the cultivation of lavender has transformed the economy of the mountainous area.

Bhaderwah in the **Doda district** is the birthplace of India's **'Purple Revolution'.**

Lavender has changed the fortunes of farmers in Jammu and Kashmir under the ***'Aroma Mission or Purple Revolution'.***

The aim of the mission is to support the domestic aromatic crop-based agro-economy by moving from imported aromatic oils to home grown varieties.

GOVERNMENT REVISES WHEAT PRODUCTION ESTIMATE DOWNWARDS BY 5.7%

The government has revised downwards the estimate for wheat production by **5.7 % to 105 million tonnes in the 2021-22** crop year ending June from the **earlier projection of 111.32 million tonnes,** as the crop productivity has been affected due to the early onset of summer.

India's wheat production stood at 109.59 million tonnes in the 2020-21 crop year

IIM-AHMEDABAD LAUNCHES AGRI LAND PRICE INDEX

IIM-Ahmedabad has collaborated with (SFarms India), an e-marketplace for agricultural land to develop a **farm land price index** that is based on the purchases and sales done on the platform. This index has been designed with the aim of recording and presenting quality-controlled data on the prices of agricultural land in India.

This index is being launched under the Misra Centre for Financial Markets and Economy at IIM-Ahmedabad and will be hosted on its official website.

WORLD BIODIVERSITY DAY 2022

International Day for Biological Diversity or World Biodiversity Day is observed on 22nd **May** every year to increase awareness and understanding of the issues of biodiversity.

Theme

"Building a shared future for all life"

WORLD MILK DAY 2022

World Milk Day was celebrated on **1st June in 2022.** World Milk Day was first observed in 2001 and was celebrated in a number of nations throughout the world.

The FAO designated June 1st as World Milk Day in 2001.

Theme of World Milk Day:

'Dairy Net Zero'

WORLD FOOD SAFETY DAY 2022

Every year on **June 7th**, World Food Safety Day is celebrated to highlight the importance of healthy eating habits. According to the WHO, this day is observed to *"bring attention to and mobilize action to prevent, detect, and manage food-borne risks and increase human health."*

Theme: "Safer food, Better health."

Cover Story

FISHERIES

AN OVERVIEW

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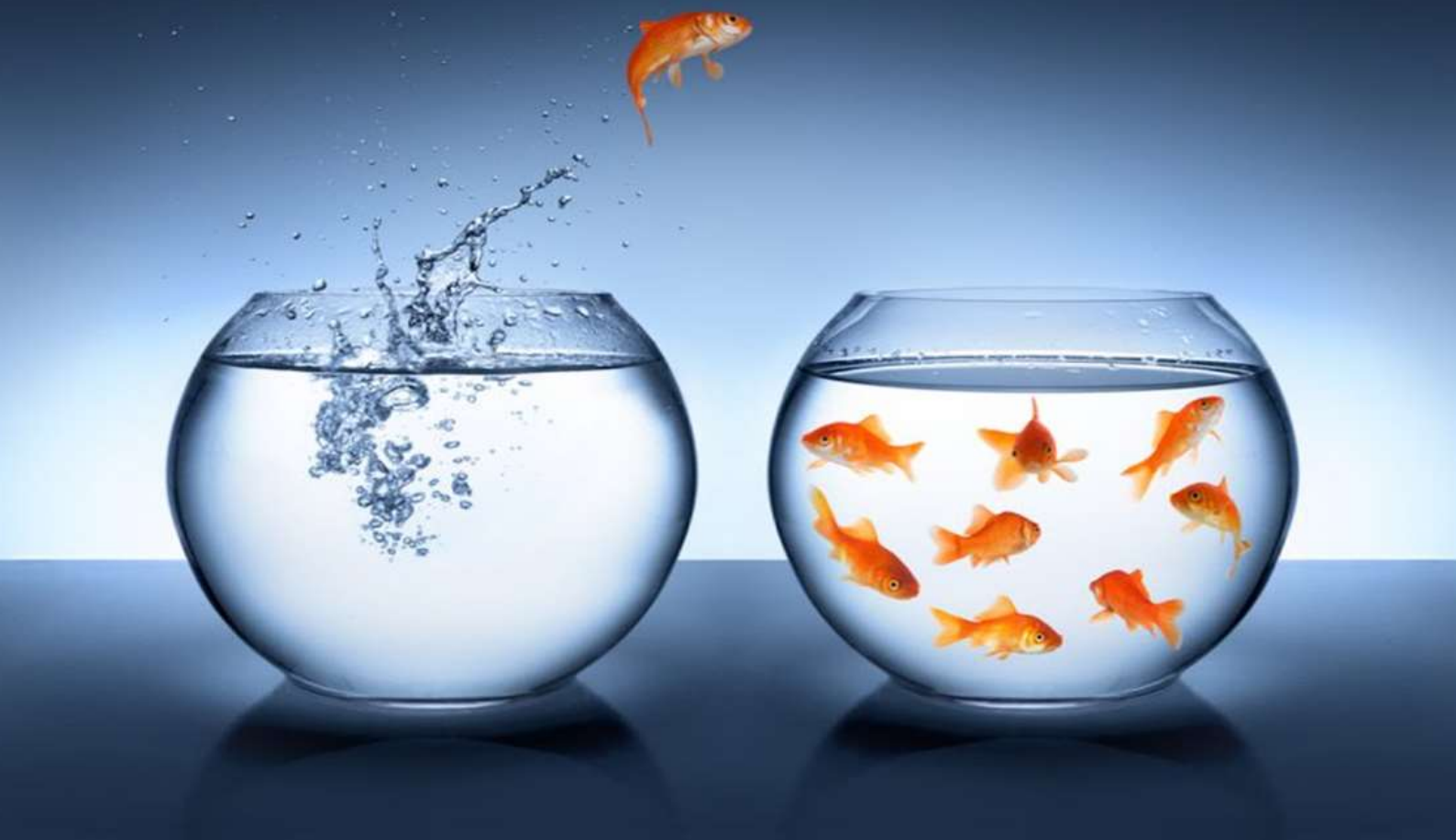


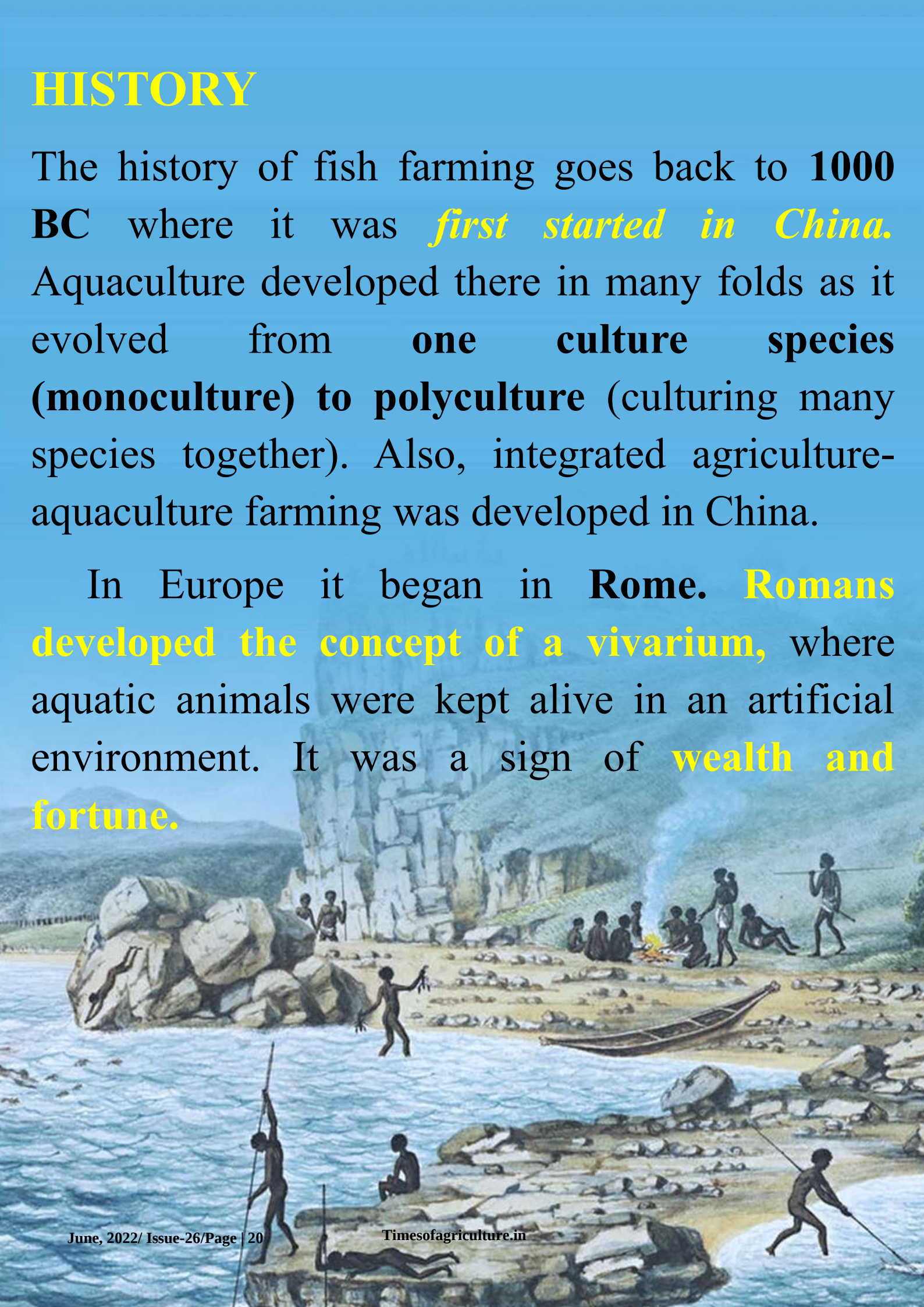
Indian fisheries sector represents an economically important and fast-growing production sector and contributing significantly to the national economy in terms of food, nutrition, socio-economic development and providing livelihood to a large section of the society.

Fisheries and Aquaculture constitute an important economic activity, with a vast potential for sustainably harvesting a wide variety of inland and marine fisheries resources in the country.

HISTORY

The history of fish farming goes back to **1000 BC** where it was ***first started in China.*** Aquaculture developed there in many folds as it evolved from **one culture species (monoculture) to polyculture** (culturing many species together). Also, integrated agriculture-aquaculture farming was developed in China.

In Europe it began in **Rome.** **Romans developed the concept of a vivarium,** where aquatic animals were kept alive in an artificial environment. It was a sign of **wealth and fortune.**



To raise seafood output and exports and promote sustainable aquaculture, **the Government has constituted an independent Ministry for Fisheries in 2019.**

The Fisheries Science Division under the Indian Council of Agricultural Research (ICAR) coordinates and monitor the research and academic programmes in fisheries and aquaculture of five resource specific fisheries research institutes *viz*.,

1. **Central Marine Fisheries Research Institute (CMFRI),** Kochi, Kerala
2. **Central Inland Fisheries Research Institute (CIFRI),** Barrackpore, West Bengal
3. **Central Institute of Fisheries Technology (CIFT),** Kochi, Kerala
4. **Central Institute of Freshwater Aquaculture (CIFA),** Bhubaneswar, Odisha.
5. **Central Institute of Brackishwater Aquaculture (CIBA).** Chennai, Tamil Nadu

Importance

Fish plays an important role in nutrition and food security. Fish is ***"nature's superfood".*** Fish is a great source of protein and essential fatty acids like *omega-3, EPA and Decosa Hexanoic Acid (DHA).* That's why aquaculture is an important measure to safe guard country's nutritional security.

Fish have one of the highest bio-diversities and play a crucial role in maintaining aqueous ecosystems. One of its main essential benefits of aquaculture are **oxygen generation, coastal protection, climate moderation, and of course sea food.**

Aquaculture also makes critical contributions to development in the areas of employment, with over **41 million people worldwide**, the vast majority of whom live in developing countries, working in fish production.

Statistical data on Fisheries

India is a major maritime state and an important aquaculture country in the world. **India ranks 2nd in Aquaculture and 3rd in Fisheries production**. It contributes **7.96 % to global production.** The fisheries and aquaculture production contributes around ***1.24% to India's Gross Domestic Product (GDP) and 7.28% to the agricultural GDP.***

Among the States, **Andhra Pradesh (27.4%)** and West Bengal (13.8%) together produce about 41% of the country's total fish production. **The state leading in marine water aquaculture production is Tamil Nadu, whereas Andhra Pradesh is the leading state in freshwater aquaculture.**

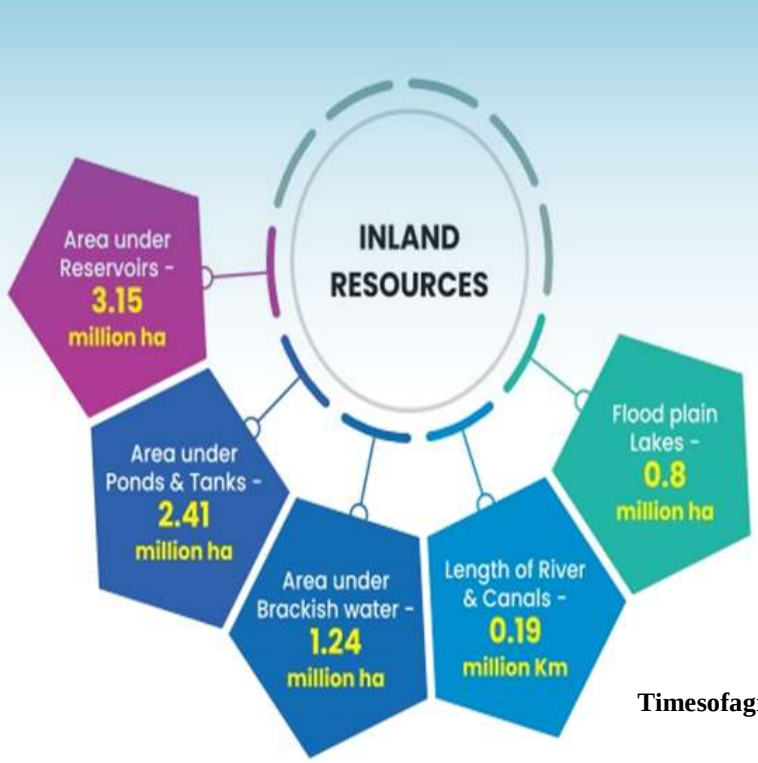
2nd **India ranks 2nd in Aquaculture**

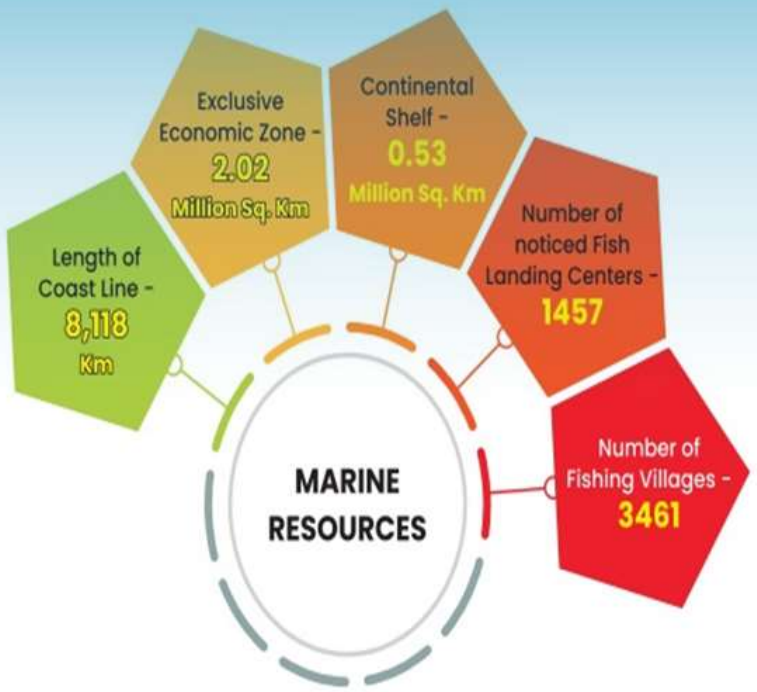
3rd in Fisheries production **3rd**

World aquaculture production attained another all-time record high of **114.5 million tons** in live weight in 2018, with a total value of **USD $ 263.6 billion.**

In financial year 2021, the export value of fish and fishery products from India was about **1.1 million metric tons amounted to over 441 billion Indian rupees.**

The annual per capita consumption of fish for the entire population is estimated at **5-6 kg,** whereas for the fish eating population it is found to be 8-9 kilograms. However, according to the Indian Council of Medical Research, recommends this to be ***12 kg per annum.***





Source- Annual Report 2021-22, MoFAHD

14.73 MMT

Total Fish production *(FY 2020-21)*

Target Fish production *(by 2024-25)*

22 MMT

Tamil Nadu

Leading state in marine aquaculture

Andhra pradesh

leading state in Freshwater Aquaculture.

Fisheries contributes

1.24% in India's GDP and
7.28% in Agricultural GDP.

Per capita consumption

5-6 Kg/Person/year

Per capita recommendation

12 Kg/Person/year

Nutritive value

Carbohydrate: The shell fish has less fat and more carbohydrate than fin fish. In the live fish, glycogen is the source of stored energy.

Protein: They contain around 20 % of protein. Fish is rich in lysine and methionine.

Fat: The lipid content of both fish and prawns is very low and varies 1-2.8 %.

Minerals: Fish is rich in calcium particularly small fish when eaten with bones. Marine fish are good source of iodine, selenium and fluoride.

Vitamins: Sea foods contain significant amounts of vitamin B12 especially shell fishes. Fish liver oils are excellent source of fat-soluble vitamins. Rohu contains vitamin C.

Major Government Initiatives

1. **Blue revolution** — 1985-90
2. **Fisheries and Aquaculture Infrastructure Development Fund** — 2018-19
3. **Sagar Mitra Yojana** — 2020
4. **PMMSY- Pradhan Mantri Matsya Sampada Yojana** — 2020

Life originated from water. About 71% of the earth's surface is covered by water. It is second most abundant and a very crucial part of the ecosystem. With a growing population, food availability is becoming scarce. That's why we need some other sources of food production. That can be achieved through aquaculture.

India aims to double the marine product exports to Rs. 1 lakh Cr. in next 5 year

The upcoming target is that fish farming will provide close to **two thirds of global food fish consumption by 2030.** The report predicts that ***62% of food fish will come from aquaculture by 2030.*** With the world's population predicted to increase to 9 billion people by 2050 - particularly in areas that have high rates of food insecurity - aquaculture, can make a significant contribution to global food security and economic growth. Aquaculture in the upcoming future, if developed responsibly, can prove to be a strong pillar for India's GDP.

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MAJOR INDIAN FOOD FISHES & ORNAMENTAL FISHES

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The planet Earth in which we live is referred to as **"Blue planet". Why so???** Water covers about 71 percent of the Earth's surface and hence the planet looks blue.

These waters are filled with numerous life forms. In particular, fishes add beauty to these waters. With their vibrant and lively colours these fishes attract the humans to a greater extent. The different under water ecosystems such as coral reefs, kelp forests, sea grass beds, seaweed beds and estuaries are fascinating places to be seen and enjoyed once in life time by everyone.

Fishes are **cold blooded *(poikilothermic)* vertebrate organisms which have paired and un- paired fins for locomotion and pharyngeal gills and gill slits for respiration.** They are highly adapted to extreme conditions and are ubiquitous in nature.

Major Food fishes

1- Freshwater Food fishes

Catla (*Gibelion catla*)

- Largest Indian Major Carps.
- Fastest growers amongst the IMCs.
- Have a big head ,an upward facing mouth.
- They are surface feeders.

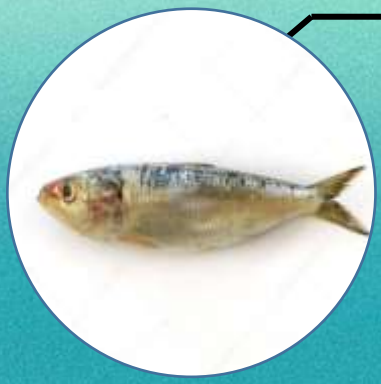
Rohu (*Labeo rohita*)

- Tastiest fish amongst the IMCs.
- Blackish in the dorsal side while silverish in the belly region.
- They are column feeders
- Have a arched head with lower lips frill like.

Mrigal (*Cirrhinus mrigala*)

- Endemic to Indo- Gangetic riverine system.
- One of the three Indian major carps cultured in South East Asian countries.
- Head is small and mouth broad and transverse.
- They are bottom feeders consuming primarily dead and decaying matters.

2- Marine Food Fishes

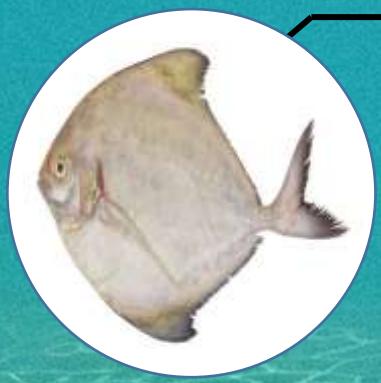


Indian Oil Sardine *(Sardinella longiceps)*

- Body sub-cylindrical and has a distinct black spot at hind border of gill cover.
- Feeds on phytoplankton and zooplankton.
- Commercially important fish in India.
- Fish oil is mainly extracted from this fish.

Indian Mackerel *(Rastrelliger kanagurta)*

- Silvery body with dark strips in upper body region and has finlets.
- It is found in Indian and west Pacific Ocean.
- It is a commercially important food fish.
- It is mainly feeds on phytoplankton and zooplankton



Black pomfret *(Parastromateus niger)*

- Other major pomfrets present in Indian waters include
  1. Silver pomfret (Pampus argenteus)
  2. Grey pomfret (Pampus sinensis)
- Black pomfret contributes majority to local fisheries
- Carnivore type of feeding habit.
- Usually found in between 15-50m depth in the ocean.

Ornamental Fishes (Living jewels)

1- Indigenous Freshwater Ornamental Fishes

Indian glass fish *(Parambassis ranga)*

- Transparent body revealing its internal structure.
- Dyes are used to produce painted glass fishes for aquarium purpose.
- Schooling fishes by nature

Scarlet badis *(Dario dario)*

- Native to India. Especially found in Brahmaputra River.
- Males with seven distinct dark vertical bars across sides of the body.

Dwarf pufferfish *(Carinotetraodon travancoricus)*

- Carnivorous freshwater puffer
- Used to control snails in aquariums
- Attractive colours (Greenish – yellow body with brown-black iridescent patches)

2- Exotic Freshwater Ornamental Fishes

Common Gold fish *(Carassius auratus)*

- Most popular aquarium fish
- Gold fish breeds vary greatly in size, colour and body shape.
- They are egg layers. Their eggs are adhesive in nature

Guppy *(Poecilia reticulata)*

- They are live bearers, directly give birth to young ones
- Popularly referred to as million fish or rainbow fish
- Most widely distributed aquarium fish.

Siamese Fighting fish *(Betta splendens)*

- Thailand's national aquatic animal.
- Referred to as the "Designer fish of the aquatic works" due to the level of selective breeding carried in the particular species

Silver Arowana *(Osteoglossum bicirrhosum)*

- Considered to bring fortune and hence referred to as *"Vasthu fish"*
- Highly predatory in nature and has the ability to jump out of water and capture its prey.

3- Marine Ornamental Fishes

Orange Clown fish (*Amphiprion percula)*

- Lives in symbiotic relationship with anemones
- They exhibit protandry, all fishes are born male but changes to female if the breeding female dies.
- Bright orange with three distinct white bars

Blue Damsel (*Chrysiptera cyanea)*

- Bright blue in colour. Males have a yellow snout and tail and females lack them.
- Aggressive and territorial in nature
- Hardy species and is preferable for beginners.

Conclusion:

India is blessed with immense freshwater, brackish water and marine water resources. About 3200 species of fish have been identified till now from the Indian subcontinent which accounts for 9.7% of the total number of fish species in the world. These valuable resources if utilized sustainably will help our nation prosper both environmentally and economically.

SPRINKLER IRRIGATION SYSTEM

FOR HIGHER YIELD AND EFFICIENT USE OF WATER

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Sprinkler irrigation involves spraying water into the air and allowing it to fall on the ground surface in a manner similar to rainfall. Water under pressure is forced through small orifices or nozzles to create the spray. Pumping is commonly used to obtain pressure. The amount of irrigation water required to refill the crop root zone can be applied nearly uniformly at a rate to suit the infiltration rate of soil by carefully selecting nozzle diameters, operating pressure, and sprinkler spacing.

Types of Sprinkler irrigation system

Sprinkler systems are divided into two basic categories based on the arrangement for spraying irrigation water.

1. Rotating type sprinkler system:

The most typical device for turning sprinkler heads in rotating type sprinklers are a small hammer actuated by the thrust of water striking against a vane connected to it. Sprinkler heads are set on risers above crop height and rotated from 90 to 360 degrees to water a rectangular area. Depending on nozzle size, spacing, and other factors, pressure requirements range from 2 to 4 kg cm^{-2} and application rates from 4 to 20 mm hr^{-1}.

2. Perforated pipe system:

The water is sprayed under pressure through drilled holes or nozzles throughout the length of the pipe. This system is typically built at a low pressure of 1 kg cm^{-2}. For varying pressure and spacing, the application rate ranges from 1.25 to 5 cm hr^{-1}

Yield response to Sprinkler irrigation system

Water savings from sprinkler systems range from 20 to 75 % traditional methods, with yield increases of 5 to 50 percent in various crops and agroclimatic situations.

Components of sprinkler irrigation system

The following are typical components of a sprinkler system: (i) A pump unit (ii), Tubings - main/submains and laterals, (iii) Couplers, (iv) Sprinkler head (v) Other accessories such as valves, bends, plugs and risers.

Advantages of sprinkler irrigation

1. Increase in yield.
2. Water saving.
3. Suitable for irrigating crop where the plants population per unit area is very high.
4. Suitable to all types of soil except heavy clay.
5. Water application can be more precisely controlled. Water application efficiency is improved by providing light and frequent watering.
6. Elimination of the channels for conveyance, therefore no conveyance loss.
7. Mobility of system.
8. May also be used for undulating area.
9. Saves land as no bunds etc. are required.
10. Influences greater conducive micro-climate.
11. Irrigated areas can be found at higher elevations than the source.
12. Use of soluble fertilisers and chemicals is a possibility.
13. Sprinkler nozzles are less likely to clog due to sediment-laden water.

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SOILLESS FARMING:

THE NEXT GENERATION GREEN REVOLUTION

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In recent years, due to a rapid increase in world population, many challenges have come to limelight. One of these challenges is the reduction in per capita land available for soil-based farming, which leads to other agricultural and environmental issues. Under these critical circumstances, it became necessary to develop advanced technologies and techniques to withstand the current situation. Although several works were carried out on cultivation of plants in soil and in vitro, few of these are concentrated on soilless cultures. Soilless agriculture is a new promising method for improving cultivation of different cash crops. Besides reservation and restoration of cultivation lands, soilless farming, especially close-loop system, has various advantages: it utilizes recycled fixed amount of water, saves 85-90% of irrigation water, can be implemented in areas unfavourable for ordinary farming, almost zero environmental pollution, better yield than conventional cultivation.

Soil is not necessarily required for plant growth. It only provides all the essential macronutrients and micronutrients for growth and development of plants. Soil based conventional agriculture has drawbacks like wastage of irrigation water, large land requirements, use of large quantity of chemical fertilizers, soil degradation, etc. The requirement of large quantity of nutritional food to fulfil the high demand of the population worldwide, justifies the priority of introducing new and advanced technologies and techniques in agriculture, which synchronize water and nutrient demand in order to achieve optimum yield. New modern agriculture system has several benefits like water efficiently, high yield and under controlled environment it can be designed for crop production throughout the year.

Advanced agriculture technology including hydroponics, aeroponics and aquaponics culture techniques utilizes nutritive medium for plant nourishment. On an average, hydroponics system consumes 10-20 times less water compared to soil-based cultivation systems. Earlier studies have shown that the yield of closed-loop soilless farming (hydroponics) increased by almost 5% compared to open system. Cultivating plants without soil open the pathway to extensive research for the evaluation and popularization of alternative farming systems.

Categories of soilless farming

Two types of soilless farming methods are widely used: (i) open farming culture and (ii) close farming culture.

1. Open farming culture:

In this method, diluted nutrients are utilized for every irrigation pattern. The plants uptake nutrient solutions which are usually delivered by dripping system. Through this method adequate amount of nutrients are synchronized in the root zone. Few techniques of open soilless culture are given below.

a. Root dipping technique

Under this process, plants are cultured in pots having small holes at the bottom. These are filled with substrate medium like coconut fibre and are placed in a container having nutrient solution. Minimum 1-3 cm of the lower portion of the pots remain in close contact with the

nutrient medium. Only few roots are partly submerged in the nutrient media and some just hang in the air. This is a simple and cost-effective system to cultivate small herbs or flowering plants.

b. Hanging bag technique

In this technique, long cylinder shaped polythene bags are utilized. These are closed at the lower end and connected to PVC pipes at the upper portion. These are hanged vertically above a nutrient supplement tank. Planting materials such as seeds, fruits, etc. acclimatized in netted pots are firmly pressed into holes on the hanging bags. A micro sprinkler is used to circulate the nutrient medium to the top of each hanging bag. The nutrient solution is proportionately spread inside the hanging bag by the sprinkler. The solution stock tank is placed at the bottom of the bag for collection of excess nutrient solution. Tubes that contain the nutrient solution should be black in colour to prevent mould growth inside. Using this technique, vegetables such as lettuce, climbers, small flowering plants, etc. are grown.

c. Trench method

In this method, small herbs and shrubs are grown on trenches constructed using bricks or concrete blocks on or above ground. To prevent the growth media from direct contact with the ground, the inner linings of trenches are covered with thick polythene sheets. The shape and size of the trenches vary from crop to crop grown in them. All nutrient supplements along with water are delivered through the dripping process. This system is suitable for growing herbs as well as tall vine plants.

2. Closed farming culture:

In this technique, the diluted concentrations of nutrients are marked and balanced for reuse. It is difficult to maintain the calibration of nutrients in a hydroponic system as the dissolved supplements must be tested in a regular time interval to obtain better results. Closed farming models incorporate both primary as well as modern culture frameworks. Few techniques of closed soilless culture are given below.

a. Hydroponics technique

Vegetables, herbs, climbers and flowers are grown hydroponically. For growing plants hydroponically, inert media such as coconut fibre, rock pieces, etc. are used. The plants are fed with nutrient solution containing all minerals and nutrients. This system has a wide range of advantages which include high yielding capacity, less pollution, better nutrient and water efficiency, etc. This method is highly beneficial which varies from simple setups to modern types.

b. Nutrient film technique (NFT)

This technique was developed by A. Cooper in England during 1960s. NFT is an example of hydroponics system where the plant roots remain in contact with the nutrient solution. In NFT, continuous supply of nutrient solution is maintained by submerged motor pump inside the culture vessel. Only air is used as a growing medium and plants are cultured inside containers with their roots hanging inside the nutrient media. As the solution remains in a continuous flow, there may be changes in the nutrient solution's salinity in comparison to the soil. One of its advantages is that plants can be grown in much higher salinity than soil-based cultivation.

c. Aeroponic technique

The aeroponics system is one of the most advanced types of hydroponics system. In this technique, the supplement solution is sprayed to create a fine mist around the root system inside the chamber. For growth of the plants, expanded polystyrene or other inert materials with holes are used. The roots of plants growing in the chamber are suspended in mid-air just below the panel and enclosed inside a spraying box. Just like other methods of hydroponics, a timer regulates the nutrient pump. However, in the case of aeroponics system, a short cycle timer is used to run the pump for 5-10 sec for every 2-3 min time interval. Mostly leafy vegetables like lettuce, spinach, etc. are grown through aeroponic culture. The most important advantage of this system is the utilization of minimum space. Through this culture system, plants can be grown on per unit floor area twice as compared to other systems. The major disadvantage of this process is that, if the nutrient spreading cycles are not working properly the roots will dry out rapidly, causing death of the plant.

d. Aqua agriculture (Aquaponics)

In this technique aquatic animals like fish, prawns, etc. are grown in water tanks in a symbiotic environment with combination of plants which are grown in hydroponics. The water from the tank gets cleaned and recycled back to the aquaculture system while moving through hydroponics system, whereas the by products are broken down by micro-organisms which live on the surface of the culture media and utilized by plants as nutrients.

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INTERPRETING THE IMPORTANCE OF USING DIFFERENT TYPES OF MULCHES IN AGRICULTURE

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Mulching is defined as a practice that helps in proper growth and development of the plants by modifying soil temperature, providing higher nutrient availability and better moisture conservation, managing weeds whilst enhancing the chemical and physical properties of soil and thereby, improving the productivity of the crop. Mulch is a layer of material applied to the surface of soil and it may be classified as organic, biodegradable and synthetic mulch.

1. Organic mulches

i. Leaves: Leaves from deciduous trees that drop their foliage in autumn, particularly of maples and oaks, can form a soggy mat in winter and spring which can impede the new growth of lawn grass and other plants. Dry leaves are used as winter mulches to protect plants from freezingand thawing in areas with cold winters.

Leaves mulch

ii. Grass clippings: Grass clippings from mowed lawns are generally used as mulch. These mulches tend to mat down and are often dried completely before application to militate against fast decomposition and excessive heat generation. They are mixed with tree leaves or rough compost to produce aeration which facilitates their decomposition without smelly putrefaction. Fresh green grass clippings are comparatively high in nitrate content, and when used as a mulch, much of the nitrate is returned to the soil.

iii. Peat moss: Sphagnum peat, also known as peat moss, is a long-lasting and packaged mulch that is both convenient and popular. When wet and dried, it can form a dense crust that prevents water from soaking in. It is typically combined with pine needles to create friable mulch. It can also reduce the pH of the soil surface, making it useful as a mulch beneath acid-loving plants. Peat is one of the largest carbon stores.

iv. Bark chips: The outer bark layer of timber trees is used to make bark chips of various grades. Bark is relatively inert, and its decay does not necessitate soil nitrates, so layers two or three inches deep are usually used.

Bark chips

v. Straw mulch / field hay / salt hay: Straw mulch, field hay, and salt hay are all light-weight products that are typically sold in compressed bales. They require an unkempt appearance and are used in vegetable gardens and as a winter covering.

2. Biodegradable mulch

Plant starches and sugars, as well as polyester fibres, are used to make biodegradable mulches and are derived from plants. Soil microorganisms decompose the mulch into two components: water and carbon dioxide, leaving no toxic residues behind.Because it is usually tilled into the soil after its usage, this type of mulch requires even less manual labour.

i. Cardboard/newspaper: Cardboard or newspaper can be used as semi-organic mulches. These work best as a base layer for a heavier mulch, such as compost, to prevent the lighter cardboard/ newspaper layer from being blown away and the amount of heavier

Newspaper mulch

mulch used can be reduced while the weed suppressant and moisture retention properties of the mulch are improved. Holes through cardboard/newspaper layer must be cut for each plant. Newspaper mulch can be applied more easily in windy conditions by briefly pre-soaking the newspaper in water to increase its weight.

ii. Ground covers (living mulches): Ground covers are plants growing close to the ground, beneath the main crop, to slow the growth of weeds and provide other mulch benefits. Some groundcovers can fix nitrogen fixation in clovers and accumulate nutrients from the subsoil.

Ground covers

3. Synthetic Mulches

i. Polypropylene and polyethylene mulch: Polyethylene is primarily used for weed control, whereas polypropylene is primarily used on perennials. The black and clear mulches absorb sunlight and warm the soil, accelerating growth. White

Polyethylene mulch

and other reflective colours will warm the soil as well, but they will not suppress weeds as effectively. If the mulch is not removed at the end of season before it begins to degrade, it will eventually degrade into ketones and aldehydes, polluting the soil. Although this mulch is technically biodegradable, it does not degrade into the same materials as more natural biodegradable mulch.

ii. Carpet: Synthetic carpet made of artificial fibres should be removed after planting to avoid fibres taking a long time to decompose, whereas natural fibre carpet can be left in place to prevent weed competition. Rain is absorbed by the carpet and slowly released into the soil, reducing the need for watering.

iii. Coloured mulch: Coloured mulch is created by dying mulch in a water-based solution of coloruant and chemical binder. It may be noted though coloured, studies show that the colourants used in coloured mulch are safer than table salt or baking soda. Coloured mulch can be

Coloured mulch

used anywhere such as large bedded areas or around plants. It provides many of the same gardening benefits as traditional mulch, such as increasing soil productivity and retaining moisture. However, if the mulch has faded, you can restore the colour by spraying dye onto previously spread mulch.

4. On-site production

Because of the large amount of mulch that is frequently required on a work site, it is often impractical and costly to source and import enough mulch materials. Growing mulch materials on-site in a "mulch garden" – an area of the site dedicated entirely to the production of mulch, which is then transferred to the growing area – is an alternative to importing them. Mulch gardens should be located as close to the growing area as possible to facilitate the transfer of mulch materials.

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CLIMATE RESILIENT AGRICULTURE (CRA)

A TECHNIQUE FOR FUTURE

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Climate Resilient Agriculture (CRA) is a method of exploiting existing natural resources sustainably in agricultural and livestock production systems to produce improved long-term productivity and farm revenues in the face of climate change. Climate resilience is a key concept in risk management for climate change. In this context, resilience refers to an agricultural system's ability to foresee and prepare for climate and extreme weather changes, as well as adapt to absorb, and recover from their effects. Implementing short and long-term climate mitigation and adaption strategies, as well as promoting transparent and inclusive engagement of diverse actors and stakeholders in decision-making and management processes, can all help to boost resilience. Changes in temperature and precipitation resulting in long-term altered temperature, rainfall patterns, and agricultural droughts are examples of hydro-meteorological dangers with a gradual onset. Tropical storms and floods, on the other hand, happen considerably more suddenly. Both require solid risk mitigation strategies based on climate risk assessments.

Why it is needed?

The UN Department of Economic and Social Affairs' Population Division provides a detailed assessment of worldwide demographic tendencies and forecasts. According to the report, the world's population could peak at around 11 billion people by the end of the century. In the next 30 years, the world's population is predicted to grow by 2 billion people, from 7.7 billion today to 9.7 billion in 2050.

Governments all throughout the world have promised to keep global warming to 1.5 degrees Celsius by 2050. According to the Intergovernmental Panel on Climate Change (IPCC), the global temperature has already risen by 1 degree Celsius above pre-industrial levels. Global warming will reach 1.5 degrees Celsius between 2030 and 2052 at the current rate of 0.2 degrees Celsius every decade. The UN has warned that reaching 1.5 degrees Celsius will plunge us into "a profoundly uncertain world," adding that "existing global pledges are insufficient to prevent temperature rises of more than 2 degrees Celsius, let alone 1.5 degrees Celsius." According to the report, average temperature rises by 2100 will range from 2.9 to 3.4 degrees Celsius, depending on current national pledges. According to the group, carbon emissions must be reduced by 45 percent by 2030 and net zero by 2050 to keep global warming below 1.5 degrees Celsius.

Climate resilient practices

- **Agriculture resilience–** By increasing production, By increasing farmers income, Ensuring food security, Adapting climate smart agriculture

- ***Reducing greenhouse gases***– Adapting clean energy, Effective crop management, Enhancing the quality of livestock farming
- ***Increasing forest cover***– Agroforestry, Social forestry, Indigenous tree plantation, Joint forest management
- ***Least land use change***– Maintain the naturality of land areas, allow least change, Adapting practices of sustainable development
- ***Water management***– Increase storage capacity, Fair policies for water supply and distribution, River health and watershed management, Treatment to create alternative source of water etc.

Conclusion

The Government of India has undertaken the convergence of multiple policy programmes and sectoral plans in order to achieve synergy and effective utilisation of existing resources. The National Mission of Sustainable Agriculture was launched in 2010 as part of the National Action Plan on Climate Change (NAPCC) to promote sensible resource management. It was one of eight missions under the NAPCC, prioritizes reducing greenhouse gas emissions from all agricultural and non-agricultural sources. One such policy action is the use of neem-coated urea. Structured training is crucial for stakeholders to gain confidence and become more aware of climate change occurrences. The necessity for CRA implementation across the country is urgent. To improve skills in agriculture and related areas, flagship farmer-oriented programmes are required. Farmers, research institutions, funding agencies, governments, non-governmental organisations, and the commercial sector are all working together to promote CRA. The SAARC countries will use these models to adapt to climate change consequences like as floods, cyclones, droughts, heat waves, and seawater intrusion. ICAR has built climate-resilient villages in 151 districts across India, which is being reproduced by state governments with the goal of creating carbon-positive villages. These magnificent achievements will aid India's development of Climate Resilient Agriculture (CRA).

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AGRICULTURAL MOBILE APPLICATIONS FOR FARM ADVISES

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Farming applications are the most easy and practical way to help farmers through the process of farming. It provides instructions for doing scientific farming, crop cultivation, seeding, and harvesting of any crop or vegetable. These days, rural India is rapidly embracing digitization and technology. According to the Boston Consulting Group's research 'The Rising Connected Consumer in Rural India,' this percentage of rural India will increase to 48 percent by 2020. Furthermore, while agriculture continues to be the most important source of income for 58 percent of Indian households, it is essential to focus more on Digital Agriculture for a developing and successful India. Furthermore, farming applications are the most convenient and effective tool for guiding farmers through the process of farming. It provides instructions for doing scientific farming, crop cultivation, seeding, and harvesting of any crop or vegetable. Farmers can simply address pest or bug infestations, as well as any other issues that place them in a tough situation. A farming app may be a farmer's best friend, allowing them to increase their output without investing any money. It is available for free download from the Google Play Store. Let us look at some of the greatest and most dependable Agriculture Apps accessible in India, as well as regional languages.

Best Agriculture Apps for Farmers:

Krish-e:

Krish-e, a popular agriculture app developed by Mahindra & Mahindra, gives farmers a customized crop calendar as well as useful agriculture information like land preparation, crop sowing, crop planning, fertilizer management, seed treatment, pest and disease management, crop diagnosis and treatment, weed treatment, and irrigation. The favourite agriculture app among farmers is this farm app, which is available in eight main Indian languages. Krish-e intends to use digital agricultural technologies to assist Indian farmers in identifying pests and crop illnesses that harm their harvests. Boost yield with the potential offered by Krish-e's personalized solutions:

- It maintains Personalized Crop Calendar for all your farm requirements.
- Our Scientific advisory; free from farmers.
- Provides Premium advisory services for quicker resolution.
- Get more Community learning with experts.
- Personalized Digital Diary that acts like a farm calculator to manage all your expenses at one place.
- The advisory services are available in English, Hindi, Marathi, Telugu, Kannada, Tamil, Gujarati and Punjabi.

IFFCO Kisan Agriculture:

Launched in 2015 and managed by IFFCO Kisan is a subsidiary of Indian Farmers' Fertilizer Cooperative Ltd. Its goal is to provide information to Indian farmers so that they may make informed decisions through customized information related to their needs. Moreover, the user may also access a number of informational modules such as agricultural advise, weather, market prices, and an agriculture information library in the form of text, pictures, audio, and videos in the specified language. This organisation began improving the lives of farmers through a variety of methods. With services like mobile advising, the IFFCO Kisan Agriculture App, and the Kisan call centre, likely to change the agricultural sector with technology while also uplifting farmers standards of living. It also provides distribution services for a variety of products, such as cattle feed, spices, and honey. The

programme also includes phone numbers for contacting Kisan Call Centre Services. Farmers all around the country may get answers to their questions by dialling the toll-free number 1800 180 1551.

Agri App:

It's a fully farmer-friendly application that includes information on Crop Production, Crop Protection, and other important agricultural allied services. It also gives farmers access to all information about "High value, low product" category crops, including varieties, soil/climate, harvesting, and storage methods. This app also includes an opportunity to interact with professionals, video-based learning, the latest news, and online markets for fertilizers, pesticides, and other products. It is an all-encompassing ag tech feature that includes ICT, IoT, Big Data, e-Commerce, and mobile commerce with the goal of bringing technology to the agricultural and food industry to give a smart farming solution.

Kheti-Badi:

'Kheti-Badi' is a social initiative app that was established in 2015 with the goal of promoting and supporting 'Organic Farming' as well as providing crucial information and concerns to Indian farmers. This software assists farmers in making the transition from chemical to organic farming. However, this software is only accessible in four languages right now (Hindi, English, Marathi, and Gujarati).

Crop Insurance:

It's a fantastic app that assists farmers in calculating insurance premiums for alerted crops as well as providing information on cut-off dates and firm contacts specific to their crop and locality. Farmers may use it as a reminder and calculation for their insurance. It may also be used to obtain information on any notified crop's normal sum insured, extended sum insured, premium details, and subsidy information in any notified region. It also has an online platform that serves all stakeholders, including farmers, states, insurance firms, and banks.

Shetkari:

Shetkari Mitra is a multi-purpose smartphone app for Indian farmers. It gives information and expertise on government programmes, crop management, agricultural business and guidelines, market rates, and agricultural success stories.

Kisan Suvidha:

It was launched by Prime Minister Shri Narendra Modi in 2016 with the goal of empowering farmers and developing villages. The app's design is clean and user-friendly, and it gives information on current weather as well as forecasts for the next five days, market pricing of commodities/crops in the nearby town, fertiliser, seed, and machinery expertise, and so on. The app's ability to be used in several languages makes it more readily accessible.

Kisan Suvidha:

Kisan Suvidha is an omnibus mobile app designed to assist farmers by instantly presenting them with vital information. They may acquire information on the weather for the current day and the next five days, dealers, market pricing, agro advisories, plant protection, and IPM practises with a single click of a button. Unique features such as extreme weather alerts and commodity market prices in the nearby area, as well as the highest price in the state and India, have been introduced to further empower farmers.

Pusa Krishi:

It's a government app that was introduced in 2016 by the Union Agriculture Minister with the goal of assisting farmers in learning about technology created by the Indian Agriculture Research Institute (IARI) that would help them increase their returns. The app also offers farmers with information on new crop types created by the Indian Council of Agriculture Research (ICAR), resource-saving cultivation procedures, and farm machinery, and its use will help farmers earn more money.

UMANG:

UMANG (Unified Mobile Application for New-Age Governance) is one of the major efforts under the Digital India program, which aims to create a uniform, unified platform and mobile app that would allow citizens to access all government services from a single location. It will serve as a master application that will integrate 200 apps to provide about 1,200 services from various federal, state, and municipal government departments, as well as certain vital utility services from the private sector. Its main goal is to relieve consumers' frustrations with maintaining many mobile applications and to provide a one-stop shop for a variety of government services.

Agri-Market:

The app's objective is to keep farmers informed about crop prices and discourage them from participating in distress sales. Farmers may use the Agri-Market Mobile App to get information on crop pricing at marketplaces within 50 kilometres of their device. ■

APPLICATION OF REMOTE SENSING IN PRECISION FARMING

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Precision agriculture, often known as Precision Farming, is a new farm management strategy that is revolutionizing the way people farm. There is a growing commitment in agriculture today to lessen reliance on excessive chemical inputs. Various technologies have been used to make agricultural products safer and reduce their negative environmental impacts, an aim that is in line with sustainable agriculture. Precision farming has emerged as an important part of the strategy for achieving this goal. Precision farming is a new agricultural technology that entails managing each crop input on a site-by-site basis in order to reduce waste, boost revenues, and maintain environmental quality. The remote sensing technology explains how it can be employed as a useful precision agricultural tool.

Precision Farming and technologies

Precision farming (PF) is a production technique that encourages varied field management practices based on site conditions. This method is based on new tools and information sources made available by modern technology. The global positioning system (GPS), geographic information systems (GIS), yield monitoring devices, soil, plant, and pest sensors, remote sensing, and variable-rate input applicator technologies are among them.

Remote sensing

The art and science of gathering information about objects or regions from a distance without having physical touch with the objects or areas under investigation is known as remote sensing. The use of electromagnetic spectrum (visible, infrared, and microwaves) to assess the earth's properties is the principle behind remote sensing. Because the targets' normal reactions to these wavelength regions differ, they can be utilized to discriminate between vegetation, bare soil, water, and other comparable phenomena.

Remote sensing (RS) and precision farming (PF)

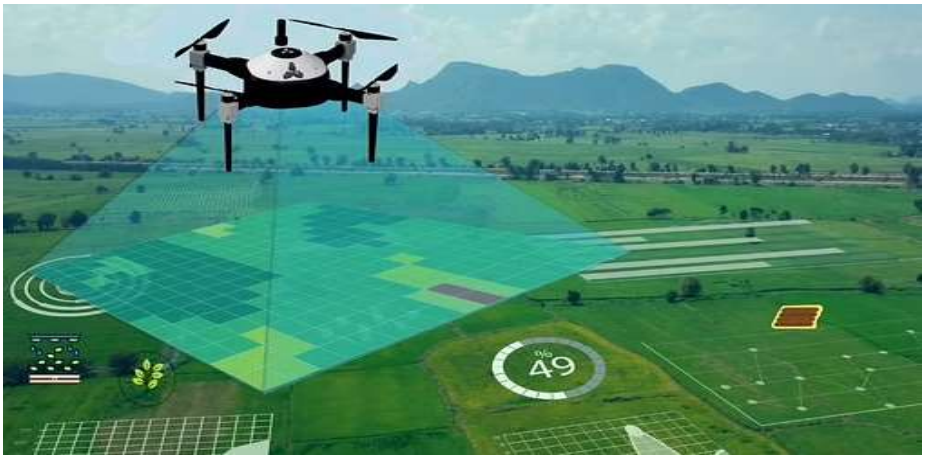
A PF system that takes advantage of current advancements in sensor technology can help to create a smart crop production system. Remote sensing technology, in particular, that enables for the non-destructive capture of information about the Earth's surface, can help with PF deployment. Remote sensing tools such as cameras, laser scanners, linear arrays, and area arrays may detect current crop status (including maturity period) and agricultural challenges such as nutrition and water stress, disease, insect, and weed infestations without actually coming into contact with them.

How can remote-sensed data be used in agriculture?

Today, RS has the potential to be a useful management tool for crop management on a site-by-site basis.

The commercial availability of very high-resolution satellite data has opened up a slew of new possibilities for Earth Observation (EO) data applications. Higher resolution satellite imaging currently overcomes prior limitations and allows for the use of such data as a quick and easy instrument for territorial management, such as agricultural analysis, statistics, and subsidy control.

New RS multispectral and hyperspectral sensors are rapidly generating large volumes of data at better spatial and spectral resolutions while being cost-effective. Hyperspectral and multispectral images, which combine reflectance from the visible, near-infrared, and mid-infrared regions of the



electromagnetic spectrum, can be used to interpret physical parameters (such as crop cover, crop health, and soil moisture) and are useful for stress mapping, fertilization and pesticide application, and irrigation management.

Soil parameters can be mapped, crop species can be classified, crop water stress can be detected, weeds and crop diseases can be monitored, and crop yield can be mapped using remote sensing photography. When employing remote sensing photos for agricultural decision-making, several factors must be considered, including: (1) how exactly the image matches the ground location (also known as geometric precision); (2) the extent to which the image depicts ground features (i.e., spatial and spectral resolutions); and (3) the quality of spectral information contained in obtained images. Quality of remote sensed photographs is influenced by a variety of factors.

Remote sensing applications in precising farming

1. **Crop production forecasting:**

Remote sensing is used to predict agricultural production and yield across a certain region and how much of the crop will be harvested under specific conditions. Researchers can forecast the amount of crop that will be produced in a certain acreage over a specific time period.

2. **Assessment of crop damage and crop progress:**

On the event of crop damage or crop progress, remote sensing technology can be utilized to infiltrate fields and assess exactly how much of a certain crop has been damaged and how the remaining crop in the farm is progressing.

3. **Horticulture, Cropping Systems Analysis:**

The use of remote sensing technologies has also aided in the study of various crop planting strategies. This technology has primarily been used in the horticultural business, where flower growth patterns may be examined and predictions produced.

4. **Crop Identification:**

The research of diverse crop planting tactics has also benefited from remote sensing technologies. This technology has mostly been applied to the horticultural industry, where flower growth patterns may be studied and forecasts made.

5. **Crop acreage estimation:**

Remote sensing has also proved useful in estimating the amount of farmland that has been planted with a crop. Because of the huge extent of the areas being evaluated, this is usually a time-consuming process if done manually.

6. **Crop condition assessment and stress detection:**

Remote sensing technology is crucial in determining the health of each crop and how well it has resisted stress. This information is then utilized to assess the crop's quality.

7. **Identification of planting and harvesting dates:**

Farmers may now utilize remote sensing to examine a range of parameters, such as weather patterns and soil types, in order to predict the planting and harvesting seasons of each crop, thanks to the predictive nature of remote sensing technology.

8. **Crop yield modeling and estimation:**

Farmers and experts can also use remote sensing to anticipate the projected crop output from a given field by calculating the crop quality and the farmland's size. This is then used to calculate the crop's overall projected yield.

9. **Identification of pests and disease infestation:**

Remote sensing technology is also useful for identifying pests in fields and providing information on the best pest control mechanisms to utilize to eliminate pests and diseases on the farm.

10. **Soil moisture estimation:**

Without the use of remote sensing technologies, measuring soil moisture can be challenging. Remote sensing provides data on soil moisture, which aids in assessing the amount of moisture in the soil and, as a result, the sort of crop that may be produced there.

11. **Irrigation monitoring and management:**

Remote sensing provides data on the amount of moisture in soils. This

information is used to assess whether or not a particular soil is moisture deficient, as well as to plan for the soil's irrigation demands.

12. Soil mapping:

Remote sensing is used for soil mapping, which is one of the most prevalent and essential applications. Farmers may determine which soils are best for specific crops, as well as which soils require irrigation and which do not using soil mapping. Precision agriculture benefits from this information.

13. Monitoring of droughts:

Weather patterns, especially drought patterns, are monitored using remote sensing equipment over a given area. The data can be used to forecast rainfall patterns in a certain area, as well as to determine the time difference between present rainfall and the next rainfall, which aids in drought monitoring.

14. Land cover and land degradation mapping:

Experts have employed remote sensing to map a certain area's land cover. Experts can now determine which parts of the land have been degraded and which have not. This also aids them in putting measures in place to combat land degradation.

15. Identification of problematic soils:

Remote sensing has also been useful in identifying problematic soils that have a hard time maintaining optimal agricultural output throughout the planting season.

Future prospects

Even at small farm holdings, remote sensing is particularly effective in analyzing various abiotic and biotic stresses in various crops, as well as in recognizing and managing various crop concerns. It is necessary to establish a state or district level information system based on available information on diverse crops acquired through remote sensing and GIS technologies in order to efficiently use crop information for economic improvement. Governments can use remote sensing data to make critical judgments about policies they will pursue or how to address national agricultural challenges. Nano-chips are implanted in plant and seed tissue and can be utilized in near-real time to monitor crops in a novel and nontraditional remote sensing application.

Conclusion

With rising population pressures around the world and the need for increased agricultural productivity, better management of the world's agricultural resources is critical. To do so, you'll need solid data on not only the types of resources, but also their quality, amount, and location. Satellite- or aerial-based RS technologies will become critical instruments for upgrading current agriculture and natural resource data acquisition and generation systems. The identification and assessment of agricultural production based on biophysical properties of crops and/or soils could be revolutionized by RS technology. Essentially, the information received from RS data is more valuable when combined with ground data, just like other Precision farming components.

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ROBOTICS IN AGRICULTURE

FUTURE ASPECTS

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Robotics is the branch of technology that deals with the design, construction, operation, structural grounds, manufacture, and operation of robots. Robotics brings together several veritably different engineering areas and chops. Currently Robotics is a fleetly growing field and it continues to probe, design, and make new robots that serve colorful practical purposes. By robotics numerous effects in husbandry can be done like sowing the seeds, Plantation, soddening the shops, cutting the weeds scattering diseases and chemicals, examining the soil and harvesting the yield, cutting the weeds, killing the pest, and insects that harm the crops.

Introduction

The future of agriculture product system aims to produce high quality and volume agrarian yield for a wide range of consumers. The main challenge to agrarian experimenters around the world is to perceive sustainable husbandry by judicious use of ever limiting natural coffers and forestallment of the terrain. Ranch robotization is one of the determining factors for the advancement of the husbandry product system and to feed the burgeoning mortal population. Agriculture has been a great source of public income. so, to contemporize the husbandry sector we can make use of a machine called an husbandry robot that automates the tasks for growers by minimizing the assiduity's reliance on physical labor and adding the effectiveness of product. The agrarian product system has witnessed a paradigm shift in the last many decades with advancements in perfection agrarian technologies. In India, a robot has been successfully employed in diligence, the service sector, and security.

Concepts and components of robots

The concept of usage of robotics in agriculture has to comply i.e. Better response to the unexpected and uncertain working environment, feasible to existing technology, and economically viable than its alternatives. The conceptual idea to replicate or imitate the traditional agricultural practices with robotic technology had been tried in the various unit operation of agriculture, yet no commercial robots are available in complex agricultural field conditions (Urrea & Munoz, 2015).

Application of Robotics in Agriculture

- Seeds are sown efficiently at a depth and at a distance between rows that are appropriate for each crop type when they are programmed.
- Using a robot with a water tank that sprays water all over the field, it eliminates the need for a large pipe setup, thus making the operation easier.
- Several parameters along the robotic path make the leveling process simple. The robot works based on commands provided by the controller.
- By improving the efficiency and productivity of crop cutting, it helps farmers think about how to improve the quality of their crops.

Advantages of robotics farming

Elimination of labor- The farmer is freed from the milking process and associated rigid schedule, and labor is devoted to the supervision of animals, feeding, etc.

- Unemployed people and those who think farming is a nightmare will have the opportunity to self-support themselves with it.
- This is a one-time investment, and you will see a drastic reduction in costs on farming.
- Using less fertilizer, pesticides, insecticides, herbicides, and water can reduce the use of all of these substances by a significant margin.
- It brings a revolution in farming, agriculture, and cattle grazing.
- Productivity will be increased to a lot extent.

Disadvantages of Robotics Farming

- It is costlier to implement.

- Complexity is increased.
- Time management and skill full labor are required.
- Although Roberts runs on electricity, more than 65% of India's farming region is without power.

Scope of farm robots in India

Our ranch outfit companies and experimenters have developed a lot of small and heavy ranch outfit for traditional husbandry requirements but some kind of robotic and curvaceous medium is needed in perfection husbandry. As robots have entered the mentioned above fields it's important to suppose about, why the robots aren't entered the husbandry field? If the robots are being used for weed control, that will help to reduce the dressings operation and the produces will turn organic, the same way robots can be used for broadcasting the seedlings to avoid ferocious labor. We used to read in journals about a many emotional innovative technologies by pastoral formulators i.e. electric motors can be operated ever by cell phones, it's veritably helpful to growers in the summertime since the power force is irregular. However, Detectors or compendiums and handheld PDAs are going to be greatly helpful in calculation and delicacy in husbandry, If we suppose advanced intelligent machines in husbandry. There are a lot of hurdles taken in the husbandry sector in all countries but especially in India.

Future Aspects

Sensors as an extension to this initial prototype many sensors can be added to detect obstacles, to detect temperature and moisture content. Sensors to detect the depth of the land to appropriately sow seeds can be added. A camera can be installed on the Agriculture Robot and the application can be modified to display the field with a 360^{o} view on the app as the robot moves. New technologies like Zigbee, WIFI, and WI Smart can be used to have a large connectivity range. Automated disease prediction. The robot can be designed with a chain roller instead of a normal wheel.

Conclusion

Agriculture has been a great source of public income. so, to contemporize the agriculture sector we can make use of a machine called an husbandry robot that automates the tasks for growers by minimizing the assiduity's reliance on physical labor and adding the effectiveness of product. Many attempts have been in India in the field of robotic operation in husbandry, but they all are developed at a laboratory scale. With the advancement of bedded systems, computing, machine literacy, and artificial intelligence, an attempt can be made to promote perfection husbandry.

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TECHNOLOGY ADOPTION IN AGRICULTURE AND KARNATAKA STEP FORWARD

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India is a major agricultural country with a large rural area. Most people still live on traditional farming systems. However, climate change, soil quality, nutrient variation, premature rainfall, etc. are many ways our farmer's life is a one-way walk.

In terms of the economy of the country, it is only about 15-20 per cent of our GDP from agriculture where over 50 per cent of the people are engaged. However, the situation has changed slightly after Covid arrived. Many have left the cities and settled in the villages, leaning towards agriculture. As such, there are many obstacles, including lack of experience and lack of modern technology, to adapt to this role. People are attracted from the technology sector to the agriculture sector.

People are attracted to technology from the technology sector to the agriculture sector, so it is a pleasure to see the use of sophisticated technology and new innovations.

This growth is optimistic in terms of the economy. It is believed that the lessons learned and experiments conducted during the Covid crisis will all add to the future of agriculture. Center and Governments have implemented ten-to-one projects to hold those who are stepping in this direction.

Until recently, there was a misconception that agriculture was a different technology. Only the industries, machinery, semiconductor sector, technology sectors were excluded from the agriculture sector. But the emphasis is on attracting youth towards agriculture and agriculture, and in this direction, the Farmers Training Scheme is recommended to provide supplementary training to the youth in order to increase the demand for the sector by linking the farmer manufacturing centers with the agricultural technology companies. Agricultural technological innovation is on the rise in the country.

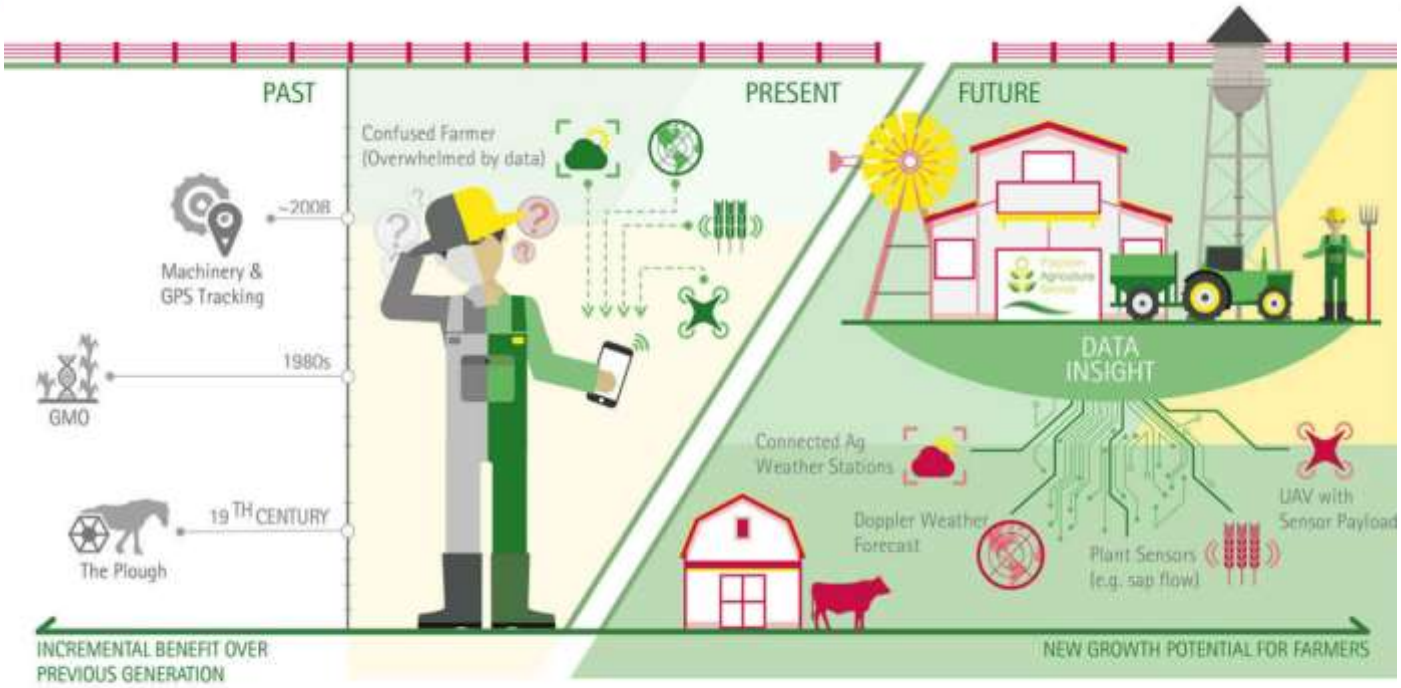
More than 70 startups are involved in providing direct marketing for agricultural products. This has resulted in farmers' income increasing by one and a half. Emphasis is placed on establishing a direct marketing network between agri-food technology companies and agro-producers, encouraging start-ups and tech entrepreneurs in the state to engage in farming and agriculture activities.

Social enterprise, such as 'agroforestry', plays an important role in facilitating price direct marketing system for farmers through agriculture. This facility is practiced in select districts and some growers are getting good prices for the produce. So far, the market has been valued at over Rs. 7 crore, with farmers earning more than Rs. 1 crore and profiting from farm producers over Rs. 80 lakh. Farmers' producers in Hosahalli village of Ramanagara, in association with the Agricultural Institute, are arranging to process the coconuts purchased directly from the farmers and deliver them directly to the consumers.

Being supplied to the Different States

People in this area have been growing coconuts for many years but due to lack of technology and the prevalence of brokers, one kg is lost. Coconut is only Rs. There was a selling situation. But now they are getting Rs. 35 per kg of coconut. The purchased coconut is best processed and supplied to outside states. "Without advanced technology in agriculture, the value of crops will be impossible and the need for food in the future will be difficult".

Government of Karnataka goal is to make every farmer a small entrepreneur with a new look at the agricultural supply chain with a



focus on farmers. The next generation of farmers will have more technical know-how and the latest technologies, including the Broad brand, will reach the far end of the country. This technological development needs to be used to increase agricultural yields, increase productivity and market linkage.

Agricultural barriers and alternative routes

In recent days, the decline of agricultural land and land fertility, lack of nutrients, and opportunities in the agricultural sector are failing to promote interest in agriculture for the younger generation. In addition, over 70 per cent of the farm is rain-based.

In the case of extreme climatic conditions, there is a loss of about 15-20% of the crop before harvest. The development of high yielding cultivars through the moderate use of water and the development of crops need to be developed. Digital technology is now being adopted in agriculture as well.

Entrepreneurs should therefore consider using this digital technology to improve farming practices and enhance the value of agricultural products. The sector is being redefined with sophisticated technology adoption, continuous experimentation and better marketing.

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STANDARDS FOR THE PRODUCTION OF HIGH QUALITY ESSENTIAL OILS

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The quality of essential/aromatic oils depends on their purity. If the oil is completely pure, its market price will definitely be good, the storage capacity will be high, and the demand will also be high. Different types of tests exist to determine good quality, depending on the purity that can be determined. In this, the GLC method is the best. For this, care must be taken from the start so that subsequent cleaning is not necessary.

1. Use of plant parts

Only the part of the plant from which the oil will be extracted should be used because the fragrance comes from the rose flower. Therefore, do not mix anything else (leaves, stem, root), etc. with rose flowers at the time of distillation, otherwise its purity will decrease. Similarly, sandalwood oil is obtained from the inner part of the stem (from the mature part). So you have to use the same part. If other woods are used at the same time, there will almost certainly be a loss of purity and subsequent cleaning will be required. Therefore, due to inaccuracy, the cost will increase and the value will decrease.

2. Use the same temperature

The same temperature should be used for distillation. The distillation process is affected by low temperatures, which affects the quantity and quality of the oil. Initially, the temperature should be kept low, and then the temperature should be gradually increased. In the modern era, this task can be done very easily. The temperature should also be checked from time to time with a thermometer. Cow dung cakes as fuel in the distillation unit are best suited for distillation, keeping the temperature under control and gradually increasing, and then gradually decreasing until the distillation process is complete.

3. Use special metal tools

In the distillation, only special metal utensils should be used so that this metal cannot be mixed with the oil. For the distillation of most oils, a copper pan is suitable, which does not affect the quality of the oil. It is not correct to use metal utensils such as iron, aluminum, copper, bronze, etc. Its use reduces the quality of the oil. It is recommended that only copper be widely used. Suitable steel utensils can also be used. But its use reduces the quality and iron utensils should not be used under any circumstances.

4. Storage and purification of essential/aromatic oils

The oil must be stored in a cool and moisture-free place; otherwise its quality may decrease. Then the oil must be carefully checked, if there is any kind of adulteration. It must be carefully filtered so that the pure oil can be obtained and stored. If all the above precautions are taken, the full amount of oil will be obtained.

5. Packing of oils

The packaging and storage of oils is very important from the point of view of marketing and maintaining the quality. The cost of some essential oils is very high, while the needs of consumers are very low. In such a situation, it is very important to provide the oil container according to the consumer's requirements. These oils cannot be sold in an open storage container. Because some plant oils are naturally volatile at normal

temperature and cannot be weighed in small quantities. If the packaging becomes more expensive than the price of the oil, then the packaging should be done in such quantity that the cost of the packaging is reduced. Oil containers vary from small glass bottles to large glass bottles, depending on the requirements. The volume of small bottles is 5 ml, and large jars up to 20 liters, glassware are quite suitable, since there is no chemical reaction in them. But it may break when falling on the ground, stone, etc. We can now store in a variety of containers, from small plastic bottles to large containers.

6. Indian and international quality standards for essential/aromatic oils

Essential oils have been traded in India since the beginning of history. Also, essential oils from India have a special position in the market. Sandalwood, palm, lemongrass and other essential oils have already been exported from India to other countries. Sandalwood oil is originally made in Karnataka and sold to other countries, but is now produced from a variety of essential/aromatic oils. With the discovery of essential/aromatic oils, the process of standardization and quality control of essential/aromatic oils began. Currently CSIR, ICAR, CAP, CIMAP, etc. are expanding and producing essential oils. Today, citronella, lemongrass, sandalwood, rose and palmrosa oils are exported in abundance. Considering the export, it is very important to determine the quality standards of the oils with which our products are not left behind in commercial competition. With the establishment of the Indian Institute of Standardization in 1947, a committee for essential oils and related products was formed to prepare national standards for these products. This committee is now known as the Committee on Natural and Synthetic Composite Substances. Here are some oil qualities testing methods.

a. Standard determination method for quality assessment

This method was developed by incorporating modern technologies. The level of international reference institutions is also taken into account in this evaluation method. Many types of tests are done this way. Like gas, character, writing that is used mainly to identify aromatic substances.

b. Oil factory selection methodology

In this test, it is recommended to test the oils whether the oil is food grade or not. On this basis, a recommendation is given as to whether or not the oil should be added to the perfumery industries.

7. Storage of essential/ aromatic oils

It is necessary to maintain the oil at a certain temperature to maintain its purity. In general, when the temperature is high, the biological action develops slowly. As a result, the purity begins to deteriorate, which leads to natural weight loss. At room temperature, some essential oils are harmless. However, some essential oils are volatile in the air. The presence of light rapidly degrades the quality of certain essential oils. Therefore, it is best to keep them in the dark and in an enclosed space. The storage environment is different for different oils. Peppermint, eucalyptus and palm oils can be stored at room temperature without damage. Stronger smelling oils are more susceptible to damage. As a result, the oils are best stored in a cool environment.

8. Marketing and commercialization of essential/aromatic oils

In India, essential oils of sandalwood, jasmine, rose, vetiver, etc. are widely prepared and used in the baking, cooking, perfumery, cosmetics and pharmaceutical industries. Rose oil is produced on a large scale in Kannauj in Uttar Pradesh and Kivada oil in West Bengal. Vetiver oil is produced in large quantities in Haryana and western Uttar Pradesh. All these products are manufactured only by specialist dealers. These merchants are mainly associated with Delhi, Mumbai, Calcutta, Lucknow and Kanoug.

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UNIVERSAL UTILIZATION OF COLOCASIA

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Colocasia (*Colocasia esculenta*) belongs to family Araceae is one of the most paying crop. Commonly it is known as alvi, arvi, ghuiyan, ghuiya, elephant ear, alooka and many more local names. It is grown all over the country, although the primary growing states are Himachal Pradesh, Uttar Pradesh, Bihar, Bengal, Uttarakhand, and Maharastra. Every year, the crop is grown twice. Summer crops are planted in February-March, whereas rainy season crops are sown in June-July. It is also used for therapeutic purposes in some parts of India; for example, the juice of petioles is dripped into the ears of youngsters with otorrhoea, and its hot tubers are used topically to rheumatism. The ash of rootstock mixed with honey is used for local application for Aphthae in the mouth.

Crop

It's a tuberous perennial with a big, heart-shaped leaf blade carried on long petioles that emerge from underground corms. It's a warm-season crop that thrives in hot, humid climates. It can't stand even the little bit of frost. Blight infection may be exacerbated by high humidity and rainfall. It grows best in soils that are deep, well-manured, and sandy loam to friable loam. Eight to ten quintals of medium-sized corms are sufficient for seed sowing over a one-hectare region. Corms that have sprouted can be sown in both flat beds and ridges. There should be enough moisture in the field at the time of planting to provide a better and more uniform emergence.

Harvesting

In 6-8 months after planting, the crop will be ready to harvest. All suckers should be wrapped around the base of the mother plant and covered with soil one month before harvest to prevent additional vegetative growth and tuber sprouting. To hasten maturity, watering must be stopped after this. Harvesting involves gently uprooting the plants and separating the mother corms and cormel. The average production per hectare might range from 200 to 250 quintal. Harvested corms should be stored in a dry, cold location and turned at regular intervals. With appropriate storage, this crop can be storage for 4 to 5 months in a cold, dry location. They should be maintained in the freezer for three to four months at 0°C to 10°C.

Nutritional Facts

Colocasia is high in fiber, potassium, magnesium, and vitamins C and E, among other minerals. It also has high levels of pyridoxine (vitamin B-6), folates, riboflavin, pantothenic acid, and thiamine, which are all important B-complex vitamins. It has a moisture content of 73%.

Colocasia – Nutritive Value of Common foods	
Fiber (g)	1
Mineral (g)	2
Protein (g)	3
Carbohydrates (g)	21
Calcium (mg)	35
Moisture (g)	72
Phosphorus (mg)	140
Vitamin-C (mg)	1.82
Sodium (mg)	4
Magnesium (mg)	37
Energy (kcal)	92
All values as per 100g of edible portion	

Where, g = gram, mg = milligram, kcal = kilocalories.

Food Uses of colocasia

However, in tribal areas, hills, and foothills, Colcocasia is more popular as a cuisine. It's a really healthy food, and the best thing is that every edible component of the plant contains necessary elements. Tubers are more commonly consumed as a vegetable. When boiled, the tubers become sticky, and when chopped raw, they produce white marks. The presence of starch is primarily responsible for this feature. When eaten partially cooked or raw, several tuber kinds are bitter and aromatic. Colocasia is a plant whose entire body is nutrient-dense and edible.

Tubers

Colocasia tubers are rich source of carbohydrates and many essential minerals. Thoroughly clean and dried tubers are peeled and cut into thin slices for simple dry-fried spicy vegetable. When shallow fried or deep fried, colocasia tubers known as kaale alva maddi make delicious fritters. These are known as maddi phodi and are a popular Konkani dish. Konkanis love Colocasia tubers, often known as maaddi. Maaddi is used to make delicious phodis, either shallow fried (tava fry/rava fry) or deep fried.

Leaves

Arvi leaves have a heart shape and are green in colour. They are widely used in Indian recipes. Colocasia leaves are a good source of fibre and are used to make a delicious treat known as patora or patrora in the local language. Fresh young colocasia leaves are carefully cleansed. The rear sides of the leaves are coated with a spicy gram flour batter, and 3-4 leaves are layered on top of one another before being rolled. These rolls can be rolled up and fastened with thread or covered with turmeric leaves or other large edible leaves. After that, they are steamed for 10-15 minutes to tenderise them. Cut the rolls into little pieces after they've been cooked. These pieces can be eaten as tea time snacks or served with food.

Benefits of Colocasia

(1) Benefits of arbi in the digestive system

The benefits of eating arbi are that it is rich in fiber, due to which it is a good food for our digestive system. With the help of fiber, the digestive system works better, due to which it helps in digestion of food. Apart from this, it can also help prevent diseases like gas, cramps, constipation and diarrhea.

(2) Benefits of arbi for healthy eyes

Arbi also has antioxidant and anti-inflammatory properties (4), which are essential for aging eye health. Along with this, essential elements like Vitamin-A, C and Zinc are also found in it, which can be helpful in removing diseases caused by it by increasing eyesight.

(3) Benefits of eating arbi for cancer

Arbi is considered a good source of polyphenols. Polyphenols have the potential to reduce the risk of cancer. Polyphenols can inhibit cancer cell growth. It also helps in reducing tumorigenic cells. These are tumorigenic cells, which cause cancer by increasing tumor.

(4) For a healthy heart

The fiber and starch in arbi can help keep you healthy by protecting you from the risk of heart disease. Research has found that people who have fiber in their diet are less prone to heart disease. The resistance starch present in arbi acts like a fiber. It lowers cholesterol and protects the heart from various diseases.

(5) Reduce fatigue

The fiber found in arbi slows down the process of digesting food and helps in providing energy to the body to keep it fit for a longer period of time. This can reduce fatigue. In this sense, it can prove to be a good food item for athletes.

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BLACK PEPPER AS MIXED CROP IN COCONUT GARDEN

AN ALTERNATE SOURCE OF INCOME FOR FARMERS

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Coconut or *Cocos nusifera* is one of the most valuable plantation crop in India. Single coconut trees are usually planted at a spacing of 7.5 × 7.5 m, allowing only 22.3 percent of the total land area to be used successfully. In addition, the full growth of the plant consumes about 30 percent of the vacant space on an average and is capable of utilizing 45 to 50 percent of solar radiation, which makes them highly adaptable to crop diversity.

According to various experts in the Coconut Laboratory, the optimum spacing of 26 feet × 26 feet between the coconut trees is ideal to give the expected yield. In addition to increasing the production of coconut, the value of land review also fell to a large extent. For maximum utilization of revenue and resources, a coconut-based high density multi-species cropping system (HDMSCS) method is required. This method can be used to cultivate vegetables, fruits and spices. Coconut cultivation with one or two suitable intercrops on the one hand ensures optimal use of land as well as provides several additional benefits. Black pepper or *Piper nigrum* is one of the most notable spice crops, and various studies have shown that it can be effectively cultivated with coconut as an intercrop. Intercropping with pepper increases coconut production and plays an important role in soil erosion and weed control. In addition, Glyricidia can be cultivated as a soil covering crop around the coconut tree which will help in the early stages of black pepper plant growth as well as help maintain moisture in the soil around the coconut tree and be used as a source of organic nitrogen fertilizer. However, it should be kept in mind that in areas with high rainfall, black pepper cultivation reduces soil productivity due to nutrient depletion, which affects crop development.

Method of planting

The rooted cuttings or seedlings should be planted 1 m away from the coconut bowl on the north-east side. Before planting, a trench of 50 x 50 x 50 cm^3 should be dug in the area mentioned above and left open for 15 days. The amount of organic manure available in the hole should be used at the time of planting and the cuttings should be planted. Both living and non-living supports can be used for climbing black vines. As an inanimate support, concrete poles 10 x 10 cm wide and 3.5 m high should be used. On the other hand, the use of Glyricidia as a living resort is known. However, it is necessary to plant Glyricidia seedlings six months before the pepper. The Glyricidia support should be 2.5 m long and a gap of at least 3 cm should be maintained between the two. However, Glyricidia used in the resort can be planted in two ways.

1) A hole of 15 cm should be dug under the support.

2) The support should be placed directly in the hole.

Proper care of Glyricidia used in the resort

During germination, special attention should be paid to the care of Glyricidia and for this it is necessary to tear off the two best developing shoots at the beginning. The minimum spacing between the two trees should be one foot. When the Glyricidia branches reach a height of 3 to 3.5 m, the tops of the trees should be pruned to avoid excessive growth. Make sure there are at least four branches. All maintenance techniques need to be adopted for proper care of Glyceridia. Special care should be taken to ensure that the height of the tree does not exceed 4 to 5 meters, otherwise it will have a negative effect on the development of black pepper.

Suitable varieties

Among the improved varieties of black pepper are Panniur-1, Panniur-4, and Panniur-5, Thevam, Srikara, Panchami and Karimunda. Under a coconut-based high-density multi-species cropping system, farmers get a good yield of 2.5 to 4 kg of dried pepper per plant per year from variety of Panniur-1. Other varieties, such as Panniur-4 and Panniur-5, Srikara and Panchami, have the potential to provide high yields of 1.5 to 2.5 kg of dried pepper per plant per year.

Rules for proper care of pepper vine

Fertilizer application should be started from 6 months after planting. When applying the fertilizer, the fertilizer mixture should be applied about 15 cm away from the tree and about 1 foot away in case of large vines, avoiding stalks and leaves and perforating well. The success of black pepper production depends largely on how the plant is cared for in terms of proper nutrition management and disease management. Nitrogen, Phosphorus and Potassium should be applied as chemical fertilizers at 50, 50 and 150 gm per plant. However, organic manure like vermicompost or dung manure or compost 2 to 3 kg of organic manure per plant gives good yield. Care should be taken while applying the fertilizer so that the root part of the plant is not damaged in any way. For this spread the fertilizer 5 cm outwards from the base and cover the place with old leaves. Irrigation is essential throughout the summer months and can be done if drip irrigation or sprinkler irrigation is available. Particular attention should be paid to the prevention of disease insects. In case of black pepper spray disease, an integrated disease management method consisting of use of fungicide and organic agent (*Trichoderma viride*) with neem cake or vermi compost should be used.

The right time to prune pepper vines

After growing about nine leaves in a row, the top three leaves should be cut off leaving the bottom six intact. However, within a week of the onset of the rainy season, the lower three leaves of the vine should be left intact and the remaining leaves should be torn off. In this method the vines will grow tubularly and the horizontal branches will bloom more from 3 or 4 main branches. Prior to application of fertilizers, shrubs that have fallen off or touched the soil should be removed.

The best time to harvest

The vines should not be allowed to grow more than 20 to 25 feet. It is easy to collect berries and there is no problem in climbing coconut from coconut tree. With proper care and maintenance, the crop can be collected from the second year. About 1 to 1.5 kg per plant can be obtained from selected local varieties and improved varieties. About 500 to 600 kg of pepper can be collected in one year from an intercrop of pepper in one acre of coconut land. At present, the sale of one kg of pepper can generate an additional income of around Rs. 700. Farmers can get a profit of around Rs. 350,000 to Rs. 525,000 from one acre of intercrop coconut land with pepper. ■

ARBORICULTURE

A GATEWAY FOR ECOTOURSIM

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Arboriculture refers growing of trees, shrubs and other woody plants with the aim of providing shade, beauty, and environmental improvement. It comprises planting, propagation, and overall upkeep to meet the goals for which they were grown. Arboriculture is primarily concerned with the well-being of individual plants. Arboriculture's fundamental ideas and goals date back thousands of years.

Importance

Trees are the primary component of arboriculture, and they have a significant influence on the local agro-climatic conditions in a variety of ways. Trees are living, active plants that adapt to their surroundings with power and flexibility. Growth removes carbon dioxide from the atmosphere and swaps it for oxygen. Forests cover huge areas and serve as the planet's lungs and carbon storage. They are part of local, regional, and global forests as urban persons and woods. They reduce floods and soil erosion by filtering pollutants from the air, cooling the nearby environment through shade and transpiration, and slowing and dissipating rainfall. Trees obtain oxygen from the earth via their roots. In the urban context, soil disturbance, capping, and compaction make it difficult for trees to access air and sustenance. Construction operations are the most serious hazard to trees.

Environmental significance

Arboriculture definitely contributes to the health of the biological environment in urban neighbourhoods, as well as the health of the social ecosystem. Barren, treeless places in residential neighbourhoods frequently become "no man's lands," discouraging resident contact and inviting crime. The presence of trees and well-kept grass may convert these wasteland areas into lovely, friendly, and well-used areas. Arboricultural inputs play an increasingly important role in informing the design process and demonstrating the interrelationship between trees and development has been fully considered and is sustainable. An arboricultural impact assessment (AIA) is an important tool in the process. Trees are important assets in rural and urban landscapes. Their benefits are

Ecotourism

Héctor Ceballos-Lascurain created the word ecotourism in 1983 to define nature-based travel to relatively undisturbed places with an emphasis on education. However, the notion has evolved into a scientifically supported approach to the planning, management, and development of sustainable tourism goods and activities. It is an illuminating participatory travel experience to natural and cultural environments that ensures the sustainable use of environmental resources at an appropriate level and, while producing viable economic opportunities for the tourism industry and host communities, makes the use of these resources through conservation beneficial to all tourism role players. It is not a marketing tactic, nor is it nature or picturesque travel.

Generally, ecotourism deals with interaction with biotic components of the natural environments. Ecotourism is concerned with socially responsible travel, personal development, and

environmental sustainability. Ecotourism usually entails visiting places where the principal attractions are flora, wildlife, and cultural heritage. Ecotourism is meant to provide tourists with an understanding of how humans affect the environment and to promote a deeper appreciation for our natural environments. Responsible ecotourism initiatives include those that reduce the harmful effects of traditional tourism on the environment while also enhancing local people's cultural integrity. As a result, in addition to assessing environmental and cultural considerations, ecotourism promotes recycling, energy efficiency, water conservation, and the establishment of economic possibilities for local populations. For these reasons, ecotourism is popular among environmental and social activists.

It is an approach that creates a variety of quality tourism products that are:

- Environmentally/ ecologically sustainable.
- Economically viable.
- Socially and psychologically acceptable.

Importance

Ecotourism is about uniting conservation, communities, and sustainable travel. This means that those who implement, participate in, and market ecotourism activities should adopt the following ecotourism principles to show the importance of the ecotourism:

- Minimize physical, social, behavioral, and psychological impacts
- Build environmental and cultural awareness, and respect.
- Provide positive experiences for both visitors and hosts.
- Generate financial benefits for both local people and private industry.
- Deliver memorable interpretative experiences to visitors that help raise sensitivity to host countries' political, environmental, and social climates.
- Design, construct and operate low-impact facilities.
- Recognize the rights and spiritual beliefs of the Indigenous People in your community and work in partnership with them to create empowerment.

Purposes

Tourism is fast evolving as nature, historical, and recreational locations gain importance, and traditional tourism is obliged to satisfy stricter environmental standards. This puts the government and corporate sector on the spot to come up with innovative ways to the tourist market. Tourism must benefit local residents economically and culturally in order to provide incentives for them to maintain the natural resources that provide the attraction. If private investors are to finance the initiatives, the strategies must be economically feasible.

Our mission is to let visitors to enjoy and learn about the ecological, historical, and cultural qualities of unique locations while protecting their integrity and encouraging economic development prospects in local communities. We feel that effective ecotourism programmes must, in particular:

- Promote the preservation of complete local ecosystems rather than specific species, views, or places;
- Be economically viable in order to attract financing and be sustainable.
- Be carefully planned, financed, managed, and promoted to fulfill the strict environmental and recreational requirements of a real ecotourism venture.

Conclusion

Given the rate of urbanisation, environmental deterioration, and a shortage of open space for urban populations, arboriculture and green spaces offer ample potential for environmental improvement, establishing an ambient atmosphere, and serving as a gateway for eco-tourism for urban residents.

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ESTABLISHMENT OF LAWN UNDER NORTH INDIAN CONDITIONS

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Lawn is a part of garden landscape consist an area covered with ground cover/ grass. It enhances the beauty of garden. Lawn can be called as turf, pitch, field or green depending upon its plantation, usage and continent.

Importance of lawn

- **Climate Control:** Turf serves as a natural air-conditioner. On a hot day, compare the difference between standing on pavement and standing on turf. The difference in temperature and comfort is measurable.
- **Dust filter:** Turf traps dust and smoke particles from the air and acts as a filter for the air we breathe. This is particularly important in urban areas where dust generated by cars and trucks can be trapped and washed down into the soil, preventing further movement.
- **Erosion control:** Grass offers a very efficient and inexpensive erosion control function. Turf intercepts raindrops before they disturb the soil. Turf promotes water percolation rather than runoff.
- **Environmental benefits:** Turf capture and use greenhouse gases, thereby counteracting climate change. Turf also traps air pollution and generates much of the oxygen we breathe.
- **Therapeutic benefits:** Turf provides mental health benefits. The horticultural therapy association exists to promote therapeutic benefits of green space as a technique for rehabilitation. Grassy areas in golf courses, cemeteries, parks and homes can create feelings of peacefulness and remind us that the earth is alive.

Establishment of Lawn

1) Selection of Grasses

a) Bermuda grass (*Cynodon* spp.): Bermuda grass which is also known as Doob grass is a major turf species for sport fields, lawns, parks, golf courses and general utility turfs in India, Australia, Africa, South America and the Southern region of the United States. It is found in over 100 countries throughout the tropical and subtropical areas of the world. The genus *Cynodon* comprises nine species with *C. dactylon* being the most widespread. It is a tetraploid species with broad genetic variability serves to explain its widespread distribution. *C. dactylon* is highly fertile, whereas the diploid species such as *C. transvaalensis* rarely produce viable seed.

b) Zoysia Grass (*Zyosia* spp.) It is native to China, Japan and other parts of Southeast Asia. *Zyosia* grass a highly versatile species, make ideal lawn grasses in some situations and can be used on golf courses, parks and athletic fields. They can be grown in all kinds of soils ranging from sandy to clay soils, both acid and alkaline in reaction. *Zoysia* grass is extremely drought tolerant. It turns straw colored under severe drought conditions and has the capacity to respond quickly to subsequent irrigation or rainfall. *Zoysia* grasses are among the most wear tolerant turf grasses. However, these are slow growing with very poor recuperative potential.

c) **Bahia grass (*Paspalum notatum*):** *Paspalum notatum*, is also known as Bahia Grass, Common Bahia or Pensacola Bahia, is a tropical to subtropical perennial grass (family Poaceae). Bahia grass is native to Mexico and South America. It prefers sandy soils and is tolerant to shade. Bahia grass is a warm season lawn and pasture grass and can survive period of drought. It involves moderate maintenance and mowing and is prone to less diseases and insect problems when compared to other warm lawn grass types.

d) **Centipede grass (*Eremochloa ciliaris*)** Centipede grass of all warm season grass types, involves least maintenance. They are uniform growing; thick sod forming and have a medium to light green coloured grass. It is a creeping perennial grass that adapts itself well to sandy and acidic soils of low fertility grade.

2) Site selection

Site should free from any kind of shade of big trees, wall and structures. Location should receive sunlight adequately. There should be adequate water availability. Lawn should face south east or south west direction

3) Soil condition

Sandy loam with good water holding capacity, well fertile and having a pH of 5-6. Grasses are shallow rooted, so there should be good quality soil rich in sufficient humus and organic matter up to depth of at least 25-30cm.

4) Preparation of land

It includes soil testing for pH reaction and nutrient availability, cleaning and grading, tillage for establishment of subsurface if needed and topsoil and finally fertilizer application and liming followed by final grading. Before grass planting soil should be dug 40-45 cm depth in month of May-June and left the soil for one month to exposure to sunlight. This will help in inactivation of soil borne insect-pest and pathogens. During this period collects the stone pieces from soil as they will hamper rooting of grasses. Destroy the roots of weeds such as motha (*Cyprus rotundus*) and Kans (*Saccharum spontaneum*). Eradication of these weeds is must because once these weeds entre the lawn their control is cumbersome. Apply three layers of FYM or well decomposed manure @25-30 ton/ha. Finally level the field with heavy roller. After that apply flood irrigation, this will lead to show the depression areas and weed seeds will germinate by attaining moisture. Remove all weeds along with roots manually or spray non selective herbicide like paraquate or gramaxone @1.0-1.5 litre/ha.

5) Planting

Grasses are generally propagated vegetatively, though there are grass species which can be propagated through seeds as well. The methods generally used are seeding, sodding, plugging, dibbing, turfing, plastering etc.

- **Seeding:** It easy cheapest and easiest method of turf establishment. Select high quality seed with high seed vigor, better germination etc. Seed rate is different according to species. For example. common cynodon grass/ zoysia grass may requires 500-700 g of seed/m^2, whereas centipede grass may require 200 g seed. Before sowing soil should be scratched to a depth of 2.5 cm. For sowing of seed, mix the seed in double quantity of sand or soil and broadcast in raked soil. After that rake the soil again in opposite direction for well mixing of seed in soil followed by light rolling. Watering is done using hose pipe fitted with fine nozzle. Germination take place in 3-5 weeks
- **Sodding/Turfing:** Sodding is an expensive method of vegetative propagation. However, it can enable establish an instant lawn. In turfing we harvest the grass with roots and soil attached to it and transplanted from its place of orgin and install like a carpet. Establishment procedures for sod include soil preparation, obtaining sod of high quality, transplanting and post planting care. Soil preparation for sodding is identical to that for seeding. The primary objective in sod transplanting is to achieve as quick rooting into the underlying soil as possible. Sod should be laid in a brick like pattern, such that corners of four pieces never comes together. Sod should be immediately watered after being installed.
- **Sprigging:** Sprigging is another method of vegetative propagation where stolons or rhizomes are planted in furrows or small holes. A sprig is an individual stem or piece of stem of grass without any adhering soil. A suitable sprig should have two to four nodes from which roots can develop. Soil preparation for sprigging should be the same as for the other methods of planting. Sprigs are planted at a depth of 1-2 inches, 4-6 inches apart in the furrows. However, shallow planting can

also be practiced provided adequate moisture is available.

Another method of sprigging is to place the sprigs on the soil surface at the desired interval end-to-end, about 6 inches apart, and then press one end of the sprig into the soil with a notched stick or blunt piece of metal like a dull shovel. A portion of the sprig should be left above ground exposed to light.

- **Stolonizing**: Stolonizing is the broadcasting of stolons on the soil surface and covering by topdressing or pressing into the soil. Stolonizing requires more planting material but produces a quicker cover than sprigs. This method is very feasible in grasses do not produces viable seeds or most of hybrids which do not set seed. Stolons are harvested from well matured turf with vertical mower. After broadcasting, stolons should be covered soil.
- **Plugging**: It is also called as spot soddding. The planting of 2- to 4-inch diameter square, circular or block-shaped pieces of sod at regular intervals is called plugging. Three to ten times as much planting material is necessary for plugging as compare to sprigging. The most common turfgrasses that are started by the use of plugs are St. Augustine grass, zoysia grass and centipede grass. These plugs are planted into prepared soil on 6- to 12-inch centers. The closer the plugs are planted together, the faster the sod will cover. However, the closer the plugs are planted together, the more sod it will take to provide plugs to cover the lawn area.
- **Dibbling**:- In this method grasses are transplanted from lawn . Grasses are taken/scrapped with roots attached to them from sunny location. The ground is dibbled at a distance of 4 by 4 inch. After planting ground is flooded or watered by using hose pipe fitted with nozzels.

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ROSE

ORNAMENTAL AS WELL AS MEDICINAL PLANT

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In the ornamental flower industry, the rose plays a significant role. There are around 150 rose species in the Northern Hemisphere alone. Originally utilized for scent and medicinal uses, the rose has since gained popularity as a decorative flower. Roses are the most significant floriculture crop, attracting pollinators as well as human admirers. Rose is a Rosaceae family woody perennial blooming plant in the genus Rose. There are around 300 species and ten thousand cultivars to choose from. Roses can be tall bushes, climbing or trailing plants with strong prickles on their stems. On the stem, the leaves are borne alternately. They are 5 to 15 cm long, pinnate with 3-13 leaflets and basal stipules, and the leaflets have a serrated border in most species. Flowers come in a variety of sizes and colours, with white, yellow, pink, and red being the most common. Flowers with five or more petals and 4-5 sepals are called peonies. Roses are naturally pollinated by insects. The rose's aggregate fruit is a berry-like structure known as a rose hip. The majority of species are found in Asia, with a few exceptions in Europe, North America, and North Western Africa.

Rose flowers

Rose hips

Medicinal values of rose

Roses are a therapeutic herb because they offer medicinal characteristics. Various secondary metabolites and nutrients in the form of vitamins and minerals can be found in the petals, rose hip, stem, leaves, and roots of a rose plant. Extracts from several parts of the rose plant have also been shown to have significant antibacterial and antifungal properties. There are three primary kinds grown for commercial purposes, including the production of rose essential oil and rose water. *Rosa gallica*, *Rosa centifolia*, and *Rosa damascene* are the three varieties. Rosehip oil is made from the Rosa canina plant. Vitamins A, B_1, B_2, B_3, B_6, C, E, and K, folic acid, potassium, calcium, iron, tannin, and a wide spectrum of enzymes are all found in rose petals and hips. Rose blossoms have antidepressant, antispasmodic, aphrodisiac, astringent, cleaning, antibacterial, and antiseptic properties. Rose hips tea can also be used to cure diarrhoea. Rose petals have antibacterial, anti-inflammatory, and antiparasitic properties. They're also a moderate laxative, a heart-supporting tonic, and a cholesterol-lowering agent. Rose petals are an excellent antiseptic for wounds, bruises, rashes, and incisions, and their anti-inflammatory characteristics make them an excellent cure for sore throats and ulcers. They have the ability to stimulate the liver, as well as enhance hunger and circulation. In the case of eye burning, the extract of rose petals is used as e drops or eye wash. *Rosa indica* is used to treat diarrhoea, asthma, leukoderma, and oral inflammation. Dry skin is treated with creams containing rose essential oil. Rose extract or oil is widely used in cosmetics as an ingredient in soap, body wash, perfumes, and body spray, among other things. According to some research, some chemicals in roses may help to reduce anxiety and promote relaxation.

Antibacterial (Antimicrobial) and Antifungal Activity of Extracts from Rose

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IMPORTANCE OF NANO FERTILIZERS

IN AGRICULTURAL CROPS

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Agriculture is the backbone of the most developing countries. In agriculture the main reason to use fertilizer to provide nutrients (macro and micro) which usually lacks in soil. Traditional nutrient management have attained saturation and neither able to increase productivity nor able to restore ecosystem degradation by existing practices. In order to sustain the soil health and productivity of crop to meet food security for growing population, nanotechnology can be one of the source.

Nanotechnology is a group of emerging technologies in which the structure of the matter is controlled at the nanometer scale to produce materials having unique properties. The term "Nano" is derived from Greek word, it means "Dwarf". Size of nanoparticle varies between 1-100nm and its small object behaves as a whole unit. In advancing in nano technology, it plays vital role in fields of Biology, Engineering, Medical, physics and Chemistry. Due to their extreme minute size, they have many unique properties that are now being explored for new opportunities in the field of agriculture. Example like nutrient use efficiency of conventional nitrogen, phosphorous and potassium fertilizer is 30-35%, 18-20% and 35-40% respectively. Whereas, Nano fertilizers has considerable surface area, it is capable of storing various types of nutrients in plentiful quantities for long duration without any relevant side effects of customized inputs, so its having higher nutrient efficiency. Nano fertilizer may have a strategy to enhance crop yields and productivity in nutrient usage.

Some of unique properties of Nano particles

- Nanoparticles having smaller size, larger surface area.
- Increased surface area to volume ratio.
- Nanotechnology able to achieve the phenomena of delivering the required product at cellular level, so its technology is more advantageous than the conventional methods.
- Slow release.
- Specific release.

Problems with conventional fertilizers

- Highly prone to losses.
- Pollution of environment.
- Low nutrient use efficiency.

Nano technological approach to enhance Nutrient use efficiency

- Encapsulation of fertilizer with nanoparticles: it is packaging the fertilizer within a kind of tiny "envelope" or shell.
- Slow delivery: Coating, binding of nano and sub nano composites are able to regulate the release of nutrients from the fertilizer capsule.
- Smart Delivery system: Smart delivery includes timely controlled, spatially targeted, self regulated, pre-programmed, avoid

biological barrier to successful targeting.

- Nanobiosensor: Under nutrient limitation, crops can secrete certain compounds into rhizosphere to enable biotic mineralization of N or P from SOM and P associated with soil organic colloids. These root exudates can be considered as environmental signals that can be recognized by nanobiosensor and release of nutrient occur that synchronise with the plant need.

Comparison of nano fertilizers and conventional fertilizer application (Cui *et al*., 2010)

Properties	Nano fertilizer	Conventional fertilizer
Solubility and dispersion	Improve solubility and dispersion of insoluble nutrients in soil, reduce soil absorption and fixation and increase the bioavailability.	Less bioavailability to plants due to large particles size and less solubility.
Nutrient uptake efficiency	Increase fertilizer efficiency and uptake ratio of the soil nutrients, reduce resource application.	Bulk composite is not available for roots and decrease efficiency.
Controlled release modes	Release rate and release pattern of nutrients for water soluble fertilizer might be precisely controlled through encapsulation in envelope form.	Excess release of fertilizer may leads to environmental degradation.
Effective duration of nutrient release	Nanofertilizer can extend effective duration of nutrients supply of fertilizers into soil.	Used by the plants at the time of delivery, the rest is converted into insoluble in soil.
Loss rate of fertilizer	Reduce loss rate of fertilizer nutrients into soil by leaching, immobilization, vaporization etc.	High loss rate by leaching, immobilization, vaporization, fixation in soil.

BIOCHAR INTERACTION WITH HUMIC SUBSTANCES IN ENVIRONMENTS

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The term biochar(s) means charcoal materials intended to be used for agronomic purposes that are produced in such a way as to sequester carbon. Biochar is a stable carbon-rich product of oxygen-limited combustion (pyrolysis) of carbonaceous biomass, such as crop residues, cull timber and sawmill wastes.

Terra preta, char, and humic substances

It is generally accepted that the stability of carbon in fresh biochar is attributed to the fused ring structures that form during pyrolysis, similar to the ring structures of coal. In contrast, the chemistry of char residues found in the terra preta sites indicates a more oxidized condition. The structure of terra preta char residues consists of groups of fused aromatic rings with substituted negatively charged COO- groups (Fig.1) that are responsible for the high cation exchange capacity (CEC) of the terra preta. These oxidized fused ring groups are similar to the char residues found in Mollisols: high fertility soils that have a history of grassland fires.

Wildfire chars are thought to contribute to the fertility of some soils by undergoing both biotic and abiotic carboxylation of their fused aromatic ring structures and converting to HS over long periods. The surface chemistry of fresh char materials applied to soils changes over long periods by undergoing natural oxidation, demonstrated by an increase in carboxyl (-COOH) and phenolic (-OH) functional groups and the concomitant evolution of surface charges from positive to more negative. In addition to the surface oxidation of char particles themselves, it is possible that the relatively high CEC could result from the adsorption of highly oxidized organic matter onto the char surfaces over long periods. The amount of time required to convert char into more oxidized materials that contribute to soil fertility suggests that simply adding biochar to soils does not necessarily result in terra preta-like materials during the relatively short time frames of agronomic production. Compared to biochar, HS demonstrates a higher density of carboxyl (-COOH) and phenolic (-OH) functional groups, along with ketone (-C (O) C-) and aldehyde (-CHO) groups distributed across numerous aromatic, cyclic, and aliphatic chains). These functional groups are responsible for numerous interactions with soil components through hydrogen bonding, electron donor-acceptor complexation hydrophobic interactions. Even though there is not a generally accepted structure for HS, molecular analysis suggests that HS are highly dynamic, demonstrating conformational flexibility and self-assembly of complex mixture components.

A primary purpose of biochar is to improve the moisture-holding capacity of soils, which is

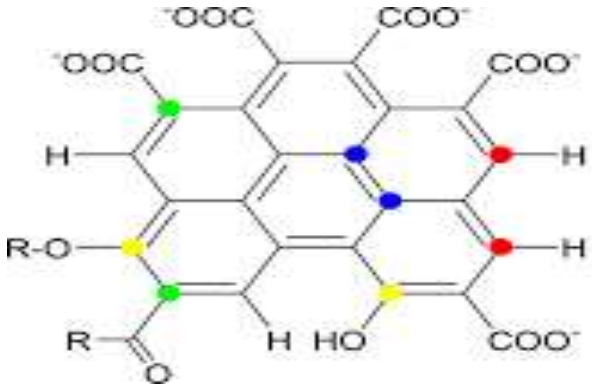

Fig 1. Fused ring structure of char residues

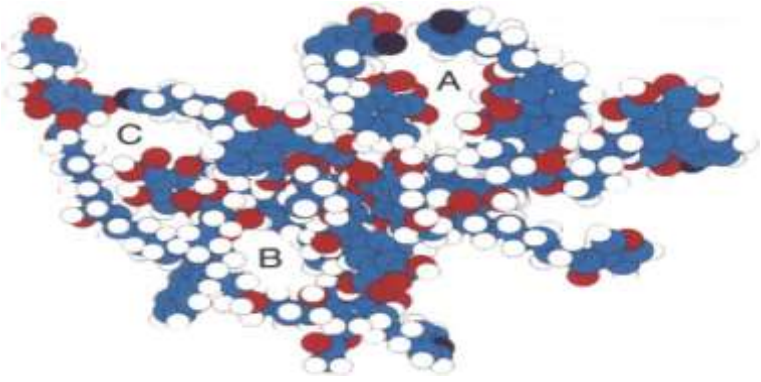

Fig 2. Proposed 3D structure of humic acids

achieved through the porous physical structure of the char product. HS are amphiphilic, having diverse chemical groups that impart both hydrophobic and hydrophilic character within their proposed structures, allowing them to interact with many soil processes. HS is known to have a high moisture content as well, but they retain moisture both by hydration of polar groups and voids in secondary structures (Fig. 2).

Element colors are: carbon = blue; hydrogen = white; nitrogen = black; and oxygen = red; A, B,C

Origin and properties of biochar

There are substantial differences in the physical and chemical properties of synthetic biochars depending on the feedstock, time and temperatures used during pyrolysis, and post-production practices. Because of the variable properties of the final products, and as there are no standardized materials, the comparison of experiments is very difficult. Post-production "activation" of chars is accomplished by either cooling rapidly in the atmosphere or with water. Both processes oxidize the surfaces of the materials, altering the character of the surface groups that interact with soil components. The production of biochars is in stark contrast to the genesis of HS. Biochars are produced from cellulosic materials, such as corn stover, switchgrass, or wood, that are subjected to relatively high temperatures over short periods under reducing (oxygen-deprived) conditions. Biochars, therefore have little or no oxygen content. Although the materials used in humic products typically originated as cellulosic materials also, they formed over much longer periods. The process typically begins with microbial decay and subsequent chemical and biochemical reactions that form the materials under more aerobic conditions. Because of that, HS have relatively high concentrations of oxygen-containing phenolic and carboxylic functional groups that account for the high chemical reactivity of HS.

Application of biochars

The application rate is important for tropical soils because they stated that in their opinion, the 11 Mg ha^{-1} rate is roughly equivalent to the amount of carbon sequestered in some types of tropical vegetation that can be converted to biochar, rather than using what they called slash and burn practices. The charcoal content of the current terra preta soils at a depth from 0 to 0.3 meters is estimated to range from 15 to 60 Mg ha^{-1} (7 to 27 tons $acre^{-1}$). Biochar is applied to acid soils to raise the pH of acid soils, but the degree to which wood ash in the char contributes to the increase in pH is unknown. Biochar application is more effective on highly weathered acid soils and hardwood feedstocks can be better at ameliorating acid pH than conifer feedstocks because they are higher in base cations (Ca, Mg, K and Na).

Application of humic substances

Humic and fulvic acids are sometimes classified as biostimulants because they appear to directly affect plant growth and metabolic processes when applied at minute rates relative to typical plant nutrient application rates. The hormone-like activity of HS has been extensively debated because it is difficult to distinguish between indirect positive growth effects caused by improvement of nutrient and the up and down regulation of plant genes involved in metabolic and signaling pathways. The definition of biostimulants is the more complex chemistry and low application rates of humic products set them apart from biochars.

Conclusions

Biochar is primarily promoted as a way to sequester carbon, improve soil water holding capacity, amend acid soils, and increase crop yields when used as a soil amendment. The main benefit of humic products would seem to be as a crop amendment, not as soil amendments. Humic products may increase soil carbon sequestration by promoting bigger root systems and possibly more root exudates.

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METHODS OF IMPROVE FARMING PRODUCTIVITY

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The productivity of farms is essential for many reasons. Providing more food, increasing productivity affects the farming market's growth, labour migration, and income. Increased agricultural productivity refers to the more efficient distribution of scarce resources. Learning how to improve production is a crucial aspect of productive farming**.** New methods and techniques have given farmers a chance to increase production and maintain their farm's long-term sustainability.

How to Improve Farming Productivity

Enhancing production is the need and demand of farmers. Many factors can improve farming productivity. Below we present some methods of improving farming production.

1. Implementation of land reforms

For improving the production, land reforms are the first and predominant point. Machines, tractors, and implements do land reforms. These machines have the qualities that make rugged farming areas smooth to work on the field efficiently. Working on the field is easy, that means an improvement in productivity is easy. Land reforms are the best method to increase production.

2. Interplant

Interplanting is a practice in which different crops are growing together at the same time. It is the best way to maximize the productivity of your growing space. Some crops are the best together, some not.

3. Plant more densely

It is the simplest way to improve the productivity of farms, in this plant crops close together. Many farmers keep their vegetables excessively away, which leads to the abandonment of large areas growing well.

4. Plant many crops

It is the simplest way to improve the productivity of farms, in this plant crops close together. Many farmers keep their vegetables excessively away, which leads to the abandonment of large areas growing well.

5. Raised beds

Traditional farming systems place crops in separate rows by tractor paths, with permanent beds planting multiple rows of crops within beds of the same width. It creates dense plantations, fewer pathways, and more active growing areas. Raised beds are symbolic of improving the productivity of crops.

6. Smart water management

Water is an essential need for planting crops, and by the management of water, you can enhance the production. Water management is the best way to improve production. Using the sprinkler irrigation system, you can increase the output by up to 50%. By the manufacturing canals, tube wells get a better irrigation system for the safety of crops.

7. Heat Tolerant Varieties

Heat tolerant varieties allow the plant to maintain the yields in high temperatures. We must improve the heat-tolerant varieties, and it increases the crop yield by up to 23%.

8. Use nitrogen

Nitrogen is a necessary element for better plant growth, and without nitrogen, most of the crops would not exist. Annually, plus 100 million tonnes of nitrogen are applied to crops in the form of fertilizer to help them grow stronger and better. The use of nitrogen can enhance the production of up to 22%.

9. Improved seeds

Seeds play an essential role in the farms, and improved seeds are best to enhance farm productivity. Improved seeds are suitable for increasing production.

10. Plant protection

According to farming scientists, about 5% of crops destroyed by insects, pests, and diseases. Most of the farmers are oblivious of the use of medicines and insecticides developed in recent years. Improving the production of the crops, yields must use these medicines. To be aware, the farmers about these governments should take steps or employ their technical staff in spraying pesticides and insecticides. ■

FIRB: FINEST WHEAT PACKAGE OF PRACTICE

LOW INPUT YET HIGH OUTPUT

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FIRB is an abbreviation of Furrow Irrigated Raised Bed. This method of cultivation includes making of lined beds with raised height through a bed planter wherein seeds (here wheat) are sown while furrows between them are left behind for later planting of other crop (here sugarcane). This system not only saves planting material, lessen the fertilizers use, reduces irrigation water requirement, but also facilitates early sugarcane sowing consequently leading to timely higher yield.

Process

Package of practice starts from the paramount i.e. soil Sandy loam to loam soil is best suited with moderate water holding capacity and pH ranging from 6 to 7. Heavy soil with good drainage is preferred. Now, to prepare seed bed, one deep ploughing with plough followed by two harrowing with disc and two or three planking with planks is done. 35-40 kg/ha urea should is given to improve wheat seed germination. 10-15 tons of well rotten farm yard manure is placed on upper surface of soil. For irrigated type NPK is 120:60:60 whereas for rainfed it is 60:40:20 wherein half dose of N and full dose of both P&K is applied as basal while remaining half is split into two doses for top dressing at CRI and late jointing stage.

Raised beds are now formed with the help of raised bed planter having top bed width 37.5 cm with 15 cm height and furrow of 30 cm. Usually two rows of wheat are grown on a raised bed after treating the pure wheat seeds with any appropriate fungicide, insecticide and azotobacter. Depth of seed depends upon the length of coleoptile (generally 5cm). Spacing between two beds is kept around 3 foot. Wheat seed rate of 70-80 kg/ha is taken and sown with raised bed planter machine simultaneously during November (at optimum time of sowing).

Irrigation is done only in furrows with first being given at CRI stage (20-25DAS), second at tillering stage (40-45DAS), third at late jointing stage (70-75DAS), fourth at flowering stage (90-95DAS), fifth at milking stage (110-115DAS), sixth at dough stage (120-125DAS) and only 2/3 furrows are wet through water, remaining space of ridge moist through capillary force.

Advantages

- Saving around 24-40% seeds.
- Cutting down nitrogen usage upto18-25%.
- Saving water about 30-50%.
- Better plant stand with reduced lodging.
- Low weed density / infestation.
- Easy drainage facilitation.
- Reduced waterlogging crop failure or water scarcity.
- Increased yield.
- Greater resource use efficiency.
- Higher economic return.

Disadvantages

- Complications in alkali soil.
- Requirement of raised bed former.

Solutions for disadvantages

- Alkali soils having high exchangeable sodium since are slowly permeable, thus, needs to be amended with gypsum by mixing in surface 10cm soil layer and leached for several days before forming seed bed.
- Raised bed former can be either bought for Rs. 40000/- (one time investment) or rented at nominal rate. Governmental subsidy or loan scheme aid can be grasped.

Conclusion

FIRB method is a highly efficacious system. More financial return is the main aim of any farmer and this method of package of practice fulfills it successfully. Low input cost whether it be direct or indirect helps save money thereby adding to increased economic output through better yield. ■

INTEGRATED FARMING

A TOOL TO MITIGATE CLIMATE CHANGE EFFECT

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In today's time, climate change has become a most pressing issue. Though a natural process, anthropogenic activities have speeded it up through more emissions of greenhouse gases, deforestation and burning of fossil fuels. It has also impacted agriculture and the natural resource base of the Earth. It is need of the hour to cope with the devastating effects of climate change and the only options for us are to adapt to it, lower our emission rate and increase carbon sequestration through suitable land use and land use changes like afforestation.

Making agriculture secure

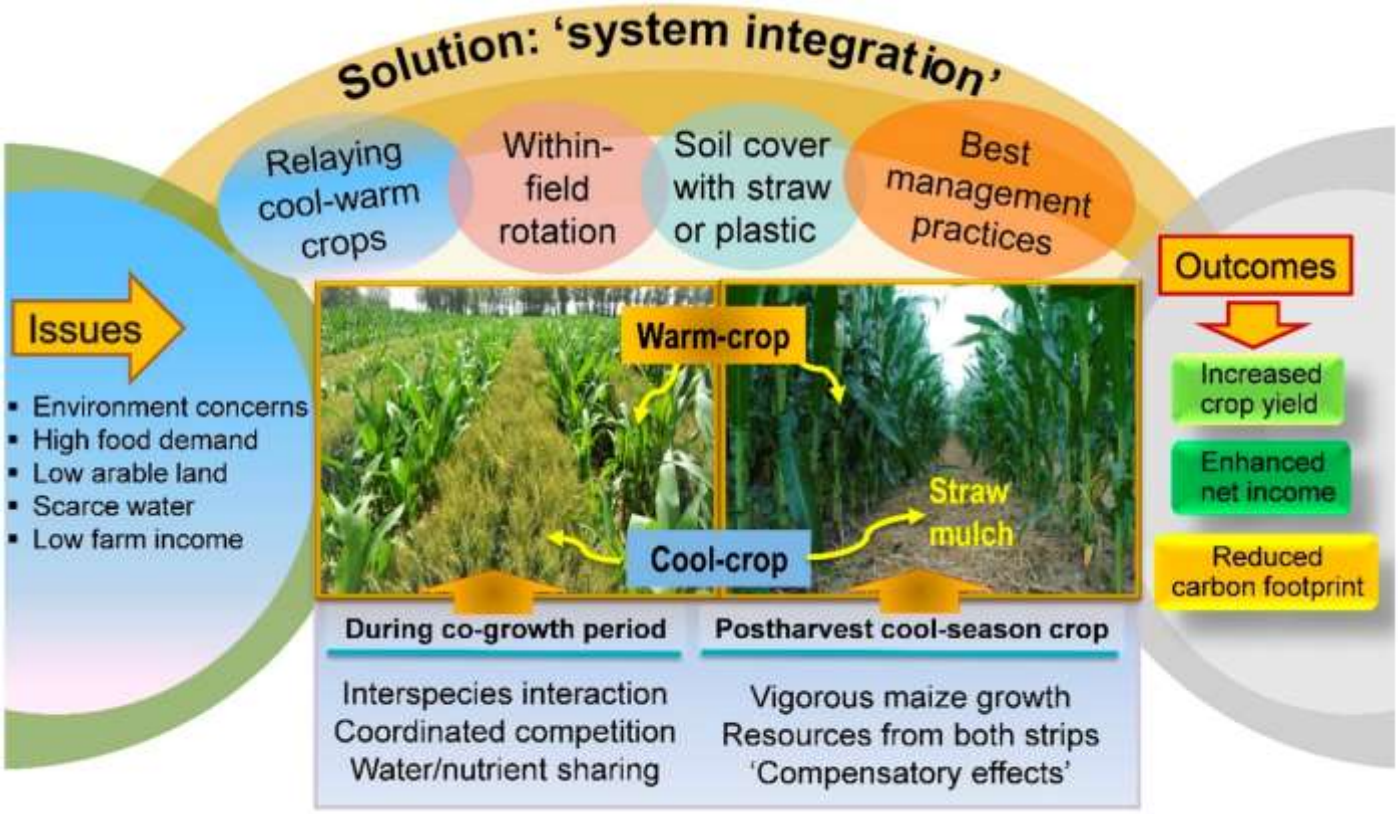
Making agriculture climate smart through integrated approach is also an ideal solution to ensure the food security of the ever-increasing global population at a time when there are twin problems of land degradation and carbon emissions. A multi-pronged strategy is required to check climate change and integrated farming is one of the options to achieve it. It provides multiple benefits that are sustainable and can pave the way for climate-smart agriculture (CSA). From shifting weather patterns that threaten food security to rising sea levels that increase the risk of flooding, the impacts of climate change are undoubtedly global in scope and unprecedented in scale. CSA is an integrated approach to develop technical, policy and investment conditions in such a manner so as to ensure sustainable development for food security. The main aim is to achieve sustainable higher productivity, ensure livelihood and food security, adapt to climate change and bring down emission of greenhouse gases.

Integrated farming

The integrated farming system is a combined approach aimed at efficient sustainable resource management for increased productivity in the cropping system. It involves different components like trees, crops and livestock arranged spatially and temporarily over the same unit of land for the best utilisation of available resources. Various types of plants, livestock, mushroom, aquaculture and other aquatic flora and fauna are managed for maximum productivity in such a way that one complements the other. The waste generated from one component is recycled and used as a resource for the other. It is system to protect and conserve land and water resources from depletion. In countries like India where majority of farmers holding less than two hectares of land practice subsistence farming, risks are heightened through mono-cropping.

Integrate Crop-Livestock-Forestry Systems

Instead of focusing the farm on one kind of production (crops or livestock or forestry), integrated systems combine them into one of four combinations: crops and livestock; crops and forestry; livestock and forestry; or crops, livestock and forestry. Integrated systems can also provide adaptation benefits. They can improve the local micro-climate by reducing local temperature and increasing precipitation and water availability; reduce the impact of extreme weather events on crops, livestock and other products; reduce soil erosion; improve productivity; and provide additional socioeconomic benefits by increasing the number of products farmers can produce for subsistence or to sell.



Rehabilitate Degraded Pastures

Rehabilitation of degraded pastures also provides climate adaptation benefits, including reduced local temperatures, increased air humidity, better resistance against heatwaves and drought and more resilience against natural disasters. It also has a positive effect on soil erosion and water availability. Degraded pasture can be more sustainably recovered by planting native forage or grass, or by introducing trees in the pasture to avoid soil erosion. Rehabilitation of pasture can contribute to new, more sustainable ways of raising animals. This combines grazing with trees to improve the health of the soil and the wellbeing of the animals while mitigating carbon emissions.

Plant Agroforestry Systems

Agroforestry integrates trees and crops in an intentionally designed system. In an agroforestry system, every plant is selected for a particular purpose -- species are selected so that plants will not compete but collaborate. This diversity of crops and trees allows the area to be productive all year long, so that small farmers can earn income in all seasons. Agroforestry systems are an important tool for climate change adaptation in agriculture. The working paper finds that agroforestry produces adaptation benefits for local climate, including reducing the impact of five types of extreme weather events evaluated by the study (drought, heatwaves, cold waves, heavy rain and floods), improving soil and water availability, attracting pollinators and improving biodiversity.

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NATURAL AGRICULTURAL PRACTICES
FOR SUSTAINABLE DEVELOPMENT

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Agriculture has a gigantic environmental footprint, playing a significant role in causing climate change, land degradation, water paucity, water pollution, deforest-ation and other processes. It is concurrently causing environmental changes and being impacted by these changes. Sustainable agriculture consists of environment friendly methods of farming that allow the production of crops or livestock without dent to human or natural systems.

Factor affecting the sustainability

The most important factors for a farming site are climate, soil, nutrients and water resources, in which water and soil conservation are the most acquiescent to human intervention. When farmers grow and harvest crops, they remove some nutrients from the soil.

Nutrients

Nitrates:

Possible sources of nitrates-

1. Recycling crop waste and livestock or treated human manure.
2. Growing legume crops and forages such as peanuts, that form symbioses with nitrogen-fixing bacteria called rhizoibia.

Phosphate:

Phosphate is a second most important nutrient for plants after nitrogen. It is important for sustainable agriculture as it can improve soil fertility and crop yields. Phosphorus is involved in all major metabolic processes as well as photosynthesis, energy transfer, signal transduction, macromolecular biosynthesis, and respiration.

Potassium

Potassium is a macronutrient very important for plant development and is commonly required in fertilizers. Potassium is essential nutrient for agriculture because it improves water retention, nutrient value, yield, taste, color, and texture and disease resistance of crops.

Soil

Land degradation is a stern global problem. Offensive soil management is threatening the ability to grow sufficient food. Rigorous agriculture reduces the carbon level in soil, impairing soil structure, crop growth and ecosystem functioning, and accelerating climate change

Water

In some areas of India sufficient rainfall is available for crop growth, but many of areas require irrigation. For irrigation systems to be sustainable, they require proper management and must not use more water from their source than is naturally replenish able. Elements of sustainable agriculture can include Agro forestry, crop rotation, natural farming, intercropping, vermi composting, floating farming and organic farming.

I. Organic farming

Organic agriculture is a production system that sustains the health of soils, ecosystems and human being. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with undesirable effects. Organic agriculture combines tradition, innovation and science to benefit the communal environment and promote good quality of life. Organic farming is an agricultural system that uses fertilizers of organic origin such as compost manure, green manure, and bone meal and places emphasis on techniques such as crop rotation and companion planting.

Organic farming methods-

1. Crop diversity.
2. Soil management.
3. Weed management and livestock.

II. Agro forestry

Agro forestry is a land use management system in which trees or shrubs are grown around or among crops or pastureland. This diversification of the organic farming system initiates an agro ecological progression. Trees as well produce a wide range of useful and marketable products from fruits/nuts, medicines and wooden products, etc.

Benefits of Agro forestry – Agro forestry systems is beneficial over unadventurous agricultural and forest production methods.

Biodiversity

Biodiversity in agro-forestry systems is usually higher than in conventional agricultural systems. Two or more interacting plant species in a given area create a more complex habitat that can support a wider variety of fauna.

Soil and plant growth

Worn-out soil can be protected from soil erosion by ground cover plants such as naturally growing grasses in agro forestry systems. It helps to befall constant the soil as they increase cover compared to short-cycle cropping systems.

III. Conservation agriculture

Conservation agriculture is a farming system that promotes minimum soil disturbance and maintenance of a permanent soil cover, and diversification of plant species. It enhances biodiversity and natural biological processes above and below the ground surface, which contribute to increased water and nutrient use efficiency.

Benefits- Within fields that are controlled by conservation agriculture the producer will see an increase in organic matter.

- Increase in water conservation due to the coating of organic matter and ground cover to help eliminate transportation and access runoff.
- Upgrading of soil structure and rooting zone.

IV. Crop rotation and intercropping

Intercropping is the growing of two or more crops reciprocally in proximity on the same land. As a result, two or more crops are managed at the same time. It differs from crop rotation in which two or more crops are grown one after the other. There are at least four types of intercropping –

Row Intercropping- Row Inter-cropping is the growing of two or more crops at the same time with at least one crop planted in rows.

Strip Intercropping- Strip inter-cropping is the growing of two or more crops together in strips wide enough to allow separate production of crops using mechanical apparatus.

Mixed Intercropping or Mixed Cropping is the growing of two or more crops at the same time with no distinct row arrangement.

Relay Intercropping or Relay Cropping is a system in which a second crop is planted into an existing crop when it has flowered (reproductive stage) but before harvesting.

Advantages of crop rotation

1. Better manage of weeds and improved soil fertility
2. Better control of pests and diseases.
3. Crop rotation improved soil structure and organic matter content.

V. Vermi composting

Vermi composting is regarded as a clean, sustainable, and zero-waste approach to manage organic wastes. Vermi compost is the product of the decomposition process using various species of worms, usually red wigglers, white worms, and other earthworms, to create a mixture of decomposing vegetable or food waste, bedding materials, and vermicast. This process is called vermicomposting, while the rearing of worms for this purpose is called vermiculture. Benefits-

Soil

- Improves soil ventilation and improves water holding capacity.
- Enriches soil with micro-organisms.

Plant growth

- Enhances germination, plant growth, and crop yield.
- It helps in root and plant growth.

Economic

- Bio-wastes conversion reduces waste flow to landfills.
- It also creates low-skill jobs at local level.

Environmental

- Helps to close the metabolic gap through recycling waste.
- Production reduces greenhouse gas emissions such as methane and nitric oxide.

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SYSTEM OF RICE INTENSIFICATION (SRI)

PACKAGE AND PRACTICES

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System of rice infestation is a new method of rice cultivation which are reducing input cost and increasing output (production) which can grow the income of farmers and maximize efficient use of natural resources. This method of rice cultivation rather than technology which involved efficient use of natural resources with the judicial use of external input to optimized use.

Why SRI

In India mostly former practiced conventional methods for rice cultivation. Rice is a staple food of India and it needs to make a sustainability of rice production for next generation, this they have to induce maximum investment and face many problems of fulfill the water demand.

As we know rice needs 1000 to 5000 liter water to produce 1 kg of rice because it's largest consumer of water in agriculture of India but there water use efficiency (WUE) is very poor this is only 18.81% water are used and remain water are leached out in soil . India is country where 65% area under and rain fed (<750 mm annual rainfall) where water has play a very important role play for human and animal as well as crop production, so its condition we should be adopt new technology or method of rice cultivation which can be easily full fill the water demand, and produce high production, and maintain the sustainability for next generation.

Importance of SRI

- It saves water 42 to 50% in conventional cultivation.
- This is to protect the environment.
- It increases yield.
- There is reduced input cost compared to conventional methods.
- Reduce the extra water demand.
- Efficient use of land and Natural resources.
- Reduce the nursery area for one hactare.

Area and distribution

First time this method was developed at Madagascar Africa in 1980 by French scientist Henari de Laulanie under draft conditions with the support of CIFAD USA. In India first started at TNAU Coimbatore high Andhra Pradesh Karnataka, Tamil Nadu some parts of MP and many states are cultivated over the country.

Selection of locations

It is a method used in all over country's rain-fed and irrigated areas, sensitive to water logged areas.

Soil requirement

Sandy loam and clay loam soil are suitable and cultivation can also be done at silty clay loam, with pH 4.5 to 6.5.

Methods of sowing

(a) Selection of variety:

In this method select the hybrid are those type varieties which have high tillering capacity.

Ex.- CSR -5, CSR-10, SR - 26 B, TN-141, APRH-1, APRH- 2 , APRH -3,KRH - 1.

(b) Nursery management:

In this method 100m square nursery is sufficient for one hectare area. Nursery either grows at field or wooden frame or plastic sheet or gunny bag at the home under the shading with proper moisture until the sprouting of the seed when seedling age 8 to 9 days these are lifted from the nursery and transplanted.

(c) Seed rate:

These methods of 5 kg seed are sufficient for one hectare area.

Field preparation

Mainly we should 3-4 time plugging with cultivator and 150q FYM applied before 20 days of transplanting, field have fine texture and wet moisture not flood.

Transplanting

In this method square planting system should be adopted and single seedlings are transplanted in every hill with proper spacing maintained (R×P) 25×25 cm are done. To care for that transplant within 30 min of pulling out the seedling, because seedling age is low.

Nutrients Management

In this system for nutrient management use of leaf color chart (LCC) which have more advantage of nitrogen management.

- Time of application is decided by LCC.
- Take the observation from 14 DAT in transplanted rice.
- Match the leaf color chart LCC during morning hour (8-10 Am)
- Take observation in 10 places.

Irrigation management

Irrigation should be applied to only the most of the soil in the early period of 14 days and after may stand 2 inch water for special stage tillering, booting and flowering stage and remaining day only wet moisture of soil is sufficient.

Weed management

In this method for reducing weed use the rotary weeder or cono weeder. Moving the weeder within forward and backward motion to worry the weed as well to aerate the soil at 7 to 10 days interval from 15 DAT.

Diseases & pest management

- **Blast or rotten neck:** Caused by *pyricularia oryzae* known as rich man's disease. Plant show eye shaped spot with grew or brown margin from leaf sheath.
- **Brown leaf spot:** Caused by *Helminthosporium oryzae*, responsible for Bengal famine.
- **BLB (bacterial leaf blight):** Caused by *Xanthomonas oryzae*, *a* killer disease of rice, ooze taste is used for this disease.
- **Sheath blight:** Caused by *Xanthomonas oryzicola*, primary source of infection is infected seeds and secondary source is rain droplets and irrigation water and debris left after harvest.

Management:

- ✓ Seed treatment with agrosan GN 2.5gm/ kg seed.
- ✓ Spray of the mixture of streptomycin in g /kg.
- ✓ Agrimycin @ 50 g/hectare.

- **Rice stem borer (*Tryporyza incertulas*)**: Larva of this cause dead heart in young plant and white ear in old plant.
- **Gall midge (*Orseolia oryzae*):** A Sucking type insect, onion shoot or silver shoot at tillering.
- **Rice hispa (*Dicladispa armigera*):** Causes white streaks on leaves parallel to midrib.
- **Gandhi bug (*Leptocorisa orentorius*):** Both nymphs and adults suck the shape of peduncle, tender stem and milky green in the early morning and at evening.

Control:

- ✓ Use of Furadon 30 to 35 kg per hectare.
- ✓ Use resistant variety. Ptd 18, Ptd 21, phalguna etc.

Harvesting

When 80% panical has about 80% ripened spikelet and moisture content of grain is 20-26% harvested should be done.

Threshing

When grain are dried at 16-22% threshing should be done.

Yield

Yields are obtained following:

Variety duration	Yield
Short duration	45-55 q/ha
Medium	65- 75 q/ha
Late	40- 50 q/ha

Conclusion

Adopted the above package and practices of system of rice infestation (SRI) method the yield may be obtained 65-75 q/ha and cost of cultivation are reduced 30-40% and yield increased 45-50% than conventional system of rice cultivation, it is very useful practices to enhance the double income of farmer.

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SUSTAINABLE AGRICULTURE

A PATHWAY FOR SUSTAINABILITY IN INDIA: A REVIEW

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Agricultural practices determine the level of food production, sustainability and largely the state of the global environment. The current agricultural practices that have greatly increased global food supply while also increasing pressure of the growing human population have adverse impacts on the environment and ecosystem services are calling in the realization of the need for more sustainable agricultural system. Sustainability implies maintain high yields in the face of major shocks, as well as agricultural practices that have acceptable environmental impacts.

What is sustainable agriculture ?

Sustainable agriculture is the successful management of agricultural resources to satisfy changing human needs while also maintaining or enhancing the environment standards and conserving natural resources.

The definition proposed by G.K. Douglas (1984) caught attention as it depicts the core of sustainable agriculture in its totality. "Sustainability must be considered in order to meet long-term food sufficiency, which needs the agricultural systems ecologically sound and don't destroy their natural base".

Sustainable agriculture is also known as eco-farming or organic farming or sometimes as natural farming or permaculture. Some other designated it as alternative farming or regenerative agriculture. Sustainable agriculture is a food and fiber production, distribution system that:

- It supports profitable production.
- Provides consumers with affordable, high-quality products.
- Improved the quality of life for rural communities and farmers.
- Decreases dependency on non-renewable resources.
- Uses natural resources efficiently.
- Environmental quality is protected.
- Will last for generations to come

Goals of sustainable agriculture:

1. Increase the efficiency of input used.
2. Sustainable agricultural systems must be maintained or enhance crops biological and economic productivity.
3. Enhance compatibility with political and social conditions.
4. Reduce the magnitude and rate of soil degradation.
5. To enhance soil quality and resilience, in order to maintain the crop productivity while minimum adverse impact on soils and the environment.
6. Minimize adverse environmental impacts on downstream and adjacent environments.
7. Lesser adverse environmental impacts both on and off the farm.

Sustainable agriculture has three dimensions:

1. Environmental health.

2. Economic profitability.
3. Social and economic equity.

Such systems involve the farming practices that protect the environment, public health and human communities, as well as they ensure animal welfare, protect biodiversity and promote ecosystem healthy. Sustainable agriculture is a way of producing food that is healthy for consumers and animals, does not harm the environment, is humane for workers, respects animals, provides a fair wage to the farmer, and supports and enhances rural communities, unlike organic agriculture, sustainable agriculture is not currently regulated by any government agency- it is more a way of life.

Sustainable agriculture practices

Key components of a sustainable agriculture

Factors affecting barriers to adoption and scaling up of sustainable agriculture practices:

- A Lack of incentives and safety nets
- A Lack of knowledge, guidance and hand-holding
- A Lack of Land-holding
- A Lack of markets for sustainable agriculture products

Farmers Factors	Farm Factors	Psychosocial Factors	Exogenous Factors
Age	Size	Attitude	Information acquisition
Gender	Location	Perception	Interaction with network
Education	Soil type	Environmental Concern	Access to resources and market
Income	Property rights	Norms	Training
			Membership

Recent advances in sustainable agriculture:

- Conservation of the environment.
- Vertical farming.
- Reduction in pesticides uses.
- Sustainable urban growths.

National mission for sustainable agriculture:

1. To make agriculture more productive, remunerative sustainable, and climate resilient by promoting composite farming system/location specific integrated.
2. To optimize use of water resources through efficient water management and expanding coverage for achieving 'more crop per drop'.
3. Adopt comprehensive soil health management practices based on soil fertility maps, judicious use of fertilizers, and soil test-based application of macro & micro etc.
4. Using suitable soil and moisture conservation measures to conserve natural resources.
5. Establish an effective, inter and intra Departmental/Ministerial co-ordination for accomplishing key deliverables of National Mission for Sustainable Agriculture under the aegis of NAPCC.
6. Pilot models in select blocks for improving productivity of rainfed farming by mainstreaming rainfed through NICRA and leveraging resources from other schemes/missions such as MGNREGS, IWMP, RKVY, and others.
7. To develop the capacity of farmers and stakeholders in the domain of climate change adaptation and mitigation measures, in collaboration with other ongoing missions such as NMAET, NFSM, NICRA, and others.

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TO REMOVE WEEDS OR TO DO WEEDING

USE POWER WEEDER

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Weed is such an unwanted plant that grows rapidly in fields and other places without sowing and reduces the yield by suppressing the growth of plants near it, which reduces the production rate of crops. Timely weed management of farmers is very important for good crop production. Due to the presence of weeds in the crops, the yield of the crop decreases.

What is power weeder

Power weeder is an AC agricultural machine for farming, which is used to destroy weeds from the crop, with its use many agricultural works can be done easily. It is used to easily destroy weeds from crops like sugarcane, cotton, maize, banana, coconut, vegetables, etc. And along with this, it is also used in soiling between rows and meadows.

This device is a good useful agricultural machine for removing weeds and weeds grown in various crops and vegetables / plantations / sugarcane / other crops in hilly areas etc. can be easily removed in less time. Its working capacity is about 1 to 1.2 hectares per day.

Power weeder: An introduction

Power weeders are generally small machines that are used to completely remove weeds. These machines can be used easily. Even their safe operation does not require any kind of prior training. This weeder is a combination of engine, frame, blades and auxiliary wheel. These are usually powered by two short stroke engines. The engine is used to rotate the blades at the front of the weeder. Recoiled starters are installed in the weeder to start the engine. After the engine is started, someone pushes the machine forward. Most of the time, engine power is used only to spin the blades.

Structure

It has one or two engines. A shaft is used to connect the blades, mechanical clutch and gearbox to the engine. Chain or belt drive or worm gear is used to control its speed. Generally two or four gear weeders are in vogue. Small weeders have a capacity of 1.5 to 5 horsepower. The capacity of two stroke engines is around 25 to 50 cc in most cases. Their fuel consumption is 60 to 80 minutes per liter.

Importance:

1. It is used to remove weeds.
2. Easily removes unwanted weeds growing between rows of vegetables.
3. It is used in weeding, hoeing and soil plowing in sugarcane crop.
4. There is a lot of weeds in the cotton field, it can be eradicated from it.
5. It is very difficult to remove weeds in floriculture because its trees are very delicate and there is a fixed decision between them, in such a situation, power weeder proves to be very helpful.
6. Suitable for weeding in horticulture.

Benefits of power weeder

1. Many laborers had to be employed in the field for the work of weed management, but with the use of power weeder, all are easily eliminated in less cost and less time.
2. Unwanted weeds growing between the rows of vegetable crops can be easily removed with this device
3. It can also be used in the work of hoeing and earthing in sugarcane crops.
4. This device is considered suitable for destroying weeds from horticultural crops.

Private thoughts:

At a time when the world is witnessing the deadly consequences of harmful chemicals and pesticides being used in agriculture. Power weeder can become a stronger and better option for this. Also it is beneficial for small farmers who are unable to buy big machines. Power weeder is a suitable tool for weeding, weeding and tilling the soil, so farmers should buy it and take advantage. ■

MARKETING OF RURAL NON- FARM PRODUCTS

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The Rural Non-Farm Sector (RNFS) is an integral part of the economic growth process. The RNFS encompasses almost all historic industries, as well as some new Small Scale Industries (SSIs). As a result, rural enterprises encompass a diverse range of business entities, including old artisans working in homes, small agricultural workshops, agro-processing units using farm surplus, units producing simple consumer items for the rural populace, ancillary units producing parts and subassemblies, handlooms, handicrafts, coir and sericulture, service activities, and so on. The importance of RNFS has long been recognised in India as an important aspect of the country's development process. These were envisioned as cottage and small-scale businesses since the commencement of independent India, it has been regarded as crucial for national progress.

Cottage and small-scale industries play a critical part in the national economy, providing opportunities for individuals, villages, and cooperatives. These industries are particularly well suited for making better use of local resources and achieving local self-sufficiency in certain types of essential consumer goods such as food, clothing, and agricultural implements. These industries have been important for national development since India's independence.

Government efforts to strengthen and support marketing of RNFs products

The Government of India has established the All India Handloom Board, All India Khadi & Village Industries Board, Coir Board, and Central Silk to provide necessary help and support to the industries' growth and development. The infrastructure for marketing the items generated in respective sectors was organised by these Boards.

Khadi and Village Industries Commission (KVIC) Marketing Network

In addition to providing raw materials, the Khadi and Village Industries Commission established a marketing network to help sell the goods of Khadi and village industries. KVIC also provides credit, equipment, technical support, raw materials, and marketing assistance. The Commission also assists in the establishment of Khadi Bhavans, Khadi Bhandars, and Gramodyog Bhavans, which sell Khadi and village industry items wholesale and retail. KVIC has the most extensive marketing network, spanning metropolitan areas, districts, and blocks.

Cottage of industries

A cottage industry is a small manufacturing operation that is typically managed from a person's home. Cottage industries play an important part in developing countries' economies. Cottage industries, particularly in rural areas, are an important source of employment.

Classification of cottage of industries

There are various cottage industries like these types:-

- **Agro-based:** Ghani oil, processing of cereals and pulses, cane, gur and khandsari, palmgur, bee-keeping, coir, quit processing and preservation and sericulture.
- **Textiles:** Handloom, polyvastra and khadi.
- **Wood related:** Match industry, carpentry, bamboo and care work and handmade paper.
- **Metal wares:** Aluminum vessels, brassware, blacksmithy and agricultural tools.
- **Leather:** Leather processing.
- **Pottery and ceramics:** Pottery, ceramics, terracotta.
- **Chemicals:** Inks, dyes.
- **Fishing:** Dried fish.

Khadi Gramodyog

The Khadi and Village Industries Commission, which has a large network of units, offer a wide range of consumer goods and contribute significantly to national development. It is environmentally benign and biodegradable, and it employs rural residents. These are managed by Khadi Institutions and recognised by KVIC, an autonomous agency within the Ministry of AgroRural Industry of the Indian government. Khadi (cotton, silk, muslin, and woollen) and a wide range of village industry products like as honey, handmade paper, agarbatti, soap, leather goods, herbal shampoo, oils, processed cereals and pulses, and so on are all produced in the Khadi sector.

Agro and food processing

The vast resource base, diversity of agro-climatic conditions under which the resources are produced, the chain of intermediaries involved from the stage of production to the final stage of consumption, and the significance share of the resources being utilised characterise the agro and food processing sector. The Indian food processing industry is currently primarily engaged in primary processing. The agro and food processing sectors are divided into the following categories:

- Cereal processing.
- Fruit and vegetable processing.
- Animal product foods.
- Marine and inland fish processing.
- Dairy processing.
- Plantation and nut-foods.
- Spices and flavour foods.
- Oilseeds and oil processing Sugar and confectionery products.
- Beverage foods.
- Backed foods.
- Traditional foods.

Market segmentation of food processing industries is as follows:

- ✓ **Soap industry:** Onion, tomatoes, garlic, mushrooms, asparagus, parsley bell peppers, cabbage, cauliflower, carrot, etc.
- ✓ **Instant-mixes industry:** Snack and savory.
- ✓ **Food services:** Canteens, cafeterias, armed forces, ration and expeditions.
- ✓ **Confectionery industry:** All dehydration's fruits in different forms and style.
- ✓ **Breakfast food industry:** Milk, cereals and fruits and vegetables based.
- ✓ **Retail trade:** Good scope for vegetables and fruits in dried form.

Powerlooms

The powerloom sector, which accounts for roughly 55% of total fabric produced in the country, substantially meets the country's population's clothing demands. In terms of employment and production, the textile sector (which includes textile mills, handloom and powerloom units) is a significant portion of the Indian economy.

Handicrafts

Handicrafts are the traditional skills of craftsmen who work with a variety of materials such as wood, metal, clay, ivory, cloth, and other materials to create consumer goods as well as decorative or aesthetic items. Only artistic and decorative items are now considered handicrafts. Marketing Rural Non-Farm Products 79 The All India Handicrafts Board is in charge of the industry's growth, while the Handlooms and Handicrafts Export Promotion Corporation promotes exports from this sector.

Handlooms

The handlooms industry is a part of India's rich tradition and showcases the weavers' wealth and artistry.

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EMPOWERMENT OF WOMEN

THROUGH RURAL ENTREPRENEURSHIP

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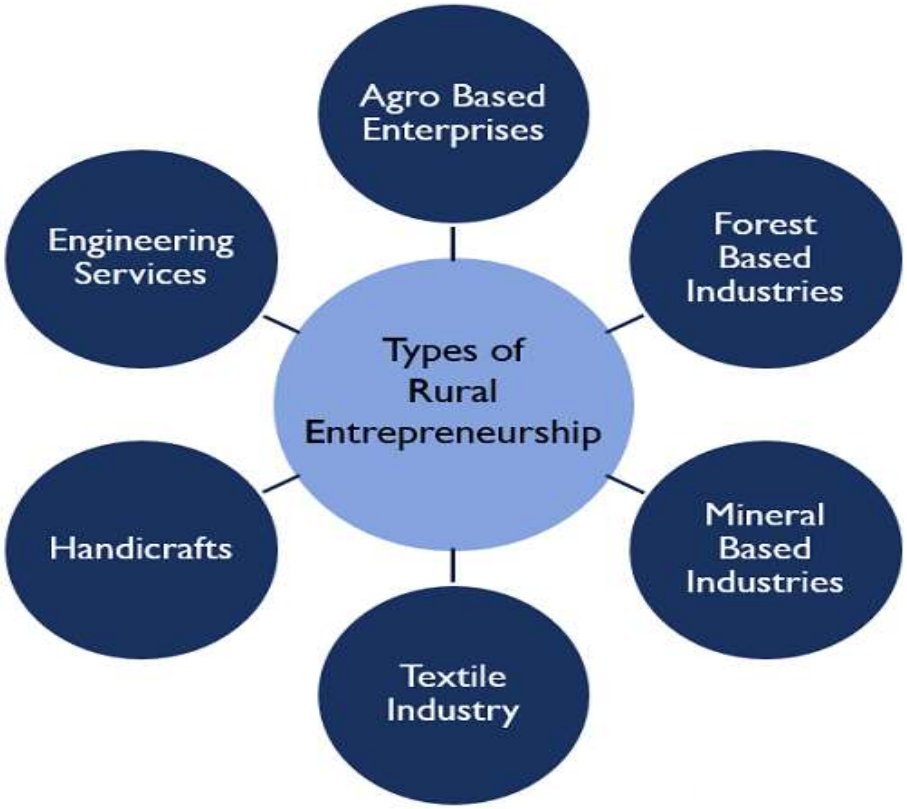
There is no chance for the welfare of the world unless the condition of the women improved.

Swami Vivekananda

When women move forward the family moves, the village move and the nation move.

Pandit Jawaharlal Nehru



General areas of agricultural livelihoods in rural areas

Crop husbandry, animal husbandry, horticulture, sericulture, fisheries, forestry, apiculture, floriculture, vermiculture, processing & value addition, marketing etc.

Entrepreneurship

To create something new, organizing and coordinating and bearing risk with economic uncertainty. It is the name given to the factor of production which performs the function of "Enterprise". Five factors of production i.e. land, Labor, capital, organization and enterprise. Organization does the work of coordination between different factors and makes the production possible by taking upon itself the risk or more appropriately the uncertainty of production.

Empowering tool (Rural women)

Economic empowerment, improved standard of living, self-confidence, Enhance awareness Sense of achievement, increased social interaction. Engaged in political activities. Increased participation level in Gram Sabha meeting, Improvement in leadership qualities, Involvement in solving problems related to women and community, Decision making capacity in family and community.

Need for rural entrepreneurship

- Rural industries generate large-scale employment opportunities in the rural sector as most of the rural industries are labor intensive.
- Rural industries are capable of checking rural urban migration by developing more and more rural industries.
- Rural industries/entrepreneurship help to improve the per capita income of rural people thereby reduces the gaps and disparities in income of rural and urban people.
- Rural entrepreneurship facilitates the development of roads, street lighting, drinking water etc. in the rural sector due to their accessibility to the main market.
- Rural entrepreneurship controls concentration of industry in cities and there by promotes balanced regional growth in the economy.
- Rural entrepreneurship can reduce poverty, growth of slums, pollution in cities and ignorance of inhabitants.
- Rural entrepreneurship creates an avenue for rural educated youth to promote it as a career.

Entrepreneurial development

Personal prerequisites- powerful urge, strong determination, hard work, risk bearing capacity, education, emotional maturity, knowledge: Attitude of the area population (technical, legal, marketing), administrative skills- long sightedness innovativeness, ability to use available resources, previous experience/entrepreneurial parents.

Environmental prerequisites- availability of infrastructural facilities, venture capital availability, technically skilled labor, accessibility of suppliers, proximity of supporting organization /institution.

Constraints of women entrepreneurs reasons and solutions

S.No.	Constraints	Reasons	Solutions
1.	Lack of Confidence	Social norms, morals in the family: women lack confidence, support, decision making powers	Social workers can develop the women entrepreneurs
2.	Over burden ness due to dual roles	Dual roles for managing family mgt. & enterprise : lack of time, concentration	Sharing of responsibility by family members
3.	Rigid and male dominated market conditions	Lack of awareness, experience, and lobbing capacities.	Family members, NGO's Gos – Information support on available market opportunities
4.	Lack of proper training	No network with other business people	Skill development through trainings & networking with other businessmen.
5.	Lack of access to financial support	(1) share in the property (2) Government or private loans, schemes incentives, etc.	Equal share in the parental property, access to private, Government loans support and complete information from other family members is all walks of their life.
6.	Lack of awareness about training programmes	Lack of exposure, networking, and restricted movement	Information support on schemes and institutions providing training, financial assistance about the enterprise and market facilities.
7.	Lack of access to resources	Withdrawal nature, societal zero paradise, hesitant nature of women keeping them away from all resources	Build the capacities to identify their priorities and shed down the hesitations to find a way to grab all kinds of resources.

Government part- adequate training programmed on management skills to be provided to women community, encourage women's participation in decision-making. , vocational training to be extended to women community that enables them to understand the production process and production management, skill development to be done in women's polytechnics and industrial training institutes. Skills are put to work in training-cum-production workshops. Training on professional competence and leadership skill to be extended to women entrepreneurs. ■

PANDEMIC OF COVID-19
ON AGRICULTURE

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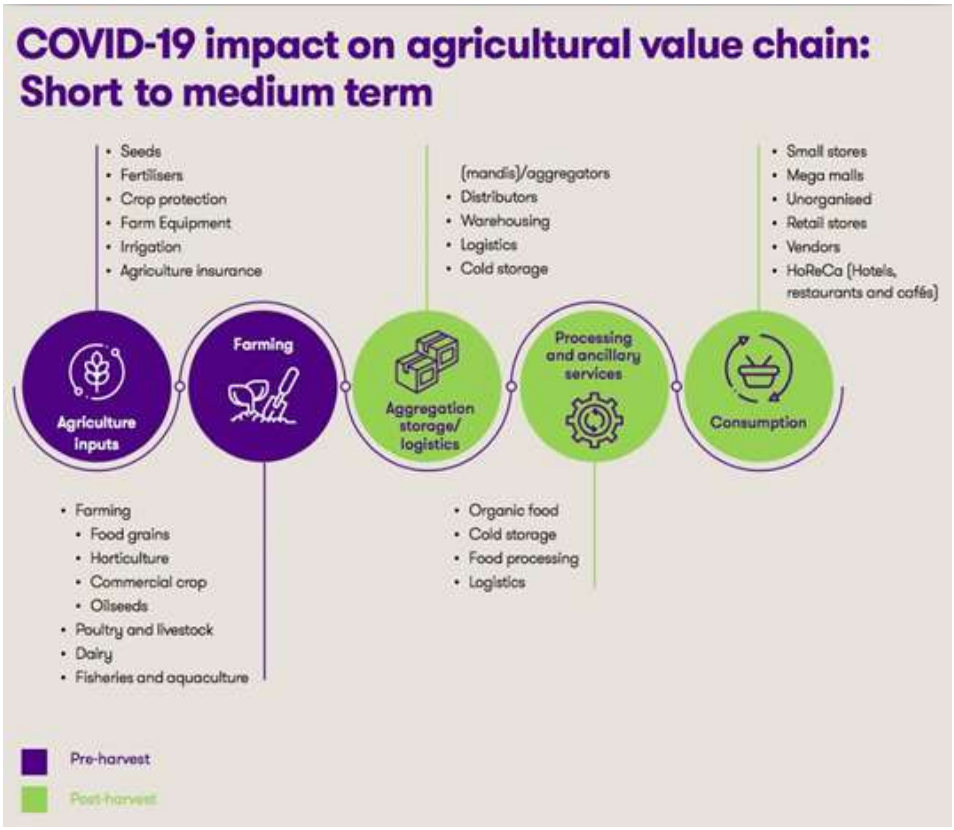
The ongoing worldwide health crisis on account of COVID-19 has impaired all routes of life. During this challenging time, how does Indian Agriculture respond to the crisis and how do government measures affect 140 million farm households across the country to cope up the losses?

As we all are well aware of the statement i.e. human basic needs are food, cloth and shelter, hence being agriculturist or educated/aware citizen we can't deny from this universal fact. Due to the current pandemic situation likewise all other sectors, agriculture sector is also tremendously affected in various ways. Besides, protecting lives of people suffering from COVID-19 including frontline health responders/workers have been the priority of nation. Government has formulated various guidelines since the Corona virus enters across boundaries and started creating an unprecedented situation. Indian Govt. has declared a three-week nation-wide lockdown till mid-April in the initial phase, which was subsequently extended for achieving satisfactory containment of the virus spread. After the nation-wide lockdown was announced, the Indian Finance Minister declared an INR 1.7 trillion package to protect the vulnerable sections (including farmers) from any negative impacts of the pandemic situation. The announcement contained advance release of INR 2000 to bank accounts of farmers as income support under PM-KISAN scheme.



The Indian Council of Agricultural Research (ICAR) issued state-wise guidelines for farmers to be followed during the lockdown period. The advisory elude specific practices to be followed during harvest and threshing, post-harvest, storage and marketing of various *rabi* crops. Agricultural term and crop loans have been granted a moratorium of three months (till May 31) by banking institutions with 3 percent concession on the interest rate of crop loans up to INR 300,000 for borrowers with good repayment behavior.

COVID-19 precautionary measures like border closures, quarantines, and market, supply chain and trade disruptions are restricting people's access to sufficient/diverse and nutritious sources of food, especially in countries hit hard by the virus or already affected by high levels of food insecurity ultimately causing loss of agriculture base economy. The migration of workers to their native places has also triggered panic buttons, as they are crucial for both harvesting operations and post-harvest handling of produce in storage and marketing centers. Therefore, losses due to pandemic are countless weither in terms of health, wealth and future security of individuals but we have to try to deal with this situation by adopting our normal routines provided following the guidelines issued by GOI.

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EDIBLE PESTS

THE SOLUTION TO THE WORLD FOOD CHALLENGE

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In the Western world, insects are considered a viable alternative to other protein sources as human food. This is a common practice in different countries and about 2000 insect species are used as food. Insect production emits greenhouse gases at a low level, which is beneficial for the environment. The insect's protein content is similar to that of conventional meat and is rich in B vitamins, zinc, and iron, along with high levels of saturated fatty acids. Along with promoting the consumption of insects, there is also a need to encourage the cultivation of insects. In Western countries, they are used as delicious food and as environmentally beneficial organisms, such as crickets. Edible insects have a high potential to contribute to a more sustainable and socially more equitable global food security. A 2013 report by the Food and Agriculture Organization of the United Nations found that eating insects can help fight world hunger and reduce pollution. Unlike meat production, insects do not use large amounts of land, water, or feed, and insect farming produces very few greenhouse gases.

Although the report states that 2 billion people worldwide already have insect dietary supplements, "consumer hatred" remains a major obstacle in many Western countries. Like other crops, most edible insects are highly seasonal. Many harvest festivals around the world include the Wasp Festival in Japan and the Caterpillar Festival in Burkina Faso. The move to bring edible insects to tables around the world has been motivated by the belief that eating insects can help boost nutrition and reduce pollution. Enthusiastic entrepreneurs or businesses are looking for new ways to appeal to the discerning consumer, such as using them in powdered form in bread and pasta, and protein shakes. It may be that such powder pushing will introduce consumers more to the pleasures of eating beetles. However, there is much more to be said for the fun and romance that unexpectedly insect-shaped dishes can bring to the table. Insects gained legitimacy and found themselves included in the list of the 2019 Food Trends and became a part of the wider movement towards health and environmentally conscious foods.

Innova Market Insights, studies food trends using data on new products that put insect protein among a variety of meat options to lure in the New Year. Although insects use less water, feed, and space, emitting greenhouse gases. For example, 10 kg of beef is required for a kilogram of animal weight, 5 kg for pork, and 2.5 kg for chicken, while only 1.7 kg is needed for an insect. To produce the same amount of protein as meat worms, a tenth of the land area of beef and about half the production space of pork and chicken is required.

The report states that insects are also good sources of protein, fat, fiber and fatty acids. For example, house crickets have an average of 205 grams per kg of protein compared to 256 grams per kg in beef. Termites are surprisingly rich in protein. Insects are also rich in essential amino acids and omega-3 fatty acids. Some are surprisingly high in iron. For example, locusts have up to 20 milligrams of iron per 100 grams and Mopane caterpillars have 31 milligrams per 100 grams, while beef has only 6 milligrams per 100 grams. Unlike livestock it is environmentally friendly to consume insects. Insects are cold-blooded and thus require less energy to maintain their internal body temperature. This means that they are very efficient at converting feed into edible body mass, unlike cattle. Crickets require about 2 kg of feed to produce 1 kg of meat, and about 80 percent are edible. Cattle, on the other hand, require 8 kilograms to produce the same amount of meat, but only 40 percent of that of a cow can be consumed.

This means that less land for livestock than insects needs to be devoted to irrigation and growing feed to reduce pesticide use. In addition, worms can also be used as livestock feed, for example as a replacement for fish farming. This would have the added benefit of increasing the supply of fish available for humans to eat. Insects require significantly less land and water than conventionally farmed animals and reproduce very quickly. They also have a short life span and thus can be grown quickly and cultivated in large quantities in small areas. Additionally, insects produce a fraction of greenhouse gases such as methane and ammonia compared to other animals, especially cattle. In addition, they can consume animal waste or plants that people and livestock cannot. This means they do not compete with the human food supply and can also help reduce environmental pollution. It was also found that insects are less likely to transmit zoonotic infections to humans than mammals and birds.

Collecting, rearing, processing and selling insects can provide significant livelihood opportunities for poor individuals living in developing countries. Not only will these activities improve their diet, but they can also provide employment and generate cash income through the sale of produce. It does not require much experience or sophisticated equipment, which means that many individuals can participate in these activities including women and people living in rural or urban areas that lack available land. According to National Geographic, stink bugs may have a foul odor, while they actually taste like apples. Red agave worms are spicy, and have tree worms that taste slightly like pork rinds. Insects may not be for everyone, but they can be a valuable asset to global food security. They are sustainable, green, and nutritious and can help lift people out of poverty. In addition, the European Commission Group is awarding a very generous $4.32 million prize to enthusiastic traders who have the best idea to grow insects as a popular food.

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INSECTS

IN HUMAN THERAPY

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Nature has been the source of life-changing and -saving medications for centuries. Since early times, insects and the substances extracted from them have been used as therapeutic resources in the medical systems of many cultures. The term "entomotherapy" comes from the Greek words entomon (insect) and therapy (treatment) (treatment in medical terms). Entomotherapy is described as the use of insects and insect-derived products to treat or prevent disease.

Global scenario of entomotherapy

It has been stated that at least 1000 species of insects are used medically around the world, and considering the lack of understanding in this sector, the true amount could be far higher. Approximately 300 medicinal insect species have been documented from China alone, divided into 70 genera, 63 families, and 14 orders, with hundreds more insects used to treat ailments in people and domestic animals reported from Tibet, Japan, Korea, India, Spain, Turkey, Africa, and South America.

Live insects in human therapy in modern medicine

Apithreapy - Bee products in Human therapy

Apitherapy is the practise of employing bee products such as honey, pollen, propolis, royal jelly, and bee venom to prevent or treat disease. It's also known as "the science (and art) of using honeybee products to maintain health and assist individuals in restoring health when illness or accident occurs.

Bee venom

Direct stinging by bees also known as apipuncture is a type of bee sting therapy. Mellitin, a key peptide found in bee venom, inhibits the expression of inflammatory genes and is used to treat rheumatoid arthritis and multiple sclerosis inflammation for humans.

Honey

Honey is used to cure head colds, coughs, throat infections, laryngitis, tuberculosis, and lung disorders. Honey's antioxidant activity, anti-inflammatory and anticancer properties are also due to polyphenolic chemicals.

Propolis

Propolis was used to embalm cadavers and prevent putrefaction in Egypt. Because of its antibacterial and therapeutic

characteristics, Greeks and Romans make use of propolis as a mouthwash and to cure wounds. Propolis was used as an antipyretic by the Incas, and it was used to cure eczemas, myalgia, and rheumatism by the Persians. Propolis was used to treat tuberculosis and wound healing during World War II. In fact, has never gone out of style and may now be found in cosmetics, health foods and beverages, extracts, capsules, and mouthwash. Because of its high hormone content, it is commonly used by menopausal women, and it is reported to have antibacterial, anaesthetic, depressive and anxiolytic, neuroprotective, anti-inflammatory, and other qualities.

Bee bread

Bee bread's constituents, it is a good supplement for vitamin deficiency for humans. It can improve digestion and intestinal disorders, as it is a source of probiotics, indicated to restore the intestinal microbiome in human body.

Beewax

Beeswax is an emulsifying and hardening agent used in cosmetics, it is able to reduce trans epidermal water loss from the skin, promoting hydration and a moisturized skin, especially for dry and chapped lips. It is a protective barrier against external factors by forming a film on the skin surface. It shows antiviral effects due to the characteristics of SARS-CoV-2, as it is an enveloped and single-stranded RNA virus, it may be sensitive to the antiviral effects of beeswax extract.

Royal jelly, Pollen and Apilarnil

RJ assists with cell regeneration and bone marrow production, as well as hormonal modulation, menopausal symptoms, anaemia, gastrointestinal ulcers, hypo- and hypertension. It can also be used to treat male infertility in humans.

Bee pollen has antioxidant, cardioprotective, hepatoprotective, anti-inflammatory, antibacterial, anticancer, immunostimulant, and antianaemic effects, among others. It's high in vitamins (A, B_1, B_2, B_6, C, and E), amino acids, calcium, iron, potassium, and sodium.

Apilarnil used to treat ovarian dysfunction, male infertility; thyroid, immunological abnormal-lities, and malnutrition in children are among the ailments and health issues for which it is utilised in complementary medicine.

Maggot Therapy:

Used in military medicine, very effectively. Maggot therapy is the intentional introduction of life, disinfected blowfly larvae (maggots) into soft tissue wounds. It selectively cleans out the necrotic tissue. As a result, it aids in the prevention of infection and the healing of chronically infected wounds and ulcers. Military surgeons have known since classical antiquity that wounds left untreated for several days and infested with maggots heal faster than wounds that are not so infested. Allantoin, urea, phenylacetic acid, phenylacet-aldehyde, calcium carbonate, proteolytic enzymes, and a variety of other compounds are secreted by maggots to destroy bacteria. They were also utilised in the Napoleonic Wars, the American Civil War, and the First and Second World Wars more recently. The commonly found/used species are. *Phormia regina, Lucillia sericata*

Blister Beetle and Spanish fly therapy: Cantharidin accepted by FDA

Cantharidin is a substance generated by blister beetles to protect themselves from predator attacks by causing reflex bleeding. It also has a historical use by the Greeks and Romans and is used as an aphrodisiac in some societies. In 2004, the FDA approved this as a treatment for warts, skin disorders, ovarian cancer cell inhibition, uro-genital tract infections, kidney infections, and potent tumor-fighting qualities.

Blood-Feeding Insects therapy: To prevent blood clot

Many blood-feeding insects like ticks, horseflies, and mosquitoes inject multiple bioactive compounds (1280 distinct protein families) into their prey. For hundreds of years, Eastern Medicine practitioners have utilised these insects to avoid blood clots and thrombosis. Modern medical research, on the other hand, has only just started to look into it. These chemicals found in the saliva of blood-feeding insects can make blood-feeding easier by inhibiting platelet coagulation near the wound and providing protection from the host's immunological response.

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IMPACTS OF NANOPESTICIDES IN AGRICULTURE

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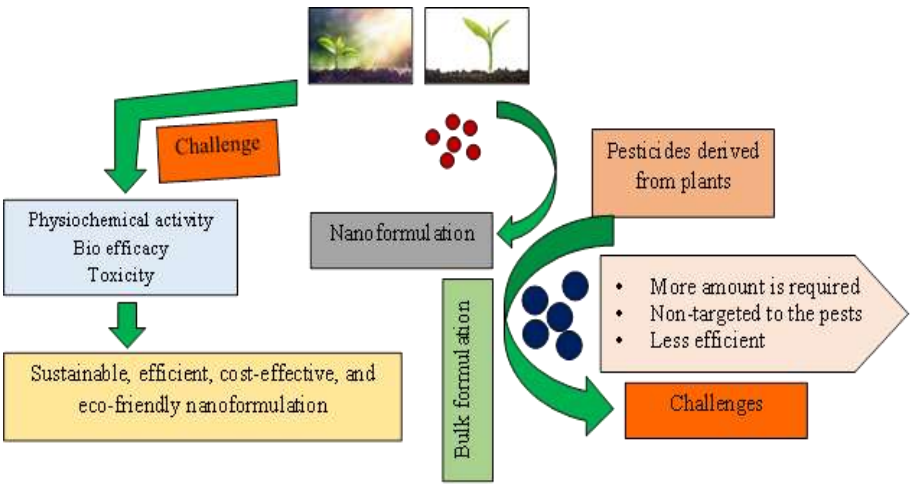
Global population expansion necessitates availability to high-quality food that can meet people's needs on all continents. As a result of the increased use of fertilizers, insecticides, herbicides, and other agrochemicals to boost agricultural production, we have seen an increase in the usage of fertilizers, insecticides, herbicides, and other agrochemicals. But the uncontrolled use of pesticides against harmful pests and insects has had a negative impact on output, causing disease and insect resistance, increasing demand for new agrochemicals, and worsening environmental imbalance.

Nanotechnology is the fifth revolutionary technology of the century after biotechnology. In this technology, we study nanometer (1–100 nm) size materials and their applications. At nanoscale, material has specific physical, optical, mechanical, and chemical characteristics in comparison with their bulk form. Because agrochemical nano particulates have a larger total surface area, they have more contact with crop pests, making them as effective. Unreasonable and haphazard use of agrichemicals increases pathogen resistance, reduces nitrogen fixation and biodiversity, and increases pesticide bioaccumulation in agricultural, livestock, and aquatic organisms, posing a serious and progressive threat to the ecosystem and humans, as well as a barrier to the development of sustainable agriculture.



Graphic representation of challenges and prospects of nanopesticides

Nanotechnology in agriculture:

Nanotechnology holds significant promise for sustainable agriculture, and it is projected to transform traditional farming into precision farming. The use of nano formulation, nanoencapsulation, functionalized nanomaterial of next-generation fertilizers and pesticides provides site-specific and controlled delivery of active ingredients (fertilizers and pest protectant) to plants and reduces excess run-off. The development of smart delivery systems such as nanofertilizers, nanopesticides, nanoherbicides, and nanosensors has opened new avenues for agricultural sustainability. The smart controlled release profile of fertilisers and agrichemicals required to boost crop yield has provided remarkable prospects to rejuvenate agriculture practices by adopting nanotechnology-based delivery systems. Innovative nanopesticides are nanoparticles designed to protect plants, reduce application losses, boost leaf coverage, improve stability, and reduce formulation ingredient requirements.

Nanopesticides

The pesticide industry's nanoformulation of traditional pesticides with polymers or metal nanoparticles is a high-demanding field. The manipulation of the outer shell of the nanocapsule allows for regulated and gradual release of the active ingredient, which delivers a

low dose over a longer time period and prevents undesirable pesticide run-off. Another advantage of nanocarriers in plant protection is site-targeted distribution and active component stability. Similarly, a nanoemulsion of water or oil boosts pesticide solubility and effectiveness against a variety of pests. Nanopesticide formulations can improve water solubility, bioavailability, and protect agrochemicals from degradation in the environment, revolutionizing disease, weed, and insect control in crops.

Nanotechnology versus Conventional practices

Nano-pesticide formulations improve adhesion of droplets on plant surface (reduces drift losses) which intern improves the dispersion and bioactivity of active ingredient (a.i.) of pesticide molecules. Therefore, Nanopesticides will have high efficacy compared to the conventional pesticide formulations and due to their small size, improvable pesticide droplet ductility, wettability and target adsorption. Pesticide use that is indiscriminate and irrational disrupts the ecosystem's balance and puts a risk everyone's health. Short-term (acute) and long-term (chronic) adverse consequences of occupational or accidental intake of pesticide residues from food or drinking water are lethal or result in disability-adjusted life years (DALY). Children are more sensitive to pesticides and are more likely to suffer irreversible tissue and organ damage as a result.

Nanoformulations, on the other hand, are well known for their vital function in minimizing active ingredient degradation, enhancing water solubility equilibrium, and increasing biological availability of active chemicals. Reduce the quality and quantity of agricultural products and foods to avoid endemic insect infestations, plant harm, and economic loss. Nanosized bacteriophages have also been found to be viable biological alternatives to traditional Cu bactericides. Nanoparticles are more efficient than their bulk components because of their small size and high surface-to-volume ratio. The apoplastic route allows engineered nanoparticles to reach the intercellular space. Particles may also penetrate epidermal and cortical cells through apoplast (cell wall) to reach endodermis and collect evenly or as aggregates.

Conclusion

Nanotechnology, in the form of nanofertilizer and nanopesticide, is the next breakthrough technology in agriculture that can bring long-term tools to traditional farming practices. Traditional agri-inputs in nanoform allow site-specific and regulated release of active ingredient, reducing excess run-off, preventing eutrophication, and preventing residual contamination. The employment of encapsulated and metal nanofertilizers and nanopesticides in agriculture has proven to be a promising strategy. However, a significant investment in research and financial assistance is required to determine the optimum approach to meet agricultural productivity demands while also protecting human health and ecosystems. The benefits of nanotechnology in agriculture are well known, but the possible toxicological effects and consequences of nanopesticides for environmental and food safety has received little consideration.

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INSECTS
OF INDUSTRIAL IMPORTANCE

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Insects are one of the most dominant and diverse groups of animal as they constitute about three-fourths of the total organisms present on earth. Insects are unique not only by their diversity but because of their markable speciation ability. Resources from insects are also vast and diverse and with their myriad uses, insects have been providing constant services to the mankind as other important resources. On the basis of their utility, insect resources are broadly classified into four different categories. One of the major category is the insects of industrial resources. This level includes the utilization of silk worm, honeybee, lac insect, dye insect and aesthetic insect. Two of the most important domesticated insects are the silkworm (Lepidoptera) and the honeybee (Hymenoptera). Some coarse silks are produced from the cocoons of large wild silkworm species. Beeswax and honey are still articles of commerce contributing in the economy at the global level. Coccids are the source of the crimson dyes. The cochineal, or carmine, from Dactylopius scale insects are utilized for dying clothes, as an additive in foods, cosmetics, drugs, and textiles. Several insect waxes are used commercially, especially beeswax and lac wax. The resinous product of the lac insect Kerria lacca (Homoptera), which is cultured for this purpose, is the source of commercial shellac. Insects are one of the major contributors in the industrial growth worldwide.

1. Insects of industrial resources

(a) Sericulture and allied purposes

The queen of the fibers i.e. silk is the product of insects of order Lepidoptera. India is home to variety of silk secreting fauna which includes an amazing diversity of silk moths. This has enabled India to achieve the monopoly of being producer of all the five commercially traded varieties of natural silks, namely, mulberry, tasar, oak tasar, eri, and muga produced by silk moth species *Bombyx mori*, *Antheraea mylitta*, *A. proylei*, *Samia cynthia ricini*, and *A. assama*, respectively. Asia is the top producer of silk in the world contributing 95% of the total global output. India, the world's second largest producer of silk after China, is also the largest consumer of silk. In India, mulberry silk is produced mainly in the states of Karnataka, Andhra Pradesh, Tamil Nadu, Jammu & Kashmir, and West Bengal, while non- mulberry silks are produced in the state of Jharkhand, Chattisgarh, Orissa, and north-eastern region. In the north eastern states of India, Assam contributes almost 90% of Muga silk and 65% of Eri silk production. Meghalaya and Manipur also appear in the map of silk producing states of this region.

Global silk market is expected to reach US$21.94 billion till 2026 at a CAGR of 7.3%. Apart from silk, there are several others by products from sericulture which can be utilized as commercial input in many fields. The mulberry foliage is exploited for the fodder purpose for cattle. Silkworm pupae were traditionally used as fertilizer, animal feed, food material, and medicine in some countries, such as China, Japan, Korea, India, and Thailand. Human consumption of silkworm pupae has been practiced in China and India by many tribal communities. Recently, silkworm pupae have been put in the list of "Novel food resources managed as common food" by Ministry of Health PR China. The major waste product of sericulture industry i.e. sericin, is also regarded as another raw material for the production of sericin powder that is used as a raw material in a variety of industries for the production of food, cosmetic, medicine, and so forth. Thus sericulture not only provides silk for fashionable clothing, it also offers several useful by products to the human society.

Silkworm cocoons boiling for the extraction of fibre

(b) Apiculture and allied purposes:

Honey production has been proven as a promising profitable venture, which is a mean of low-cost or high-yield enterprise without requiring compulsory land ownership or capital investment. It has been used traditionally in various diet preparations, such as medicine, cosmetic, ointment, candle, and household bee wax items. The

propolis of the bee hive is used in lip balms and tonics whereas royal jelly is used to strengthen the human body, for improving appetite, preventing ageing of skin, leukemia and for the treatment of other cancers. On an estimate, about 80% honey is used directly in medicines and 10% in Ayurvedic and pharmaceutical production. Honey bees during foraging for pollen and nectar from flowers of different plant species, enhance agricultural productivity to the tune of 30%–80% annually through cross-pollination. Of the five honey bee species of the world, only two species, *A. cerana* and *A. mellifera* are reared in India. Global Apiculture market is expected to grow at a CAGR of 2.8% till 2024.

(c) Lac culture: Lac is a resinous substance produced by an insect popularly known as lac insect. Lac insects, the crowning glory of India's rich insect fauna (representing 21.8% diversity of the known lac insect species) are exploited for their products of commerce, namely, resin, dye, and wax. The total numbers of lac insect species reported from the world are 87 species under nine genera, of which 19 species belonging to two genera are found in India. Concerning the economic viewpoint, India is the largest producer of lac in the world, accounting for about 50%– 60% of the total world lac production. India produces about 20,000 metric tons of raw lac every year. The major lac producing states are Jharkhand (57%), Chhattisgarh (23%), and West Bengal (12%) while Orissa, Gujarat, Maharastra, Uttar Pradesh, Andhra Pradesh, and Assam are minor producers. India fetches approximately Rs.120-30 crore of foreign exchange through export of lac every year.

Lac resin being natural, biodegradable and nontoxic, finds applications in food, textiles, and pharmaceutical industries in addition to surface-coating, electrical, and other fields. It provides immense employment opportunities in the country. Species belonging to genus Paratachardina produce a hard, horny substance, which is insoluble in alcohol. These are univoltine and are generally treated as parasites of economically important plant such as tea and sandal. Recently, Paratachardina spp. have been found to be potential biocontrol agents for managing weeds. Of the 19 species of lac insects reported from India, Kerria lacca is mainly exploited for commercial production of lac. K. chinensis in the northeastern states and K. sharda in coastal regions of Orissa and West Bengal are also cultivated to a certain extent. Potential of other lac insect species reported from the country remains to be exploited and also a persistent exploration of new species is required.

(d) Natural dye from insect: The coccid, *Dactylopius coccus* (Hemiptera: Dactylopiidae) is the most important species due to its being used for the extraction of carmine acid, a natural red dye used in food, pharmaceutical, and cosmetic industries. Dried females are a source of red dyes widely utilized in food, textile, and pharmaceutical industries. The residuals from coloring extraction can be used to enrich food for avian species or to prepare fertilizers. Cochineal is used to produce scarlet, orange, and other red tints. Likewise, oak galls are used commercially as a

Red dye from the cochineal insects

source of tannic acid. It was a principal ingredient in wool dyes and black hair colourants used during the Greek empire as early as the 5th century BC. It is still used commercially in the leather industry for tanning and dying and in manufacturing of some inks.

(e) Insect trade for aesthetic purposes: The body colouration, beauty, and mode of life of the insects always attract us. Coloured wing and elytra of many coleopterans are used in jewellery, embroidery, pottery, and basket makings. Among the insects of aesthetic value, butterfly attains maximum attention from museums and collectors for which it is established as one of valued items in market. For satiating the growing need of butterfly amongst the collectors, numerous butterfly farms have been developed in European countries.

Conclusion

Insects are by far the most successful and diverse animals inhabiting this earth and have largely earned the reputation of being harmful. This is despite the fact that less than 1% of the insect population is actually harmful. Insects owing to their tremendous adaptations to diverse habitats have much to offer to us humans for technological advances in all spheres of our lives. Other than the known avenues of silk, honey and lac production, insects have much to offer in the field of food, nutraceuticals, pharmaceuticals, therapies, weed and pest management, etc. ■

ECOLOGICAL IMPORTANCE OF ELEPHANTS

Dr. Madhvee Dhairykar
SWFH, NDVSU

"Elephants play a crucial role in our environment. They provide numerous ecosystem services, such as providing food, shelter and water, helping to create pathways in forests, and identifying salt licks. These services not only benefit elephants, but other species as well."

Elephants are the largest mammals on land, and they are found across Africa and Asia. Elephants are also among the most intelligent species on Earth and are the descendants of mammoths, which have continued to fascinate humans long after their extinction. These broad-eared creatures also play a crucial role in several religions, cultures and traditions across the world, and several communities worship them. Elephants serve a critical role in our ecosystem and are therefore known as a "***keystone species***." Keystone species are those that provide vital ecosystem services, many of which are essential for the survival of other species in the community.

There are some of the amazing services that elephants provide and how this helps other animals!

Elephants create watering holes during drought

Many regions around the globe are facing a crisis of water scarcity. During these times of intense drought, elephants use their trunks to sniff out areas where water may be found underground. They can then use their tusks to dig for water and create new watering holes, which allow them to survive during the drought season. These watering holes are not only used by elephants, however, but many other species as well.

Elephants are not just flagship species; they are so much more.

Elephants disperse seeds

As we know, elephants are herbivores, meaning that they consume many plants, along with their seeds! Elephants eat these seeds and then plant them on their wanders via their dung. These seeds, in turn, grow into new plants, grasses and bushes. The dung also acts as a fertilizer and provides numerous nutrients that promote germination and growth. As elephants move from one area to another, they help plants colonize and grow in newer regions, thus creating additional habitats for animals.

Did you know that African elephants are capable of dispersing seeds from 335 different plant species and Asian elephants can do the same for 122 different plant species?

Elephants create new paths

As we know, elephants are a solid, well-built species, which means that they are capable of trampling quite a few plants while walking from one area to another. This creates a clearance in densely vegetated areas, enabling smaller animals to move more freely. Similarly, elephants pull down and uproot thorny bushes, which further helps in clearing safe pathways for smaller animals. The clearance of some thorny bushes also allows more light to reach the ground, which promotes the growth of new plant species and reduces competition. Elephants are not only clearing the way for smaller animals, but also creating more opportunities for plants to flourish!

Elephants provide food

Elephant dung is a food resource for many species, primarily insects. Given that elephants defecate over 15 times per day. Their dung creates ample food for

those species that rely on it. As a result, innumerable insects swarm near freshly deposited dung. These swarms then act as a food source for birds who feed on the insects. Dung beetles are also known to collect elephant dung and store it as a source of food for their larvae. Honey badgers then capitalize on this collection and feed on beetle larvae!

It has observed butterflies visiting fresh dung, as it keeps them warm. They have also reported that dung contains minerals that are essential for reproduction, and is therefore ingested by male butterflies.

In addition, when elephants forage for food, tree branches, leaves and twigs will fall to the ground. This helps in the pruning of trees, which facilitates their growth. These fallen tree parts become food for large herbivores like gaur (*Bos gaurus*) and sambar deer (*Rusa unicolor*), who also share ecosystem space with elephants.

Elephants provide shelter

Just as they provide food, elephants also provide shelter for smaller creatures, especially amphibians and insects. It has observed that during the dry season, elephant tracks fill up with water, which creates an ideal environment for frogs to lay their eggs and for tadpoles to grow. Also, the footprints of elephants provide predator-free breeding grounds for frogs and act as connecting sinks for frog populations to connect.

Elephants help in finding natural salt licks

Minerals are essential for the growth and development of most creatures, including elephants. In the wild, elephants obtain the minerals they need from plants. When resources are scarce, however, they can obtain other minerals, especially sodium, directly from the soil. Elephants, which have a good sense of smell, use their trunks to detect areas in the ground that have large quantities of minerals. They will then use their tusks to dig into the soil and then bend down to eat it. These salt lick sites are not only used by elephants, but also other herbivores that may need to increase their mineral intake.

As we can see, elephants play a very important role in their respective ecosystems. Their role can neither be replaced nor played by any other species, which is why organizations around the world have been working hard for decades to protect these creatures and ensure their survival!

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VEGETABLE WASTE MANAGEMENT

BENEFITS AND CHALLENGES

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World produce enough food to feed twice of its population. Around 89 million tons of food is wasted annually in the European Union. Moreover, the World Food and Agriculture Organization calculated that one-third of the edible parts of food intended for human consumption get lost or wasted. Due to severe food losses in India, it ranks 102 among 117 countries with a score of 30.3 in the Global Hunger Index.

Vegetable waste

Vegetables has a crucial role in our diet and human life, and therefore the demand for such important food commodity has increased very significantly as a result of the growing world population and the changing dietary habits. Higher production and growth, and the lack of proper handling methods and infrastructure, have led to huge losses and waste of vegetables. Vegetable waste is defined as the inedible parts of vegetables that are discarded during collection, handling, transportation and processing or plant tissue residues generated right from agricultural field to processing factories. The main forms of organic vegetable wastes are:

1. Domestic/household wastes
2. Agricultural wastes
3. Agro-Industrial wastes

Waste management

An Waste Management System (WMS), according to U S Department of Agriculture (USDA) is a "planned system in which all necessary components are installed and managed to control and use byproducts of agricultural production in a manner that sustains or enhances the quality of air, water, soil, plant, and animal resources". WMS consist of six basic functions as noted by USDA: production of vegetable waste, collection, transfer, storage and treatment and utilization.

The most efficient ways to utilize vegetable waste

1. Energy from vegetable waste
- Briquetting
- Biogas

2. Nutrient recycling from vegetable waste
- Composting

3. Power alcohol from vegetable waste

4. Recovery of different compounds

Briquetting

Biomass briquettes are a bio-fuel substitute to coal and charcoal. Briquettes are mostly used in the developing world, where cooking fuels are not as easily available. There has been a move to the use of briquettes in the developed world, where they are used to heat industrial boilers in order to produce electricity from steam. The briquettes are co-fired with coal in order to create the heat supplied to the boiler.

Biogas

Biogas is produced after organic materials (plant and animal products) are broken down by bacteria in an oxygen-free environment, a process called anaerobic digestion. Biogas systems use anaerobic digestion to recycle these organic materials, turning them into biogas, which contains both energy (gas), and valuable soil products (liquids and solids). Since the useful gas originates from biological process, it has been termed as bio-gas. Methane gas is the main constituent of biogas.

Composting

Composting is the biological decomposition of organic waste such as food or plant material by bacteria, fungi, worms and other organisms under controlled aerobic conditions. The end result of composting is an accumulation of partially decayed organic matter called humus. Composting with worms, also known as vermiculture, results in nutrient-loaded worm castings.

Power alcohol

Conventional bioethanol produced from starch (e.g. maize or wheat) and sugar crops (e.g. sugar cane and sugar beets) is the largest contributor of total biofuel production and therefore represents the largest renewable contribution to transport.

Challenges in vegetable waste management

Some of the limitations for utilizing organic vegetable waste are:

1. public acceptance (nuisance or environmental concern),
2. acceptable integration into agriculture,
3. quality control of residues being applied,
4. logistics and organization,
5. satisfaction of environmental regulations,
6. economic viability and
7. sustainability.

Initiatives by GOI:

1. Central Sector Scheme – Pradhan Mantri Kisan SAMPADA Yojana (PMKSY) implemented by Ministry of Food Processing Industries (MoFPI) Schemes under PMKSY:
   - Mega food parks.
   - Integrated cold chain and value added infrastructure.
   - Creation/ expansion of food processing/ preservation capacities.
   - Infrastructure for agro-processing clusters.
   - Creation of backward and forward linkages.
   - Food safety and quality assurance infrastructure.
   - Human resources and institutions.
   - Operation greens.

2. National Biogas and Manure Management Programme (NBMMP): implemented by Ministry of New and Renewable Energy.

Conclusion

Large amounts of food processing wastes are buried in landfills at a cost, while liquid food processing wastes are released untreated into rivers, lakes, and oceans or disposed of in public sewer systems. It has become important to develop alternative methods for treating food processing wastes due to the greenhouse gas emissions and leachate into groundwater that result from traditional disposal of food wastes, the reduced availability of landfill sites, and high landfill disposal costs. Conversion of food processing wastes into bioenergy and bio-products can reduce waste disposal costs and generate revenue from the wastes of food processing facilities. Wet food processing waste is usually better suited for biological processes, such as anaerobic digestion, while dry waste is better suited for thermo-chemical conversion processes, such as combustion. Food processing wastes, which are rich in sugars, vitamins, and minerals, are very suitable as raw materials for the production of high-value chemicals or metabolites, such as organic acids, enzymes, antibiotics, antioxidants, vitamins, and mushrooms, by microorganisms.

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ZERO BUDGET NATURAL FARMING IN INDIA

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Zero budget natural farming is the type of farming which promotes chemical free farming. It was originally introduced by Agriculturist Subhash Palekar in the mid 1990's as an alternative to the green revolution method such as the adoption of high yielding varieties, seeds & use of inorganic fertilizers and pesticide while current farming practices are driven by using chemical zero budget natural farming promotes low cost input such as the use of cow-dung, cattle urine, jaggery, pulse flour, other plants based extracts.

Palekar has argued that the cost of external inputs such as pesticides and fertilizers were the leading cause of indebtedness and suicides among farmers in the country. By implementing traditional methods, he said that production cost and interest rates for credit should be significantly reduced. Similarly, according to food and agriculture organization of the United Nations, a zero budget promises to end reliance on loans which in turn could help in ending the depth cycle for farmers.

Basic pillars of zero budget natural farming

ZBNF footholds under four important pillars (Palekar, 2014).

1. Jivamrit: The nectar of Life. Jivamrit = cow dung (20kg) + Urine (5-10 L) + Jaggery (20 kg) + Gram flour (2 kg) + live forest soil (1 kg) + 200 l water.

The mixture is fermented for 5 to 7 days with regular stirring thrice a day. This is used for 1 acre along with irrigation water. It helps to prevent fungal and bacterial plant diseases, also provides nutrient and acts as a catalytic agent for microbial and earthworm activity.

2. Bijamrit- Bijamrit is a treatment use for seeds, seedling or any planting material. It is an effective in protecting young roots from fungus as well as from soil and seed borne diseases that commonly affect plants after the monsoon period. It is composed of similar ingredients as jeevamrutha- local cow dung, a powerful natural fungicide, and cow urine, a strong anti- bacterial liquid, lime, soil.

3. Acchadana/mulching: Mulching can be done either by soil mulch, straw or live mulch. Various benefits of mulching include the conservation of soil moisture by reducing evaporation, controlling weed population besides increasing organic matter status of the soils. It provides favourable environment to the micro-organism present in the soil.

4. Waaphasa It is the condition where there exist both air molecules and water molecules present in the soil. In this system, irrigation should be practiced only at noon, in alternate furrows. It was given

importance as plant roots needs air molecules in addition to water.

PRINCIPLES OF ZERO BUDGET NATURAL FARMING

1. **Intercropping-** This is primarily how ZBNF gets its "Zero Budget" name. It doesn't mean that the farmer is going to have no costs at all, but rather that any cost will be compensated for by income from intercrops, making farming a close to zero budget activity. Palekar explains in detail the crop in association that work will for the South-Asian context.
2. **Contours and bunds-** This method is useful for preserve the rain-water, contours are constructed along in order to best slow the water flowing down the slope, which increases the green water pool of the soil and prevents erosion.
3. **Local species of earthworms-** Palekar opposes the use of vermi-compost. He claims that revival of local deep soil earthworms through increased organic matter is most recommended.
4. **Cow dung-** According to palekar, dung from the Bos-indicus is most beneficial and has the highest concentrations of Micro-organisms as compared to European cow breeds such as Holstein. The entire ZBNF method is centered on the Indian cow, which historically has been part of Indian rural life.

Outcomes/merit of zero budget natural

- **Expenses will be low-** As we know farmer use insecticides and pesticides which is expensive for them instead of them farmers can their own things in zero budget farming which will be cheap for farmers.
- **Increases land fertility-** Farmer use insecticides and pesticides to protect the crop from insects and pests due to which fertility of land gets affected and later on production capability of land gets affected but if we use zero budget farming than the fertility and production capability of land does not get affected.
- **Economical/ profitable faming-** In-zero budget farming can use their own natural fertilizer which is made by them which will be very economical for themand will get more profit
- **Yield increases-** zero budget farming increases the yield of crops if farmerthink that the yield of crops gets affected in zero budget farming than it is completely wrong.

Government approach towards zero budget natural farming

A handful state governments in India have supported a few trainings, and while this is welcome, it's amounts to very little support. One state Andhra- Pradesh, has recently announced plans to support 3000 farmers to adopt "ZBNF" via state support.

An area of 4.09 lakh hectare and an amount of Rs.49.9 crore has been released by the central government to eight states. The NITI-Aayog to has been at the forefront in the adopt and promoting of Zero budget natural farming practices. In this farming system already 25lakh farmers in India are already practicing the zero budget natural farming.

Zero budget natural farming gained prominence when Hon'ble Finance Minister Mrs. Nirmala Sitaraman had highlighted the approach as a source of doubling farmer's income by 2022 during the first budget speech of the 17th Lok-Sabha in July 2019.

Conclusion

The conclusion of zero budget natural farming is to savings the cost of seeds, fertilizers and plants protection chemicals has been substantial. The new system has freed the farmers from debt trap and has instilled in them renewed sense of confidence to make farming an economically viable. According to a survey that suggests benefits of zero budget natural farming work not in agronomic terms but also brings about a variety of social and economic benefits.

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HIGH-THROUGHPUT PHENOTYPING FOR CROP IMPROVEMENT

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Improving plant genetics and breeding is one of the best ways to increase the productivity of major crops worldwide. However, the discipline of crop improvement must evolve to meet the increasing challenges of climate change. Moreover, some predictions suggest that crop yields must approximately double by 2050 to adequately feed an increasing global population. Modern techniques for crop improvement rely on both DNA sequencing (genotyping) and accurate quantification of plant traits (phenotyping) to characterize germplasm and experimental populations to identify useful genes/QTLs. Despite recent advances in genomics, a lack of suitable phenotyping data (phenomics data) has led to poor results in gene/QTL discovery, limiting progress in genomics-assisted crop improvement programs. Therefore, acquisition of high-throughput, effective and comprehensive trait data needed to understand the genetic contribution to phenotypic variation has become an acute need. The modern phenomics tools aim at recording data on traits like plant development, architecture, growth, biomass, photosynthesis etc. for hundreds to thousands of plants in a single day. Thus high-throughput phenotyping platforms allowed screening of large plant populations, germplasm collections, breeding material and mapping populations with increased precision and accuracy in phenotypic trait acquisition coupled with decreased labor input achieved by automation, remote control and data (image) analysis pipelines amenable to high-throughput.

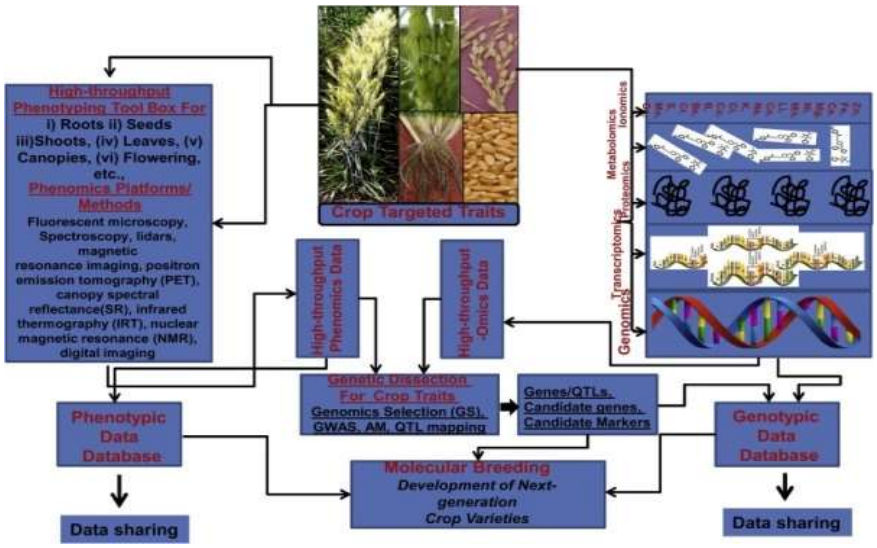

Fig. 1. Holistic view of role of crop phenomics in crop

The phenomics bottleneck

Unprecedented recent developments in next-generationc DNA sequencing technologies have resulted in tremendous progress in unravelling and understanding crop genomes, thus shifting the plant science research bottleneck from genomics to phenomics. This shift has driven the need and efforts for the development of high-throughput, non-invasive phenotyping technologies able to capture trait phenotypic data that can be linked to genomics information for crop improvement. Despite these advances, our ability to collect reliable phenotypic data still lags behind the current capacity to generate high-throughput molecular genotyping data resulting in a "phenotypic bottleneck", which is currently hindering plant breeders from making fast progress.

The figures shows different –omics (genomics, transcriptomics, proteomics, metabolomics and ionomics) platforms which can be integrated with phenomics platforms. Some of the most important phenotyping bottlenecks include:

- Phenotyping mapping populations for a wide enough array of traits that would lead to QTL/gene discovery and cloning of important genes for their use in molecular breeding programs. This step in gene discovery is very laborious, time consuming and technically challenging;
- Phenotyping populations or germplasm in a sufficient range of environments in replicated trials to enable the capture of representative variation for traits like grain size, abiotic stress tolerance, grain quality traits, Rubisco specificity, spike photosynthesis, yield and yield contributing traits is slow and costly;
- Less effective estimates of recorded trait data that could lead to weak correspondence of trait data with allelic variations of candidate genes in a germplasm set and hence poor results in use of alleles of candidate genes in molecular breeding programs.

Efforts are being made to alleviate such phenotyping bottleneck through the use of sophisticated non-invasive imaging, spectroscopy, robotics, high-performance computing facilities, and development of phenomics databases and phenotypic data sharing.

Effective /cost-efficient/ affordable phenotyping

Cost-efficient phenotyping is developing rapidly due to decreases in cost of equipments such as environmental sensors, and smartphone embedded applications for mobile imaging to capture images and crop performance datasets both under controlled environments and in the field. Effective and affordable phenotyping is considered a crucial factor for bridging the genotype–phenotype gap for quantitative traits and the discovery of candidate QTLs. However, good phenotyping does not only comprise collecting and recording effective trait data, but also collecting data that is relevant and meaningful from biological and agronomic points of view.

The phenotyping environment and its control

The environment plays a crucial role in plant phenomics since most of the important traits in plants are quantitative in nature and highly influenced by environmental factors. Further, plant breeders aim to develop crop varieties with good buffering and stability that perform well under different environmental conditions. Therefore, appropriate documentation of the experimental environmental conditions (e.g. rainfall, temperature, photoperiod and soil characteristics) is essential for any crop phenomics strategy. New technologies allow the systematic collection and integration of meteorological data at different spatio-temporal scales and real-time inspection. This becomes particularly important in trait-based breeding and when specific environments are targeted.

Conclusion

Tremendous progress has been made with continually expanding genomics technologies to unravel and understand crop genomes. However, the impact of genomics data on crop improvement is still far from satisfactory due to a lack of effective phenotypic data. Thus, the research bottleneck in plant sciences is shifting from genotyping to phenotyping. These modern phenomics platforms and tools are creating a phenomics revolution. It is believed that this revolution will provide plant scientists with the knowledge and tools necessary for unlocking information coded in plant genomes. To further acclerate these efforts, the International Plant Phenomics Initiative was also launched. Maay advances have also made in the last 10 years in phenomics platforms and their use in generating phenotypic data on different traits in several major crops including rice, wheat, barley, and maize. ■

PILU FRUIT BREEDING

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Pilu, also known as toothbrush tree, is a bushy evergreen tree native to India. In the Indian subcontinent, it is known by the names Vann in Punjabi, Mitha Jal or Pilu in Hindi, Sindhi jall in Pakistan, and Tuch in Iran. Salvadora is a common tree that may be found flourishing in Indian deserts, particularly in Rajasthan and Gujarat. Locals consume the fruits, and the seeds are high in oil (40-50%), which is non-edible but has a lot of economic use. It grows in highly salty desert regions and is a good source of food for camels and goats. It creates a virtually impenetrable growth through root suckers around the stem and seedlings that come up under the shade of the canopy, making it an effective plant for shelterbelts and windbreaks in deserts. Because of its prevalence in non-saline to very saline settings, *S. persica* was classified as a facultative halophyte. It is one of the species that has been identified as having great salt tolerance and drought resistance, and it can be utilized to restore salt-damaged soils. Several therapeutically and industrially beneficial preparations and chemicals have also lately been marketed, causing scientists to become increasingly interested in learning more about this medicinal plant.

COMPOSITION AND USES

Because of its fruit yielding potential, pharmaceutical use, fodder, fuel values, shelterbelts, and as windbreaks in desert trails, this tree species is of multipurpose use. Fruits are tasty and popular among the locals. Seeds make up 44 to 46 per cent of the whole fruit, with 2.8 per cent moisture, 45 to 48 per cent fat, 18.94 per cent albuminoids, 23.48 per cent carbohydrates, 5.8% fibres, and 3.5 per cent ash. The plant's seeds have recently become more important than the fruit pulp, which is high in glucose, fructose, and sucrose.

ORIGIN AND DISTRIBUTION

Salvodera persica L. is distributed in S-W Asia, India to Sri Lanka. S. persica showed some variations in it's distributional behaviour in different countries, which may be attributed to changes in water resources, climatic factors, edaphic variables, and anthropogenic pressures along the elevation gradient. It grows in arid and semi-arid parts of Rajasthan, Gujarat, and to a lesser extent Punjab, Haryana, Karnataka, Andhra Pradesh, and Tamil Nadu in India. *S. persica* is the dominating species in saline tracts of various deserts and arid regions, whereas *S. oleoides* is more numerous and widespread in the dry and hot desert.

BREEDING OBJECTIVES

In pilu, there are no descript cultivars. Natural variations, on the other hand, are available and should be examined and used for commercial purposes as well as enriching existing gene pools. The key goal for improvement in *Salvadora* right now should be to collect superior genotypes with regard to fruit and tree attributes.

Future breeding programmes should involve interspecific and intergeneric hybridization, which may result in superior progenies. Another key breeding goal in this species is to develop variations with high yield potential (fruit and oil) and to breed for resilience to biotic and abiotic stressors.

BOTANICAL DESCRIPTION

Pilu is a member of the Salvadoraceae family of the genus *Salvadora*, of which India has two species (*S. oleoides* and *S. persica*). They are an evergreen shrub or small tree native to India, with a slender twisted trunk and drooping branches, and opposite, linear-lanceolate, thick leaves. Flowers are sessile, with a greenish white colour in a paniculate spike that can be either terminal or axillary. Fruits are globose, aromatic drupe that turns yellow when ripe.

SPECIES DIVERSITY

1. *S. persica* - Kharapal, kharapii, Sali bush, mustand tree, and tooth brush tribe are the sole names given to them. It is found in the arid and semi-arid regions of Rajasthan, Gujarat, and to a lesser extent Punjab, Haryana, Karnataka, Andhra Pradesh, and Tamil Nadu in India. *Persica* is the dominating species in saline and dry environments, including several deserts and arid regions. *Salvodona persica* seeds produce a pale yellow solid fat.
2. *S. oleiodes* - Mishajal or pilu is the name given to it. In the arid and both deserts, *S. oleiodes* is more frequent and widespread. The tree may be found in abundance in the Jodhpur areas of Rajasthan. Barmer, Jalor, and Pali are three states of Rajasthan. Lauric acid is about 47% in the seed fat of *Salvodora oleiodes*.

CROP IMPROVEMENT METHODS

a) Selection

The Central Arid Zone Research Institute in Jodhpur has been working to select, conserve, and protect oleoides from pests and illnesses. NBPGR, New Delhi, and Jodhpur collected 21 accessions of oleoides on an exploration tour to parts of western Rajasthan. In this species, there was a lot of variation in fruit colour (red, brown, yellow), size (length 1.88-2.90 mm and width 1.04-2.99 mm).

b) Bio-technological approach

Saini and Yadav (2013) used isozyme electrophoresis using 7 enzyme systems to examine genetic diversity in 11 natural populations of *Salvadora oleoides*.

Yadav *et al.*, (2014) used 16 RAPD primers to investigate the genetic diversity of 19 *Salvadora oleoides* accessions collected from different locations of North-West India. A total of 164 bands were scored, averaging 10.25 bands per primer, with 146 bands displaying polymorphism (90.09 per cent).

FUTURE PROSPECTS

Pilu has a low seed germination rate, low seed viability, low fruit set, and seeds with inhibitors that prevent seed germination. As a result, tissue culture should be used to improve and speed up it's regeneration. To conserve and preserve the germplasm for future use, both traditional (seed, cutting, grafting, budding, and layering) and non-conventional (embryo culture, callus, and shoot tips via cryopreservation) procedures should be used. Research on reproductive biology and salt tolerance physiology should also be pursued.

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DISEASES OF BER (*Zizyphus jujube*) IN INDIA

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Ber (*Zizyphus mauritiana* Lamk - Rhamnaceae) is one of the important fruit crops of arid and semi-arid zones of the world. In India though it is a minor fruit but recently the ber become an important cash crop in some areas and its average and production are increased. The ber, a tropical fruit crop is prevalent in arid and semi-arid region of the world.

Fruit rot

Disease symptom:

- ***Phoma* fruit rot**: The disease appears on the ripening fruit. The infected fruits remain small and develop slightly depressed, dark brown spots near the stem ends. The lesions become irregular in shape and measure 15-25 mm in diameter.
- ***Alternaria* fruit rot**: Slightly depressed, brown to dark brown, circular lesions appear on the fruit. Sometimes concentric rings are also present on these spots. The smaller spots coalesce to form larger spots.
- ***Colletotrichum* fruit rot**: The disease appears at the start of ripening of the fruit in the form of small, slightly depressed, light brown, water-soaked lesions. These spots coalesce and enlarge. Under humid conditions, the acervuli are formed in masses on these spots.
- ***Trichothecium* fruit rot**: The disease is observed during the spring in the form of pink spots on the fruits. The fungus can survive in the soil for a long time. Fruits touching the soil may become infected and develop symptoms.
- ***Cladosporium* fruit rot**: The disease appears near the time of fruit ripening. Injured fruits become infected. The symptoms of the disease start from the tip of the fruit forming light brown to dark brown spots. Later, a greenish fungal growth is also seen on these spots.

Transmission and favourable conditions:

- ***Phoma* fruit rot:** The fungus survives in plant debris, the primary source of infection.
- ***Alternaria* fruit rot:** The fungus survives in debris and soil; the fruits touching the soil become infected and the disease spreads later by dissemination of spores through the air.
- ***Colletotrichum* fruit rot:** Being saprophytic the pathogen survives in soil, along with the debris, for a long period. This becomes the primary source of infection. The spores are present in the air and act as secondary sources of infection and are disseminated by rain splashes.
- ***Cladosporium* fruit rot:** It is also spread by spores present in the air. The fungal spores survive in plant debris and soil, the primary sources of infection.

Powdery Mildew

Disease symptom: The symptoms of the disease are noticed on flowers and newly set fruits. The disease may appear earlier if conditions are favorable. The developing young leaves show a whitish powdery mass, which causes them to shrink and defoliate. The disease also appears in the form of white powdery spots on the surface of the fruits and later covers the whole fruit surface. The spots turn into light brown to dark brown discoloration. The infected area becomes slightly raised and rough. Affected fruits either drop off prematurely or become corky, cracked, misshapen and remain underdeveloped. Sometimes the whole crop is rendered unmarketable.

Survival and spread: The powdery mildew fungus overwinters in dormant buds. When conditions are favorable for growth of the fungus in spring, spores are produced, released, and cause new infections. Secondary spread of the disease can occur if spores are produced in these new infections.

Favorable condition: The development of powdery mildew is favour by relative humidity around 80-85% and temperature range of 24-26°C.

Sooty mould

Disease symptom: The disease is common in the orchards where mealy bug, scale insect and hopper are not controlled efficiently. The disease in the field is recognize by the presence of a black velvety coating, i.e., sooty mould on the leaf surface. In severe cases the trees turn completely black due to the presence of mould over the entire surface of twigs and leaves. The severity of infection depends on the honey dew secretion by the above said insects. Honey dew secretions from insects sticks to the leaf surface and provide necessary medium for fungal growth.

Survival and spread: The severity of infection depends on the honey dew secretions by the scale insects which provide the necessary medium for the fungal growth. Transmission occurs by air-borne ascospores.

Favorable conditions: High humidity and moist situation favors the development of disease.

Leaf spot Disease symptom:

(1) Black leaf spot: The disease is characterized by sooty tuft-like circular to irregular black spots on the underside of the leaves. Later, it covers the entire lower surface giving a sooty appearance. The leaves show yellowish and brownish discolorations on the upper surface and drop prematurely**.**

(2) *Cercospora* leaf spot: The disease manifests itself in the form of circular to oval spots, measuring up to 4 mm in diameter, epiphyllous, yellow at first and turning brown surrounded by a dark brown margin. The spots grow larger and become visible on both sides of the leaves. The infected leaves fall off. *Cercospora* leaf spot is also found on Chinese jujube, causing leaf yellowing.

(3) *Cladosporium* leaf spot: The symptoms appear in the form of small, light brown to brown irregular spots on the lower surface of leaves. The disease starts on leaves closest to the soil surface, where the fungus occurs.

Transmission and favourable conditions

(1) Black leaf spot: The fungus survives in plant debris and soil, which are the primary sources of infection. Secondary infection is initiated from spores present in the air.

(**2) *Cercospora* leaf spot:** The fungus produces dark coloured stroma. It survives in debris and soil, the primary sources of infection. The spores are disseminated by wind.

(3) *Cladosporium* leaf spot: It is also spread by spores present in the air. The fungal spores survive in plant debris and soil, the primary sources of infection.

Die back symptom

The pathogen causing dieback, tip dieback, graft union blight, twig blight, seedling rot, wood stain, stem-end rot, black root rot, fruit rot, dry rot, brown rot of panicle etc. The disease is most conspicuous during October-November. It is characterized by drying back of twigs from top downwards, particularly in older trees followed by drying of leaves which gives an appearance of fire scorch. Internal browning in wood tissue is observed when it is slit open along with the long axis. Cracks appear on branches and gum exudes before they die out.

Survival and spread: Pathogens survive in plant debris which is the source of primary inoculums.

Favourable conditions: High humidity and moist conditions favours the development of disease. The disease is most common in October-November.

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COAT PROTEIN-MEDIATED VIRUS RESISTANCE (CPMR) IN PLANT PATHOLOGY

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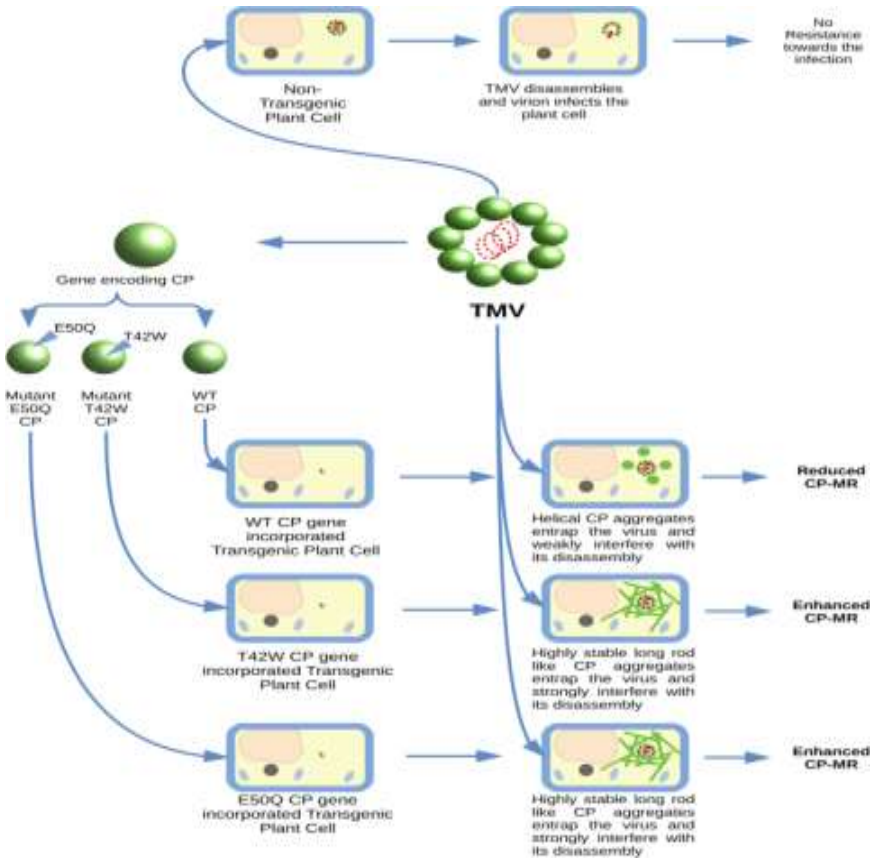
Plant viruses significantly reduce commercial agricultural output worldwide and, in some circumstances, plant demise. In most situations, genetically engineered resistance is the most efficient strategy to control viral diseases. Developing virus-resistant (VR) crops through traditional breeding, on the other hand, can take many years and, in some situations, is not even conceivable. As a result, the introduction of the first VR transgenic plants in 1985 drew a lot of interest.

In contrast, there are no viricides that may be applied to the plant host and precisely inhibit viral infection. Chemicals that influence the virus in general also impact the host cell. Furthermore, due to the multiplicity of plant-infecting viruses, no one technique to virus disease control can be considered.



In 1986, Abel and colleagues reported the first example of genetically engineered virus resistance. They demonstrated resistance to TMV in transgenic tobacco plants engineered to express the TMV coat protein (CP) gene. Tobacco mosaic virus (TMV) coat protein (CP) self assembles in viral RNA deprived transgenic plants to form aggregates based on the physical conditions of the environment. Transgenic plants in which these aggregates are developed show resistance toward infection by TMV referred to as CP-MR.

Addressing real world problems using CPMR

The early results of plant disease resistance (PDR) utilizing coat protein (CP) or replicase sequences aroused the curiosity of plant breeding firms. Because of the considerable crop losses that viral infections may cause, breeding for plant virus resistance is an important goal for commercial vegetable and fruit breeding programmes.

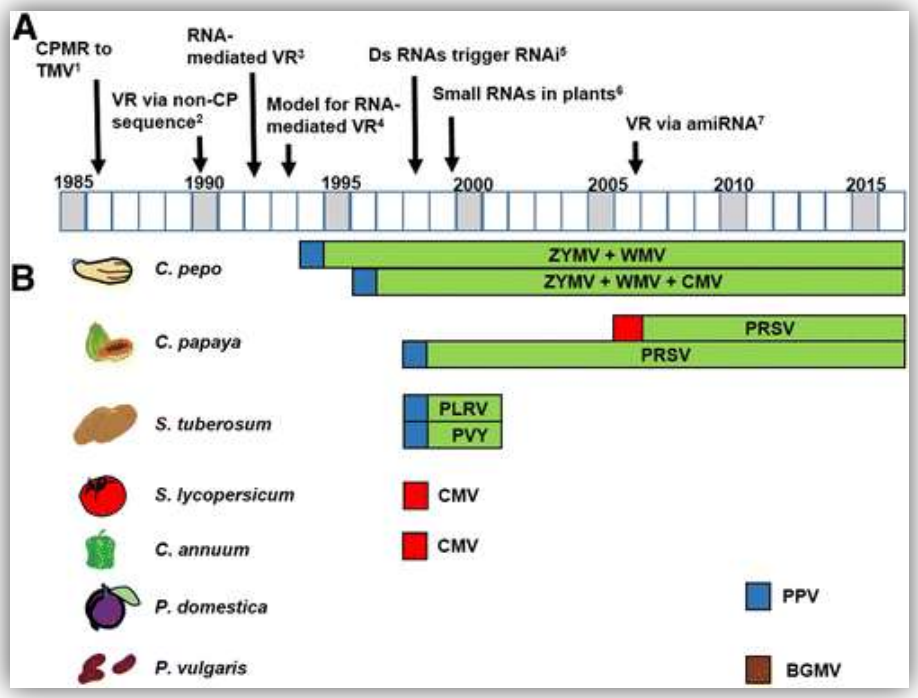
A real challenge for plant breeding companies was to find existing sources of resistance and cross these genes into elite inbred plant lines. The main problem had been identifying sources of high levels of resistance that were easy to work with from a genetic standpoint.

✓ There was a strong need for new effective sources of virus resistance for many important food crops and remarkably rapid progress was made by applying the concept of CPMR/PDR.

Some engineered virus resistance plants using CPMR

Genetically engineered virus resistance in squash-

Both potyviruses and CMV are transmitted by aphids so rapidly that controlling spread of these



viruses with insecticides was not effective. Genetically based resistance was the most desirable and effective way of limiting losses due to these viruses and discouraging growers from unnecessarily spraying insecticides. Expression cassettes consisting of a single virus CP gene sequence joined to a plant-functional promoter were constructed. Recombinant DNA molecules of either two or three different expression cassettes were assembled and transferred into squash cells by *Agrobacterium tumefaciens* mediated transformation. Transgenic plants expressing both the ZYMV and WMV CP genes were resistant to these two viruses. Transgenic plants expressing the CP genes of ZYMV, WMV, and CMV showed resistance to all three viruses.

Genetically engineered virus resistance in potato

Diseases caused by the aphid-transmitted viruses Potato virus Y (PVY, a member of the genus *Potyvirus*) and Potato leaf roll virus (PLRV, a member of the genus *Polerovirus)* were major problems in potato. Transgenic potatoes expressing the PVY CP gene and the PLRV CP gene were found to be highly resistant to PVY and PLRV.

Genetically engineered virus resistance in papaya

Papaya is the most successful example of a designed VR crop (*Carica papaya*). Infection with the papaya ring spot virus (PRSV, a member of the genus *Potyvirus*) causes the most damaging disease of papaya and is a serious disease concern globally. In the late 1980s, Gonsalves and coworkers began working to apply the "coat protein-mediated resistance" approach to generate PRSV-resistant papaya. After years of effort they succeeded in producing a transgenic papaya expressing the PRSV CP gene.

Genetically engineered virus resistance in plum

The most serious viral disease for the stone fruit industry is sharka disease, caused by plum pox virus (PPV, a member of the genus *Potyvirus*) infection. Transgenic plants engineered to express the PPVCP gene were generated. Some plant lines generated showed highly effective and durable resistance to PPV challenge.

Conclusion

A capsid is the protein shell of a virus, enclosing its genetic material. It consists of several oligomeric (repeating) structural subunits made of protein called protomers. A protein coat that covers the nucleoprotein core or nucleic acid of a virion is called as coat protein.

The vast majority of plant viruses are nonenveloped. Therefore, the coat protein (CP) (or proteins, as is the case in some virus species) contacts the cell and delivers the viral genome into plants. At the end of the infection process, CP will exit the infected plant with the genome.

Over time we have observed an evolution of strategies for engineering virus resistance in plants. The evolution has been toward producing fewer and fewer virus-specific biomolecules in plants and yet recovering higher and higher percentages of VR plant lines. Each change has been a more specific, targeted design, requiring the addition of less and less "foreign" sequences to plants for each virus resistance generated.

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USE OF PLANT GROWTH REGULATORS (PGRs) IN FIELD CROPS

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Plant growth regulators (PGRs) are organic compounds, other than nutrients, that modify plant physiological processes. PGRs, also called biostimulants or bioinhibitors, act inside plant cells to stimulate or inhibit specific enzymes or enzyme systems and help regulate plant metabolism. PGRs may be naturally occurring, plant produced chemicals called hormones, or they may be synthetically produced compounds. They normally are active at very low concentrations in plants.

The classical groups of plant hormones are the auxins, gibberellins, cytokinins, abscisic acid and ethylene. Auxins, gibberllins and cytokinins are plant growth promoters, while abscisic acid and ethylene are plant growth inhibitors. Brassinosteroids and jasmonates are also regarded to be having phytohormonal functions. Plant hormones can be formed at different cytological or morphological sites. Their main sites of production are meristems and growing fruits.

PGRs can be used effectively where arable and plant cultivation measures or selection practices are not sufficient in overcoming difficulties in crop cultivation. Many products of plant growth promoters are being marketed with claims made for beneficial effects on crop growth and yields. These products are supposed to: promote germination and/or emergence, stimulate root growth, promote mobilization and translocation of nutrients within plants, increase stress tolerance and improve water relations in plants, promote early maturity, increase disease resistance, retard senescence, improve crop yields and/or quality.

Use of PGRs in field crops

- **Cereal crops**

Lodging is often observed in grain cereals (including wheat, barley, rye, triticale, oats, rice) and grasses grown for seed purpose. Tall shoots with heavy ears, panicles, or other fruit structures at their top can no longer stand upright and fall over, particularly when there is windy and rainy condition. Grain yield reductions of up to 40 % must be expected in years with high lodging incidence. The use of stem shortening PGRs in cereals to reduce the risk of lodging is a very prevalent practice worldwide. Approximately 25 % of the global PGR sales are represented by anti-lodging products. Chlormequat chloride was the first PGR to be used on a large scale as an anti-lodging agent in European cereal production. Combinations of chlormequat chloride or mepiquat chloride with trinexapac-ethyl or prohexadione-calcium, either as sequential sprays or by tank-mixing or by using ready-mix formulations, currently represent the best technical solutions for lodging control.

- **Pulse and oilseed crops**

Plant Growth Regulators (PGRs) can be used to overcome inherent limitations in pulse crops such as poor germination, source limitation, slow dry matter accumulation, indeterminate growth habit, C_3 photosynthetic apparatus, decrease in nodule activity, abscission of flowers and pods, higher energy requirement and reduced sink activity which intern will lead to lower yield and productivity. TIBA (2,3,5 tri iodo-benzoic acid) spray @ 75 ppm is used for nipping in chickpea at 50-55 DAS, to stop apical growth and promote lateral branching. GABA (a mixture of Gibberellic acid (GA_3) and abscisic acid (ABA)) is an effective plant growth regulator to increase plant growth characters and seed yield of black gram.

Excessive shoot growth may reduce the digging efficiency in groundnut at the time of harvest. Prohexadione-calcium, which has been registered in the US, retards vegetative growth and improves the visibility of rows, resulting in improved harvesting efficiency. Its application has been found to increase the pod yield and kernel quality too.

Recently combination of metconazole with mepiquat chloride and paclobutrazol with the fungicide difenoconazole also has been used in rape. These PGRs are also used in winter oilseed rape to prevent intense growth of plants in late autumn, thereby making the crop less vulnerable to freezing and desiccation in winter in European countries. Triiodobenzoic acid (TIBA) was registered briefly in US to increase yield in soybean. TIBA reduces plant height and petiole length, and stimulates branching and fruit set. The chemicals mepiquat chloride and ethephon are most

effective stem shorteners to improve sunflower husbandry principally by shortening the stem and insuring against lodging.

- **Cotton**

In cotton, defoliants such as DEF (S,S,S-tributlyphosphorotrithi-oate) are used to remove green leaves that can then fall free of the lint from the open cotton ball. These compounds are, therefore, useful aids in the mechanical harvesting of the crop. Application is limited, however, to those parts of the world where mechanical harvesting is practiced, an estimated one-sixth of the total worldwide acreage. Ethephon has been used successfully in cotton and is widely accepted as a harvest aid to accelerate boll dehiscence prior to harvesting. PGRs may also be effective in reducing the pest population in cotton by altering the morphological and biochemical characteristics of cotton (e.g. mepiquat chloride treatment against bollworm damage).

- **Sugarcane**

The use of chemical ripeners in sugarcane paralyzes the cane development, which induces the translocation and storage of sugars and confers resistance to lodging, which facilitates cutting and reduces losses in the field and the amount of foreign matter transported to the industry. These chemicals help in acceleration of sucrose storage within the stalk by rapidly reducing the sink demand of young and growing plant parts, leading to higher harvest yields. They have to be applied *via* aircraft or special ground-operated booms.

Among the chemical products used as ripeners, those that stand out include ethephon (a growth regulator) sulfometuron methyl (a plant growth regulator from the sulfonylurea chemical group), glyphosate (a growth inhibitor that can cause destruction of the apical bud of the plant and induce lateral growth) and ethyl-trinexapac (which reduces the level of gibberellin without affecting photosynthesis and the integrity of the bud). Other chemicals include fluazifop-p-butyl (Fusilade), maleic hydrazide, paraquat and imazapyr.

- **Other field crops**

Lodging can constitute a problem in poppy cultivation too. Use of trinexapac-ethyl and prohexadione-calcium has been found to improve lodging resistance as well as the alkaloid content in the harvested plant material. Trinexapac-ethyl is now registered in Australia for use in opium poppy. Maleic hydrazide is used in tobacco to control the growth of lateral buds that reduce leaf quality.

Demerits associated with the use of PGRs

The action of a PGR is highly specific as to plant species, variety, organ and the stage of development. The use of PGRs is very stage-specific and concentration specific. Incorrect time of application and high doses of PGRs may cause unintended injury to plants. The action of a PGR is strongly dependent on its rate of application, for which reason over-dosages, under-dosages, unintenti-onal double treatment or any other inaccuracy may lead to detrimental effects. Unfavourable weather conditions may spoil a treatment or lead to crop damages or unwanted side-effects. There is still limited understanding of how the PGRs work and how, when and where they should be used for appropriate results in different crops. The development of new compounds is very expensive for the pesticide industry and much time is required to obtain official registration. This situation is especially hindering the introduction of new PGRs, because they require a higher degree of attendance when being developed or introduced into the market.

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INDIA'S VIBRANT AND GROWING SEED SECTOR

FEATURES, CHALLENGES, AND OPPORTUNITIES

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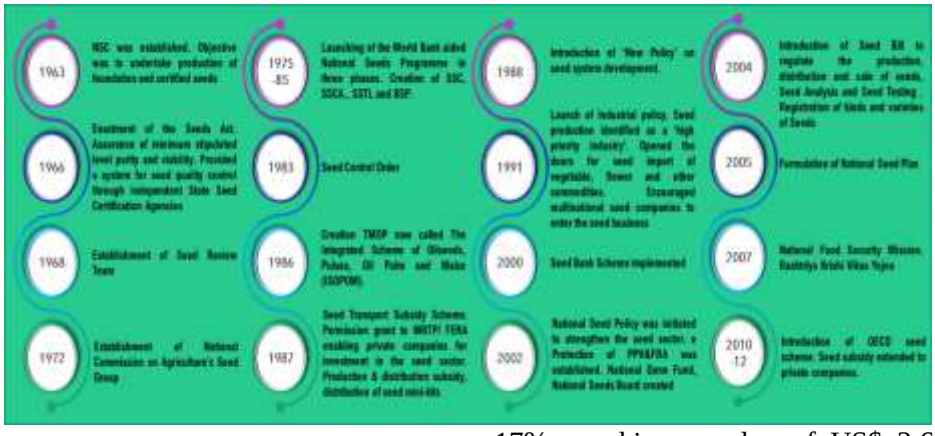
Seed is the most fundamental and crucial input for long-term agricultural sustainability, serving as a link between the present and the future. On a worldwide scale, India has developed into a vibrant seed industry, which has grown and expanded in lockstep with Indian agriculture over the years. Starting with the practise of conserving seeds from previous crops, Indian farmers have built a powerful institutional, informal, and interconnected seed infrastructure across the country. In the last 30 years, the Indian seed sector has witnessed major changes. The formal seed system has become increasingly diverse throughout time. The government's policy support has contributed to the evolution and development of the seed platform, which reflects India's changing needs and market realities. The Indian Council of Agricultural Research (ICAR) and international institutes (*e.g.* CGIAR: Consultative Group on International Agricultural Research) both made significant contributions with new improved crop varietal seeds. However, policymakers often face a challenging task in developing laws and regulations that encourage both formal and farmer-based seed systems while minimising negative effects on breeding, selection, and seed output in either system. The Indian seed industry is being influenced by the private seed sector with international funding and specific technical expertise. Indian seed corporations and multinational seed firms contributed a strong R&D basis for product development, with a focus on high-value cereal and vegetable hybrids, as well as improved technologies. Farmers now have a wider selection of products to pick from, and the seed industry is moving toward a more "farmer-centric" with a market-driven strategy.

Prominent seed policy and initiative milestones in India:



(NSC=National Seed Corporation; SSC=State Seeds Corporations; SSCA=State Seed Certification Agencies; SSTL=State Seed Testing Laboratories; BSP=Breeder Seed Programmes; TMOP = Technology Mission on Oilseeds & Pulses; MRTP = Monopolies and Restrictive Trade Practices); FERA = Foreign Exchange Regulation Act; PPV&FRA = Protection of Plant Varieties & Farmers' Rights Authority; OECD = Organization for Economic Co-operation and Development)

Status of Indian seed sector

The expansion of the Indian seed sector can be likened to the increase in agricultural production. After the United States (27%) China (20%) France (8%), and Brazil (8%), India's seed market is presently the world's fifth largest, accounting for 4.4% of global seed market (6%). The Indian seed market is dominated by non-vegetable crops such as corn, cotton, rice, wheat, sorghum, sunflower, and millets. In terms of global trade, India is nearly self-sufficient in floral, fruits, vegetables, and field crop seeds. Paddy, maize, and vegetables are expected to drive the Indian hybrid seed business forward in the next five years. From 2010 to 2017, the Indian seeds market grew at a CAGR of over 17%, reaching a value of US$ 3.6 billion (Rs. 36000 lakh) and is expected to increase at a CAGR of 14.3% from 2018 to 2023, reaching a

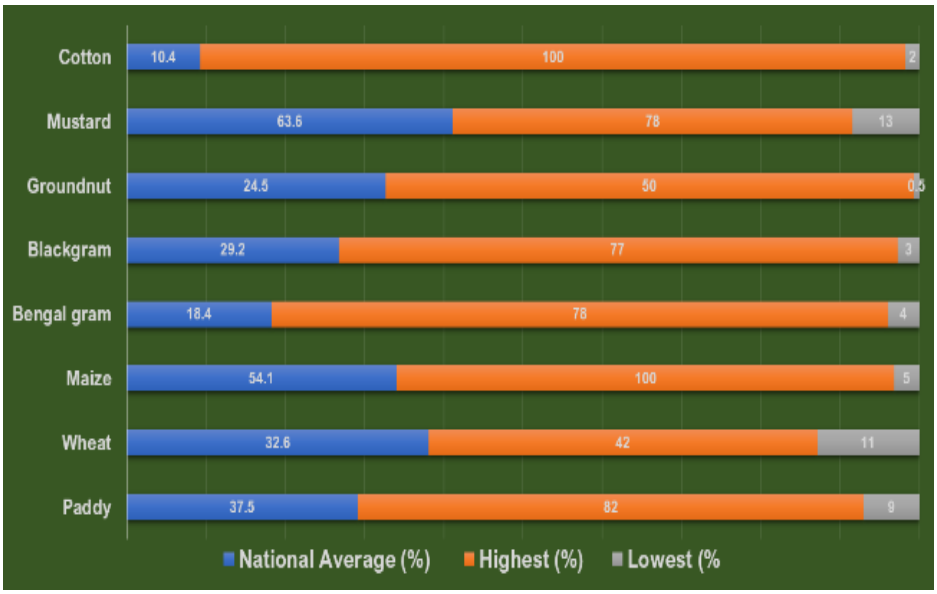
value of more than US$ 8 billion (Rs. 80000 lakh).

Seed production system in India

The Indian seed multiplication programme primarily adheres to the limited generations concept. The system justifies three generations of seeds: breeder, foundation, and certified seeds, and offers sufficient quality assurance measures in the seed multiplication chain to ensure that the varietal purity is maintained as it passes from the breeder to the farmer. State Departments of Agriculture (DoA) collect seed indents from various production agencies and send them to the Department of Agriculture and Cooperation (DAC), Ministry of Agriculture, Government of India, which compiles the information crop by crop and sends it to the Project Coordinator/Project Director of the respective crops in ICAR for final allocation of production responsibility to various State Agricultural Universities/ICAR institutions. The NSC, State Farms Corporation of India (SFCI), SSC, State Departments of Agriculture, and private seed producers have been tasked with producing foundation seed possessing the necessary infrastructure. Certified seed production is managed by the SSC, Departmental Agricultural Farms, Cooperatives, and other organizations. State governments are primarily responsible for the production and distribution of quality/certified seeds.

Seed Replacement Rate (SRR) of major crops in India

SRR is the percentage of crop sown/planted in the season using certified/quality seeds other than farm saved seed. As a result, SRR has a direct impact on productivity and income enhancement for farmers and is one of the means for doubling farmers' income.



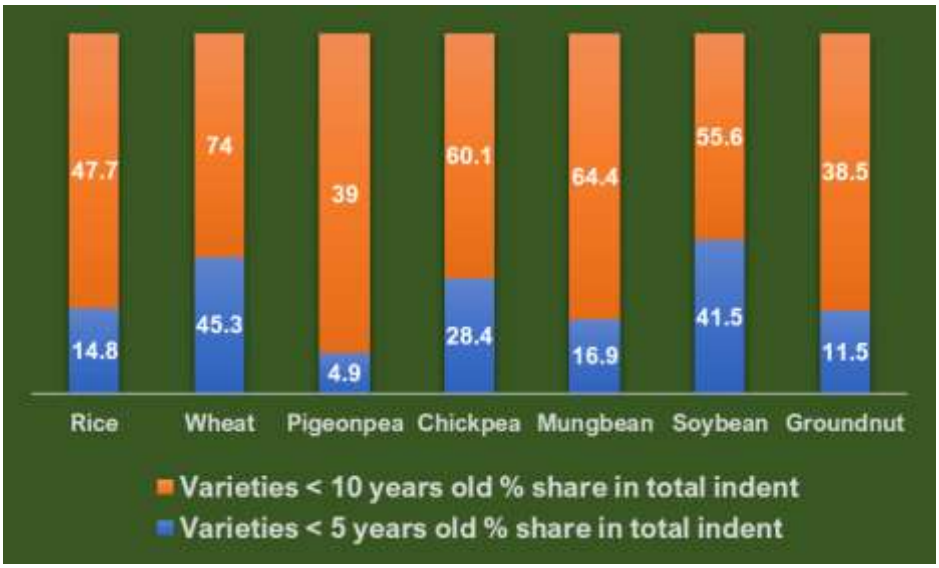
Source: *Directorate of Economics & Statistics, Ministry of Agriculture, GOI, 2012 (http://dacnet.nic.in/eands)*

Varietal Replacement Rate (VRR) of major crops in India

VRR is an important factor in increasing crop productivity. The rate of progress in food production is largely determined by the progress of seed programmes that can supply high-quality seed of high-yielding varieties with superior genetics. According to recent data, wheat had the fastest rate of VRR across all crops, followed by mungbean, chickpea, soybean, rapeseed & mustard, rice, and pigeonpea.

Varietal protection in India

India is a member of the World Trade Organization (WTO), which has a half-dozen inter-governmental agreements influencing the agriculture directly. India established the Protection of Plant Varieties and Farmers Rights (PPV&FR) Authority under the Protection of Plant Varieties and Farmers Rights Act, 2001, in accordance with the Trade-Related Aspects of Intellectual Property



Source: *AICRP on National Seed Project (Crops), 2018 ICAR, Krishi Bhavan, New Delhi*

Rights (TRIPS) agreement, and it has been operational since November 11, 2005. Establishment of PPV&FR was necessary to have an effective system in protecting plant varieties, farmers' and plant breeders' rights, and encouraging the development of new plant varieties.

Seed certification system in India

In general, seed certification is a process for ensuring the physical identity and genetic purity of notified crop varieties by maintaining and making available to the general public with a continuous supply of high-quality seeds and propagating materials. Seed certification is a legally recognised system in India for ensuring the quality of seed production and multiplication. In 1970, Maharashtra became the first state to establish an official Seed Certifications Agency (SCA) as part of the DoA, while Karnataka became the first state to establish an autonomous SCA in 1974. Under the Seed Act of 1966, 22 states in the country now have their own SCA. Seed certification is voluntary in most countries around the world, including India, while labelling is mandatory.

Key challenges of seed sector in India

- **Seed has a short shelf life:** Certified seeds are only good for one season and must be revalidated or quality seeds to produce before being used the following year.
- **Unpredictability of demand:** It is exceedingly difficult for dealers to precisely predict demand for certified seeds due to the unpredictability of nature, changes in commodity prices, and adoption dynamics.
- **Lack of an effective monitoring system:** There is no effective monitoring system in place to control seed quality at the point of sale. The seed producing and marketing companies have little control over the product once it has been sold.
- **Lack of infrastructure:** Poor infrastructure in remote villages, a lack of purchasing power at the time of sowing, and the uncertainty of rainfall, on which sowing is heavily reliant, exacerbate the problem of farmers' access to seeds at the right time.
- **Poor extension services:** Often the extension functionaries are generally seen as active only for the purpose distributing mini kits and conducting field demonstrations, rather than emphasizing the results-oriented approach for effective impact.

Key opportunities to strengthen the seed sector in India

- India's share in global seed exports is about 0.6%. To give a boost to seed export, India decided to participate in OECD seed schemes in five categories *viz.*, grasses and legumes; crucifers and other oil or fibre species; cereals; maize, sorghum and vegetables.
- Future of agricultural production will largely depend upon development of improved varieties/ hybrids of various crops, supported by efficient, cost-effective seed production technologies.
- Diversification of areas for seed production and development of appropriate production technology needs to be focused for expansion in the country.
- Significant efforts should be made to investigate the impact of climate change on seed production of various crops to develop appropriate crop management technologies and offset the negative consequences.
- GPS/GIS applications include equipment guiding, such as micro irrigation, fertilizer/pesticide applicators, and tillage implements; pest and disease mapping to eliminate overlaps and skips and enable precision seed production.
- Different seed testing techniques now in use in India must be modified in accordance with international seed testing standards such as ISTA, AOSA, and OECD to improve seed quality assurance and facilitate international seed trade.
- Genomics should be used to discover gene(s) governing dormancy, germination, and longevity, as well as stress tolerant genes, to produce superior quality seeds.
- During the maturation stage, apart from germination, desiccation resistance, and longevity, chlorophyll presence on seed has a direct link to maturity and may be determined quickly yet precisely using image analysis.
- Creation of cutting-edge seed processing and storage technologies, such as thermal seed processing plants (high precision, high throughput process).
- Seed coating with polymer-based method to influence the time of seed germination. The timing of germination of coated seeds can

be regulated and the synchronization problem of parental lines in hybrid seed production can be overcome by coating the seeds with Intelimer polymers.

- Seed treatment with carbon nano tubes (CNTs), array of nano particles (gold/silver/borates) is a whole new field, yet to be fully unraveled.
- Application of biological agents to crop seeds have focused on root colonizing bacteria, termed rhizobacteria. PGPR (Plant Growth Promoting Rhizobacteria) that cause beneficial effects on plants by promotion of plant growth and biological control of plant diseases.
- Seed sector has a two-fold responsibility in seed health: to deliver sufficiently healthy seed to farmers and seed producers, and to respect international phytosanitary regulations.

Conclusion

The Indian seed sector is responding more quickly to the shifting food consumption patterns in the country. Food spending has fallen in both urban and rural areas during the last three decades. Cereal and pulse consumption fell dramatically between 1990 and 2010, whereas fruit and vegetable consumption nearly doubled. Because of the growth and development of the food processing industry, as well as changing consumer tastes, the country will experience a rise in the cultivation of vegetables and fruits. One of the most important future trends will be a rise in demand for high-quality vegetable and fruit goods as a result of growing consumer awareness and disposable income. The export sector is likely to expand as well. As a result of this tendency, protected cultivation will become increasingly popular in India. Because of workforce limitations, the present seed industry may need to develop new products/technologies in the near future to stay up with India's agriculture sector's rising mechanization. Hybrid seeds are projected to gain popularity in the country's seed market in the future. An increase in demand for cultivars with higher nutritional and health benefits is another projected development in the seed market. Obesity, diabetes, malnutrition, and other lifestyle-related disorders are on the rise in the country, and as a result, people are becoming more health-conscious, leading to greater consumption of higher-nutrient fruits, vegetables, and cereals.

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IMPACT OF SEED PRIMING ON SEED GERMINATION

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Seed germination efficiency is critical in agriculture. Rapid and uniform emergence and root growth are required for successful early seedling establishment. The simple imbibition of water by the seed is frequently the immediate cause of germination. However, there may be other obstacles to germination that must be overcome. The seedling's early growth is heterotrophic. The seedling can't photosynthesize at first because the chloroplasts haven't differentiated, or it can't photosynthesize at high enough rates to support its growth. The accumulated food reserves are a source of carbon, nitrogen, and metabolizable substrates that the sprouting seedling can utilise for energy and biosynthesis. During germination, these food reserves are released. Food reserves must be digested where they were deposited since they are complex, water-insoluble compounds. As a result, hydrolytic enzymes are required for the mobilisation of stored food reserves. Proteases, lipases, and amylases are examples of hydrolytic enzymes.

Water-based seed priming is a pre-sowing treatment that partially hydrates seeds while preventing them from emerging. During the reversible period of germination, a variety of interventions can be used. They vary greatly depending on the priming solution's osmotic potential, the duration, the external temperature, and the presence of specific chemical substances. The effective treatments engage metabolic pathways that are initiated during germination and then temporarily inhibited before desiccation is lost. The overall result of seed priming is increased seed vigour, which is defined as the entire set of qualities that influence a seed lot's performance in a variety of environments. Priming techniques may benefit cultivated plants for a range of economic and agronomic reasons. Numerous studies in the literature indicated not only an increase in germination rate and uniformity, but also a noticeable improvement in the behaviour of the seedlings in terms of plant growth and stress resistance.

Primed seeds have a higher germination rate and more uniform germination. Regular crop establishment may be helped by improved and uniform seedling emergence. Priming may improve processes that occur at the start of germination, but the entire process is halted at a specific point, which is the same for all seeds involved. Priming may also cause structural and ultrastructural changes in the seeds, facilitating subsequent water uptake and reducing initial discrepancies in imbibition, resulting in more uniform germination.

A change in plant hormone biosynthesis and signalling could explain the priming-induced increase in germination. Priming has been shown to increase the ratio of gibberellins (GA) to abscisic acid (ABA), which could be the result of a priming effect on gene expression. A more consistent GA endogenous concentration in primed seeds should help with endosperm weakening, embryo cell elongation, and reserve mobilisation. Ethylene also has a direct impact on the rate and percentage of germination. Increased ethylene production during priming may facilitate endosperm weakening and post-priming germination by increasing endo-mannase activity. Priming has been shown to trigger the repair and reactivation of pre-existing mitochondria, as well as the

synthesis of new mitochondria. As a result, it may be possible to sustain final germination with a higher amount of energy for a shorter period of time.

Methods of seed priming

Seed priming techniques are separated into two categories: traditional and sophisticated. Hydropriming, osmo-priming, nutrient priming, chemical priming, bio-priming, seed priming with plant growth regulators, and priming with plant extracts are examples of traditional seed priming techniques, whereas advanced seed priming techniques include seed priming with nanoparticles and priming with physical agents.

Hydro-priming is a simple and cost-effective process that involves soaking seeds in water for a set amount of time and then drying them to a specific moisture level before sowing. Osmo-priming is a commercial procedure in which seeds are watered to a specific level to allow for pregermination metabolic activities.

Micronutrient seed priming is a well-known strategy for increasing osmosis in seeds during the germination period in order to regulate water. To soak a variety of crop seeds prior to germination, a range of chemicals are used. Seeds that have been pre-treated with these compounds develop more quickly and are more resistant to abiotic stressors.

Bio-priming was first described by Callan and Coworkers in 1990 for the biological management of Pythium pre-emergence in sh2 sweet corn. Imbibitions containing a biocontrol mediator and served at a specific temperature improve fortification. Additionally, seed priming combined with helpful microbes may help agricultural plants mature more quickly, mainly if the inoculated microorganisms colonize the rhizosphere of the plant and maintain plant physiology and plant growth for a longer period. Plant growth regulators (PGR) seed priming has been shown to reduce the negative impacts of a variety of environmental. Allelochemicals such as phenolic compounds, terpenoids, flavonoids, saponins, alkaloids, and steroids may restrict or accelerate plant growth when used as a priming agent.

Seed priming with nano particles has been reported to enhance seed germination and vigor in many crops. Ghafari and Razmjoo (2013) reported that seed priming with calcium-phosphate, SiO_2, ZnO, and Ag nanoparticles enhanced germination and seedling development. Some of the physical agents utilised for seed priming include the magnetic field, UV radiation, gamma radiation, X-rays, and microwaves. It has been observed that priming with a magnetic field improves germination rate, vigour, and seedling biomass, as well as stress resistance.

Effects

Seed priming is a physiological process that involves controlling seed hydration in order to promote a suitable pregerminative metabolic process, efficient nutrient uptake and water use efficiency, dormancy breaking, timely maturity, and crop production. Using existing messenger ribonucleic acid (mRNA), water intake drives protein synthesis and respiratory processes during imbibition, as well as the commencement of many physiological functions connected to germination. In most field crops, this approach has been shown to be the most viable and cost-effective for uniform seed emergence. Hydro-priming, osmo-priming, nutritional priming, chemical priming, bio-priming, priming with plant growth regulators, priming with plant extracts, seed priming with nanoparticles, and seed priming with physical agents are only a few of the well-developed seed-priming approaches.

Limitations

However, there are still certain drawbacks to priming technique. The extended seed treatment during priming may result in seed desiccation tolerance loss, which lowers seed viability. Similarly, all priming techniques may not result in considerable germination and growth if the priming circumstances are improper, causing the protective proteins to degrade.

Conclusion

As a result, substantial research is needed to determine the best priming technique for diverse plants in terms of germination and growth under varied climatic circumstances. ■

IMPORTANCE AND BENEFITS OF VALUE ADDITION OF AGRICULTURAL COMMODITIES

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What is value addition ?

Adding value to a raw product by taking it into, at least, the next stage of production.

Value addition in horticultural crops

Horticulture deals a large group of crops. Therefore, cultivation of crops which belong to us and possess great medicinal, nutritional, health promoting values. India as second largest producer of fruits and vegetables, only 10 per cent of that horticultural produce is processed, but other developed and developing countries where 40-80 per cent produce is value added Horticultural crops provide varied type of components, which can be effectively and gainfully utilized for value addition like pigment, amino acid, oleoresins, antioxidants, flavours, aroma etc. Post-harvest losses in horticultural produce are 5 to 30 per cent which amounts to more than 8000 crore rupees per annum. If we subject our produce to value addition the losses can be checked Horticultural crops are right material for value addition because they are more profitable, has high degree of process ability and richness in health promoting compounds and higher potentional for export.

Therefore, horticultural crops are right material for value addition in present context of agricultural scenario.

Need for value addition in horticulture

To improve the profitability of farmers. To empower the farmers and other weaker sections of society especially women through gainful employment opportunities and revitalize rural communities. To provide better quality, safe and branded foods to the consumers.

Why value addition is important ?

For better income, improve processing utilization. To keep in phase with consumer needs. To provide variety of products. Eco – friendly aspects. Value-added items are very eco-friendly for the most part because they usually utilize the resources you already have, and keep new land use and new raw material use to a minimum, or both.

Objectives

To increase the value addition and reduce wastages, thereby increasing the income of farmers and delivering better quality products to consumers. To create rural employment and improve quality of life of rural people. To assist small-scale agro based units to remain competitive in global markets. To increase export of value added agri products.

What creates added value?

Quality: Does the product or service meet/exceed customer's expectation?
Functionality: Does the product or service provide the function needed of it?
Form: Is the product in a Useful form?
Place: Is the product in the right place?
Time: Is it in right time?
Ease of possession: Is it easy for customers to obtain?

Creating a value-added product

Procurement of inputs.
Converting inputs into products.
Marketing and sales.
Supply chain logistics, and customer service activities.

Scope for value addition in India

Packhouses:

Providing services for Cleaning, Washing, Grading, packaging, storage, transportation, marketing Situated in production sites. Scope for vegetables, banana, pineapple, oranges, local fruits

Fruit jams and jellies:

Prepared by boiling the fruit pulp with sufficient quantity of sugar to a moderately thick consistency. Jams, jellies and

marmalades share approximately 17% of the total processed fruit and vegetable products. Fruits and vegetables like pineapple, papaya, banana, local fruits, roselle etc. can be used.

Semi-processed products:

Pulp/puree from banana, pineapple, jackfruit, tomato, papaya, passion fruit.Juice concentrates from oranges, lemons, pineapple, local fruits like mango, sweet orange, jamun, Aonla, pomogranates etc.Juice powders

Dehydrated vegetables and spices:

Controlled dehydration of vegetables consists of grading/ sorting, washing, peeling/ trimming, size reduction, blanching, chemical treatment, dehydration and packing unit. Cabbage, cauliflower, mushroom, carrot, roselle calyces, potato, tapioca, sweet potato, chillies, onion, ginger, garlic, turmeric etc. are good for drying

Beverages:

RTS and other beverages have an emerging market. Oranges and other citrus fruits, banana, pineapple, jackfruit, indigenous fruits like *Garcinia*, peach, plum, pear, jamun, bael, carambola, passion fruit etc. are promising sources. Vegetables can also be

used. Good sources are watermelon, roselle, carrot, leafy vegetables etc.

Prepackaging:

It involves cleaning, trimming, cutting of the fresh produce and packing the same in unit packages in polyethylene bags or other packagings Tomato, bean, carrot, brinjal, green chilli, root crops, leafy vegetables, and fruits like orange, lemon, banana etc. are good – shelf life up to 2 times, remain fresh and attractive

Osmo-air dried fruits:

Novel approach towards dehydration. Osmo-air dehydrated product is near to the fresh fruit in terms of colour, flavour and texture. Products like slices of pineapple, jackfruit etc. processed. Osmotic agent like sugars used. Finally air dried to about 15% moisture

Fruit toffees and bars:

Made from pulp of many local fruits along with certain ingredients. Any variety of pulpy fruits like papaya, banana, pineapple and other indigenous fruits, singly or in combination, can be used to manufacture fruit bar.Fruit bars are becoming increasingly popular due to good shelf life, taste, flavour and texture.

Tutti frutti:

Colourful confection containing various chopped and usually candied fruits, or an artificially created flavouring simulating the combined flavour of

many different fruits. It is often used for making a tutti frutti ice cream flavor. Papaya is largely used to make tutty-fruity, maraschino cherry etc. Other local fruits can also be used. Consumption of these products is rapidly increasing

Minimally processed products:

Meets the consumers' demand for more fresh, natural, and convenient foods Pineapple slices, cubes etc. Jackfruit pieces, Cucumber slices, Carrot discs, Garlic cloves and Orange segments.

Conclusion

In the present agricultural scenario when the globe has become a single market agricultural has to be competitive, the diversification, quality enhancement and value addition have become key.

words of success in agricultural trade at international level. If our agriculture has to be competitive, we will have to diversify and the produces will again have to be subjected to product developement and product diversification for harnessing full advantage from present scenario and development. Beside making agriculture competitive, value addition also helf in avoidance of postharvest losses, industrialization, employment generation, export, extended availability of produce, foreign exchange earning and product diversification, easy marketing etc. It is therefore, appropriate time for us to come out of primary processing and bulk exporting of pulps and get into newer product development and marketing of ready to consume product through value addition.

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SOCIAL MEDIA

FOR AGRICULTURAL EXTENSION

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Social Media: What, Why and How

Social media are web based tools of electronic communication that allow users to personally interact with others individually or in groups for the purposes of exchanging information, sharing thoughts and opinions, influencing and facilitating decision-making by creating, storing, retrieving and exchanging information in any form (text, pictures, video, etc.,) by anyone in the virtual world. These are digital networks that are used to share and discuss user generated information - opinion, video, audio, and multimedia. Merriam-Webster (2015) defines social media as forms of electronic communication through which users can create online communities to share information, ideas, personal messages and other content. The definition of Ahlqvist et al. (2008) is focused on three basic components – content, communities and Web 2.0 - and operationalizes social media as the interaction of people and also to content creation, exchange and commenting in virtual communities and networks. According to Michelle Chmielewski (2011), social media is not about what each one of us does or says, but about what we do or say together, worldwide, to communicate in all directions at any time by any possible digital means. Social media is basically digital technologies facilitating communication of user generated content through constant interaction. Accessibility of social media through mobile phones and the scope of mass-personal and mass-self communication makes it a popular platform among the masses to share ideas and increase likability and content sharing across multiple platforms.

Why use social media

The special features of participation, openness, conversation, community and connectedness makes social media a unique user experience (Mayfield, 2008). Facebook has 195.16 million active users in India, YouTube gets more than 50 million unique users each month, Twitter has 23.2 million users, WhatsApp has 70 million users in India and the highest monthly active users in the world (www. statista.com, 2016). All these statistics prove the huge potential that social media can be for extension practitioners to reach out to the people. India is a huge market for social media that is constantly expanding into the rural areas and that improves the scope of reaching not only the farmers but the farm families and youth altogether for higher impact.

Social media can be advantageously used in agricultural extension, as discussed below:

- Highly cost effective.
- Simultaneously reaches large numbers of clients.
- Location and client specific, problem-oriented.
- User-generated content and discussion among the community members.
- Easily accessed from mobile phones.
- Increases internet presence of extension organizations and their client reach.
- Democratization of information by making it accessible to all.
- Brings all stakeholders into a single platform.
- Can measure reach and success by tracking number of visitors, friends, followers, mentions, Facebook 'likes', conversation index and number of shares.

These potentials make social media a highly relevant and beneficial platform for extension personnel to engage with their clients and peers. Lack of connectedness with farmers have long been cited as a serious lacunae of extension services and social media gives ample opportunities to solve this issue. There are definitely shortcomings at personal (lack of interest in social media, negative attitude, or organizational restrictions), infrastructural (lack of internet connectivity for target clients or the extension personnel), and policy level (organizational policies that restrict use of social media for official purposes) that hinder the use of social media.

How to integrate social media in extension ?

Internet based services are increasingly restructuring the daily life of people, instead of dividing them into on-line and offline experience. Rural people are using social media for connecting with friends and family, reading current news, to get information from peers. Connecting that to agriculture and leveraging it to bridge the farmer-extension gap can prove to be a boon to the agriculture sector and the farm families. A few pointers in engaging with farming community through social media are given below:

- A thorough planning is needed before engaging online through social media, specifically about objectives, target audience, channels and approaches.
- Posting information at times when target audience are most probably active online.
- Interacting in real time to keep the interest of the involved clients alive.
- Sharing only relevant posts or information.
- Focusing on specific platforms based on clients' preferences and engage them continuously rather
- than engaging in a number of platforms but failing to engage properly.
- Keeping holistic view in mind while sharing information rather than focusing on single enterprise as most smallholders have multiple enterprises on their farm.

Challenges and opportunities of social media in extension

Social media use is not growing at a desired rate in rural India as there are multiple challenges that need to be taken care of to leverage the opportunities.

Challenges

- Ensuring participation.
- Quality control and monitoring of posts.
- Internet and IT infrastructure issues.
- Satisfying heterogeneous users.
- Institutionalising social media.
- Continuous engagement.
- Skilled human resource to maintain social.
- Media interactions.
- Measuring the impact – lack of capacity for tools and analytics that help monitoring and assessing the value of information.
- Creating awareness about social media's.
- Potential at the organisational level.
- Allocating time to update content.
- Encouraging stakeholders to access resources through social media links.

Opportunities

- Few social media apps are available without internet.
- Forming global/national interest groups is possible.
- Reaching one to many.
- Greater engagement and dialogue
- Allows for integration of a wide range of stakeholders.
- Can act as catalyst for resource mobilization (technological, organizational, and financial).

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BREEDING POLICY FOR CATTLE AND BUFFALO

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Although India has a large cattle and buffalo population 193.46 and 109.85 million respectively (as per 20th Livestock Census-2019), the productivity per animal is very low. The major reasons for low productivity are unorganized breeding, inadequate nutrition, high incidence of disease, hostile climate and social unawareness of economic benefits. Presently the average availability of milk per capita per day is 427 gms (It is higher than the world average availability i.e. 285 gm/capita/day) against a recommended level of 300 gms/day. The milk production potential of indigenous cow is far too low. The Indian buffaloes justifiably contribute to more 65% of milk produced by buffaloes in the world and 57% of the total milk produced in India. Indian cows contribute nearly 3.61% of total milk produced by cows in the world and 43% of the total milk produced in India.

Policy issues

National Commission on Agriculture in its report had projected the gross demand of milk for different years at low and high levels. The breeding policy for cattle and buffaloes was designed to increase the production of milk in the country, at the same time ensuring that the requirements for draught breeds for agricultural ploughing and transportation in rural areas was adequately met. From the mid-sixties onwards, cross-breeding with exotic breeds was introduced on a fairly large scale, mainly to enhance production of milk.

On the basis of recommendation of the National Agricultural Commission, a National Breeding policy was evolved, which inter alia suggested:

1. Development of nationally indigenous breed of cattle, through selective breeding in their home tract or breeding tract.
2. Cross breeding of low producing non-descript cattle with exotic dairy breeds.
3. Continue interse breeding among cross-breed cattle using pedigreed or proven bulls.
4. Upgrading the non-descript cattle through improved native breeds in the area of the country where quality of cattle is poor, availability of nutrients is limited, it will be desirable to upgrade the scrub animals by using sire of the improved native breed.
5. Improvement of buffaloes through selective breeding in the breeding tract of well-defined breeds.
6. Upgrading non-descript buffalo through improved native breeds.
7. Grading-up with recognized breeds in other areas where buffaloes have established themselves.

Recommendation of the Committee:

1. Breeding Plan:

- The government should review its breeding policy and provide more emphasis to conservation of indigenous breeds.
- Cross breeding with exotic strain should be totally banned in the home tract of the important cattle breed.
- A judicious mix of cross-breeding with exotic strains and preservation of indigenous germplasm should be maintained, while formulating the policy.

2. Implementation of breeding programs:

- A proper monitoring mechanism for implementation of the breeding policy
- Directions should be given to the state Government, in terms of actual number of cattle heads of the particular breeds, infrastructure facilities such as semen station, bull farm etc
- Targets should be allocated to the concern state governments, in terms of actual numbers of cattle heads of a particular breed
- Regular review meetings for the results achieved
- The center in turn should provide adequate funding to the state governments to implement the programs.

3. Creation of scope for large use of indigenous cattle breeds:

- The geographical boundaries of the areas where non-descript cattle should be upgraded by crossing with bulls of indigenous breeds.
- Once such areas are earmarked, no cross-breeding of non-descript cattle, other than with bulls of indigenous breed should be permitted.

4. Supply of good quality breeding material (germplasm) in the breeding tracts:

- Status of indigenous breeds needs to be evaluated afresh.
- The breeds which are not in favour of the farmer for long time should be identified and these breeds should be preserved only in the institutional farm with improved conservation technol-ogies.
- The breeds accepted by the common farmer should be developed region-specific and breed specific program.
- For sourcing crossbred bulls, the Military Farms should be used as major source of contribution to the bull production program.

5. Promotions of breeders organization:

- Government should encourage and promote the organizations and establishment of breed specific association to represent the requirements for development of particular indigenous breeds.
- Such associations can form Federation at state or central level.
- Government should accept the private sector play as partner.

6. Enhancing the role of voluntary organization- NGOs:

- An inventory of Goshalas/ Gosadans/ Pinjrapoles should be maintained with the details and the number of cattle heads.
- Such organizations should be distinguished from the other organizations maintaining non-descript and aged animals.
- Each such designated organization should adopt only one or two breeds and a specific breed improvement and conservation should be taken up in consultation and collaboration with government agencies.
- Such organizations can also participate in Government sponsored programs for rearing of male calves from weaning to maturity.
- The designated organization should provide scientific and technical inputs and training for genetic evaluation selection of germplasms for breed improvement and upgradation programs.

7. Use of science and technology:

- Scientific and technological intervention in breeding programs should be urgently taken up as a priority by the Government.
- Monitoring cells for frozen semen should be established as state level and certified semen should be used for artificial insemination.

8. Statistical Database:

Statistical database regarding breed improvement program, semen stations, bulls, breedable female of different breed etc should be maintained.

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SHRIMP PRODUCTION

A BOONE TO INDIAN FISH MARKET

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Fishing is a key economic sector in India, with numerous developmental potential. This is due to the country's vast resources and possibilities. Andhra Pradesh is the largest shrimp producer, accounting for more than half of overall output. In order to reduce the environmental impact of shrimp aquaculture, the Indian government is pushing sustainable shrimp farming practises to produce high-quality 'sustainable' shrimp. Furthermore, the Seafood Exporters Association of India (SEAI) and the Marine Items Export Development Authority (MPEDA) promote shrimp exports, particularly ready-to-eat and ready-to-cook products.

Fig.1: Pacific White shrimp

Importance as food

Shrimp are invertebrate marine animals with elongated bodies that are commonly consumed as food. This is a nutritious food because it contains proteins, selenium, vitamins, phosphorus, magnesium, copper, iron, and vitamin B_{12}. Weight loss, age management, improved bone strength, reduced menstrual pain, and the prevention of cardiovascular illnesses are just a few of the health benefits connected with shrimp eating. Table 1 compares three main shrimp species cultivated in India: Tiger shrimp, Pacific White shrimp and Indian White shrimp.

Fig.2: Shrimp farming area in Punjab

Table 1: Comparison between important shrimp species cultured in India (FAO, 2004; Mahesh *et al.*, 2020).

Sr No.	Characteristics	Tiger shrimp (*Penaeus monodon*)	Pacific white shrimp (*Litopenaeus vannamei*)	Indian White shrimp (*Fenneropenaeus indicus*)
1	**Growth rate**	1 g/week	1.5 g/week	0.8 g/week
2	**Production**	4000-15000 kg/ha/year	28000-68000 kg/ha/year (2 crops/year)	10000-20000 kg/ha/year
3	**Stocking density**	20-60 PL/m^2	60-300 PL/m^2	50-100 PL/m^2
4	**Salinity tolerance**	10-25	0.5-45	20-30
5	**Temperature tolerance**	12-37.5°C	Tolerant down to 15°C	Below 34°C
6	**Dietary protein requirements**	36-42 %	18-35 %	40 %
7	**Food Conversion Process (FCR)**	1.8: 1	1.2-1	_
8	**Larval Rearing**	20-30 %	50-60 %	_

Shrimp's easy availability and excellent nutritional content are the primary growth factors. As one of the most traded species of seafood,

they are a key component of several cuisines.

Shrimp market

India has become one of the leading exporters of shrimp to the United States and the European Union, owing to rising demand for disease-free and stable shrimp. One of the major trends observed in the Indian shrimp market is the expansion of the food sector as a result of rising demand for ready-to-eat food items.

It is fueled by reasons such as rising urbanisation, altering lifestyles, stressful work schedules, and an increase in the number of working women. As a result, the Indian shrimp market is seeing excellent production. Furthermore, the increasing global demand for shrimp has boosted Indian shrimp imports. Furthermore, increased disposable incomes, rising consumer health consciousness, and improving living standards are some of the other important factors driving up demand for shrimp in India. Table 2 shows the state-by-state production of shrimp in India.

Table 2: State-wise area under shrimp cultures (Ha) (MPEDA 2018; Mahesh *et al.*, 2020).

State	1990-1995	1996-2000	2001-2005	2006-2010	2011-2015	2017[#]
Andhra Pradesh	34500	83930	61429	3418	40445	42462
West Bengal	34400	41980	50215	47488	53947	58285
Kerala	14100	14470	10797	9545	15385.44	12622
Orissa	8500	9000	7030	4769	9297	10778
Karnataka	3500	3635	1528	1484	813.41	
Maharashtra	2400	533	524	660	1400.71	1413
Tamil Nadu and Pondicherry	2000	1882	3684	2381	5199.94	8263
Gujarat	700	447	891	1925	4426.18	4552
Goa	600	770	295	272	34	10

Area under shrimp culture (shown in interval of five years)

[#]**Not applicable five years interval data.**

Conclusion

Although shrimp aquaculture has grown significantly, the industry has faced a number of challenges, including viral infections, marketing concerns, and poor farm-level performance. We should strive to raise awareness, overcome obstacles, and give chances for shrimp growing in India's salt-affected salty soils. There is an emphasis on the importance of using water wisely through modern technologies such as recirculation, re-use, and crop rotation. Furthermore, better management procedures for sustainable shrimp aquaculture in this region must be developed and strictly implemented, and farmers must look forward to long-term rewards through sustainable approaches.

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CLIMATE CHANGE

A CURRENT ISSUE AND THEIR DEVASTATING IMPACT ON FISHERIES AND AQUACULTURE FOR LAST DECADES

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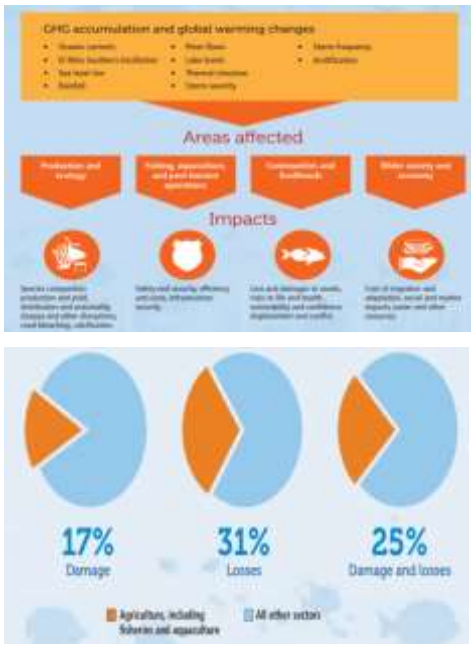


Fig 1. Climate change impact pathways in fisheries and aquaculture (Source: From Badjeck *et al.* (2010) and Damage and losses from climate related impacts on agriculture, fisheries and aquaculture (Source: FAO, 2015)

Billions of peoples around the world depend on fisheries and aquaculture sector for food supply, food security and livelihoods. The fisheries is fastest growing sector, playing significant role in the Indian economy, contributing about 1% to the National GDP, 5.23% to the agricultural GDP.

What Is Climate Change?

We live in a time of a changing climate. The term "climate change" refers to a rise in the average global temperature due to an increase in the concentration of atmospheric greenhouse gases, resulting shifts and impacts around the globe. "Global warming is a gradual increase in the earth's temperature generally due to the greenhouse effect caused by increased levels of carbon dioxide, CFCs, and other pollutants.

Impact of climate change on fisheries & aquaculture

It is an issue of great environmental concern. There is no any doubt that our fisheries are already a highly vulnerable sector. Climate change has serious implications for fisheries and aquaculture, which affect directly by influencing fish stocks and the global supply of fish for consumption, or indirectly by influencing fish prices or the cost of goods and services required by fishers and fish farmers.

Changing sea temperatures-sea surface Temperature (SST)

Temperature plays a critical role in the growth and development of fishes, which may impact fish diversity, distribution, abundance and phenology.

With increase in SST, evidences is now available for: increase in dispersal, abundance, reduction in mean size, length at first maturity, fecundity, change in spawning season and diet composition in commercial fishery such as oil sardine, Indian mackerel, *Nemipterus* and coastal shrimps.

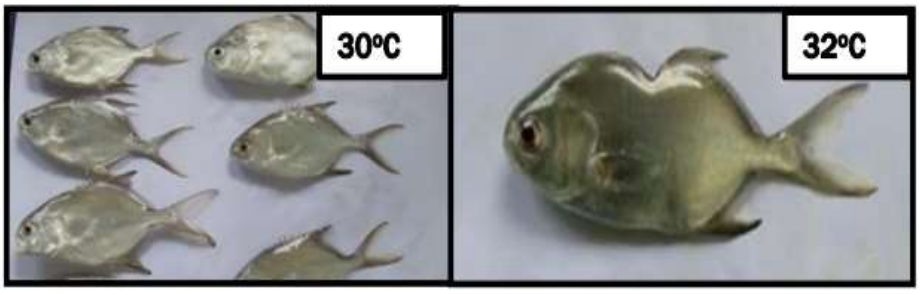
Coral bleaching is major phenomenon, cause by climate change. Coral may bleach for other reasons, like extremely low tides, pollution, or too much sunlight. By the end of the century, 99% of coral reefs are likely to experience bleaching so severe as to cause coral death: we risk losing all our coral reefs.

Rising sea level (Sea Level Rise-SLR)

Mean sea level is predicted to rise between 10 and 90 cm during this century, with most predictions in the range of 30-50 cm. This may destroy coastal ecosystems, such as mangroves & salt marshes, aquaculture production, breeding programs, affect the cage and pen farming system and damage the coastal communities.

Inland temperature changes

Higher water temperatures may reduce the wild fish population by affecting water quality, worsening



Effects of Elevated Temperature on Pompano fingerlings: grown at 30°C and 32°C show the effects of elevated temperature on early stages of growth.

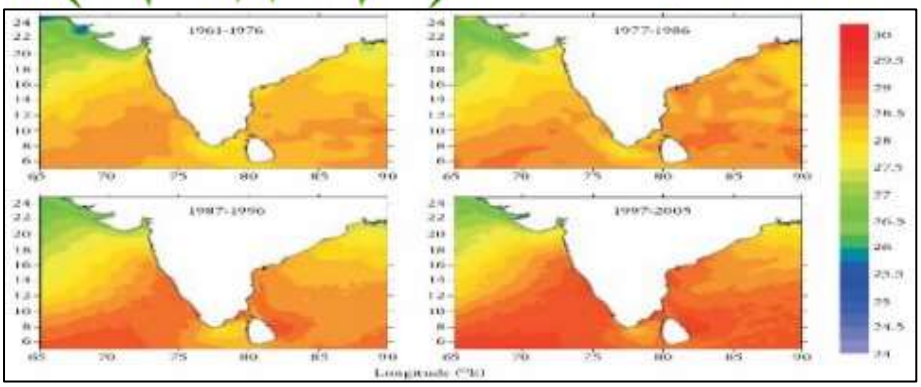


Fig 2. Plot of SST showing warming of sea surface along the Indian coast during 1961-2005 (Vivekanandan, 2010)

Indian mackerel is getting deeper: Indian mackerel generally occupies surface and sub-surface water. Conventionally caught by surface drift gill nets by artisanal fishermen. In recent years , the fish is increasingly getting caught in bottom trawl nets operated by large mechanised boats at about 50 m depth.

dry season mortality, bringing new predators & pathogens and food availability.

Changes in rainfall (Precipitation) pattern

It will affect aquaculture production and sustainability in two directly opposite ways; increased rainfall (Flooding) and no rainfall (Drought). These risks include losing fish from ponds during floods, invasion of ponds by unwanted species and ponds damage. Drought events may lead to water stress, such as shortages and quality deterioration that have negative impact on fish production.

Changes in sea surface salinity (SSS)

Salinity variations are caused by input of freshwater from precipitation, loss of water through evaporation, river runoff, rising temperature, melting & freezing of ice, the mixing & circulation of sea surface water or by climate change. Most fishes have specific salinity levels within which they can survive, any alterations may lead to mortalities.

Ocean Acidification (OA)

It refers to the oceans becoming more acidic due to a decline in pH levels resulting from atmospheric CO_2 uptake and is often called "climate change's evil twin". Due to OA, more difficult for zooplankton & marine animals such as shrimps, oysters or corals to form their shells a process called calcification. Thus the entire marine food web is being altered there are "cracks in the food chain".

Extreme Climatic Events

Such as cyclones, waves, and storms are expected to influence aquaculture development especially marine ornamental products, and those in coastal areas.

Changes in primary production

Climate change has altered the timing and amplitude of the seasonal cycle. While primary production has generally increased along with an intensified uptake of CO_2, some areas show a reduction in production.

Diseases and Harmful Algal Blooms (HABs)

Diseases in aquaculture, such as bacterial, parasitic, viral, and fungal diseases are likely to be affected by a changing temperature regime, but in a largely unpredictable manner.

Changes in fish distribution

Production from capture fisheries has been stagnant during the past 10 years because of overfishing, unregulated fishing, habitat destruction and pollution; climate change may exacerbate this situation.

Major challenges to fishing communities posed by climate change

Coastal and fishing populations and countries dependent on fisheries are particularly vulnerable to climate change.

Short-term effects of climate change on fish harvests

Such as reduce the abundance of fishes, production, employment, prices, income & profits and revenues.

Conclusion

Adverse impacts of climate change are putting enormous stresses on the people, engaged in fisheries. Developing policies and programs to improve the resilience of natural resources, through assessments of risk and vulnerability, by increasing awareness of climate change impacts and strengthening key institutions, would help the communities adapt to climate change.

- Develop knowledge base for climate change and marine fisheries
- Adapt the Code of Conduct for Responsible Fisheries (CCRF)
- Increase awareness on the impacts of climate change
- Reducing energy consumption
- Low impact fishing methods and gears as ways to sequester carbon in aquatic ecosystems.

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THE STATUS OF AQUACULTURE IN INDIA

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Global aquaculture production has increased dramatically since the 1970s, and it is now one of the fastest expanding food production sectors in many countries. Despite the fact that Asia is by far the dominant region, accounting for over 90% of aquaculture production, aquaculture's importance is expanding and there is plenty of room for growth. Aquaculture is a frequently overlooked option in agricultural growth, despite its promise. Planners and agricultural extension workers frequently lack the information needed to identify aquaculture development prospects and assess their viability under specific conditions. Aquaculture research and extension has always been conducted by specialized institutes separate from agricultural and livestock research and extension.

Successful introduction and planned propagation of aquaculture requires policy-makers and planners to take into account diverse and location specific social, economic, cultural and environmental conditions in traditional farming systems.

The major goal of this essay is to raise knowledge of the criteria for aquaculture in various farming systems, as well as its potential contributions. This article also highlights important considerations for achieving successful aquaculture and agriculture integration on small farm holdings, as well as encouraging more collaboration between aquaculture and farming systems specialists and institutions, resulting in improved support and development of efficient farming systems in the country.

Why aquaculture?

Protein deficiency affects millions of individuals around the world, resulting in poor health. In India, the importance of fish in the diet is greatest in the east and south. Fish is a high-nutrient food. Fish protein contains enough of all of the necessary amino acids that the body needs for growth and maintenance. Fish is high in easily digestible protein and Vitamin B-12 and is low in fat. Some fish are abundant in cholesterol-lowering oils that are good for your heart. It's a high-protein food, with most types containing roughly 23.5 percent protein, which is comparable to meat.

Scope of aquaculture in India

Because India is primarily an agricultural economy, policymakers and bureaucrats have spent the majority of their time focusing on increasing agricultural productivity. Around 80% of India's population lives in villages, and 90% of the rural population relies on agriculture and related activities for a living. Fisheries can help with food security and poverty reduction. However, advances in fisheries productivity may not always imply long-term increases in supplies. Indeed, in wild-catch fisheries, such improvements can lead to the extinction of species and a reduction in productivity.

Despite the fact that India receives plenty of rain and is blessed with a variety of perennial rivers and seasonal rivulets, appropriate rainwater management has been a major source of concern. Several projects for the proper use of rainfall through water collecting structures have been undertaken in rural India over the last few decades. The rainwater collected in these storage facilities during the rainy season can be used to raise fish, increasing the farm's overall return.

Present Scenario of Aquaculture in India

Aquaculture production figures reveal the enormous potential of this source of food towards food security and poverty alleviation provided its planned growth and sustainability issues receive sufficient attention. Aquaculture is a rapidly growing fisheries sector in India with an annual growth rate of over 7%. Freshwater aquaculture

contributes over 95% of the total annual aquaculture production of 5.77 million tone.

Benefits of Aquaculture

In terms of inherent production efficiency, pond culture has a number of benefits over crop production and livestock raising. A pond habitat's three-dimensional feature provides a number of biological niches that can support a wide range of creatures. A well-managed pond in China is stocked with over eight distinct fish species, all of which may thrive because they inhabit different areas of the pond water and exploit different nutritional niches. Furthermore, because aquatic species are cold-blooded, they invest more energy on growth than than maintaining body temperature. They also employ both natural and synthetic feeds. The following are some of the potential benefits of combining aquaculture with other components of a smallholder farming system:

- **Enhanced food and economic security**: Greater availability of protein for home consumption could result from increased aquaculture production. Aquaculture products, on the other hand, can be considered as a commodity that can be traded for cash or essential household supplies. Both strategies improve household financial stability.
- **Decreased risk and enhanced production:** Pond water may also be used for irrigation and cattle watering, incorporating aquaculture into farming systems reduces the hazards associated with small-scale farming while also increasing overall productivity from the pond. Furthermore, good species selection allows all levels of the ponds to be utilised to their full potential, resulting in increased pond productivity.
- **Multiple uses of ponds**. Fishponds are used for combating and irrigating homestead fruit and vegetables in many sections of the country, and for dumping of domestic waste in others. Pond water is usually richer in nutrients than tell water as an irrigation source, and it also contains nitrogen-fixing blue-green algae, which helps boost soil fertility. The nutrient-rich pond muck can be utilised as fertiliser when the fish are harvested, or the pond can be used to grow forage and other crops. A pond can be essential for ensuring year-round crop production, livestock watering, domestic water supply, and fire protection in places where seasonal water shortages occur.
- **Environmental benefits**: When farm wastes are produced in large amounts, incorporating them into aquaculture ponds not only improves management efficiency but also saves them from being dumped into the environment. Integrated aquaculture, such as rice-fish farming, can help to reduce the use of toxic pesticides. Rice pests, mosquito larvae, and snails are all eaten by several fish species. When appropriate fish species are put in rice fields, the fish's eating on weeds and algae, as well as their subsequent excretion, minimize pesticide use and raise phosphorus and nitrogen levels in the water. As a result, the need of chemical fertilizers is reduced. In the end, this results in better resource utilization, increased income, and a healthy rice and fish crop. This in turn reinforces farmers' acceptance of integrated pest management and rejection of pesticides.

Conclusion

Although the aquaculture sector experienced a boom in the 1980s and early 1990s, it plummeted in the mid-1990s, there is still a chance for the business to recover. What is necessary is the practise of environmentally friendly and sustainable aquaculture that is both responsible and technologically competent. It will help India earn a lot of foreign currency and provide a lot of job opportunities. ■

CLOUD SEEDING

ARTIFICIAL RAIN MAKING PROCESS

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Vincent J. Schaefer, a chemist who invented cloud "seeding" and created the first artificially induced snow and rainfall, Cloud seeding is a weather modification technique that improves a cloud's ability to produce rain or snow by artificially adding condensation nuclei to the atmosphere, providing a base for snowflakes or raindrops to form. After cloud seeding takes place, precipitation falls from the clouds back to the surface of the Earth. Some studies have suggested that it is "difficult to show clearly that cloud seeding has a very large effect". The usual objective is to increase precipitation (rain or snow), either for its own sake or to prevent precipitation from occurring in days afterward.

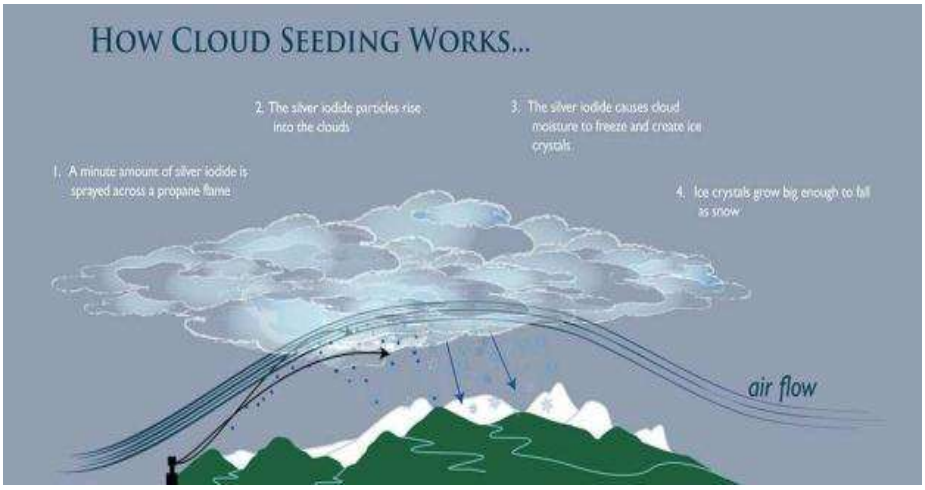
Cloud Seeding Methods

There are three cloud seeding methods**:** static, dynamic and hygroscopic.

1. **Static cloud seeding** involves spreading a chemical like silver iodide into clouds. The silver iodide provides a crystal around which moisture can condense. The moisture is already present in the clouds, but silver iodide essentially makes rain clouds more effective at dispensing their water.

2. **Dynamic cloud seeding** aims to boost vertical air currents, which encourages more water to pass through the clouds, translating into more rain [source: Cotton]. Up to 100 times more ice crystals are used in dynamic cloud seeding than in the static method. The process is considered more complex than static clouding seeding because it depends on a sequence of events working properly. Dr. William R. Cotton, a professor of atmospheric science at Colorado State University, and other researchers break down dynamic cloud seeding into 11 separate stages. An unexpected outcome in one stage could ruin the entire process, making the technique less dependable than static cloud seeding.

3. **Hygroscopic cloud seeding** disperses salts through flares or explosives in the lower portions of clouds. The salts grow in size as water joins with them. In his report on cloud seeding, Cotton says that hygroscopic cloud seeding holds much promise, but requires further research.



Types of cloud seeding:

i. Dry Ice Seeding:

It is to change super-cooled cloud droplet to ice crystal in the laboratory and in the atmosphere by dropping pellets of dry ice into the cloud and causing large number of ice crystals to appear spontaneously. Dry ice is solid frozen carbon dioxide at a temperature below -80°C. An air craft drops dry ice pellets of size 0.5 to 1.0 cm at the top of super-cooled clouds.

They fall through the cloud and result in a sheet of ice crystals. This method is reliable for stimulating showers from cumulus clouds provided their tops have temperatures lower than -5°C and the clouds last for more than 30 minutes.

ii. Silver Iodide Seeding:

Minute crystals of silver iodide produced in the form of smoke acts as efficient ice forming nuclei at temperatures below -5°C to produce enormous number of nuclei (10^{15} per gram of silver iodide). When this smoke is introduced into super-cooled cloud, some ice crystals appear when temperatures fall below -4°C, but its formation rapidly increases with decreasing temperatures.

Cloud seeding by silver iodide is done either from ground generators or from airborne generators. Substances other than silver iodide as artificial nuclei are lead iodide, cupric sulphide, cupric oxide, ammonium fluoride, cadmium iodide and iodine. However, all these are not as effective as silver iodide.

iii. Warm Cloud Seeding:

It is a process in which nuclei of droplets grow to radii of several microns in coalescence between drops. Once drops have grown to about 40 μ diameter, they are capable of colliding with and sweeping up smaller droplets in their path. Once the droplets reach the size of 60 μ diameter, coalescence dominates and condensation can be virtually ignored. Coalescence process is mainly responsible for growth of rain drops in warm cloud.

Advantages of cloud seeding:

- ❖ It creates rain, providing relief to drought-stricken areas.
- ❖ It makes a place more hospitable.
- ❖ It would allow for economic growth.
- ❖ It can reduce crop damage.
- ❖ It has the potential to help regulate the weather.
- ❖ It helps to regulate weather pattern in particular location.

Disadvantages of Cloud Seeding:

- ❖ It uses chemicals that might be harmful.
- ❖ It can lead to abnormal or unpredictable weather patterns and flooding.
- ❖ It is yet to be fully proven as cost-efficient and effective.
- ❖ It can cause cloud pollution.
- ❖ It is a costly process.
- ❖ This work could alter weather patterns in other areas.

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