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Cold Storage

Scenario || Need || Availability

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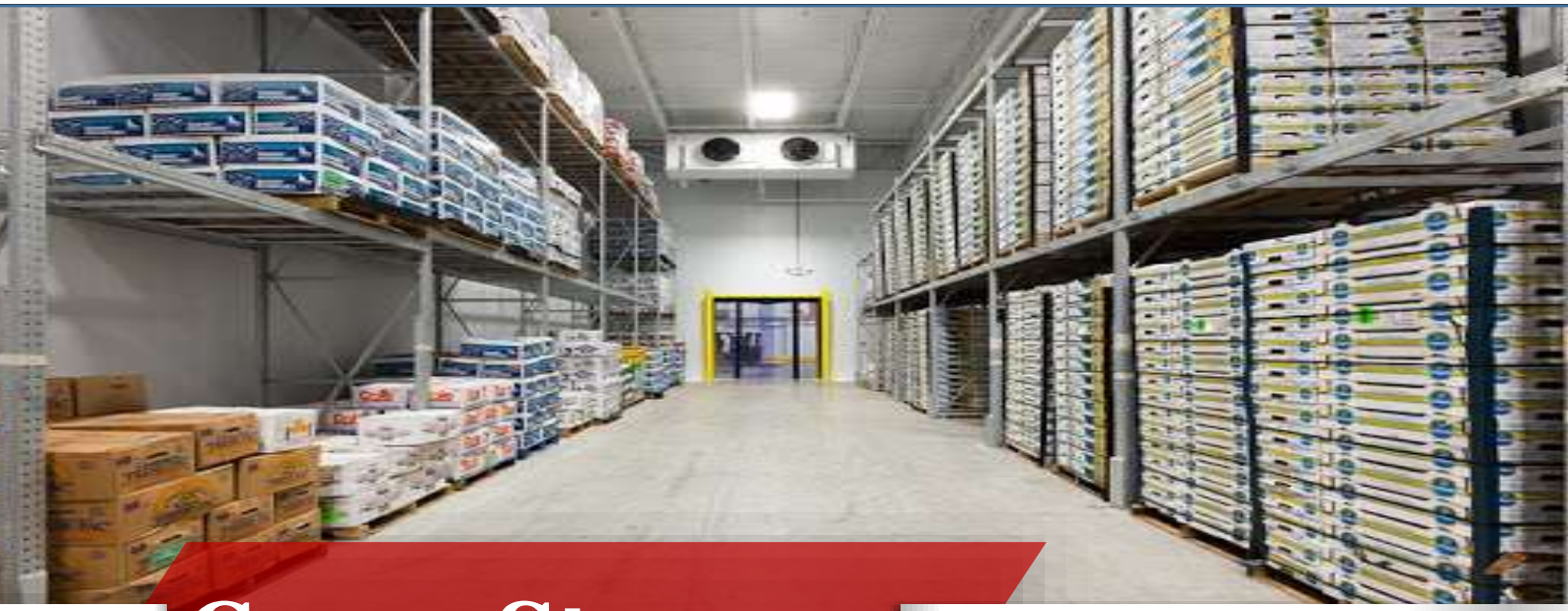
From the Editor`s Desk

Dear readers, a very happy five-day Prakash Parv (Deepawali) on behalf of the Times of Agriculture Family. This issue gives you detailed information about cold storage their need and availability. In this issue all the information related to the storage of agricultural products have been discussed. As you all know that the every time `Times of Agriculture` is comes with a special segment among you, in which various current issues, updates is shared with you. In the same process, this time the November issue is presented among you with a focus on Cold storage. As we know that after production of agricultural commodities, their storage is a very important aspect because if there is no proper storage, then the whole hard work is wasted, which is very harmful from the economic point of view. So we should have a proper knowledge of storage. Once again, with deepest wishes of Deepawali, thank you very much.

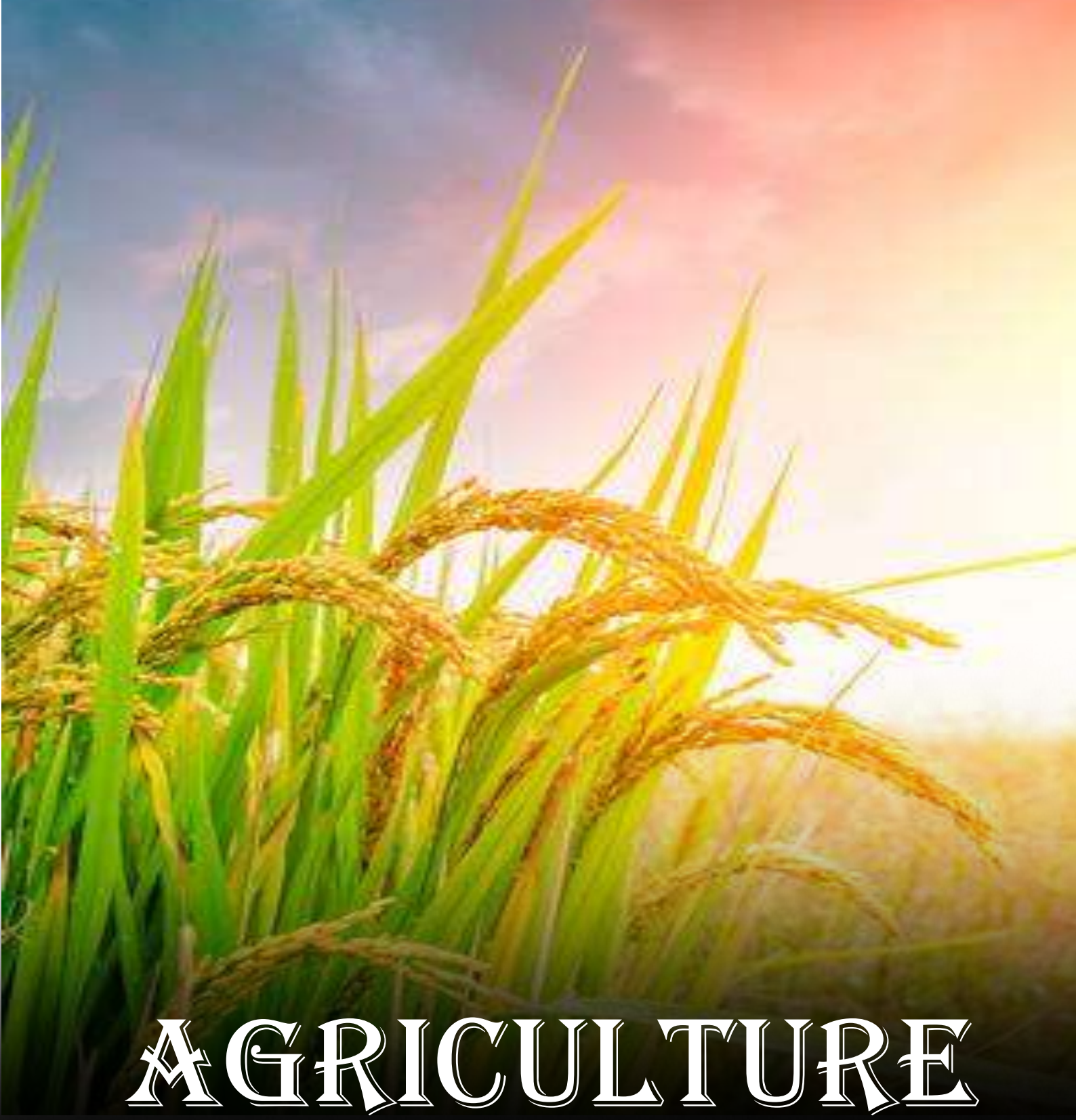
(Devaraj Singh)
Editor-In-Chief

CONTENT



Cover Story

Cold Storage: Scenario | Need | Availability



AGRICULTURE UPDATES

Finance Minister announced **65000 crore fertilizer subsidy**

Finance Minister **Nirmala Sitharaman** on November 12 announced a **Rs. 65,000 crore** fertilizer subsidy to enable timely availability of fertilisers in the upcoming crop season for farmers in her third set of stimulus package to boost the economy. The likely time period of the expenditure has not been specified but this is in addition to **Rs 71,309 crore** budgeted to **be disbursed during FY21**.

Increased supply of fertilisers at subsidised rates will **help 140 million farmers**, the FM said. According to the Department of fertilizer dashboard **around 77 million farmers have purchased subsidised fertiliser with almost a 22 per cent share** coming from Uttar Pradesh. Farmers from Bihar and Maharashtra contribute another 15 per cent.

Tezpur Litchi gets GI tag

Tezpur Litchi of **Assam** has been granted the Geographical Indication (GI) tag. Now Tezpur Litchi has been protected from the production of the fruit in other places. GI tag has granted Tezpur Litchi an incontrovertible proof of its origin in the state.

The news has been confirmed by the Agricultural and Processed Food Products Export Development Authority (**APEDA**), an apex body under the Union ministry of commerce and industry, which is responsible for the export promotion of agricultural products. Litchi is known for its excellent quality pleasant flavour, juicy pulp with attractive red colour. Litchi (Litchi Chinensis) is one of the most important sub-tropical evergreen fruits produced in Tezpur.

IFFCO Bazar and SBI YONO tie-up to boost accessibility of farm input

IFFCO Bazar, the e-commerce arm of **Indian Farmers Fertiliser Cooperative (IFFCO)** has announced its integration with the **SBI YONO Krishi**, which is the dedicated portal catering to the farmers' needs. This will insure that a wide variety of agriculture products are made accessible to lakhs of Indian farmers. Hassle free payment portal of SBI YONO and quality products of IFFCO is a combination which aims to **drive the digital sales in this segment**, Ministry of Chemicals and Fertilizers has said in a statement today. Speaking on the partnership, **Dr US Awasthi, MD, IFFCO** said, "**IFFCO and SBI are two of the oldest business institutions in India**. "The collaboration will help IFFCO Bazar to reach out to over three crore registered customers of YONO, a large part of which happens to be farmers.

Telangana minister launches tribal women-owned food processing unit

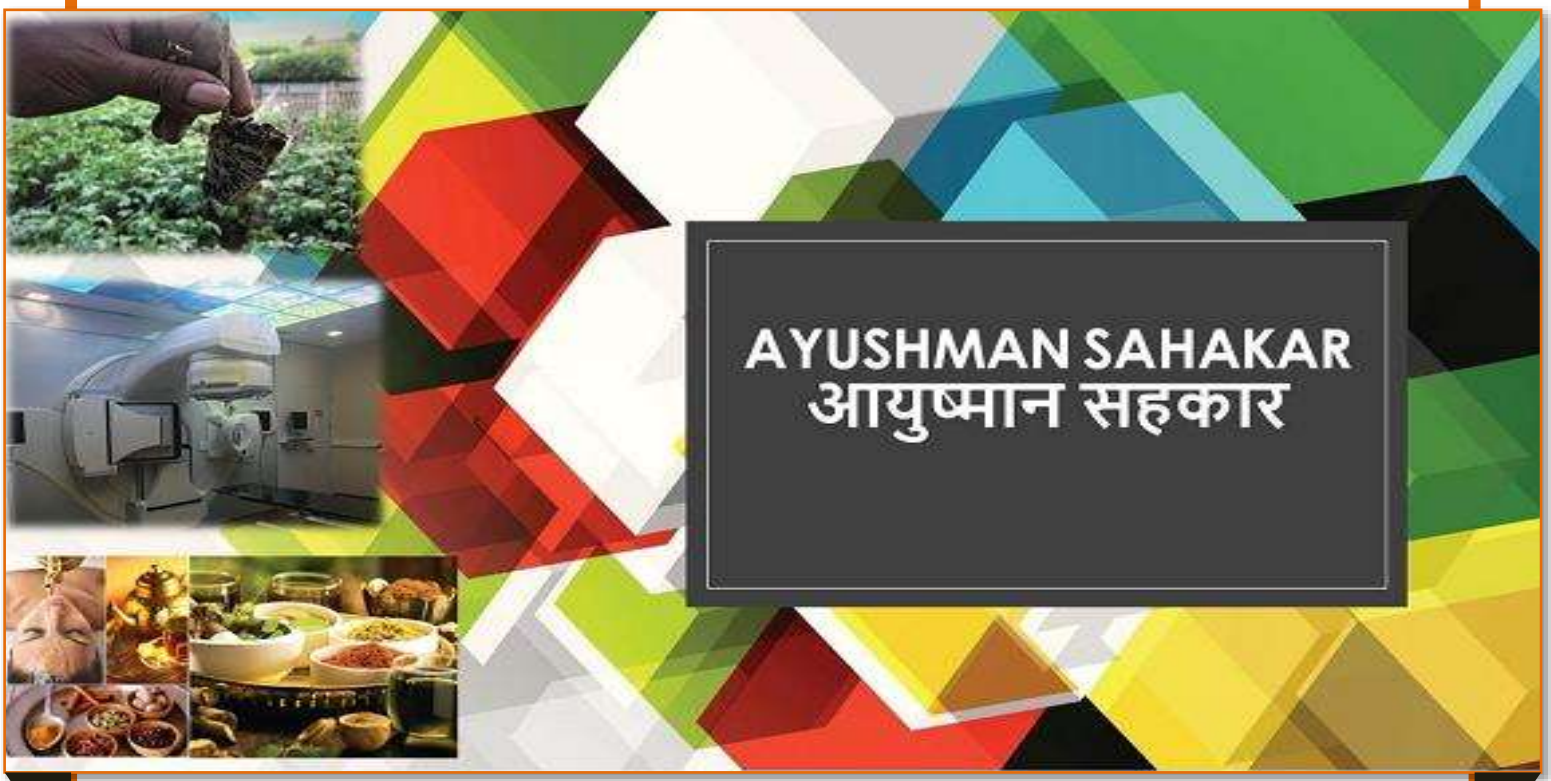
Allola Indrakaran Reddy, Minister for Endowment, Law, Forest and Environment, Telangana, inaugurated a **tribal women-run food processing unit** in **Utnoor** in Adilabad district on **November 2**. The **Komaram Bheem Peanut Chikki** Industries that the minister opened is wholly owned by first generation tribal entrepreneurs. The unit will supply to government nutrition programmes and anganwadis in the tribal region. The project trains tribal women to be "Nutrition Entrepreneurs" and is critical to ensure evolution of local value chains around local food production and consumption to make vulnerable tribal communities sustainable, especially post **COVID-19.** Going forward, this initiative will empower tribal communities by establishing more units and build their capacity to run the units in a sustainable manner, contributing towards not only health and nutrition, but sustainable livelihoods as well.

‘Dharani’ Portal launched by Telangana Govt.

On 29th October 2020, **Telangana Chief Minister K Chandrasekhar Rao** launched **‘Dharani’** Portal at **Mudu Chinatalapalli** village of **Medchal-Malkajgiri** district. The portal will be used to **store land record and for property registration digitally**. Thus the need for a human interfere and eliminating the scope for graft will be abolished. The portal is a step ahead in revenue reforms by providing an easy land and property registrations.

Through the portal one can register their property, succession and also the partition of agriculture lands and after the registration is done, the owner will be **provided with e-pattadar passbook**. The portal keeps record of property of all citizens. Those not included will be treated as illegal and will not be allowed for further registrations or mutation.

Ayushman Sahakar Scheme



Union Minister of State for Agriculture **Shri Parshottam Rupala** on **October 19, 2020** launched **AYUSHMAN SAHAKAR,** a scheme to **assist cooperatives in creation of healthcare infrastructure** in the country. formulated by the apex autonomous development finance institution under the Ministry of Agriculture and Farmers Welfare, the National Cooperative Development Corporation (NCDC).

Shri Rupala announced that NCDC would extend term loans to prospective cooperatives to the tune of **Rs.10,000 Crore** in the coming years. NCDC's scheme will be a step towards strengthening farmers welfare activities by the Central Government. **Shri Rupala** said that **AYUSHMAN SAHAKAR** scheme would revolutionize the way healthcare delivery takes place in rural areas.

Kerala becomes the 1st state in the country to fix the floor price for vegetables

Kerala becomes the **first state** in the country to fix the **floor price for vegetables**. The floor price will be **20 per cent** above the production cost of the vegetable. Even if the market price goes below the floor price, the product will be procured at the floor price from the farmers. This is the **first time in the country** that the **floor price is being fixed for vegetables** produced in the state. This is going to provide relief as well as support for the farmers.

The produce will be graded and the **floor price will be fixed based on the quality**. **16 varieties** of vegetables would be covered in **the first phase** and there is a provision to revise the floor price on a regular basis.

Cabinet approves extension of the Market Intervention Scheme for procurement of apples in Jammu and Kashmir for the year 2020-21

The Union Cabinet, chaired by Prime Minister Shri Narendra Modi, approved the extension of **Market Intervention Scheme (MIS)** for **apple procurement** in **Jammu and Kashmir (J&K)** for the current season also **i.e. 2020-21** on the same terms and condition as was done in J&K during last season i.e. 2019-20.

The procurement of apple will be done by **Central Procuring Agency** i.e. **National Agricultural Cooperative Marketing Federation ltd. (NAFED)** through State Designated Agency i.e. Directorate of Planning and Marketing, Department of Horticulture & Jammu & Kashmir Horticulture Processing and Marketing Corporation **(JKHPMC),** directly from apple farmers of J&K and the payment will be made through **Direct Benefit Transfer (DBT)** into Bank account of apple farmers. 12 LMT of apples can be procured under this scheme.

Wheat variety : MACS 6478 Doubles farmers' yield in a Maharashtra village

wheat variety — **MACS 6478**–, developed by scientists from Agharkar Research Institute (ARI), an autonomous institute under Department of Science and Technology (DST), Government of India, has doubled the crop yield for farmers in Karanjkhop, a village in Maharashtra.

The farmers of the village in Koregaon tehsil of Satara district in Maharashtra are now getting a yield of 45-60 quintal per hectare with the new variety as against earlier average yield ranging 25-30 quintal per hectare when they cultivated Lok 1, HD 2189 and other old varieties, the Ministry has further said.

PM dedicates 17 biofortified varieties of 8 crops to the Nation

The Prime Minister, Shri Narendra Modi issued a Commemorative Coin of Rs. 75 and dedicated **17 biofortified varieties of 8 crops** to the nation on the occasion of **75th** Anniversary of the FAO also Celebbrated as **World Food Day.** The biofortified varieties are **1.5 to 3.0 times** more nutritious than the traditional varieties. The rice variety **CR DHAN 315** has excess zinc; the Wheat variety **HD 3298** is enriched with protein and iron while **DBW 303** and **DDW 48** are rich in protein and iron. The **Maize hybrid varieties 1, 2** and **3** are enriched with lysine and tryptophan, the Finger varieties of Millet **CFMV 1** and **2** are rich in calcium, iron and zinc. The **CCLMV1** variety of Small Millet is rich in iron and zinc. The **Pusa Mustard 32** is enriched with low Araucic Acid, while **Girnar 4** and **5** varieties of Peanuts are rich in increased Oleic Acid and Yam's **Shri Neelima** and **DA 340** varieties are enriched with Anthocyanin**.**

15 October : Mahila Kisan Diwas

The Union Agriculture Ministry celebrated, **'Mahila Kisan Diwas'** or the **Day of Women Agriculturists** on **October 15** for the first time in India. It is being organized in association with the Ministry of Women and Child Development.This was being done to recognize the contribution of women in agriculture as 80% independent women in India were associated with the farm sector, while women lead 18% of all agricultural households.

Interaction between Shri Parshottam Rupala and successful women farmers and women entrepreneurs was held during the event. The e-book on *'Inspiring Stories of Progressive Women Farmers'* was released and two short video films on 'Mahila Krishak and her Contribution in Agriculture' and 'Global Examples of Successful Women Farmers' were launched during this event.

PUSA DECOMPOSERS

Dr. Devraj Singh
Vegetable Science

The Scientists has developed a **bio-decomposer technique** called **'PUSA Decomposers'** for converting crop **stubble into compost.** Delhi and many other North Indian States are covered with smoke during winters due to **stubble burning** in the neighboring States by the farmers.

The decomposers are in the form of **capsules** made by **extracting fungi strains** that help the **paddy straw** to decompose at a much faster rate than usual. The fungi help to produce the **essential enzymes for the degradation** process. This would then rule out the need to burn the stubble, and also help in retaining the essential microbes and nutrients in the soil that are otherwise damaged when the residue is burned. The decomposer **improves the fertility** and **productivity of the soil** as the stubble works as **manure** and compost. It is an **efficient and effective, cheaper, doable and practical technique** to stop stubble burning. It is an eco-friendly and environmentally useful technology.

Decomposer Mixture- It involves making a liquid formulation using decomposer capsules and fermenting it over 8-10 days and then spraying the mixture on fields with crop stubble to ensure speedy bio-decomposition of the stubble. The farmers can prepare **25 litres of the liquid mixture with 4 capsules, jaggery and chickpea flour.**

Time to Decompose- It takes around **20 days** for the degradation process to be completed.

COVER STORY

Cold Storage

Scenario I Need I Availability

India is witnessing phenomenal growth in horticulture, meat & dairy product over the last 10 years. India comes amongst top 3 in terms of production of vegetable, milk, fruit, poultry, spices, fisheries but unfortunetly India's present share in global farm trade is very low. One of the main reason behind this situation is wastage of perishable crops, near about 5%-16% of wastage is recorded in fruits and vegetable segment, 10.5% in marine product, 5% in inland fish, 2.8 % in meat and 6.7 % in poultry meat. The NCCD (National Centre for cold chain development) has estimated the gap of 3.2 mn MT in the capacity of cold storage, more than 69k pack-houses, more than 50000 moving vehicle and around the gap of 8000 ripening chamber, this industry is trying to fulfill these gaps as soon as it is possible. In recent years government has also focused majorly on integrated cold chain and food parks to deal with the wastages.

Level of wastages

1. Each year India witnesses nearly 4.6% - 15.9% of wastage in vegetbale and fruits due to lack of modern infrastructure and cold storage.

Lack of modern cold storage

2. The wastage in other perishale items is also high like 5.2% in inland fish, 10.5% inmarine fish, 2.7% in meat and 6.7% in poultry meat.

High Wastage perishale items

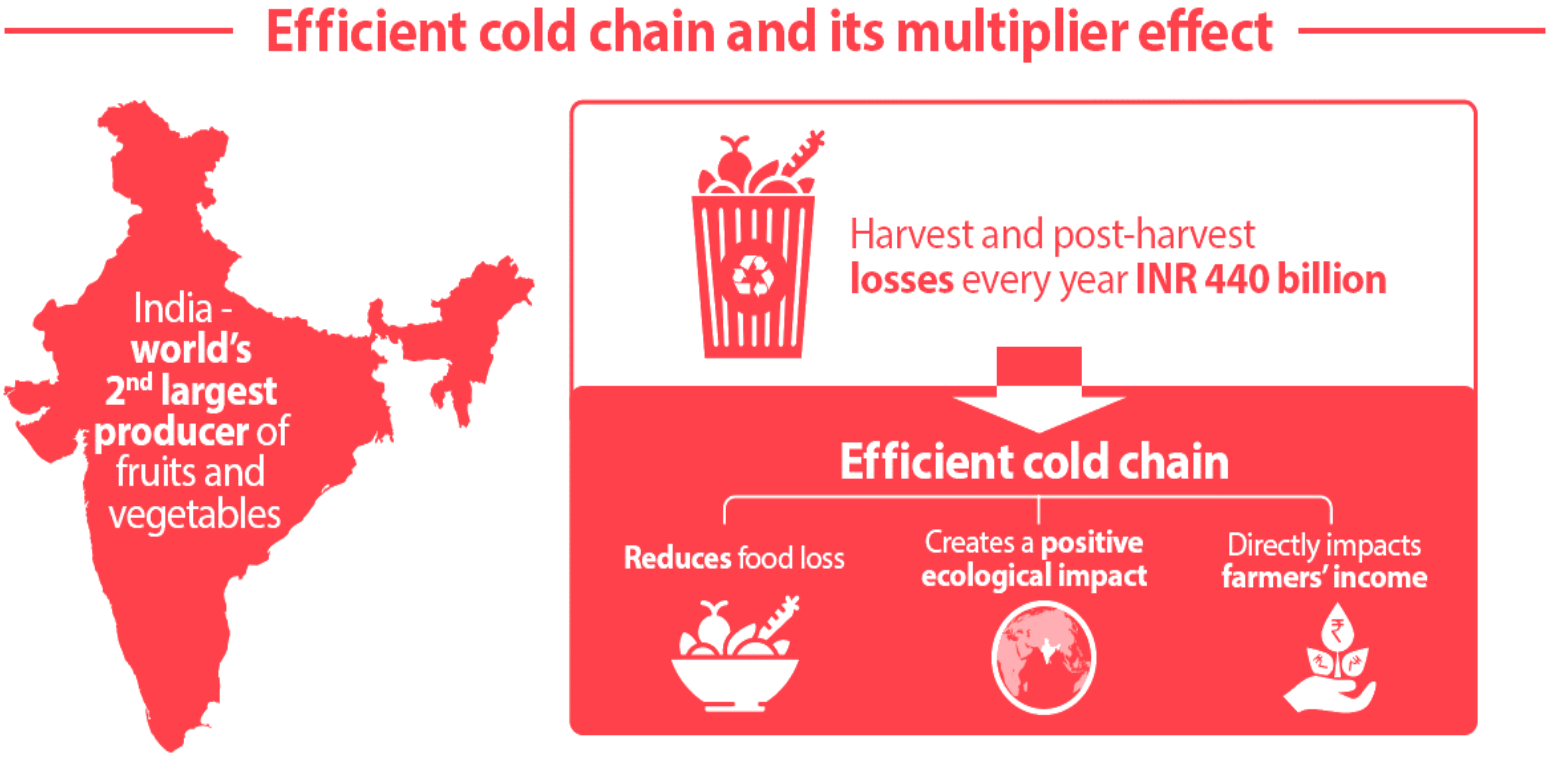
3. INR 92651 cr is the total loss in agriculture produce annually & 58478 is the total loss in meat , fish and milk.

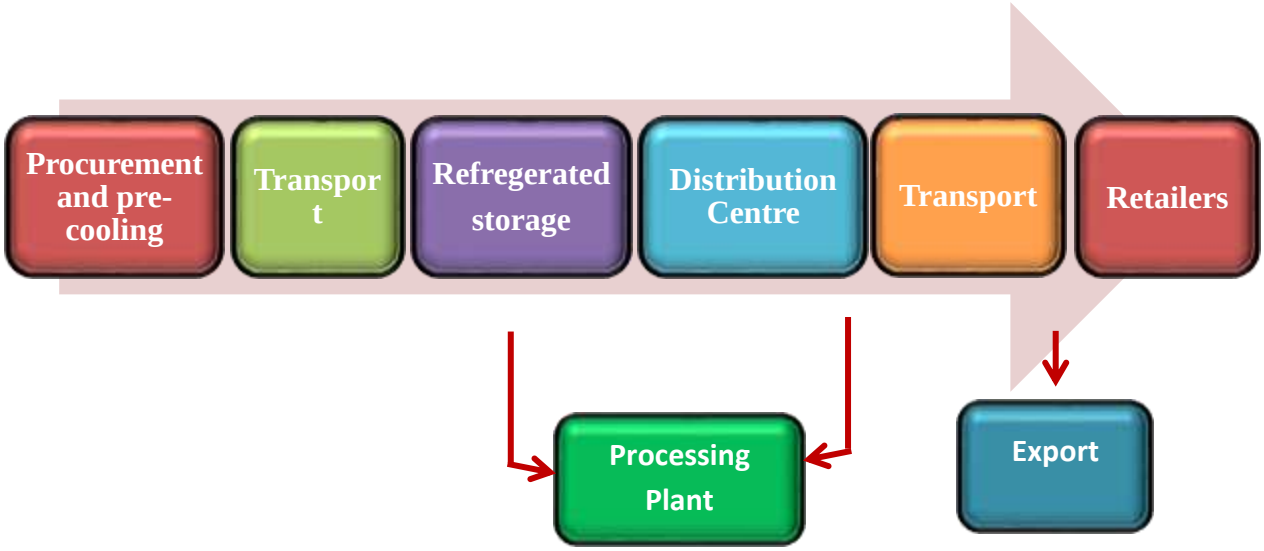
Loss in agriculture produce

Need of Cold storage

- One of the major problems in Indian agriculture is its poor cold storage infrastructure, due to which the farmers do not get their remunerative prices because of less investment in cold storages, warehouse.
- If the production is very high in a year then there must be some glut in the market and prices comes down drastically ,so now farmers tries to get better in some large consuming areas and for that he have to take the produce to the particular place and moving the produce will lead some wastage risk , so for that famers will need rear vehicle so that they can easily move the items
- Country like India where a large number of populations is dependent on the agriculture for their livelihood hence we need to invest more in this segment to avoid any wastage
- Despite of being 2nd largest producer of fruits and vegetables and largest producer of milk , about 40-50% of production get wasted every year
- There are 7645 cold storages in India with total capacity of 37mt MT , which is only 13% of total production of perishable items , so we can imagine the gap
- Physical loss of food has a multiplier effect in associated waste of inputs like water, electricity and fertilizers. It also adds to greenhouse emissions, contributing to climate change.

Process flow of cold chain





So the first stage is procurement of agricultural produce and taking them to a precooling Centre which should be located nearby the production zone. Why precooling is required? So by precooling the traders are trying to prepare the fruits and vegetables for transportation over long distance, some refrigerated or refer trucks are also used to transporting highly perishable items from precooling Centre to cold storage. Packaging, sorting grading is all done at collection Centre

As we all are aware about the poor situation of cold storage in India, hence all the cold storages are situated in Centre so that they can cater to different production zones & pre-cooling centres like hub and spoke model. There are different factors like what is the use of product, how long product need to be stored and accordingly they are stored in cold room storage , chilled storage & controlled atmosphere storage

The procured produce are transported to the processing plant and after processing (like jams, jellies, pickles, or juices) is transported through refers trucks to the distribution Centre and then from there it is either transported to retailers or exported. At retailer the perishable food items are stored at low temperature in refrigerated display unit to increase the shelf life as well as to maintain the freshness of the items

Classification of Cold Storage:

- **Multipurpose:** Designed for variety of commodity like fruits, vegetables, spices, pulses, dry fruits, milk products etc.
- **Bulk:** Used for storage of single commodity, usually operates on seasonal basis like potatoes, chilies etc.
- **Frozen:** It provides freezing facility for fish, meat, dairy, poultry and processed vegetables and fruits with or without processing facility.

➢ **Ripening chambers**

✓ **Controlled atmosphere (CA):** Suitable for products like apple, cherries and pears. In CA the inside air is replaced by inert gas to quickly obtain vert low level of oxygen inside the chamber so that it will reduce produced respiration , will also decrease ethylene production , inhibiting pathogen infestation , and will kill all the harmful bacteria's in order to increase the shelf life

Types of cold chain Infrastructure, product & end user segment

Business Models	Temperature Controlled Warehouse (TCW)	Temperature Controlled Vehicles (TCV)	Value Added Services (Sorting, Grading, Packaging etc.)
Key Products	Potatoes, F&V, Meat, Sea Food, Milk & Milk Products	Meat, Ice Cream, Milk & its products, Pharma products, Confectionery	Fruits (Apples), Pharma, Packaged Food, Meat & Sea Food
Technology used	✓ Ordinary Cold Store ✓ Gas Controlled Cold Stored ✓ Controlled Atmosphere Cold Store ✓ Deep Freezer Storage		
Key End User Segment	✓ Wholesalers (70-75%) ✓ Organized Retailers (10-15%) ✓ Food Service (15-20%) ✓ Others (3-5%)		

Driving Factors for cold chain and food processing in India:

India ranks 2nd in terms of food production globally, 2nd to China

India ranks 1st in the world in production of milk, bananas, mangoes, guava, papaya, ginger and okra

India ranks 2nd in the world in production of green peas, potatoes, tea, tomatoes, sesame seed and many other key commodities

Strategic geographic location and proximity to food importing nations makes India favourable for export of processed foods

With a coastline of 480 km, 4th in Shrimp production

Processing levels for perishables in India is considerably low - F&V 2%, Marine produce - 23%, Poultry - 6%, Meat - 21%, Dairy - 35%

Among the top 3 cashew producing states in India

By 2020, Indian Food and retail market is projected to touch $ 482 Bn, the Indian Dairy industry is expected to double to $ 140 Bn, the Food processing industry has the potential of attracting $ 33 Bn of investment and by 2030, Indian annual household consumption to treble, making India 5th largest consumer globally

Proactive policy support

FDI

- 100% FDI through automatic route in food procesing
- 100% FDI in food retail for the food products that are Produced in India

Credit

- Huge fund for food parks and processing unit designeted by NABARD (INR 2000 crore)
- Under priority sector lending food processing unit can avail preferential rates

Regulatory reforms

- Food safety standards are modulated with international standards

Fiscal Reforms

- Implementation of GST to harmonize the tax regime-seamless operations across states

Infrastructure support

- **Mega Food Parks:** With the investment of US $ 750 million on 42 mega food parks
- **Cold Chain**: With the investment of US $ 500 million on 135 Integrated cold chain projects

Proactive state investment policies

- Large number of attractive investment policies across every state

Fiscal Incentives:

Exercise duty reduced from

- 12.6% to 6% on Refrigerated containers
- It has reduced from 10% to 6% on food processing machinery.

Service tax exemption

- On pre-cooling , ripening , waxing , retail packing , labeling of vegetables and fruits & pre-conditioning
- Erection , construction & commissioning or installation of cold storage /post- harvest infrastructure.

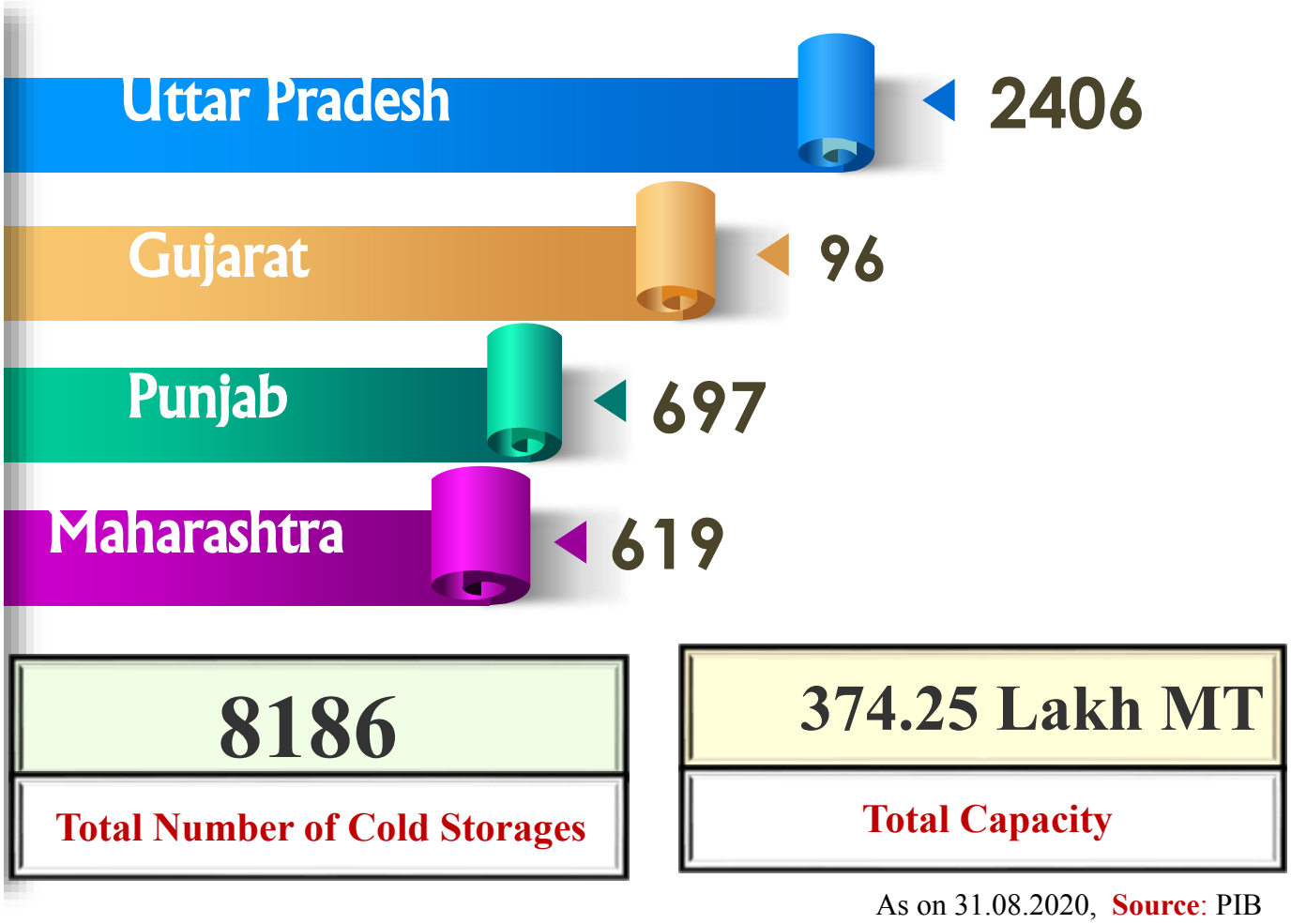
100% Income tax deduction

- On investment for warehouse/cold chain
- On profit for new food processing , packagin units & preservation.

On Imported equipment there is provision of Concessional Custom Duty.

Basic custom duty reduced from 10% to 5% on Refrigearated Containers.

State wise cold storage capacity



As on 31.08.2020, **Source**: PIB

Scenario

The table above represents the total distribution of cold storage in different Indian states along with their capacity, In India there are about 7640 cold-storages with the total capacity 34.9 Mn MT. From the figure it is clearly mentioned that UP, WB, Punjab, Gujarat, AP & Telangana are the top five states in terms of cold-storage capacity. **83% of cold storages are utilized for agri-based and horticulture products, 9% for processed food, 7% for animal husbandry product & 1% for pharma products.**

The cold storage industry is still in the initial stage despite of having large producer or perishable items now increase in urbanization and growth in food processing industry along with growth in modern retail has enhanced growth in cold storage industry, to increase the investment in cold storage industry, Indian government has taken several schematic and policies. There are 7645 cold storages in India with total capacity of 37mt MT, which is only 13% of total production of perishable items, so we can imagine the gap. So we can

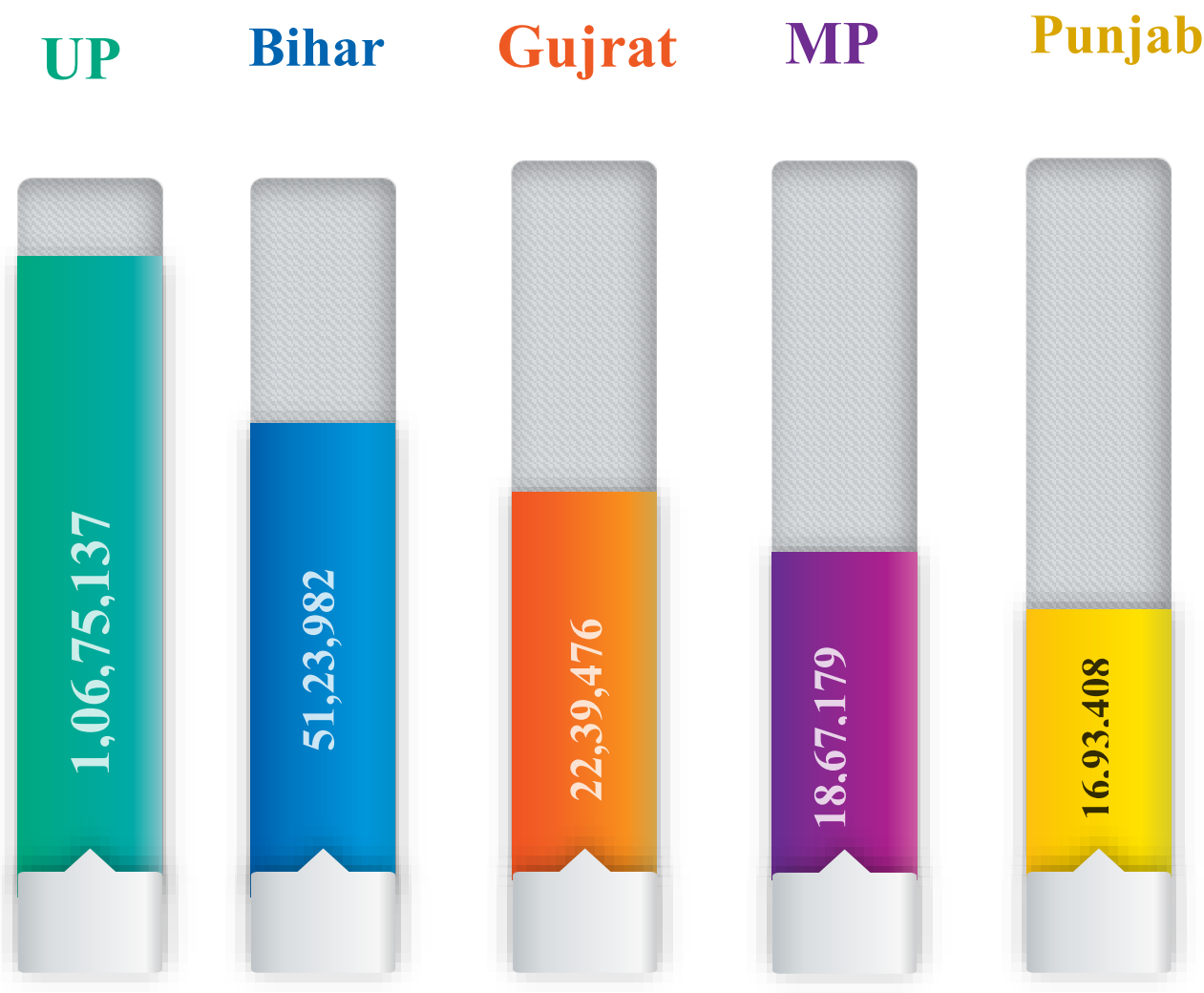
conclude that the situation of cold storage is not up to the mark and we need to increase our cold storage because as time passes our production will also increase, so to deal with we need to have more numbers of cold storage across states. Below mentioned are the commodity wise indicative intervention and after that we have also the list of exact requirement of cold storage in different states.

Areas for cold-chain intervention

Commodity	Potential States	Indicative Intervention
Apple	HP,NCR, J&K, Mizoram, AP, Sikkim , Uttrakhand	Reefers, precooling, CA store solutions at Farm level.
Mangoes	AP, Gujrat , Maharashtra	Controlled atmosphere storage / cold storage, Ripening chambers for Mangoes.
Kiwi	AP	Modern pack house Cold chain.
Onion	Gujrat, Maharashtra	For long term storage technology needs to be advanced.
Banana	TN , Maharashtra , AP Gujrat	Ripening chambers & Modern pack house.

Potato	UP , WB , Punjab	Upgrading existing cold chain & advance system for storing process grade potatoes.
Fish	AP, Kerala, Gujarat, TN, WB, Odisha, Manipur, Mizoram	Refer vans, cold storage, Pre-cooling, Freezing unit (IQF), Blast freezer, plate freezer.
Meat	Maharashtra, A P, Kerala, U P, Nagaland, Assam & other North Eastern states	Cold chain and Modern abattoirs for meat and meat product.
Dairy	PAN India	Advance technology for chilling milk at farm level and insulated vehicle as well as processing plant for high value dairy product.

State wise requirement of Cold storage



State wise requirement of Cold storage

Sr.No	State	No of required CS
1	**UP**	**1,06,75,137**
2	**Bihar**	**51,23,982**
3	**Gujrat**	**22,39,476**
4	**MP**	**18,67,179**
5	**Punjab**	**16,93,408**
6	**J&K**	**9,07,842**
7	**AP**	**5,30,925**
8	**Chhattisgarh**	**5,13,830**
9	**HP**	**3,06,147**
10	**Odisha**	**3,05,500**
11	**Telangana**	**2,77,129**
12	**Haryana**	**2,40,395**
13	**Karnataka**	**2,10,313**
14	**Tamil Nadu**	**1,94,640**
15	**Maharashtra**	**1,57,709**
16	**Assam**	**71,996**
17	**Rajasthan**	**53,395**
18	**Kerala**	**45,874**
19	**Delhi**	**40,122**
20	**Jharkhand**	**24,951**
21	**Meghalaya**	**18,704**
22	**Mizoram**	**8,920**
23	**Nagaland**	**8,675**
24	**Tripura**	**8,554**
25	**AP**	**7,508**
26	**Manipur**	**5,062**
27	**Sikkim**	**2,621**
28	**Goa**	**2,271**

Source: All India Cold-chain Infrastructure Capacity (Assessment of Status & Gap)

No of required CS =Total Capacity – CS Hub + CS Bulk (MT)

Future prospect:

- The industry has been growing at CAGR of 20 % from last 4-5 years and expected to reach INR 650 billion+ by 2023, major contributor of cold storage industry is cold stores and the numbers are increasing rapidly which will directly lead to improve cold storage industry situation in India.
- However, the market is gradually getting organized and focus towards multi-purpose cold storages is rising.
- More than 50 percent of the cold storage facilities in India are currently concentrated in Uttar Pradesh and West Bengal, while other states still face a challenge with investments from the government and private operators.
- Mega food parks are another innovative way to boost agriculture industry as well as it will also play a vital role in improving Cold storage Industry India.

Mega food parks

Mega Food Park aims at providing a mechanism to link agricultural production to the market by bringing together farmers, processors and retailers so as to ensure maximizing value addition, minimizing wastage, increasing farmer's income and creating employment opportunities particularly in rural sector

Ministry of Food Processing Industries is implementing Mega Food Park Scheme in the country since 2008.

Ministry of Food Processing Industries is implementing Mega Food Park Scheme (MFPS) to create modern infrastructure for the food processing industries since 2008. This scheme is now a component of the new Central Sector Umbrella Scheme– Pradhan Mantri Kisan Sampada Yojana (PMKSY). The Mega Food Park Scheme (MFPS) aims at providing modern infrastructure facilities for food processing along the value chain from farm to market.

- It aims at **providing a mechanism to link agricultural production to the market** by bringing together farmers, processors and retailers.
- These food parks give a major boost to the food processing sector by adding value and reducing food wastage at each stage of the supply chain with particular focus on perishables.

As on date, Ministry has accorded final approval to **37 MFPs** in 23 States/UTs which are under various stages of implementation. Out of this, **19 MFPs are operational**. **Total 42 Mega Food Parks (MFPs)** were envisaged by the Government. As per the scheme guidelines, each fully operational Mega Food Park will provide direct/indirect employment

to about 5000 persons. The scheme of Mega Food Park has the primary objective of providing modern infrastructure facilities for the food processing along the value chain from the farm to the market. It will include creation of infrastructure near farm (i.e. collection centres & Primary Processing centres), transportation, logistics and centralized processing centres etc. This will have impact on increased realization of farmers, reduction in wastage and creation of an efficient supply chain backed by collection centres, primary processing centres and logistic infrastructure.

Pattern of Assistance:

The scheme provides for a capital grant at the rate of 50 percent of the project cost (excluding land cost) in general areas and at the rate of 75 percent of the project cost (excluding land cost) in difficult and hilly areas i.e. North East Region including Sikkim, J&K, Himachal Pradesh, Uttarakhand and ITDP notified areas of the States subject to a maximum of Rs. 50 crores per project.

Land: The requirement of land for establishing the CPC is minimum 50 acres either by purchase or on lease of at least 75 years for the Central Processing Centre of the Mega Food Park

Some major Advantage of Food parks

- Direct as well as indirect employment generation in rural areas.
- Exposing farmers to a more systematic, market driven and profitable farming activities.
- Generation of additional income for the farmers.
- Reduction in post-harvest losses.
- Maintenance of value chain from the farm to the market.

Mega Food Park will reduce post-harvest losses, so basically these parks will help cold storage industry in decreasing wastage, farming has remained in unorganized sector for decades resulting in poverty of the farmers (about 70 per cent of Indian population is

engaged in farming) in the absence of infrastructural support such as rural connectivity, storage and warehousing facilities to reduce high percentage of agricultural wastage.

Effective cold chain remote monitoring helps in:

- Milk Quality
- Per Litre better price realization
- Optimal BMC utilization
- Cleaning-in Place protocol adherence
- Optimum power consumption
- BMC rating
- Pilferage Control

Conclusion

So basically India's present share in global farm trade is very low, and this is because of level of wastages of agricultural produce at different stages. Now the main reason for the wastages is lack of sufficient cold stores, rear vehicle, mega food parks, storage facility, processing Centre and procurement Centre, so overall we can say that this is due to poor of infrastructure. The NCCD (National Centre for cold chain development) has estimated the gap of 3.2 mn MT in the capacity of cold storage, more than 69k pack-houses, more than 50000 moving vehicle and around the gap of 8000 ripening chamber, this industry is trying to fulfil these gaps as soon as it is possible, The industry has been growing at CAGR of 20 % from last 4-5 years and expected to reach INR 650 billion+ by 2023 and this growth will be supported by mega food parks , some favourable government policies which have already discussed in the article other than this there are lots of innovative technologies coming in the Cold storage industry which will definitely help the industry to grow at rapid rate .

Adarsh Tiwari

COVID-19: Impact on Indian Economy

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"This study investigates the impact of COVID-19 on India. COVID-19 affect badly to the whole universe. The COVID-19 spread from the Wuhan, China at the end of 2019 and it's converted into pandemic in the month March 2020. It affects the most on the India economy. This study has some factors which help in the growth of India economy in the worldwide domain."

Introduction

The COVID-19 pandemic in India is essential for the overall pandemic of COVID sickness 2019 (COVID-19) brought about by serious intense respiratory disorder COVID 2 (SARS-CoV-2). The first instance of COVID-19 in Quite a while, which began from China, was accounted for on 30 January 2020. Coronavirus, is an exceptionally irresistible infection that causes destructive respiratory affliction, which is of extraordinary public prosperity concern. The most widely recognized manifestations of COVID-19 are fever, sluggishness, and dry hack. A few patients may have a throbbing painfulness, nasal

blockage, runny nose, sore throat or the runs. These indications are typically gentle and start bit by bit. A few people become contaminated however don't build up any indications and don't feel unwell. The vast majority (about 80%) recoup from the sickness without requiring extraordinary therapy. On 30 January, India detailed its first instance of COVID-19 in Kerala, which rose to three cases by 3 February; all were understudies getting back from Wuhan. Aside from these, no huge ascent in transmissions was seen in February. On 4 March 22 new cases were accounted for, including 14 tainted individuals from an Italian traveller gathering. In March, the transmissions developed after a few people with make a trip history to influenced nations, and their contacts, tried positive. On 12 March, a 76-year-elderly person, with a movement history to Saudi Arabia, turned into the primary COVID-19 casualty of India. A Sikh evangelist, who had a movement history to Italy and Germany, transformed into an "excessively spreader" by going to a Sikh celebration in Anandpur Sahib during 10–12 March. 27 COVID-19 cases were followed back to him. More than 40,000 individuals in 20 towns in Punjab were isolated on 27 March to contain the spread.

The flare-up of COVID-19 carried social and financial life to a halt. The primary focal point of the examination is on evaluating the effect on influenced segments, for example, flying, the travel industry, retail, capital business sectors, MSMEs, and oil. Global and inner portability is limited, and the incomes produced by movement and the travel industry, which contributes 9.2% of the GDP, will negatively affect the GDP development rate. Flight incomes will descend by USD 1.56 billion. Oil has plunged to 18-year low of $ 22 for each barrel in March, and Foreign Portfolio Investors (FPIs) have pulled back immense sums from India, about USD 571.4 million. While lower oil costs will shrivel the current record shortfall, turn around capital streams will extend it. Rupee is ceaselessly deteriorating. MSMEs will go through an extreme money crunch. The emergency saw an astonishing mass migration of such coasting populace of travellers by walking, in the midst of countrywide lockdown. Their concerns essentially were loss of work, day by day proportion, and nonappearance of a government backed retirement net. India must reconsider on her improvement worldview and make it more comprehensive. Coronavirus has likewise given some one of a kind chance to India. There is a chance to take an interest

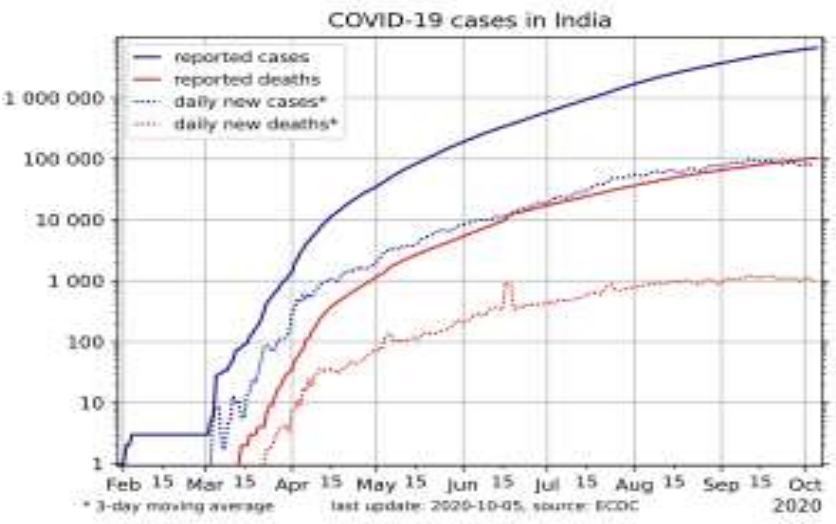

Fig: COVID-19 report of India

in worldwide gracefully chains, multinationals are losing trust in China. To 'Make in India', a few changes are required, work changes being one of them.

Hindered monetary exercises in metropolitan regions have influenced all the rustic zones too. Various contextual analyses, information specialists from the field show that a significant extent of rustic family unit earnings originates from transient and every day wage workers. The businesses in urban communities being profoundly influenced because of the pandemic has brought about loss of provincial family unit salary. Gigantic cutbacks of work alongside absence of alleviation measures are pushing transients to re-visitation of their town towns, which will undoubtedly unquestionably expand the danger of the spread of the COVID.

Make in India after COVID-19

Prime Minister Narendra Modi launched the **Make in India** initiative on September 25, 2014, with the primary goal of making India a global manufacturing hub, by encouraging both multinational as well as domestic companies to manufacture their products within the country.A lot of changes have been put ahead to "Make in India" an achievable target. There have been amendments in the labour law,online filling of returns, a lot of changes in the regulatory systems to increase the tenure of industrial licenses etc. the bureaucracy and red tapsim have been replaced with the new technology of driving applications and tracking their progress.

Sectors Attracting Significant FDI in India in 2019-2020

- **Rising FDI in India**

Foreign Direct Investments (FDI) in India has witnessed a positive trend since the launch of the Make in India campaign in 2014. FDI inflow from April 2014 to March 2020 (USD 357.35 Bn) is 52.5% of the over FDI in India has received in the country since April 2000 (USD 680.91 Bn). For the first time, India has crossed the USD 70 Bn mark in FY 2019-20 and recorded total FDI inflow of USD 73.45 Bn.

- **Service Sector**

The service sector in India includes Financial, Banking, Insurance, Non-Financial/ Business, Outsourcing, Research and Development (R&D), Courier, Tech, Testing and Analysis services. It has the highest contribution of 17% amongst other sectors in terms of total FDI inflow received in the country during April 2000- March 2020. It also witnessed the highest FDI equity inflow of USD 7.85 Bn in FY 2019-20.

- **Auto and Auto Components Sector**

The Automobile sector in India witnesses a growth of 35.12% in FDI during the last two fiscal (FY 2017- 18 to FY 2019-20). FDI equity inflow increased to USD 2.82 Bn during FY 2019-20. The FDI equity inflow received by the sector in FY 2019-20 is 12% of the total equity inflow received by the sector since April 2000 (USD 24.21 Bn).

- **Telecommunication Sector**

The telecommunication sector in India saw a substantial growth of 67% in FY 2019-20 in terms of FDI equity inflow, which increased from USD 2.66 Bn in FY 2018-19 to USD 4.44 Bn in FY 2019-20. The sector holds a share of 8% in the total FDI inflow received in the country during April 2000 – March 2020.

- **Construction Development Sector**

The construction Development sector in India which includes townships, housing, built-up infrastructure and construction development projects has witnesses an exponential growth of about 190% in terms of FDI equity inflow in FY 2019-20. The sector received FDI equity inflow of USD 213 Bn in FY 2018-19 which almost tripled to USD 617 Bn in FY 2019-2020. The sector holds a share of 5% in the total FDI inflow received in the country during April 2000 – March 2020.

Impact on GDP Growth Rate

While the COVID-19 pandemic is constantly growing and showing little signs of containment as of 15 April 2020, its adverse impact on economic growth of the country will probably be very serious. The UN warned that the coronavirus pandemic is expected to have a significant adverse impact on global economy, and most significantly, GDP growth of India for the present economy is projected to decline to 4.8 per cent (United Nation 2020). Similarly, the UN 'Economic and Social Survey of Asia and the Pacific (ESCAP) 2020 reported that COVID-19 would have extensive socio-economic consequences in the region with inundate activities across borders in the areas of tourism, trade and financial linkages (United Nations, 2020).

Conclusion

COVID-19 pandemic has twisted the world's flourishing economy in unusual and vague terms. Yet, it fundamentally showed that the current plunge appears to be essentially not the same as downturns of the past which had shocked the nation's monetary request. While the countries, aggregates, companies and multinationals keep on understanding the greatness of the pandemic, it is without a doubt the need of great importance to get ready

for a future that is economical, fundamentally more suitable for living and working. While the remarkable circumstance has made an incredible harm the economy, particularly during times of lockdown, the country should deal with it, by presentation of financial measures. As the public government imagines, insurance of the two lives and work is required. The monetary action must start continuously subsequent to screening of the work power. Severe preventive measures ought to be actualized by the business so as to protect the wellbeing of the labours. While strategy and changes ought to be given out by the administration sufficiently to rescue the economy, the business, common social orders and networks have an equivalent part in keeping up the harmony. The standards of social separating, maintaining a strategic distance from or dropping get-togethers and utilization of covers and sanitizers ought to be the lifestyle till we can annihilate the infection. During this time, the economy is compared with social conduct of mankind, so the obligation of bringing back financial activity isn't of government alone. The danger of a worldwide downturn because of COVID-19 out of 2020 and 2021 would be very high, as it has been watched universally that the closure of every single monetary movement—creation, utilization and exchange—to control the spread of COVID-19 is impending. The idea of closure is exceptional in the event of COVID-19 because of a flexibly stun, an interest stun and a market stun. The recuperation in economy relies upon the timings and size of government uphold just as the degree of corporate obligation and how the organizations and markets adapt to bring down interest. Government help to those most out of luck (to a great extent comprised of chaotic area, transients and minimized networks) is a basic measure to spare numerous lives. Notwithstanding, every emergency achieves a one of a kind chance to revaluate on the way embraced for the advancement of an individual, network and society. The COVID-19 pandemic has an unmistakable directive for the Indian economy to receive supportable formative models, which depend on independence, comprehensive systems and are climate well disposed.

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ICT FOR AGRICULTURE AND RURAL DEVELOPMENT:

A NEW EMERGING TECHNOLOGY

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"Information and communication technology (E-Extension) is an extensional term for information technology that stresses the role of unified communication (chat, presence information voice, audio and video) and the integration of telecommunication (telephone lines and wireless signals) and computer as well as necessary enterprise software, store, transmit and manipulate information. Information and communication technologies (ICT) at present are influencing every aspect of people life. ICTs as catalysts for change: change in working conditions, handling and exchanging information, teaching and learning approach, scientific research and in accessing new information technologies. ICTs allow students to monitor and manage their own learning, solve problems and giving opportunities to learn and apply the required 21st century skills."

Introduction

Information and communication technology is an umbrella term that refers to all information and communication system and technology including the digital formats

such as the internet or world wide web, but also interfaces with radio, cables and wireless television, cellular phone and print media. According to UNESCO " ICT is a scientific, technology and engineering discipline and management technique used in handling information, its application and association with social, economic and cultural matter". ICTs are making dynamic change in society. ICT can enable disadvantage individuals and communities to participate in the national and global policy decision that can change their living standard, improving education and empower them to take decision, action that can financially, socially and politically benefits. ICTs are of crucial importance for economic growth for many reasons: liberalization process, new technologies progress, productively growth, contribution to GDP growth, emerging of new services and industries etc. Some of them affected cultural way; the benefits of ICT make it possible to carry out new cultural practices, awareness for many people special in rural area and ensure their inclusion in what happening around them.

Role of ICT for agriculture and rural development

The following areas where ICT could play a catalytic role in agriculture and rural developing are presented below:

1. **Economic development of agriculture producers**

ICT can provide up-to-date information about new technologies, new varieties of crop, package of practices, input supply, fertilizer dose, weather forecasting, market information, current price information, effective production strategies, banking, financial and new ways to increase quality control for agriculture produces.

2. **Empowering rural communities**

ICT can empower rural communities and give them a voice that permits them to contribute to the development process. ICT can enhance rural communities' opportunities by improving their access marketing information, social, economic growth increasing access to a higher quality of life, education, training, information and dialogue with others.

3. **E-Commerce**

Farmers could access direct contact between local producer, traders, retailers and suppliers. E-Commerce is the most preferred way to trade goods and services. Farmers could promote their product and handle transaction such as order over web, internet and assistive technologies.

4. **Employment generation**

ICTs connected people to employment. ICTs also support innovation that has created new, more flexible form of employment and work: online contracting uses ICT

to increases access to work opportunities worldwide, rural areas by telecentre managers, subject matter specialists, and information technologies technicians etc.

5. Early warning system

ICTs are an important component of multi- hazard early warning system, which manage and deliver alerting messages to those in affected areas about disease/ pest infestation, natural calamities like drought, flood and reduce damage and economic losses of property.

6. Easy access to government information and services

ICT could provide all facilities for obtaining information from government. Offices save time and money. Facilitation of land records, online registration services, forms, easy availabilities of government schemes and accounting information etc could be obtain through ICT.

7. E-learning (Formal and Non-formal)

E-Learning is also known as online learning. E-Learning encompasses learning at all levels both formal and non-formal that uses an information network. In formal way ICTs provide both students and teachers with more opportunities in adapting learning and teaching according to individual and society needs. Non-formal way learning electronic technologies to access educational curriculum outside of a traditional classroom. In most cases, it refers to course, program training and diploma delivered completely online.

Tools of information and communication technologies for agriculture and rural development

The major ICT tools for agriculture sector include personal computer, mobile telephones, radio, television, e-Krishi app and other telecommunication devices. ICT has many potential applications in delivering agriculture extension and can bring new information technologies services to rural areas. Applications areas of ICT tools range from farm layout, farm recording, measurement, communication, extension services, soil testing, budgeting and weather forecasting.

1. Mobile application (app) tools for agriculture

Mobile applications have great advantage over desktop packages. The reason is obvious because it is available any time according your need. Distance is not a barrier here. Mobile application that provided latest agriculture information about trends, equipment, technologies and other method being used, help identify pest/ disease, provide real time data about weather, early warning about flood, local market information, seeds and fertilizers. Top 5 best android apps for agriculture and rural development (2018)

A. Agriapp: Agriapp is one of the most like app by the rural peoples. It is a provided online farming market place brining kisan, farming input/output and government service on an online platform.

B. IFFCO Kisan app: Iffco kisan app is the small android app it terms of memory with an easy interface to use. It is provided information about latest mandi prices, agriculture alertes in 10 different Indian language and various farminging types.

C. M-Krishi: It can provided information on weather, micro climate, soil, perticides that are specific to farmers plot.

D. FarmBee: It can provided fertile agriculture content and information at every phase of crop life cycle.

E. Kisan Yojana: It is provide the schemes of different state government like PMSBY, MGNREGA and SAGY.

2. Video Conferencing: It is provide an opportunity for two-way communication of the farmers with expert and scientists help in better understandings of farmers' problems and providing the timely solutions.

Video conferencing facility has helped in improve the productivity, communication and strengthening of farmers-scientist of linkage.

3. Kisan Call Center: Kisan call center toll free number 1800-180-1551 has been allotted. This number is accessible through mobile of all

telecom networks. Replies to the framers queries are given in 22 local languages' from 6 A.M. TO 10 P.M on all 7 days a week.

4. Radio: Vital information for agricultural and rural development can be passed on through the use of radio for example early warning, new varieties and technologies. The first and foremost role of radio education is to help the rural peoples accept new agricultural technologies for obtaining improve yield and changing the traditional concepts.

5. Television: Television enhancement of farmers' knowledge. Keeping these points in view, Doordarshan, krishi Darshan and E-choupal programs started for communicating agriculture information to the farmers on experimental basis.

Conclusion

ICTs help in growing demand for new approaches. ICT is an important contributor to growth every economic, social and cultural. It also helps in empowering the rural farmers and agriculture providing better access to natural resources, improved technologies, production strategies, markets, banking, financial services, and weather forecasting. It is a vital machinery to support both the extension scientist and the rural farers. The timely reach of information through it bridges the barrier between the developers of technologies and the practitioner leading to an enhanced internet. Improve the quality of life, learning, education medium, health and cultural areas.

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USE OF PLANT BIOTECHNOLOGY FOR DEVELOPMENT OF NUTRITIOUS VARITIES IN AGRICULTURE

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"Plant biotechnology is a innovative tool in agriculture which deals with health problems of population by complementing it with supplying safe and nutritious food by reducing negative impact on environment."

As the rate of world population increased it parallelly increased the rate of chronic hunger among the population. In developing countries it is estimated that nearby 850 million people suffering from undernourishment and deficiency of micronutrient. One of the biggest reason behind this problem is quantity and quality of food as people are only dependent on staple crops which is deprived of micronutrients and can lead to various severe illness (mental illness as well as physical illness) or may cause threat to life in longer run. The traditional breeding practices was primarily adopted to overcome this problem, which able to solve this to some of extent. Triticale, which is hybrid of wheat and rye produced by introduction of new genes from wild species (Brar and Khush, 1997). However this technique alone is not enough to fulfill demands of increasing population so conventional breeding practices were employed which was satisfying but there is limitation of reproductive barrier. The plant biotechnology gives information to

understand plant genome and plant molecular biology which helps to modify plant for biotic- abiotic stresses, better nutrition value, better flavor, Enhanced crop protection etc which fulfill almost all limitations. The genetically modified plants are also called as transgenic plant which is the latest development in agriculture.

Achievements

Achievements of plant biotechnology and transgenic research are as follows.

1) Golden rice

Ingo Potrykus and Peter Beyer engineered golden rice which is rich in β-carotene to improve human health. The rice plants have a machinery to produce β-carotene in leaves but not in grains so, by inducing two genes plant phytoene synthase (psy) and phytoene desaturase (crt I) grains results in increase of β-carotene which is responsible to give yellowish colour to grains.

2) Soyabean transgenics

Hinchee and co-workers (1988) made first stable transgenic soybean plants by using agrobacterium mediated gene transfer system. In this procedure Cotyledon explants of soybean were inoculated with *Agrobacterium tumfacieans* conferring kanamycin resistance or glyphosate tolerance and cultured on shoot induction medium containing kanamycin. The regeneration of shoot achieved on kanamycin-selected cotyledons were transgenics.

3) Haploidy in *Datura*

Guha and Maheshwari (1964) cultured mature anthers of *Datura innoxia to* observe physiology of cell division but instead of this they accidentally noticed various embryos were growing from the anthers on the nutrient medium which later developed into plantlets.

4) Protein improved potato

Asis Datta and his group at National Institute for Plant Genome Research (NIPGR) puts an effort of producing potato rich in protein nick named as "protato". They selected AmA1 (Amaranth Albumin 1) gene from *Grain Amaranthus,* which results in genetically modified potato increased in various amino acid upto 60 percent.

Conclusion

The plant biotechnology in agriculture shows undeniable progress. But as we all know innovations open the gate for new issues. Similarly releasing genetically

modified plant for field trial and commercialization races many concern one of them is how to use antibiotics or herbicide so latter not become allergens, which demand for more advancement. We must also ensure to respect intellectual property rights (IPR) and plant varietal protection (PVP) rights.

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VEGETABLES THAT YOU SHOULD GROW AT HOME IN WINTERS

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"Vegetables are an important part of our diet. They compile up our diet throughout the day i.e., breakfast, lunch and dinner. If we talk about them they are not only used in our boring meals but they are also an important part of our exciting food like pizza, noodles, burger, etc. Moreover, they are also rich in nutrients, minerals and vitamins. There is now doubt in saying that vegetables are "wonders" for us."

If we talk about winters, they are one of our favorite seasons. This season supports the growing of most nutritious vegetables on earth. This season is the best time to grow plenty of veggies in the kitchen garden. They can be grown from the month of November to March when the temperature is in the range of 15 – 20°C in most parts of the country. This growing season is also known as Rabi season.

Why to grow vegetables at home ?

As I mentioned earlier that they serves as an important component of our diet. A person who eats more vegetables and fruits is thousands of miles away from chronic diseases. They are enriched with many properties whether it is nutraceuticals, medicinal, carcinogenic, etc. Following are some of the points which will illustrate the facts that growing vegetables at home is boom:

- They are low in fats and calories.
- They are considered as health foods and protective foods.

- They are rich in dietary fibers important for making our muscles stronger.
- They are a rich and cheaper source of vitamins.
- They also contain important minerals like K, P, Ca, Fe, Mg, Zn, etc.
- They also help in reducing the risks of various chronic diseases.
- They can be easily grown at home.
- They can be grown organically at home.
- They don't require too much care and maintenance.
- They also occupy less space and some of then can be grown in pots also.

Basic Requirements and time to grow vegetables at home

Requirements

The vegetables can be easily grown at home. This requires only 3 essential things and they are enlisted below:

- Small space uncemented or the boat shaped containers.
- Soil enriched with compost (Compost can also be made at home).
- Seeds or propagules.

Time

The best time for sowing of the seeds for winter vegetables is Autumn or beginning of winters (Ending September to Mid October).

Vegetables to be grown in winters at home

The following list of vegetables can be easily grown at home. Most of them are easy to grow and require minimal care at home. These vegetables can also be grown in the pots, you don't always require fields to grow something for you asap.

1. Spinach

Scientific Name *Spinacia oleracea*
Family Chenopodiaceae

Spinach is popularly known as "Palak" in India. It can be very easily grown in the pots or garden. To grow spinach at home is very beneficial. It is said that spinach loses its nutrients very fast. It loses 90% of the nutrients within 24 hours of plucking. Also, it is grown once but its benefit can be taken 6 – 7 times in several cuts. Therefore, it is beneficial to grow at home. Additionally, it is very easy to grow. Just sow the seeds and water them. It does well

in the cool climate and under partial sunlight for 3 – 4 hrs. After sowing, the cut will be ready within 30 days. Thus, spinach is a good choice for kitchen gardening during winters.

Moreover, spinach is also rich in Fe and vitamins. It is used for making soup, salad, dishes and juice. It is very good for health.

2. Green Peas

Scientific Name *Pisum sativum*
Family Fabaceae

Green peas are a good option for kitchen gardening and are also grown in cool climates. Green peas are an important part of the vegan diet. It is rich in dietary fibers, starch, vitamins, proteins and phytochemicals associated with good health. Peas are very easy to grow. The seed is to be sown and watered and within 30 days, you will observe a climber coming out and it starts flowering in 45 days and lastly bears fruits in 70 – 80 days. It is generally consumed as salad, soup, (snacks sometimes), curry and also in various dishes as an important ingredient.

3. Bell pepper

Scientific Name *Capasicum annum*
Family Solonaceae

Bell pepper, commonly known as Capasicum and 'Shimla mirchi' popularly in India. It is one of the exotic vegetables used world-wide and is popularly known for its delicious flavor. The growth of this veggie is booming during the cool climate and also favors the formation of colored bell peppers.

They can be grown in the pots also from seeds and give the fruit within 70 – 80 days of seed sowing. It is very versatile to grow as it can also be easily grown in the containers and doesn't require much space.

As a vegetable, it is used as salad and also as a key ingredient in Indian, Chinese and European cuisines.

4. Lettuce

Scientific Name *Lactuca sativa*
Family Asteraceae

Lettuce adds value to our salad and at the same time the burger is also incomplete without lettuce. Lettuce is such a loved salad and fresh lettuce tastes better. In India, it is not very common but it's a great opportunity to experience their taste. It tastes very amazing when we just pluck and have it fresh.

Lettuce is rich in dietary fibers, vitamin A, K and D. Lettuce can be easily grown in the containers and the greens can be harvested multiple times.

5. Mustard greens

Scientific Name *Brassica* spp.
Family Brassicaceae

In India, mustard greens are popularly known as "*Sarson ka saag*". They are known for their aroma and delicious taste, often cooked as gravy and coupled best with the millets.

Mustard greens are basically the green leaves of the mustard plant. For the greens, they can be planted in the containers. They require full sunlight during day time and cool temperature during the night. They require regular watering at a 5 days interval once they are sown. Thus, planting them in our kitchen garden can also be a good option.

6. Mustard greens

Scientific Name *Brassica oleracea* var. *capitata*
Family Brassicaceae

It is one of the most important vegetables of India and also nutritious for us. Cabbage is rich in Vitamin C and Sulfur compounds. It has a crunchy taste which makes it so popular as a key ingredient in noodles, burger, Manchurian, fried rice, etc.

It can be grown easily in the large boat shaped containers and grows well in heavy soil and is also a heavy feeder crop.

7. Carrot

Scientific Name *Daucus carota* subsp. *sativus*
Family Apiaceae

Carrots are the root crops and are also known as 'the salad vegetable'. It is one of the richest sources of Vitamin A and antioxidants. It comes in several varieties varying in size, color and shape.

Carrots can be easily grown in the container but I prefer to choose ground for their cultivation at our home, if possible. Make sure that the soil must be fine for good root free proliferation. The roots can be harvested after 80 – 100 days of sowing depending upon variety.

8. Radish

Scientific Name *Raphanus sativus*
Family Brassicaceae

Radish is commercially propagated for salad purpose and is consumed throughout the world because of its crunchiness. Moreover, it is generally consumed raw. It is rich in nutrients like Vitamin A, C, E, B & K, anti-oxidants, fiber and minerals (P, K, Zn, Mn, Ca, Fe, Mg, Cu).

The cultivation idea for radish is similar to carrots but the only difference is that the roots of radish are ready to harvest within 50 – 60 days of sowing. They are well known to keep the body fit. Moreover, they are good for the liver and often suggested to the jaundice patients to eat them as much as possible during empty stomach.

9. Coriander

Scientific Name *Coriandrum sativum*
Family Apiaceae

Coriander is one of the most special herbs which is cultivated widely during winters and spring summer. They are used throughout the world for garnishing the dishes.

At the same time, it is rich in nutrients and has surprising health effects on us. It is very easy to sow and can be grown in the containers. They are ready to harvest after 25 – 30 days of sowing. After cuts, it regrows again and again several times. It grows faster after the first cut.

10.Broccoli

Scientific Name *Brassica oleraceae* var. *italica*
Family Brassicaceae

Broccoli is just similar to cauliflower, the only difference is that it has green curd in-spite of white. It can also be referred to as the cousin of cauliflower.

Broccoli demand has increased from the past 3 – 5 years in India. As it is rich in antioxidants, Vitamins and minerals. It is raised as similar to the Cauliflower. There is no big difference in the cultivation of both the vegetables. It is also considered as one among World's Healthiest foods.

Conclusion

Vegetables are very important to keep ourselves healthy. One can easily grow vegetables at their home and the above list contains only those vegetables which are easy to grow and require only minimal care. We should try to grow them at our home organically as it will be free of chemical pesticides and are also fresh.

I have personally tried them and they taste 100 times better than those bought from the market. Hence, try to grow your own food; try to grow organic food; try to stay healthy and eat veggies.

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Electronic National Agricultural Market (e-NAM)

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> "e-NAM has a huge potential to increase the farmer's income and prevent exploitation by middleman. To realize this, it is necessary to undertake reforms to ensure transparency and cost - efficiency of the mechanism is achieved."

National Agricultural Market (e-NAM) is an online trading platform for agricultural commodities in India. This platform aims to create better marketing opportunities for the farmers to sell their products through a competitive and transparent price discovery system along with online payment facility for the buyers. It was launched by the Centre in 2015 and the government had to extend it in a phased manner across the 615 mandis of the country by March 31, 2020

The Small Farmers Agribusiness Consortium (SFAC) which act as the lead agency for implementing e-NAM under the Ministry of Agriculture and Farmer's Welfare. Central government will provide the software free of cost to the states and in addition, a grant of up to Rs. 30 lakhs per mandi or market or private mandis will be given for related equipment and infrastructure requirements.

Objectives of National Agricultural Market (e-NAM):

- To integrate markets, at the state-level and national-level through a common online platform that would facilitate a pan-India trade in agricultural commodities.

- ❖ To streamline marketing and transaction procedures and establish uniformity across all markets within the country to promote the efficient functioning of these markets to enhance better marketing avenues for both the seller (farmers) and the buyers (trader).
- ❖ To put in place quality testing facilities that would help in better-informed biddings by buyers.
- ❖ To promote stability in pricing and ensure the availability of quality products to the end-consumer.

e-NAM Transforms agriculture:

- ✓ National Agriculture Market or e-NAM is an online trading platform for agricultural commodities in India.
- ✓ The market is helping in better price discovery and providing facilities for smooth marketing of their produce.
- ✓ The e-NAM markets are becoming popular as the crops are weighed immediately and the stock is listed on the same day and the payments are cleared online.
- ✓ Some attractive features like MIS dashboard, BHIM and other mobile payments, is helping adoption even more.
- ✓ Around 1.66 Crore farmers & 1.28 lakhs traders are registered on the e-NAM platform.

Key Highlights National Agricultural Market (e-NAM):

- ✓ This brings the total number of e-NAM mandis in the country to 785.
- ✓ It is for the first time that Karnataka State has been added to the list of e-NAM States.
- ✓ The e-NAM has been integrated with the Unified Market Platform (UMP) of Karnataka's Rashtriya e-Market Services (ReMS).
- ✓ This will help farmers of Karnataka to sell their produce to a large number of traders registered with e-NAM.

Salient Features of the National Agricultural Market (e-NAM) are as follows:

- ❖ e-NAM portal will enable farmers to showcase their products through their nearby markets and facilitate traders from anywhere to quote price.
- ❖ e-NAM provides single window services for all Agricultural Produce Market Committee (APMC) related services and information. This includes commodity arrivals, quality & prices buy & sell offers & e-payment settlement directly into farmers account, among other services.

- ❖ Using the e-NAM service, license for the trader, buyers and commission agents can be obtained from the state-level authorities without any pre-condition of physical presence or possession of shop or premises in the market yard.
- ❖ Harmonization of quality standards of agricultural products and infrastructure for quality testing is made available in every market. Recently, common tradable parameters have been developed for 25 commodities.
- ❖ Provision of Soil Testing Laboratories is provided for the selected mandi (market) in order to facilitate the farmers visiting the mandi.

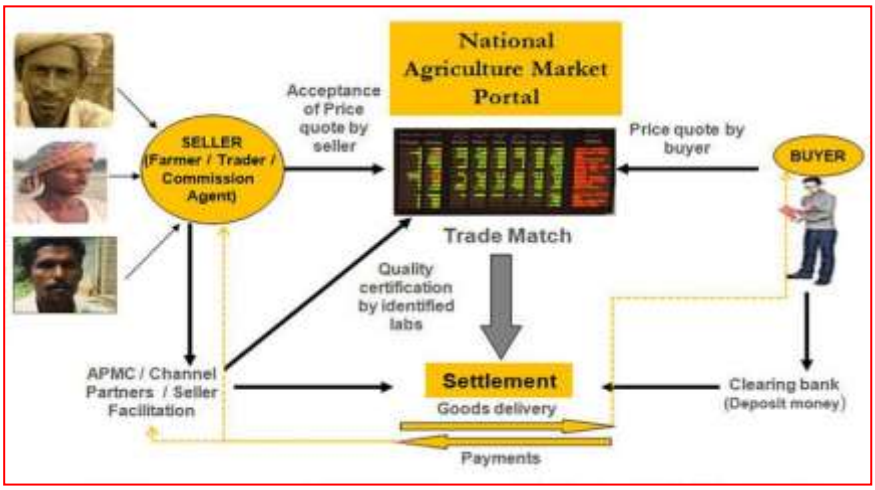
Vision

To promote uniformity in agriculture marketing by streamlining of procedures across the integrated markets.

Benefits of Trading on National Agricultural Market (e-NAM):

The benefits of trading on e-Nam are listed below:

- ❖ Transparent Online Trading.
- ❖ Real-Time Price Discovery.



e-NAM has the following advantages:

- ✓ For the farmers, NAM promises more options for sale. It would increase his access to markets through warehouse-based sales and thus obviate the need to transport his produce to the mandi.
- ✓ **For the local trader** in the mandi / market, NAM offers the opportunity to access a larger national market for secondary trading.
- ✓ **Bulk buyers, processors, exporters** etc. benefit from being able to participate directly in trading at the local mandi / market level through the NAM platform, thereby reducing their intermediation costs.

1. The gradual integration of all the major mandis in the States into NAM will ensure common procedures for issue of licenses, levy of fee and movement of produce.
2. The NAM will also facilitate the emergence of value chains in major agricultural commodities across the country and help to promote scientific storage and movement of agri goods.

Challenges faced by National Agricultural Market (e-NAM):

- ✓ Governments are facing difficulty in convincing all the stakeholders like farmers, traders etc., and move to the online platform.
- ✓ In Maharashtra, Haryana and Bihar, it is found that any reform in APMC system is facing stiff resistance from traders.
- ✓ Though the government claims that around 1 crore farmers are using the e-NAM platform, the ground reports suggest that most of the transactions recorded on e-NAM were conducted through the old system and that a single market for the nation is still not a reality.
- ✓ There is no evidence to suggest that farmers have gained from this new system in terms of re reduced commissions to traders and/or better returns for their produce.
- ✓ The scarcity of electricity, computers, internet facilities and a shortage of staff and sorting and quality testing facilities also remains a huge challenge for this scheme.
- ✓ Lack of awareness of the e-NAM scheme among the farmers prevents them from adopting the same.

Online Registration Procedure for Farmers/Traders

The farmers can register under the e NAM portal by following the steps given below:

Step 1: The farmer/trader has to visit the website.

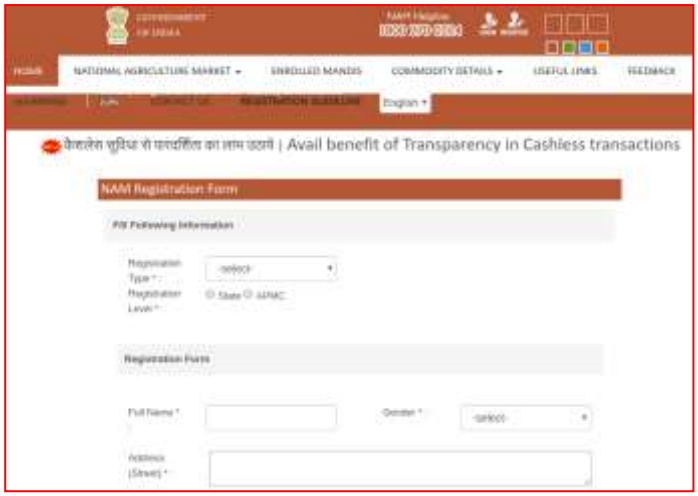
Step 2: Select "Registration Type" as to whether "Farmer/Trader" and select the desired "APMC" from the registration page.

eNAM – Home page

eNAM – Registration Page:

Step 3: Provide your correct Email ID as you will receive Login ID and Password in the same.

eNAM – Provide Login Details



Step 4: Once successfully registered, you will receive a temporary Login ID and Password in the registered e-mail.

Step 5: Now, login to the Dashboard by clicking on the login icon through the system.

Step 6: Then the user will find a message on the dashboard as "Click here to register with APMC".

Step 7: Click on the link which will redirect you to Registration Page for filling or updating details.

Step 8: After KYC is completed, the request will be sent for approval to your selected APMC.

Step 9: After Successful Login to your dashboard, you will be able to see all APMC address details.

Step 10: Upon Successful Submission user will get an e-mail confirming the submission of the application to concerned APMC along with the status of the Application was Submitted/In progress or approved or rejected.

Step 11: Once approved by APMC, you will receive eNAM Farmer Permanent Login ID and Password for complete access under eNAM platform on the registered e-mail id.

Conclusion

e-NAM has a huge potential to increase the farmer's income and prevent exploitation by middleman. To realize this, it is necessary to undertake reforms to ensure transparency and cost -efficiency of the mechanism is achieved.

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KOKEDAMA: HANGING GARDENS PERFECT FOR SMALL SPACES

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"A hanging basket is a suspended pot utilized for growing ornamental plants and they are hung on buildings or street furniture's for beauty an environment enhancement. It is made by wires with lining materials to retain substrate for nourishment of the young plants."

Kokedama, also known as Moss balls or string garden are a unique way to garden vertically. Kokedama, 'koke' meaning moss and 'dama' meaning ball, is the practice of taking the root ball of a plant and suspending it in a mud ball, coated with soft green moss. Floating in midair, these plant do not take up surface space or even wall space. Plus, we don't have to shell out money for a petty container, as each plant is contained in its own moss covered pot and is suspended from the ceiling using inexpensive twine. It is a living planter.

With just few materials, we can start hanging plants with an Asian Japanese gardening techniques.

Material needed:

- A small plant
- Bonsai soil
- Potting soil
- Peat moss
- Sheet moss
- Sphagnum moss
- Twine

Best Kokedama Plants

When choosing the plants for hanging the string garden, choose the plant that doesn't require full Sun, because moss prefer a shady environment. A plant that require little root space are the best for string gardens. Here are some varieties that would not mind hanging out in a shady spot.

- Many varieties of ferns, including maidenhair fern, button fern, macho fern and bird's next fern
- Staghorn fern
- Jade
- Pothos
- Philodendron
- Begonias
- Spider plant
- String of pearls

Shade plant suggestions:

Pothos, philodendron, African violet, begonia, ferns, grape ivy, dracaenas, cyclamen, elephant's ears, rabbit's foot fern, peperomia, Jacob's ladder, prayer plant, creeping fig.

Full sun/ part shade plant suggestions:

Kalanchoe, aloe, string-of-beads, wax plant, basil, thyme, mint, parsley, oregano, croton, English ivy, wandering Jew, Christmas cactus, donkey's tall, sedums.

Plant to avoid

There are also certain plants that won't work well for a kokedama string garden, cacti and succulents may seem like a viable option due to their trendy reputation, although the loose, sandy soils of these plants makes it hard to create the ball needed for kokedama.

- Cacti
- Succulent
- Flowering plant
- Ming Aralia

Soil preparation

To make a 4 inch ball, measure 2 cups potting soil in a bowl or bucket.

Wetting the soil

Slowly add water to the potting soil until it just holds together when pressed firmly; more water can be added later if necessary.

Forming the soil ball

Press the soil mixture into a ball, firmly packing so it stays together. If you toss it into the air a few times, it should hold together.

How to make a Kokedama string garden

Step 1: Remove the plant from its current home and prune the roots

Remove excess oil and untangle healthy roots gently as we would do when repotting a plant. Once the root are successfully freed from the most of the soil, quickly soak them in room temperature water. At this point, the sphagnum moss is also soaked in water too.

Step 2: **Wrap the roots with sphagnum Moss**

Remove the sphagnum moss from the water, and Surround the plant's roots with enough sphagnum moss. Ring out the moss to remove any excess water and wrap it around the roots for securing within the cotton thread.

Step 3: Mix the Peat, Bonsai and potting soil together.

A mixture of 4 cup of potting soil, 1 cup Peat, 1 cup Bonsai and 1 cup of water are mixed together. A right consistency will be achieved when the soil is clay-like and easy stick together. Gradually water is added to the mixture if necessary.

Step 4: Use the soil mixture to mold a ball around the roots

Use the soil mixture to create a ball big enough to surround the moss covered roots. If the soil is not binding together add more soil and water.

Step 5: Cover the ball with the sheet moss.

Wrap the sheet moss around the soil base and fasten with twine. It is a little tricky holding it all together, but the aim is to keep adding malls and wrapping the cotton around the ball until a round shape is achieved. Secure twine properly so the plant can be hanged nicely. The amount of moss needed varies depending on the size of ball.

Step 6: Attach more twine and create a loop the plant will hang form.

Continue to wrap the Twine around the moss and tie knot secured enough to hang it properly. Don't forget to attach a loop to the existing twine, be sure that the loop it strong enough for hanging.

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ADVANCE MOBILE APPS APPLICATION: IMPORTANT ROLE IN AGRI-HORTI INFORMATION SPREADING

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[1, 2]Research Scholar (Horticulture), [3]Associate Professor (Horticulture)

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"A mobile or smart phone application which is called apps could avail all such information with changing seasons and climate. The mobile app is one of the platforms, where a farmer can get all solution and information in just one touch. Smartphone apps revolutionized the connectivity and used for transferring agri-horti information to farmers."

Agriculture and Horticulture farming have been always a basic need for past, present and future. All human survival and culture flourish only when farming community is well developed. Many ICAR research institutes, State agricultural universities, Krishi Vigyan Kendra and philanthropic foundations are working together to make agriculture more profitable. Information about policies, good agricultural practices, market prices of commodities, current demand of commodities and various useful agriculture schemes are helpful to farmer for reaping good profits. Thus, it is important for farmers to have all such information on their door steps. Even though all information is available on

public domain, it is a very tedious task to farmer to access it. A mobile or smart phone application which is called apps could avail all such information with changing seasons and climate. The mobile app is one of the platforms, where a farmer can get all solution and information in just one touch. Smartphone apps revolutionized the connectivity and used for transferring agri-horti information to farmers. Smart phones with advanced feature like high resolution cameras, greater memory, bright display, touch screen along with 3G or 4G speed internets attracted the users. These smart phones usages are rapidly increasing in many sectors like banking, medicine, shopping, lifestyle, games, artificial intelligence, etc. and agriculture in the same path of development but usage is very less.

Here we discussed the different types of app used for agriculture and agriculture related activities and technology transfer in future.

Current agriculture mobile applications: The utility depends upon the information, content and the mandate of app creation. Most of the apps are useful only for specific information while others are multi informant. Some are just calculative types and for academic usage. According to mobile application use in agriculture they were classified as:-

Agri-horti crop mobile application

These are mobile applications which are related to crop cultivation and production. It provides information of good package of practices, market, weather, etc.

S.N.	Apps Name	Feature
1.	**Agri-horti app**	This app provided users to get information in three languages along with important agricultural news for the farming communities and also providing the assistance by the experts through chat and call. Further the app consists of various useful video like pomegranate cultivation, mushroom cultivation, goat farming and dry land farming, etc.
2.	**Kisan Yojana**	This app provides information about the schemes and benefits provided by government to the farmers and rural people.
3.	**Weather app**	These applications are useful for the farmers for obtaining forecasts of the weather. Weather related apps are the most used applications in agriculture. e.g. sky met weather app. This app also helps farmer for planning of farm operations like harvesting, sowing etc.

4.	**Disease management app**	This app provides an interactive platform for farmers, gardeners and growers for the analysis of any kind of disease and plant deformity in the development stages. It also provides information for time of initial symptoms which appears at the start of any disease and disorder.

Multi-informative mobile applications

These are multidisciplinary agriculture app provides information from sowing to marketing.

S.N.	Apps Name	Feature
1.	**IFFCO App**	This apps provides weather related information with the help of India Meteorological Department and about prices of crop from sources like Agmarket or National Commodity and Derivatives Exchange Limited. This app is very handy as it serves all information in single platform.
2.	**myRML**	It is composite app developed by Reuters Market Light (RML) which is providing information related to various operations namely agriculture practices of various crops, expert advice, market price and weather information. It also acts as a wallet for various practices of major crops like rice, wheat, pea, tomato, etc.

Calculative mobile applications

This category of app is required for calculating the requirements of the agricultural inputs/ outputs. The applications enables farmers to calculate pesticide quantities, seed in crop spacing, harvest losses and planting densities. Some of such apps are discussed in detail.

S.N.	Apps Name	Feature
1.	**Ag PhD harvest Loss**	This app is useful in calculating crop loss per acre and also one can predict loss in terms of money by putting the current price of crop in market.
2.	**Ag PhD planting population**	This application helps to determine the spacing to be kept for the required planting population per acre. It also helps the farmers to maintain the population stand, and help farmers in thinning operation.
3.	**Fertilizer calculator**	This app used for the conversion of nutrient content of nitrogen, phosphorus, potassium in fertilizer doses.

Diagnostic mobile applications

These mobile applications provide the option of insect and disease diagnosis of various crops including deficiencies. These apps also provide an opportunity for diagnosis of problems at field level.

Some common applications used for such purpose are:

S.N.	Apps Name	Feature
1.	**Ag PhD Deficiencies**	These apps provide an idea about deficiency symptoms in 36 different crops with photograph. It also includes major deficiencies of 14 nutrients.
2.	**Ag PhD Field Pest Identification and control**	This app provides basic information of insect, weeds and its control with photographs. Such kind of app is not only useful for the farmer, but also for extension workers. The app also contains an option of saving pest information in an app during field.
3.	**Soil Web**	Web is a unique app which utilizes Global Positioning System.

Agri-horti academic mobile applications

These kinds of applications are mostly used in academics for better understanding of terms and concept. These are relevant to students, agriculture graduates, professionals, researchers, extension workers and farmers. It includes dictionaries such as agriculture dictionary app, genetics dictionary, entomology dictionary, learning modules, etc. Agriculture dictionary app which contains terms related to agriculture, livestock's, horticulture, plant breeding, Economics, Communication technologies, weather, agriculture policies and environment.

Agri-horti professional mobile applications

These applications are especially useful for Agri-horti professionals, Scientists, agriculture and policy makers. These mobile applications include a diverse range of apps like agriculture extension app, research highlight app, laboratory app regarding various techniques like soil analysis; PCR (Polymerase chain reaction mixture) apps etc. The few apps are discussed below.

S.N.	Apps Name	Feature
1.	**Laboratory apps**	This category of app is useful in determining the specific laboratory techniques like Polymerase Chain Reaction (PCR), soil testing, and real time PCR etc.
2.	**Research highlight app**	This app was developed by Elsevier and is more useful for scientists and researchers to find up emerging research studies and updated information.
3.	**Agriculture Policy Research app**	The policy research updates are required to provide valuable information to new researchers, which ultimately lead to the agriculture growth.

Indian government apps and M-Kisan portal

M-Kisan portal is a government initiative which started in India on July 16, 2013 for aiming to connect 38 crore mobile phones of farmers in rural areas with subject specialists (m-Kisan, 2016). This service mainly aimed for the message based information broadcast using internet. The Indian government has also developed the application for agriculture, horticulture, animal husbandry and other useful services applications. Only agriculture applications are discussed here. In agriculture so for six applications were developed which are M-Kisan app, Shetkari Masik Android App, Farm-o-pedia, Bhuvan Hailstorm App, Crop Insurance mobile app and Agri Market.

S.N.	Apps Name	Feature
1.	**M-Kisan app**	This app helps to send information by experts and government officials to farmers.
2.	**Shetkari Masik Android App**	This is magazine based app. This android app is to provide users the access to magazine by mobile, internet or Wi-Fi. Registration is required for this app.
3.	**Farm-o-pedia**	This application provides crop specific information on weather data, crop suitability data.
4.	**Bhuvan Hailstorm App**	This is crop loss estimation app from hailstorm given to the Agriculture Officer which having this app in his mobile and capture longitude, latitude and photograph of the area.
5.	**Crop Insurance mobile app**	This application is mainly used for Crop Insurance, required for calculation of Insurance Premium for notifying crops based on the area, coverage amount and loan amount in case of loan farmer.

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DAMINI MOBILE APP WILL GIVE WARNING BEFORE LIGHTNING

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Ramkhelawan Degree Collage Shekhpur Damodar Asandara Barabanki U.P.

"The Indian Institute of Tropical Meteorology (IITM) launched 'Damini', a free mobile-based application that can warn people about lightning at least 30-45 minutes before it strikes."

The Indian Institute of Tropical Meteorology (IITM) launched 'Damini', a free mobile-based application that can warn people about lightning at least 30-45 minutes before it strikes. The first-of-its-kind app was launched by Vijay Bhatkar, eminent scientist and chancellor of Nalanda University, during an event to mark the 57th foundation day of IITM, in Pune on Saturday.

Among the vagaries of weather and extreme climate conditions- floods, droughts, lightning, heavy rainfall, cold waves and heat waves- lightning strikes are known to cause the maximum casualties in India. Of the 2038 deaths reported due to extreme weather conditions in India in 2019, More than 2,300 people were killed by lightning in India in 2018, according to the National Crime Records Bureau and at least 2,000 people have died

in lightning strikes every year since 2005. As per the 'Climate of India' report released by the India Meteorological Department (IMD) that year.

"This app will be able to track lightning and send alerts and notify individual" Mr. Narendra Kumar Verma, Scientist Krishi Vigyan Kendra Mainpuri by in each block Farmer's awareness program in district Mainpuri at Uttar Pradesh.

"Whenever a person is within 20-km radius of the lightning event, the app will send warnings… the alert will be sent 30 minutes to 45 minutes before the event and this will help people get to safer locations. For now, the warnings will be given in Hindi and English… more languages will be added later," India has as many as 48 lightning detecting sensors, many of which are located along the Himalayan foothills and north-eastern states, which experience lightning strikes on several days. Ahead of the next pre-monsoon season, another 20 sensors will be added to the existing network. Lightning is most commonly reported during pre-monsoon months- March to May- over most parts of the country. The total number of days when lightning is recorded in Assam can vary between 100 to 120 days, followed by 60 to 80 days along the foothills of the Himalayas, Kerala, Odisha and Maharashtra. The highest casualty from lightning strikes is reported along the Himalayan belt, Kerala, Odisha and Maharashtra. The casualty rate from lightning strikes in north-eastern states is comparatively lower.

"The local orography and tree cover play a crucial role in preventing deaths caused by lightning strike," In Maharashtra, Vidarbha records the maximum number of days with lightning- 30 to 40 days every year, followed by Marathwada, with 20 to 30 such days. The number of deaths from these sub-divisions are also significantly high. A fortnight ago, two women farmers were killed near Kamshet after being struck by lightning. The IITM team took two months to develop this app and the institute has handed it over to the respective state governments. Scientists said the app will be most effective when disaster management teams in every district actively engage in information dissemination.

'Advanced technologies will be meaningless unless climate change is taken seriously'

Scientist and Chancellor of Nalanda University, Vijay Bhatkar, said that no technological advancements would be of any use if climate change is not considered as a serious threat. Speaking on the occasion of the 57th foundation day of IITM, he said, "Climate change is today's biggest problem and it questions the very basic survival of humankind. Droughts and floods have a serious impact on farmers and on our food and water supplies. Even the world's best technologies will be of no use if measures to address and study climate change are not taken." He also emphasized on the need to strengthen weather prediction models, for which scientists must exploit the power of supercomputers.

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UNDERSTANDING THE MINIMUM SUPPORT PRICE FOR AGRICULTURE PRODUCE

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"MSP is a price fixed by Government of India each year to protect the producer-farmers against excessive fall in price during bumper production years. It is also a guarantee price for their produce from the Government. The Minimum Support Price are announced by the Government of India on the basis of the recommendations of the Commission for Agricultural Costs and Price (CACP)."

Minimum Support Price (MSP) is a tool which guarantees the farmers, prior to the sowing season, that a fair amount of price is fixed for their upcoming crop to encourage higher investment and production of agricultural commodities. MSP is a price fixed by Government of India each year to protect the producer-farmers against excessive fall in price during bumper production years. It is also a guarantee price for their produce from the Government. The Minimum Support Price are announced by the Government of India on the basis of the recommendations of the Commission for Agricultural Costs and Price (CACP).

There are two objectives of the Minimum Support Price system.

- To prevent distress sale by the farmer in the case of a bumper crop and market demand is low to recover the cost of production.
- To produce the grains for public distribution by fair price shops.

Determination of MSP

The prices of agricultural commodities are inherently unstable, primarily due to the variation in their supply, lack of market integration and information asymmetry - a very good harvest in any year results in a sharp fall in the price of that commodity during that year which in turn will have an adverse impact on the future supply as farmers withdraw from sowing that crop in the next / following years.

In formulating the recommendations in respect of the level of Minimum Support Price and other non-price measures, the Commission takes into account, apart from a comprehensive view of the entire structure of the economy of a particular commodity or group of commodities, the following factors:-

- Cost of production
- Changes in input price
- Input-output price parity
- Trends in market prices
- Demand and supply
- Inter-crop price parity
- Effect on individual cost structure
- Effect on cost of living
- Effect on general price level
- International price situation
- Parity between prices paid and prices received by the farmers
- Effect on issue prices and implications for subsidy

Implementation of Minimum Support Price System

The MSP for all the crops under the ambit of the MSP regime is announced before their sowing season. This makes it possible for the farmers to have an idea about the extent of price insurance cover provided by the Government. Besides, the announcement of the MSP, the Government organizes procurement operations of these agricultural commodities through various public and cooperative agencies. The Food Corporation of India (FCI) is a nodal Central agency along with other State agencies which undertake the procurement of wheat and paddy. Coarse grains are procured by the State Governments' agencies for central pool while procurement of oilseeds, pulses, cotton etc., is done by the NAFED, Small

Farmers Agribusiness Consortiums (SFAC), Cotton Commission of India (CCI) and other agencies under Price Support Scheme (PSS). For sugarcane, MSP has been assigned a statutory status and termed as Fair and Remunerative Price (FRP). There is a statutory binding on the sugar factories to pay the FRP declared by the Government each year.

Minimum Support Price (MSP) of different crops- Fixed by Government (Rs/Quintal)

Kharif Crops

Commodity	Variety	2017-18	2018-19	2019-20	2020-21
Rice	Common	1550	1750	1815	1868
	Grade A	1590	1770	1835	1888
Jowar	Hybrid	1700	2430	2550	2620
	Maldandi	1725	2450	2570	2640
Bajra	-	1425	1950	2000	2150
Maize	-	1425	1700	1760	1850
Ragi	-	1900	2897	3150	3295
Tur (Arhar)	-	5450	5675	5800	6000
Moong	-	5575	6975	7050	7196
Urad	-	5400	5600	5700	6000
Cotton	Medium Staple	4020	5150	5255	5515
	Long Staple	4320	5450	5550	5825
Groundnut	-	4450	4890	5090	5275
Sunflower seed	-	4100	5388	5650	5885
Soyabean	Black	3050	3399	3710	-
	Yellow	-	-	-	3880
Sesamum	-	5300	6249	6485	6855
Nigerseed	-	4050	5877	5940	6695

Rabi Crops

Commodity	Variety	2017-18	2018-19	2019-20	2020-21
Wheat	-	1735	1840	1925	1975
Barley	-	1410	1440	1525	1600
Gram	-	4400	4620	4875	5100
Masur (Lentil)	-	4250	4475	4800	5100
Rapeseed & Mustard	-	4000	4200	4425	4650
Safflower	-	4100	4945	5215	5327
Toria	-	3900	4190	4425	-

Other Crops

Commodity	Variety	2017-18	2018-19	2019-20	2020-21
Copra (Calender Year)	Milling	6500	7511	9521	9960
	Ball	6785	7750	9920	10300
De-Husked Coconut (Calender Year)	-	1760	2030	2571	2700
Jute	-	3500	3700	3950	4225

Source- Farmers` Portal

Advantages

- The system of Minimum Support Price (MSP) system acts as a tool for the government to control sharp fall and rise in the prices of any crops.
- The concept of Minimum Support Price (MSP) system acts as a surety to farmers so that their crops get the fair amount for their produce and helps them sustain their losses and does not affect them drastically.
- Minimum Support Price (MSP) also helps government control the growth of crops which are low in production. The government can offer more price support for these crops.
- The Minimum Support Price mechanism has been beneficial in transferring incomes to rural areas and to counter farm level inflation.
- It can also counter the agricultural distress brought on by natural hazards in the country. It gives farmers hope of earning more in the new sowing season.
- In the last few years, India has become a net importer of pulses. Massive hike in the MSP of these crops will encourage the farmers to grow nutritional crops.
- A higher Minimum support price regime will also help in achieving the Government s target of doubling farmer s income by 2022.
- It also acts as an incentive for farmers to produce the crop which is in short supply.
- Today due to lack of sufficient penetration of agricultural insurance schemes farming has become a risky profession exposed to weather and price fluctuations. The minimum support price to some extent will protect the farmer by guaranteeing a minimum floor price so that they can plan in advance for the next season.

Disadvantages

- According to studies, most of the drought affected farmers are small and medium scale farmers. These farmers do not procure loans from financial institutions. They prefer loans from private money lenders which are not covered under these schemes.

- Even though recently the MSP for pulses has increased drastically there is no visible correlation between higher MSP and area under pulses.
- In order to meet the obligations under the National Food Security Act (NFSA, 2013) mostly only paddy and wheat are procured regularly and in bulk by the Government agencies. For all others the procurement is irregular so there is no incentive or bankability for the farmer to produce other crops.
- As MSP is declared by the Union Government most of the States do not have the funds to procure crops at rates announced by the centre. Eg: In Assam due to budgetary constraints procurement was not carried out for the past two seasons.
- Less than 6% of farmers sold their produce at the minimum support price. According to a survey by National sample survey many small and marginal farmers are unaware of the concept of minimum price and the benefits are taken away by large farmers.
- Yield per hectare is the lowest among economies with a large agriculture sector. Hence agriculture productivity needs to improve, for that MSP alone is not enough we need a wide range of interventions.

Way Forward

- There is a need to adopt a more scientific approach to agriculture and allocate higher budget in research to boost productivity per hectare.
- The NITI Aayog has advocated for timely dissemination of information via the Krishi Vigyan Kendras (KVKs) and also to announce MSP s well ahead of the sowing season.
- The criteria for fixing prices for MSP must be current costs rather than a historical basis.
- There needs to be a complete overhaul of procurement procedures and more focus must be on local procurement especially at the panchayat level. Use of modern warehousing infrastructure is needed like modern storage facilities, weighing bridges etc. to extend shelf life and prevent rotting of grains.
- Farmers must be made to understand the benefits of crop diversification so as to produce more pulses to ensure nutritional security and prevent supply-side shocks.

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GUAVA IS A STOREHOUSE OF NUTRITIOUS AND MEDICINAL VALUES

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"Guava is one of the rich sources of vitamins, minerals and dietary fiber. Besides immunity, guava do wonders to skin and also promotes fertility. Guava also helps in regulating metabolism which overcomes to weight loss."

Nothing else can match up to the scrumptious jams, jellies and Preserves laced with an intoxicating stiff-sweet fragrance. Undeniably, it is one fruit which always got enough lauding from our grandmothers. Guava, known as Amrood in Hindi, comes loaded with small hard seeds at the center. It is believed to have its genesis in Central America where it is alternatively known as "sand plum". It is round or oval in shape with light green or light yellow skin, and the colour of its flesh varies from white (Allahabad Safeda) or pink to dark red (Lalit) and has edible seeds. Besides its unparalled flavour and fragrance, guava has been hailed as one of the super fruits due to the numerous health benefits it offers. It indeed is a treasure of nutrients. "This humble fruit is extraordinarily rich in vitamin C, lycopene and antioxidants that are beneficial for skin. Guavas are also rich in Mn which helps the body to

absorb other key nutrients from the food that we eat. Guavas benefits are credited due to the presence of folate, a mineral which helps promote fertility. The potassium in guavas helps balanced blood pressure levels as well. Since it contains about 80% of water it helps keep your skin hydrated", says Dr. Manoj K. Ahuja, Sukhda Hospital.

Guava Nutritional Value

Guava fruits have good amount of Nutrients. A 100 g serving of the fruit contains just 68 calories and 8.92 g sugar, according to the data of USDA. Guavas are also rich in calcium as they contain 18 g of the mineral per 100 g of the fruit. It also contains 22 g of magnesium per 100 g of the fruit, as well as significant amounts of phosphorus and potassium- 40 and 417 g per 100 g, respectively.

Benefit of Guava

Guava act as an anticarcinogenic

"Lycopene, quercetin, vitamin C and other polyphenols act as potent antioxidants which neutralise free radicals generated in the body, preventing the growth of cancer cells. Guava fruit has shown to be widely successful in reducing prostate cancer risk and also inhibit the growth of breast cancer cells since it is rich in lycopene", says Dr. Manoj K. Ahuja.

Immunity Booster

Guava fruit contains four times the vitamin C content present in oranges. Vitamin C helps improve immunity system and protects you against common infections and pathogens. Moreover, it has sufficient amount vitamin A which keeps your eyes healthy.

Treats Constipation

It is one of the richest sources of dietary fibre in comparison to other fruits and just 1 guava fulfils about 12% of your daily recommended dose of fibre, which makes it extremely beneficial for your digestive system. Guava seeds, if ingested whole or chewed, serve as perfect curatives too, helping the formation of healthy bowel movements.

Diabetes-Friendly

Due to the rich fibre content and low glycaemic index, guavas prevent the development of diabetes. While the low glycemic index inhibits a sudden spike in sugar levels, the fibre content ensures the sugar levels are well regulated.

Heart Healthy

It helps improves the sodium and potassium balance of the body, thereby regulating blood pressure in patients with hypertension. Guavas also help lower the levels of triglycerides and bad cholesterol (LDL), which impart to the development of heart diseases. This charming fruit improves levels of the good cholesterol (HDL).

Guava during Pregnancy

Guava's benefits pregnant women too as it contains folic acid, or vitamin B-9, which is recommended for pregnant women since it can help in developing the baby's nervous system and protect the newborn baby from neurological disorders.

Better Eyesight

Due to the presence of Vitamin A, guava is well known as a booster for vision health. It can not only prevent degradation of eyesight, but even improve eyesight positively. It can help slow down the appearance of cataracts and macular degeneration. Even though guavas are not as rich in Vitamin A as carrots, they are still a very good source of the nutrient.

Beats Toothache

Guava leaves have a potent anti-inflammatory action and a powerful antibacterial ability which fights infection and kills germs. The juice of guava leaves has also been known to cure toothaches, swollen gums and oral ulcers. Consuming guava leaves works as a fantastic home remedy for toothache.

Stress-Buster

The magnesium present in the fruit is responsible for one of the many benefits of guava, helps to relax the muscles and nerves of the body. So after a hard workout or a long day at the office, a guava is certainly what you need to relax your muscles, combat stress and give your system a good energy boost.

Good for Your Brain

“Guavas contain vitamin B3 and vitamin B6, also known as niacin and pyridoxine respectively, which help in improving blood circulation to the brain, stimulating cognitive function and relaxing the nerves”, remarks Dr. Manoj K. Ahuja.

Weight Loss

Without compromising your intake of proteins, vitamins and fibre, guava helps you lose weight by regulating your metabolism. Guava, especially raw guava, also has far less sugar as compared to apples, oranges, grapes, and other fruits.

Cough and Cold

Guava has one of the highest quantities of vitamin-C and iron among fruits, and both are proven to be preventive against cold and viral infections. The juice of raw and immature guavas or a decoction of guava-leaves is very helpful in relieving cough and cold since it helps get rid of mucus and disinfects the respiratory tract, throat and lungs.

Anti-Ageing Properties

Guavas are rich in vitamin A, vitamin C and antioxidants like carotene and lycopene which help protect the skin from crinkles.

Improves Condition

Guava helps regain the skin's radiance and freshness. Reap the benefits by preparing a DIY scrub at home: All you have to do is mash some guava flesh with an egg yolk and apply it on your face. Rinse off after 20 minutes with warm water. When used once or twice a week, this scrub will remove dead cells from your skin and lighten your colour.

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ENTOMOPATHOGENIC NEMATODES

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"Nematodes which are capable of killing, sterilizing or seriously hampering the development of insect and completing at least one stage of their life cycle in the host. They are also called as entomogenous, entomophilic, insect parasitic nematodes etc. Important groups of EPNs."

Introduction

Nematodes which are capable of killing, sterilizing or seriously hampering the development of insect and completing at least one stage of their life cycle in the host. They are also called as entomogenous, entomophilic, insect parasitic nematodes etc. Important groups of EPNs.

1. Family: Mermithidae: (Order - Enoplida).
2. Family: Steinernematidae (Order - Rhabditida).
3. Family: Heterorhabditidae.

Special Qualities of Steinernematidae and Heterorhabditidae

1. Quick mortality of the host (24 – 48 hr).
2. Wide host range (> 200 insect species of 10 Orders).
3. Wide distribution – found all parts of the world except Antarctica.
4. Symbiotic association with bacteria (*Xenorhabdus; Steinernematidae* and *Photorhabdus; Heterorhabditidae*).
5. Infective stage (3rd stage) is non-feeding, free living, durable and capable of withstanding adverse climatic changes.
6. Can be mass produced both on natural host and artificial diet.
7. Good shelf life.
8. Easy to apply.
9. Safer to non-target organisms

Advantages of Microbial Agents as Component in IPM

1. Exploitation for pest control is environmentally safety due to host specificity.
2. Micro-organisms have natural capability of causing epizootic levels due to their persistence in soil and efficient transmission.
3. Compatible with chemicals insecticides.
4. The cost of development and registration of microbial insecticide is much less than that of chemical insecticides.
5. Large scale culture and application is relatively easy and inexpensive.
6. No resistant development.

Factors Affecting Biological Control

1. Tolerance limit of crop to insect injury - Successful in crops with high tolerance limit.
2. Crop value - Successful in crops with high economic value.
3. Crop duration - Long duration crops highly suitable.
4. Indigenous or Exotic pest - Imported NE more effective against introduced pest.
5. If alternate host available for NE, control of target pest is less.
6. If unfavourable season occurs, reintroduction of NE required.
7. Presence of hyperparasites reduces effectiveness of biocontrol. Downloaded from www.agrobiosonline.com.
8. Tritrophic interaction of Plant-Pest-Natural enemy affects success of biocontrol, e.g. *Helicoverpa* parasitization by *Trichogramma* more in tomato than corn.
9. Use of pesticides affect natural enemies.

10. Selective insecticides (less toxic to NE required).
11. Identical situation for successful control does not occur.
12. Depends on life cycle of NE.

Factors Affecting Biological Control

1. The host (pest) population will continue to exist at a level determined by the properties of the host, its natural enemies and of the habitat they occupy.
2. The effectiveness of natural enemies must be considered relative to man's economic thresholds.
3. The attainment of biological control of one major pest on a crop necessitates the elaboration of a system of integrated control for other pests of the crop, if any exist; and the research necessary in seeking a biological control solution to a problem is often demanding in terms of scientific and technical staff, funds, and time, and a solution cannot be guaranteed in advance.

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EROSION OF WATER AND THEIR MANAGEMENT

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“The erosion problem arises when the natural vegetative cover is removed and rates of soil erosion are greatly accelerated. Erosion is a three-step process: detachment followed by transport and deposition. The energy for erosion is derived from falling rain and the subsequent movement of runoff water.”

The word erosion has been derived from the Latin word ‘erodere’ which means eating away or to excavate. The word erosion was first used in geology for describing the term hollow created by water. Soil erosion has is an old phenomenon as mankind. Soil erosion is usually characterized by three actions, involving soil loosening, transport, and deposition. Soil erosion is the process of detachment of soil particles from the top soil and transportation of the detached soil particles by wind and / or water or Soil erosion is a complex process that depends on soil properties, ground slope, vegetation, and rainfall amount and intensity.

Generally, the rates of soil erosion are low unless the soil surface is exposed directly to the wind and rainwater. The erosion problem arises when the natural vegetative cover is removed and rates of soil erosion are greatly accelerated. Erosion is a three-step process: detachment followed by transport and deposition. The energy for erosion is derived from falling rain and the subsequent movement of runoff water. Based on the agents causing erosion, erosion is divided into: **1.** Water erosion **2.** Wind erosion.

1. Water erosion

Loss of soil from land surface by water including run off from melted snow and ice is usually referred to as water erosion.

Forms of water erosion

Water erosion occurs in stages identified as splash erosion, sheet erosion, rills, gullies, tunnel erosion, ravines, landslides and stream bank erosion and coastal erosion.

a. Splash Erosion- This type of soil erosion is because of the action of raindrop. The kinetic energy of falling raindrop dislodges the soil particle and the resultant runoff transports soil particles. The Splash erosion is the first stage of soil erosion by water. It occurs when raindrops hit bare soil. The explosive impact breaks up soil aggregates so that individual soil particles are 'splashed' onto the soil surface.

b. Sheet erosion- It is the uniform removal of surface soil in thin layers by rainfall and runoff water. The breaking action of raindrop combined with surface flow is the major cause of sheet erosion. It is the first stage of erosion and is least conspicuous, but the most extensive. Early signs of sheet erosion include bare areas, water puddling as soon as rain falls, visible grass roots, exposed tree roots, and exposed subsoil or stony soils. Soil deposits on the high side of obstructions such as fences may indicate active sheet erosion.

c. Rill erosion- Rills formation is the intermittent process of transforming to gully erosion. The advance form of the rill is initial stage of gully formation. When runoff starts, channelization begins and erosion is no longer uniform. Raindrop impact does not directly detach any particles below flow line in rills but increases the detachment and transportation capacity of the flow. Rill erosion starts when the runoff exceeds 0.3 to 0.7 mm/s.

Fig.1 Rill erosion

Incisions are formed on the ground due to runoff and erosion is more apparent than sheet erosion. This is the second stage of erosion. Rills are small channels, which can be

removed by timely normal tillage operations. Rill erosion is common in bare agricultural land, particularly overgrazed land, and in freshly tilled soil where the soil structure has been loosened.

d. **Gully erosion**- The advance stage of rills is transformed into initial stage of gully. Gully formation are initiated when the depth and width of the rill is more than 50 cm. It is the advanced stage of water erosion. Size of the unchecked rills increase due to runoff. Gullies are formed when channelized runoff form vast sloping land is sufficient in volume and velocity to cut deep and wide channels. Gullies are the spectacular symptoms of erosion. If unchecked in time no scope for arable crop production.
e. **Ravines-** They are the manifestations of a prolonged process of gully erosion. They are typically found in deep alluvial soils. They are deep and wide gullies indicating advanced stage of gully erosion.
f. **Tunnel Erosion-** Tunnel erosion occurs when surface water moves into and through dispersive sub soils. Dispersive soils are poorly structured so they erode easily when wet. The tunnel starts when surface water moves into the soil along cracks or channels or through rabbit burrows and old tree root cavities. Dispersive clays are the first to be removed by the water flow. As the space enlarges, more water can pour in and further erode the soil. As the tunnel expands, parts of the tunnel roof collapse leading to potholes and gullies. Indications of tunnel erosion include water seepage at the foot of a slope and fine sediment fans downhill of a tunnel outlet. This type of erosion is more frequent in foothills where elevation is between 500-750 meter.
g. **Landslides-** Landslides occur in mountain slopes, when the slope exceeds 20% and width is 6m.
h. **Stream bank erosion**- Small streams, rivulets, torrents (hill streams) are subjected to stream bank erosion due to obstruction of their flow. Vegetation sprouts when streams dry up and obstructs the flow causing cutting of bank or changing of flow course.
i. **Coastal erosion-** The waves, geology and geomorphology are the three major factors that affect the coastal erosion. Waves are the cause of coastal erosion. Wave energy is the result the speed of the wind blowing over the surface of the sea, the length of fetch and the wind blowing time. The geology of the coastline also affects the rate of erosion.

Factors affecting water erosion

a. **Climate:** Water erosion is directly a function of rainfall and runoff. Amount, duration and distribution of rainfall influences runoff and erosion. High intensity rains of longer duration causes severe erosion. Greater the intensity, larger the size of the raindrop. Rainfall intensity more than 5 cm/hr is considered as severe. Total energy of raindrops falling over a hectare land with rainfall intensity of 5 cm /hr is equal to 625 H.P. This

energy can lift 89 times the surface 17.5 cm of soil from one ha to a height of 3 ft. Two-thirds of the above energy is used for sealing soil pores. Runoff may occur without erosion but there is no water erosion without runoff. The raindrop thus breaks down soil aggregates, detaches soil particles and leads the rainwater with the fine particles.

b. **Topography:** The degree, length and curvature of slope determine the amount of runoff and extent of erosion. Water flows slowly over a gentle slope whereas at a faster rate over a steeper one. As water flows down the slope, it accelerates under the forces of gravity. When runoff attains a velocity of about 1 m/s it is capable of eroding the soil. If the percent of slope is increased by 4 times the velocity of water flowing down is doubled. Doubling the velocity quadruples the erosive power and increases the quantity of soil that can be transported by about 32 times and size of the particles that can be transported by about 64 times.

c. **Vegetation:** Vegetation intercepts the rainfall and reduces the impact of raindrops. It also decreases the velocity of runoff by obstructing the flow of water. The fibrous roots are also effective in forming stable soil aggregates, which increases infiltration and reduces erosion.

d. **Soil Properties:** Soil properties that influence soil erodability by water may be grouped into two types.
   i. Those properties that influence the infiltration rate and permeability.
   ii. Those properties that resist the dispersion, splashing, abrasion and transporting forces of rainfall and runoff.

e. **Man and beast:** Man and beast accelerates erosion by extensive farming and excessive grazing. Faulty practices like cultivation on steep slopes, cultivation up and down the slope, felling and burning of forests etc., leads to heavy erosion. Excessive grazing destroys all vegetation and increases the erosion.

f. **Biological Factors of Soil Erosion:** Biological factors that influence the soil erosion are the activities like faulty cultivation practices, overgrazing by animals etc. These factors may be broadly classified into following three groups: (i) Energy factors, (ii) Resistance factors, and (iii) protection factors.

Estimation of soil loss by water erosion

Based on the mechanism and factors influencing soil erosion, a universal soil loss equation (USLE) developed by Wischmeier in 1959 is most useful for predicting soil loss due to water erosion. It is an empirical equation and estimates average annual soil loss per unit area as a function of major factors affecting sheet and rill erosion. It enables determination of land management erosion rate relationships for a wide range of rainfall,

soil slope and crop and management conditions and to select alternative cropping and management combinations that limit erosion rates to acceptable limits.

$$A = R \times K \times L \times S \times C \times P$$

where,

A= predicted soil loss in t/ha/year
R= rainfall erosivity factor or index
K= soil erodibility factor
L= length of slope factor
S= slope steepness factor
C= soil cover and management factor and
P= erosion control factor

Management of water erosion

Water erosion occurs simultaneously in two steps: detachment of soil particles by falling raindrops and transportation of detached particles by flowing water. Hence preventing the detachment of soil particles and their transportation can minimize water erosion. Principles of water erosion control are

1. Maintenance of soil infiltration capacity.
2. Soil protection from rainfall.
3. Control of surface runoff and.
4. Safe disposal of surface runoff.

Measures of water erosion control

1. Agronomic measures
2. Mechanical measures
3. Forestry measures
4. Agrostological measures

1. **Agronomic measures of soil conservation**- In soil and water conservation programmes agronomic measures have to be considered in co-ordination with others for their effectiveness. These measures are effective in low rainfall areas particularly in fairly erosion resistant soils having gentle slope (< 2 %). The different agronomic measures includes:
   a. Land preparation.
   b. Contour cultivation.

c. Choice of crops.
d. Strip cropping.
e. Crop rotation / cropping systems.
f. Cover crops.
g. Mulching.
h. Application of manures and fertilizers.
i. Application of chemicals.

a. Land preparation- Land preparation including post-harvest tillage influence intake of water, obstruction to surface flow and consequently the rate of erosion. Deep ploughing or chiseling has been found effective in reducing erosion. Rough cloddy surface is also effective in reducing erosion.

b. Contour cultivation (Contour farming)- A line joining the points of equal elevation is called contour. All the cultural practices such as ploughing, sowing, intercultivation etc. done across the slope reduce soil and water loss. By ploughing and sowing across the slope, each ridge of plough furrow and each row of the crop act as obstruction to the runoff and provide more time for water to enter into the soil leading to reduced soil and water loss.

c. Choice of crops- Row crops or tall growing crops such as sorghum, maize, pearl millet etc., are not effective in conserving soil as they expose majority of the soil and hence they are known as erosion permitting crops. Whereas close growing crops such as cowpea, groundnut, green gram, black gram etc., which protect soil are known as erosion resisting crops as they are very effective in reducing soil loss by minimizing the impact of rain drop and acting as obstruction to runoff.

Fig. 2 Strip cropping

d. Strip cropping- It is a system of growing of few rows of erosion resisting crops and erosion permitting crops in alternate strips on contour (across the slope) with the objective of breaking long slopes to prevent soil loss and runoff. Close growing erosion resisting crops reduce the transporting and eroding power of water by obstructing runoff and filtering sediment from runoff to retain in the field. The width of the erosion permitting and erosion resisting crops vary as per the slope of the field. The strip cropping resembles the intercropping.

i. **Contour strip cropping-** The erosion permitting crops and erosion resisting crops are grown in alternate strips along the contours.

ii. **Field strip cropping-** Alternate strips of erosion permitting crops and erosion resisting crops are raised across the general slope not necessarily on exact contour.

iii. **Wind strip cropping-** Strip cropping of erosion permitting and erosion resisting crops across the direction of the most prevailing wind irrespective of the contour.

iv. **Buffer strip cropping-**this type of strip cropping is practiced in areas having steep slopes and badly eroded soils where strips of permanent cover crops or perennial legumes or grasses or shrubs are alternated with field crops.

e. **Crop rotation/cropping system-** Monocropping of erosion permitting crops accelerates soil and water loss year after year. Intercropping of erosion permitting crops and erosion resisting crops or their rotation has been found effective for reducing soil and water loss. Inclusion of legumes like lucerne in crop rotation reduces soil loss even in soils having 13% slope.

f. **Cover crops-** Good ground cover by canopy gives the protection to the land like an umbrella and minimize soil erosion. Besides conserving soil and moisture, the cover crops hold those soluble nutrients, which are lost by leaching. The third advantage of the cover crops is the addition of organic matter. The legumes provide better cover and better protection. Among the legumes cowpea has been found to produce maximum canopy followed by horsegram, green gram, black gram and dhaincha.

g. **Mulching:** Mulching of soil with available plant residues reduce soil loss considerably by protecting the soil from direct impact of raindrop and reducing the sediment carried with runoff .A minimum plant residue cover of 30 per cent is necessary to keep runoff and soil loss within the acceptable limits. Vertical mulching also reduce soil loss particularly in vertisols by increasing infiltration.

h. **Application of manures and fertilizers-** Organic manures besides supplying nutrients improve soil physical conditions thereby reduce soil loss. Fertilizers improve vegetative canopy, which aid in erosion control.

i. **Use of chemicals**- Breakdown of aggregates by the falling raindrops is the main cause of detachment of soil particles. Soils with stable aggregates resist breakdown and thus resist erosion. Aggregate stability can be increased by spraying chemicals like poly vinyl alcohol @ 480 kg/ha (rate will depend on the type of soil). Soils treated with bitumen increase water stable aggregates and infiltration capacity of the soil.

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EFFECTIVENESS OF FENUGREEK PRODUCTION IN AGRICULTURE FIELD

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"Fenugreek seeds curbs a key constituent in soluble fibre named as galactomannan which helps in lowering the rate of digestion and absorption of carbohydrates which proportionally lowers the blood glucose levels in people with diabetes and improves glucose tolerance."

With the advent of modern lifestyle the versatility of edible ingredients in our Indian society changed by a large margin. Traditional Indian cuisine are a perfect blend of taste and tonic to a healthy lifestyle. One such gem of our household is fenugreek (*Trigonella graecum* L). Though underrated for its peculiar taste, the medicinal properties are hard to speculate within a single dimension. To enhance the sensory quality of foods it has been used as spice through the world and also found as famous spice. Its seeds play a vital role in playing anti-diabetic and anticancer activities. Due to its medicinal qualities such as anti-diabetic, anti-carcinogenic, hypocholesterolemic, antioxidant, and immunological activities it considered as biologically active compound. It is to be known as fasting growing crop due to its varying growth dry grasslands, cultivated or uncultivated lands, hillsides, planes as well as field

edges, it does not need or require fixed place but only it needs a fair amount of sunlight. To enhance the texture of food fenugreek seed contains 25% of dietary fiber. The fenugreek leaves contain saponins, and also minerals and vitamins are present in the surface of the leaves which include calcium, zinc iron, phosphorous, riboflavin, carotene, thiamine, niacin and vitamin C. Now-a-days due to its high fiber, protein and gum content it is widely used as food stabilizer, adhesive and emulsifying agent. It aslo has key role for the increasing development of healthy and nutritious bakery product.

Applications

Due to its indispensable production and adaptabiltiy it has wide range of applications which are follows as:-

1. Lactation aid

For the stimulation of sweat production fenugreek has been fondly at wide spectrum. The data revealed by scientist stated that fenugreek can increase a nursing mother's milk supply within 24–72 hr (Snehlata and Payal, 2012). As it contains hormone precursor to increase milk formation.

2. Hypoglycemic effect

The fenugreek seed contains Dietary fiber i.e. of galactose and mannose which blunts glucose after a meal. The galactomannan-rich soluble fiber fraction of fenugreek seeds may be responsible for the anti-diabetic activity also lowered blood glucose levels.

3. Anticancer activity

It increases level of apoptosis by inhibiting 7,12-dimethylbenz(a) anthracene for the protective effects of cancer and responsible for anticancer activity. Fenugreek seed powder decreased colon tumor incidence and hepatic lipid, and also increased activities of catalase, superoxide dismutase, glutathione S-transferase and glutathione peroxidase in liver (Devasena and Menon, 2007).

4. Antifungal activity

In a study, it revealed that fenugreek plant showed its antifungal potential and its reflected its action through defensing which is cysteine rich peptide against the fungal strains such as *Fusarium graminearum*, *Botrytis cinerea*, Alternaria.

5. Antibacterial activity

The studies which has been reported that maximum pollens obtained from fenugreek than other plants which has highest antibacterial activity against bacterial strains such as against *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Escherichia coli*.

6. Emulsifying and stabilizing

For the use of fenugreek in food industry the dietary fibre which contains in the seed of fenugreek played the vital role in the widespread application. Due to its galactomannan composition it has emulsifying and stabilizing properties

7. Fenugreek in traditional food

The popular food in turkey of Fenugreek paste, locally termed as "Cemen." (Isikli and Karababa, 2005) which is prepared from ground fenugreek seeds. For making clarified butter, the fenugreek seeds are crushed for making its powder.

8. Fenugreek in bakery products

For preparing bakery foods such as pizza, bread, muffins fenugreek fiber has been used which contains 8-10% of its flour fortified. Its acts as rich source of dietary fiber and contains important minerals and also helps its food help in the reduction of blood sugar. The insulin resistance is the key functional property of fenugreek which used to maintain in bread and also used to treat diabetic patients.

Conclusion

Fenugreek is allegedly consumed as a medicinal plant. Due to its nutritional value and biologically active compound it is highly acknowledged by medical science. Its plays indispensable role for its wide adaptability to various climatic regions such as drought, saline and heavy metal tolerability. Fenugreek seed curbs essential amount of fiber, phospholipids, glycolipids, oleic acid, linolenic acid, linoleic acid, choline, vitamins A, B1, B2, C, nicotinic acid, niacin, and many other functional appreciated by medical science. In addition to its medicinal uses, it also produces well in off-season fodder and animal food supplement .Still there is necessity to improve the production in agriculture field which have been indicated to researchable areas for its better effectiveness and adaptability.

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PHYSIOLOGICAL DISORDERS CAUSED BY MICRO NUTRIENT IN FRUIT AND VEGETABLES

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"Physiological disorders are abnormalities in plants which are associated to non-pathogenic factors. A plant or its parts may show unusual growth, function or deformity. Such abnormalities are widely referred to as disorders. These may be incited by nutrients deficiency or excess."

Introduction

The nutrient elements which are required comparatively in small quantities are called as micro or minor nutrients or trace elements. Micronutrients are essentially as important as macronutrients to have better growth, yield and quality in plants. The requirement of micronutrients (boron, iron, copper, zinc, manganese, chloride and molybdenum) is only in traces, which is partly met from the soil or through chemical fertilizer or through other sources.

Physiological disorders are abnormalities in plants which are associated to non-pathogenic factors. A plant or its parts may show unusual growth, function or deformity.

Such abnormalities are widely referred to as disorders. These may be incited by nutrients deficiency or excess.

Horticultural crops suffer widely by zinc deficiency followed by boron, manganese, copper, iron (mostly induced) and Mo deficiencies. Cl, Cu, Fe and Mn are involved in various processes related to photosynthesis and Zn, Cu, Fe, and Mn are associated with various enzyme systems; Mo is specific for nitrate reductase only. B is the only micronutrient not specifically associated with either photosynthesis or enzyme function, but it is associated with the carbohydrate chemistry and reproductive system of the plant. The significance of micronutrients in growth as well as physiological functions of horticultural crops fruits are briefed here nutrient wise.

1. Iron

- **Grape Chlorosis:** The leaves turn yellow (*chlorosis*) during iron deficiency and the entire shoot become yellow to yellowish green under extreme conditions. Iron deficiency may occur due to the presence of excess calcium in the soil (lime induced chlorosis).

2. Zinc

- **Leaf mottling/frenching in citrus:** The deficiency is very common in sweet oranges, pummelos, lemons and mandarins in South India and some parts of North India. Zinc deficiency is also known as *mottle leaf* and indicates yellow blotches between veins or terminal shoot leaves, reduced leaf size, narrow pointed and chlorotic leaves and appearance of small green spots in yellowed areas, but veins remaining green followed by small sized and misshapen fruits. Internodes are short giving the shoot a rosette look and the fruits become small and hard with reduced yield.
- **Bronzing in guava:** Small leaf and leaf chlorosis are the major symptoms of deficiency. Interveinalchlorosis was also observed with reduction in leaf size. Die back, scant flowering, drying and cracking of the fruits are other symptoms.
- **Little leaf + Leaf bronzing in litchi:** Bronzing in litchi is a complex nutritional disorder. When fruiting starts in a soil marginal in P and K, the nutrients are mobilized from older leaves to the fruits, causing bronze coloured leaves which results in reduced photosynthate transfer to the roots and reduced uptake.

3. Boron

- **Mango black tip:** Coal fumes of brick kilns containing sulphur dioxide, ethylene and carbon monoxide are observed to be responsible for *black tip*. The damage has been noticed in the mango orchards located up to 200metres of distance from brick kiln. It is

characterised by depressed spots of yellowing tissues at the distal end of the fruit, which gradually increase in size, become brown and finally black. The necrotic area is always restricted to the tip of the fruit. The growth of the fruit is almost at stand still and the fruit becomes soft after premature ripening. Such fruits never reach full maturity and drop earlier. The preventive measure is to have orchards 1.5km to the east and west and 0.75km to the north and south away from the kilns.

- **Granulation in citrus:** Granulation is a serious problem of citrus and is related to B deficiency especially under North Indian conditions. This abnormality is initiated at the stem end of the fruit which gradually extends towards the styler end. The affected juice sacs become hard and dry, fruits become grey in colour, enlarged in size, have flat and insipid taste and assume a granular texture. It is reported that in the areas with high incidence of granulation, the plant tissues contain high Ca and Mn, and low P and B. Poor micronutrient status also leads to general decline of trees.
- **Hen and chicken in grapes:** The presence of small sized fruits and large sized fruits in the same bunch is known as *hen and chicken* disorder. The fruits are sour in taste. The symptoms include death of growing tips, leaf fall and brittleness of young shoots. The leaves may be deformed with interveinal chlorosis spreading from margins to inwards and this is particularly evident after the fruiting.
- **Fruit Necrosis in aonla:** Browning of innermost part of mesocarp at the time of endocarp hardening. It follows browning of epicarp. Development of black area on the fruit surface. Turning of mesocarp completely black, corky and development of gummy pockets on the fruit surface.
- **Fruit cracking in pomegranate:** Fruit cracking is a serious problem of pomegranate. The malady is thought to be due toboron deficiency in young fruits while in developed fruits it may be caused due to variations insoil moisture content and atmospheric humidity. At the time of fruit ripening, if the soils becometoo dry and then irrigated heavily or there is some rains, cracking may occur. Some cultivars,like Guleshan, Khog, Kazaki are reported to be resistant to fruit cracking.
- **Cracking in tomato:** Yellowing of lower leaf tips and brittleness are the typical symptoms of deficiency. Under severe deficiency, the upper leaves show orange brown colouration along the margins. Poor fruit set, uneven ripening of and development of corky pits are the predominant symptoms.
- **Browning or brown rot or Red rot in cauliflower:** Boron deficiency in cauliflower, turnip, radish, cauliflower and other root crops, commonly cause *brown heart*. It is manifested first by dark spots on the roots usually on the thickest parts. The plant gradually becomes stunted or dwarfened. The leaves are smaller than normal and

fewer.In the case of cauliflower, the flower head will show hollow stem and bronzing due to the decay of the core tissues of the stalk.

4. Copper

- **Exanthema/Ammoniation or dieback in citrus:** The deficiency is called *exanthema*, red rust, die back, multiple bud or peach leaf conditions. The disorder is also called as foliocellosis. S shaped shoot, small swellings, bumps along the stem simultaneously with yellowish blotches and gummosis are the common symptoms. Die back of twigs, slits on the bark and multiple bud development resembling witch's broom are often witnessed under acute deficiency.

5. Manganese

- **Chlorosis in cauliflower:** The deficiency symptom appears in the older leaves with grey interveinal mottling and necrotic areas. Yound leaves retain their normal colour but become chlorotic between veins, which gradually spread to older leaves.
- **Marsh spots in peas:** Marsh spots (Minute brown spots) on the older leaves during flowering which become yellow mottled in the interveinal areas. Flowers shed after fading and seed development is affected.

6. Molybdenum

- **Whiptail in cauliflower**: Cauliflower requires high molybdenum. It is an indicator crop for this nutrient. Young plants show chlorotic and may turn white along the leaf margins, also become cupped and wither. In older plants, the lamina of the newly formed leaves are irregular in shape, frequently consisting of only a large midrib and hence the name *whiptail*. At low soil pH of 4.6, a mixed syndrome of Mo deficiency and Mn toxicity appear on the same plant.

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SCIENTIFIC CULTIVATION OF SNAKE GOURD (*Trichosanthes cucumerina* L.)

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Introduction

The snake gourd (*Trichosanthes cucumerina* L.) is a creeping plant. It belongs family cucurbitaceae and chromosome number is 22. It is originated from India. It bears elongated twisted fruits and is generally consumed as a vegetable. The plant is cultivated all across south and south-east Asian countries counting India, Nepal, Bangladesh, Pakistan, Indonesia, Sri Lanka, Myanmar, Malaysia, and China. The species is native to Australia, Africa and major parts of India. Growing well in Tropical countries, it produces greenish-white and whitish color fruits that develop into 100-150 cm in length and 60-75 cm in diameter (approx). Backed by agricultural research, varieties of hybrid snake gourds are now grown in India, which have high demand and being exported overseas. In India, a number of smaller species of snake gourd with high yield also grow in abundance.

Nutritional value of Snake gourd

S.N.	Nutrient component	Nutrient value per 100g edible portion	S.N.	Nutrient component	Nutrient value per 100g edible portion
1.	Moisture (g)	94.6	**8.**	Calcium (mg)	26
2.	Carbohydrates (g)	3.3	**9.**	Phosphorus (mg)	20
3.	Protein (g)	0.5	**10.**	Iron (mg)	0.3
4.	Fiber (g)	0.8	**11.**	Niacin (mg)	0.3
5.	Fat (g)	0.3	**12.**	Riboflavin (mg)	0.06
6.	Thiamine (mg)	0.04	**13.**	Vitamin A (IU)	96
7.	Vitamin-C (mg)	0	**14.**	Energy (kcal)	18

Climate and Soil: Snake gourd prefers tropical, warm humid climate. It can be grown successfully to 1500m above mean sea-level. The crop is susceptible to frost and cold especially temperature below 10^0C. The optimum temperature for better growth and development of snake gourd is around 25-35^0C. Low temperature <20^0C and high temperature >35^0C are harmful for its growth, flowering as well as fruiting hence, snake gourd cultivation <20^0C and 35^0C should be avoided. Heavy rains during flowering affects it yields. A loamy soil with p^H of 6.0-7.0 is ideal for its cultivation.

Important varieties

CO – 1: An early maturing cultivar developed at Tamil Nadu Agricultural University, Coimbatore through selection from a local type of Alangulam, District Tirunelveli of Tamil Nadu, bears 10-12 fruits per vine. The fruits become ready for harvest within 70 days after sowing. The average fruits length is 160-180 cm having dark-green color with white stripes. The fruits possess good cooking quality. The average fruit weight is about 500-750 g. The average fruit yield is about 180 quintals per hectare in crop duration of 135 days.

MDU – 1: A F_1 hybrid developed at Tamil Nadu Agricultural University, Coimbatore, by crossing between Pannipudal (a short-fruited type) and Selection 1 from Thaniyamangalam, is suitable for high density planting due to less spreading plant habit. The fruits are medium long (about 70 cm) and green with white stripes. The average fruit yield is about 320 quintals per hectare in crop duration of about 140 days.

PKM -1: A Vigorously growing mutant induced from H.375 at Tamil Nadu Agricultural University KVK, Periyakulam, is suitable tor growing round the year. Fruit colour is dark green with white stripes on the outside and light green inside. The average fruit size is about 155 to 170 cm and fruit weight is 500 to 800g. The average fruit yield is about 240 quintals per hectare.

Apau Swetha: A variety developed at Acharya N.G. Ranga Agricultural University, Hyderabad. Through selection from a local type snake gourd. The fruits are long, having a whitish background with green stripes. The average fruit yield is about 240 quintals per hectare.

Baby: A variety developed through a natural selection from the locally collected material of Peruva, Ernakulam district, bears 5040 cm long elongated attractive uniformly white fruits. 1 he average fruit weight is about 470 g with yield potential of 400 quintals per hectare in 8 to 10 pickings. First picking starts in about 55 days after sowing and total crop duration ranges from 120 to 140 days. It can be grown all through Kerala but mainly suited for cultivation in the central zone of the State.

Manusree: An early high-yielding variety developed at Agricultural research Station of the Kerala Agricultural University, Munnuthi, through a selection from local collection from kurupanthara is growing in warm humid tropics of Kerala, especially in Thrissoor. Ernakulam and Palakkad. It bears 65-70 cm long attractive white fruits with green stripes at the pedicel end. It has a yield potential of 600 q/hectare with average fruit weight of 700-800 g.

Sowing time

Being a cucurbitaceous crop, snake gourd is also sown twice in a year, preferably February to March as a summer crop, while during June to July as a rainy season crop. However, snake gourd can also be grown successfully in the winter season during October to November in the regions of mild winter as in the case of southern states of India.

Seed rate

In general, about 4.0-6.0 kg seed is enough for sowing a hectare land area. However, Seed sowing in pits at a spacing of 2.0 m × 2.5 m requires about 1.5 kg seeds per hectare. In general, seeds should be collected from larger fruits as the healthier seeds produce vigorous seedlings, in turn higher fruit yield. In order to protect the seeds or seedlings, the seed should be treated with *Trichoderma viride* @ 4g, *Pseudomonas fluorescens* l0g or carbendazim 2 g/kg of seed.

Sowing/planting methods

Shallow pit or flatbed method

In case of shallow pit method of planting, pits of 60 x 60 x 45 cm size are dug at least 5 weeks before sowing seeds. The pits are then filled with a mixture of soil, compost (4-5 kg/pit) and recommended dose of nitrogen, phosphorus and potassium. Carbofuran @ 1.5 g/pit should also be thoroughly mixed before sowing seeds. After filling the pits, water is applied for better germination of seed. Per pit, at least three or four seeds are sown at a depth of 2-3 cm. The recommended spacing of 1.5-2.5m x 60-120 cm should be adapted for better growth and development of snake gourd.

Sowing of seeds on raised beds or ridges

In this method, usually channels of 40-50 cm width should be prepared either manually or mechanically with spacing or about 2.0-.2.5m between two channels. Seeds are then sown on both the edges of channel at least with a spacing of about 1 meter. In order to maintain the optimum plant population for higher fruit yield, at least 2 to 3 seeds per hill should be sown followed by light irrigation in between the channels for obtaining better growth and development. Using this method, 3500-4500 plants per hectare land area can be accommodated.

Plant population density

In snake gourd, population density generally varies from 3500 to 10,000 plants per hectare, depending varieties season of cultivation as well as cultural method adopted. However, under high density system adopting suitable training practices about 8,000-10,000 plants can be accommodated in a hectare land area.

Nutritional requirement

Snake gourd responds well to both organic manure and fertilizers application. Farmyard manure should be applied @ 10-15 t/ha at the time of land preparation or applied in pits with soil at least two weeks before planting. Although snake gourd responds well to nutrients application, especially nitrogen but applying excessive nitrogen under frequent irrigation condition should be avoided, as it promotes excessive vegetative growth, especially in heavy soils, which increases the male flower production proportionately than female flowers, thereby reduction in fruit yield.

Irrigation requirement

Snake gourd is treated as one of the moisture-sensitive crop, which suffers badly with both excess and moisture stress conditions. Irrigation should be restricted to the base of the plant or root zone without wetting the stems, leaves and developing fruits promotes decaying of vines and fruits. The critical stages of irrigation for snake gourd include immediately after

seed sowing. Active vegetative growth stage, lowering and fruit setting stage as well as fruit development stage. Moisture stress during this stage of crop growth significantly reduces the fruit yield of snake gourd.

Intercultural operations

Hoeing and weeding: In general, in most of the cucurbits including snake gourd, it is essential to keep the held weed tree in order to obtain better growth and development of the crop. The snake gourd field should be free from weed flora during the initial growth stage by application of herbicides such as pre emergence application of either pendimethalin or Alachlor @ 1kg/ha, which will effectively control the weed flora under field conditions. Subsequently, it weeds pose problem in snake gourd crop, one manual weeding nay be done n order to keep the weed population low.

Training of vines: In general, the snake gourd prefers proper training for better growth and yield. The crop has the potential to produce very long and large-sized fruits; hence, more prone to inflections when coming in contact with wet soils. In order to improve the fruit yield and quality, it is generally advocated to trail the vines on bowers or pedals. This crop is usually grown by training the vines over low trellises or bowers of 60 cm height, made up with bamboos and ropes or wires. The major advantages of training vines of snake gourd are lower incidence of diseases.

Use of plant growth substances

Being a monoecious cucurbit, the proportion or female flowers can be increased by spraying plant growth regulator, preferably after pruning the vines, either Ethrel @150 ppm or potassium naphthenate @ 0.1-0,2% at the two- and four-true leaf stage.

Harvesting

Depending upon the variety, season and cultural practices adopted, snake gourd starts fruiting 60 to 80 days after sowing seeds. The fruits should be harvested when they are still tender and about half to two-thirds of their full size, depending on the variety under cultivation. 1he fruits will beat a tender stage when harvested 15-20 days after anthesis. In snake gourd, flowering and harvesting usually remain continued for 1-2 months, depending upon the growing season and cultivars. For obtaining higher fruit yield with high quality, the harvesting should be done at 5- to 6-day intervals, and generally, six to eight pickings are possible.

Yield

In general, the local cultivar yields about 6-10 fruits per vine while that of the improved cultivar is up to 50 fruits per vine in a cropping season. The average fruit weight varies from

300 to 1000 grams. Depending upon the variety, season and cultural practices adopted the average fruit yield varies from 100 to 250 quintals per hectare.

Insect-Pests

- **Fruit fly (*Bactrocera cucurbitae)***: Among the important cucurbits cultivated, snake gourd is treated as the most preferred crop by the fruit fly when it infests at early stages of crop growth, the fruit yield is drastically reduced. The fly completes incubation, larval and pupal stages within 3 weeks, hence, it is very difficult to control effectively. Adult females usually lay 20 to 30 eggs, which are cigarette-shaped with white color on lender fruits. Soon alter hatching or the eggs; the white maggot's laid inside the fruits, causing damage to the fruits. The typical symptoms of fruit infestation include deformity, rotting, and n severe case, premature dropping of fruits. There activity becomes severe during rainy season, as more than 80% fruits are damaged.

Control

- Grow resistant or tolerant variety, it available.
- Spray the crop with cypermethrin 0.025% or fenthion 0.05% along with 5% jiggery.

- **Red pumpkin beetle (*Aulacophora foveicollis*):** Shiny yellowish-red, orange, or black-colored adults of this polyphagous pest lay eggs in moist soils around the plant. The beetles attack most or the cucurbits at seedling stage, especially at cotyledonary leaf stage. However, snake gourd is less affected by the beetle. The yellow-brown flying adults infest plants immediately after germination and defoliate their leaves. On hatching the grubs feed on the roots and the underground portion of the host plant and also on fruits touching the soil. Young seedling and tender leaves are mainly preferred by the adults, and damage at this stage may cause death of seedling.

Control

- Follow clean cultivation.
- Collect and destroy the adult beetles.
- Follow deep ploughing after harvesting to kill the grubs in the soil.

- **Leaf Miner (*Liriomyza trifoli*):** This is an introduced polyphagous pest and destructive to almost all cucurbitaceous crops including Snake gourd. The incidence starts after 15 days of seed germination. 1he mines at the beginning remain very thin, which gradually widen with the enlarge in soil. The loss in severely infested crop is vital. The crop seems to be burnt. Usually, the infestation of leaf miner increases during March-April.

Control

- Collect and destroy the infected plant parts after 7 days of germination.
- Spray the crop with 0.4% neem seed kernels extract at weekly intervals.

- **Root knot nematodes (*Meloidogyne incognita, M. hapla and M. Javanica*)** In general, all the cucurbits including snake gourd are highly susceptible to nematode infestation viz., root-knot nematode. These nematodes are normally long slender and microscopic organisms, which prefer to attack the root system of the crops. These plant parasitic worms incite root galls, causing poor and stunted growth and drastic reduction of yield.

Control

- Grow resistant variety, if available.
- Plough the field deep in hot summer months follow long crop rotation with non-host crops.
- Apply neem cake @ 12-15 t/ha.

Diseases

- **Anthracnose (*Colletotrichum lagenarium*):** This is the most harming disease of cucurbits like muskmelon, pumpkin, squash and gourds. The fungus is highly prevalent in high humidity, especially when summer rain occurs regularly, affecting mostly the above-ground plant parts. Foliar symptoms vary considerably depending upon the severity of infection. The disease is characterized by the formation of yellow, more or less angular spots on ne upper surface or the leaves. White-purplish spores appear on upper surface or the leaves.

Control

- Apply well-decomposed farmyard manure with *Trichhoderma harzianum* 1t/ha.
- Treat the seed with carbendazim or captan 2.5g/kg of seed.
- Apply 250 kg/ha neem cake immediately after germination and at the time ot flowering.

- **Downy mildew (*Pseudoperonospora cubensis*):** This is one of the most destructive foliar fungal diseases attacking the snake gourd and other cucurbit. Subsequently, if not controlled, gradually the lesions grow in size and coalesce with each other. The severely infected leaves of downy mildew roll upward with brownish tinge that produces a blighted appearance. Greyish black downy fungal growth is usually noticed on the under surface of the affected leaves.

Control

- Use disease-tree healthy planting material.
- Strictly follow proper field sanitation
- Spray the crop with mancozeb 0.25%, or Ridomil 0.2% at 10- l5day intervals.

- **Powdery mildew (*Sphaerotheca fuliginea*):** The disease causes maximum damage in warm and dry areas where moisture is present as dew. The infection of powdery mildew disease first appears on upper side of the leaves, as well as the stem, as white to dull white powdery growth, which subsequently further increases, covering most of the leaf surface, resulting in serious true withering, drying and finally defoliation of leaves. In severe cases, the infected fruits may be covered with a white powdery mass, and they may drop off subsequently. In addition, the infected fruits also deteriorate in quality.

Control

- Grow resistant varieties, if available.
- Spray the crop with Bavistin 0.1%, Benlate 0.2%, Karathane 0.1%, wettable sulfur 2%, or Topsin M 1 g/liter of water at 15day intervals.

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POTENTIAL TROPICAL MINOR FRUIT: THE JACKFRUIT

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"Being a minor tropical fruit crop, potential of Jackfruit is yet to be explored and required promotion and publicity among local, national as well as international market. Jackfruit presents edible and medicinal properties. However, uses of Jackfruit is limited up to fewer areas, therefore, it is required to familiarize the food value of this crop in other countries also, as it contains various numerous health benefits."

Introduction

Jackfruit is an Indian origin tropical evergreen largest fruit tree referred by different names such as jack, jackstones, panasa, pala, fanas and Kathal. It is a very popular fruit among the Garo tribe of Meghalaya commonly known as 'Tebrong' and is grown as a homestead crop. Botanically, Jackfruit is known as *Artocarpus heterophyllus* belonging to family Moraceae and order Rosales. It is believed that jackfruit is indigenous to the rain forests of the Western Ghats of India and from India it spread to South-East Asian countries and the East Indies, east Africa, Uganda, Brazil, Mauritius and Philippines. In India,

plantation of jackfruit is widely done in Bihar, West Bengal, Uttar Pradesh, Orissa, Assam, Kerela and Tamil Nadu. Its regular plantations are found only in U.P. Often used as meat substitute, jackfruits are highly nutritive and a rich source of vitamin A, B, C, potassium, fibre, calcium, iron, proteins, minerals and carbohydrate. It also contain pectin, carotene, ascorbic acid, riboflavin, folate and niacin which help in preventing diseases like cancer and heart disease, as well as eye problems like cataracts.

It is commonly propagated through seeds. Air-layering, grafting (inarching and epicotyl) and budding (forket, chip, and patch) are means of its vegetative propagation. Seedling tree starts bearing from seventh to eight years onwards while the grafted ones from third year of planting. 40-50 tonnes of fruits/ha on an average could be obtained. The fruit matures during the rainy season from July to August.

Taxonomical classification

Kingdom- Plantae; Order- Rosales; Family- Moraceae; Genus- *Artocarpus*; Species- *heterophyllus.*

Botany

Jackfruit *(Artocarpus heterophyllus)* is largest fruit of all trees, reaching as much as 55 kg (120 pounds) in weight, 90 cm (35 inches) in length, and 50 cm (20 inches) in diameter.

It is an evergreen tree that has a relatively short trunk with a dense tree top system. It easily reaches heights of 10 to 20 m (33 to 66 feet) and trunk diameters of 30 to 80 cm (12 to 31 inches). It sometimes forms buttress roots. The bark of the jackfruit tree is smooth and reddish-brown in colour.

1. **Leaves**: Leaves are alternate and spirally arranged. Leaves are gummy, thick and are divided into a petiole and a leaf blade. The leathery leaf blade is oblong to ovate in shape.
2. **Flowers:** The inflorescences are formed on the trunk, branches or twigs (caulifloria). Jackfruit trees bears both male and female flowers (monoecious. The inflorescences can be pedunculated, cylindrical to ellipsoidal or pear-shaped,
3. **Fruits:** The ellipsoidal to roundish fruit is a multiple fruit formed from the fusion of the ovaries of multiple flowers. The fruits grows on thick stem on the trunk. Fruits can vary in size and matures from an initially yellowish-greenish to yellow, and then yellowish brown at maturity. The fruits consist of whitish fibrous core (rachis) which is about 5–10 cm (2–4 inches) thick.

Medicinal properties of Jackfruit

- According to texts of Ayurveda, ripened fruit alleviates *vata* and *pitta*. It acts as body coolant.
- The latex of this tree has anti-inflammatory properties. Hence it is recommended in inflamed abscesses and wounds. Poultice prepared from latex of jackfruit helps to cure and reduce pain and swelling in abscesses and wounds.
- The bark of tree helps to reduce and cure intestinal motility and hence useful in diarrhea and dysentery. The decoction obtained from bark can be used for this purpose.
- The flesh and seeds of jackfruit are used to reduce influence of alcohol.

Toxicity

Even in India there is some resistance to the jackfruit, attributed to the belief that overindulgence in it causes digestive ailments. Raw, unripe fruit is astringent and indigestible. The ripe fruit is laxative in nature; and if consumed in excess amount it can cause diarrhea. Raw seeds of jackfruit are indigestible due to the presence of a powerful inhibitor trypsin. This element can be destroyed by boiling or baking.

Processed products of Jackfruit

Jackfruit can be processed into various products such as Jackfruit Bar, Canned jackfruit, Jack jam/preserve, Jack nectar, jack syrup, Jack pickle, Jack chips.

1. Jackfruit bar

2. Jackfruit jam

3. Jackfruit pickles

4. Jackfruit chips

Conclusion

Being a minor tropical fruit crop, potential of Jackfruit is yet to be explored and required promotion and publicity among local, national as well as international market. Jackfruit presents edible and medicinal properties. However, uses of Jackfruit is limited up to fewer areas, therefore, it is required to familiarize the food value of this crop in other countries also, as it contains various numerous health benefits. It can also referred as vegan meat. To fully utilize food value of this crop more researches should be conducted and increase uses of its culinary and processed products because its processed products have good export market potential especially in Middle East countries. Therefore presenting good scope for setting up jackfruit processing units in jack growing areas which will not only help the farmers to utilize the perishable raw material but also generate more employment opportunities in rural areas.

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VEGETABLES FOR NUTRITIONAL SECURITY

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"Food security as well as nutritional security have, therefore become the most important issues in national development programmes. Fighting hunger and malnutrition has become global moral responsibility and a major concern in the developing countries. In India, about 53 per cent of the children in the age group of 1-4 years suffer from malnutrition. The recommended dietary allowances (RDA) per caput per day by the Indian Council of Medical Research (ICMR) for adult males includes cereals (475g), pulses (80g), green leafy vegetables (125g), other vegetables (75g), roots and tubers (100g) and fruits (120g)."

Present scenario

Presently the two major concerns of the developing countries are suffering from hunger and malnutrition. Food security as well as nutritional security have, therefore become the most important issues in national development programmes. Fighting hunger and malnutrition has become global moral responsibility and a major concern in the developing countries. The International Conference on Nutrition (1992), the World Food Summit (1996) and five years later The World Food Summit (2000) convened by the Food and Agriculture

Organization (FAO) of the United Nations have been landmarks in the international efforts to assess the situation of food insecurity and malnutrition and to take appropriate steps to overcome the problem, particularly in developing countries.

In India, about 53 per cent of the children in the age group of 1-4 years suffer from malnutrition. About 79 per cent of the world's malnourished children live in Asia. The three anthropometric measures of underweight, wasting and stunting due to protein energy malnutrition among children under five years, are quite high in India. Such malnourished children include wasted (17%), stunted (63%) and underweight (50%). Besides, low birth weight (LBW) in India is also high (33%). The low birth weight in the child has been found to have association with coronary arterial disease in the adult. Infant mortality rate in India is among the highest in the world, about 70 per thousand births.

The challenge

It has been estimated that in the year 2020 the population of the world will increase to 8 billion and 1.2 billion in India. Around 80 per cent of the world population (6 billion) will be in developing world, of which 2 billion people will be undernourished.

Nutritional requirement and vegetable consumption

The recommended dietary allowances (RDA) per caput per day by the Indian Council of Medical Research (ICMR) for adult males includes cereals (475g), pulses (80g), green leafy vegetables (125g), other vegetables (75g), roots and tubers (100g) and fruits (120g). The adult female should have the same quantities of vegetables, roots and tubers and fruits as recommended for the adult male but less quantities of cereals (350g) and pulses (70g). Human nutrient requirements vary with sex, age, weight, height and physical activity. The balanced diet should contain adequate energy source (calories) and nutrients, like protein, carbohydrate, fats, minerals, essential amino acids and vitamins. Vegetables are good sources for these nutrients, particularly vitamins and minerals.

Calories

In comparison with other crops, like cereals, pulses and animal products vegetables are not good sources of energy in human diet. Energy is derived mostly from carbohydrates and fats. Beans and peas, like cowpea, hyacinth bean, French bean, scarlet runner bean and peas are rich sources of calories.

Proteins

Proteins in human diet are for body building, mainly for tissues, muscles and blood. In human body enzymes and antibodies are also basically proteins. Dry beans and peas and leafy vegetables are rich sources of proteins. The protein content varies from 24g to 43g in leguminous vegetables and between 3g to 6.7g in leafy vegetables.

Phytonutrients

The phytonutrients, also known as, phytoceuticals, found in some plants have protective and disease - preventing functions. These are grouped on the basis of their protective functions and physical and chemical characteristics.

Carotenoids or beta-carotene

Greens, preferably dark green leafy vegetables (amaranths, palak, curry leaves, drumstick leaves, radish leaves, fenugreek leaves and others) and orange-or yellow-coloured vegetables (carrot, tomato, pumpkin, melons) have high beta-carotene content. These vegetables containing beta-carotene act as antioxidants and provide protection against coronary heart diseases, like atherosclerosis, thrombotic strokes and myocardial infarction.

Vitamins

- **Vitamin C:** It is an antisorbic vitamin important in immune response, wound-healing and allergic reactions. Vitamin C, beta-carotene and vitamin E provide protection against some cancers. It is also an antioxidant and facilitates absorption of iron in the body. Cruciferous vegetables, like broccoli, cauliflower, cabbage and brussels sprouts and sweet peppers, tomatoes, potatoes, beans and leafy vegetables are good sources of vitamin C.
- **Vitamin A (Carotene):** Vegetables do not contain vitamin A but have carotenoids with active ingredient carotene, mostly beta-carotene, a precursor of vitamin A ale known as pro-vitamin A. Human body is not able to synthesise vitamin A and bence it has to be supplied through food. Several leafy vegetables, particularly dark green leaves like amaranth, rumex, palak, curry leaves, drumstick leaves, fenugreek leaves Malabar spinach (Basella) and radish leaves are rich sources of carotene, varying from 1920-7440 micrograms. Orange and yellow coloured vegetables, like carrot, pumpkin, muskmelon, tomato and kakrol also have high carotene content.
- **Vitamin B_2 complex**

Riboflavin: The deficiency of riboflavin causes tongue sourness, redness and burning sensation of eyes, scaliness of skin and scrotal dermatitis. Rich sources of riboflavin are leafy vegetables, like amaranth, palak, curry leaves, fenugreek leaves, portulaca, radish leaves, spinach and turnip greens.

Vitamin B_6: It is a coenzyme which is useful in synthesis and breakdown of amino acids, synthesis of fatty acid and conversion of tryptophan to niacin. In general vegetables are good sources of vitamin B_6.

- **Vitamin E:** It is an antioxidant at the cell level and prevents the pre oxidation of polyunsaturated fatty acids. It reduces the incidence of heart attack and along with vitamins C and A delays the cataract formation in the eye. Vitamin E also slows down the

Alzheimer's disease in early stages. Parsnip, spinach, broccoli and watercress are rich sources of vitamin E.

Minerals

Human body requires certain minerals, like calcium, phosphorus, iron, potassium and magnesium. Calcium is useful for bones and teeth, especially in children and women during pregnancy and lactation. Calcium from green vegetables, like mustard leaves, kale and broccoli reduces the risk of colon cancer. Calcium, potassium and magnesium in vegetables help to prevent high blood pressure. Leafy vegetables, beans peas, root vegetables, crucifers and tomato are the best sources of these minerals. Phosphorus is helpful in utilization of calcium and assimilation of carbohydrates and fats in human body. The requirement of iron in the body can be met by consumption of about 50g of leafy vegetables in daily diet. It is useful in prevention of anemia, especially in pregnant women. In India, 87.5 per cent of pregnant women and 56 per cent of pre- school age children suffer from anemia. Iron rich leafy vegetables include amaranth, fenugreek leaves, radish leaves, drumstick leaves and palak.

Iodine deficiency disorders (IDD)

The major iodine deficiency disorder is a goiter. About 2.3-65% school age children suffer from goiter. In India, about 70 % households consume iodized salt which prevents goiter.

Fibre

Dietary fibre (cellulose, non-starch polysaccharides and lignin), though not a phytonutrient is also an essential requirement for good health. It improves the digestive system, lowers cholesterol and protects against certain types of cancer including bowel cancer. Vegetables are the best sources of dietary fibre. Beans that are rich in fibre have a digestive by-product which reduces cholesterol production in the liver.

Colour-coded diet According to Dr. David Heber of the USA, colour is the key to good nutrition and he advocates colour-coded plan of using vegetables and fruits in human diet. The red/purple vegetables, like brinjal, red cabbage, red sweet pepper, red Asiatic carrot, amaranth and beet root containing anthocyanins are antioxidants and prevent heart disease and stroke by inhibiting clot formation. The fresh red tomatoes and ketchup and sauces of tomato having lycopene are antioxidants and cancer-fighting. The red watermelon is also useful. The orange-coloured carrot, pumpkin and sweet potato contain beta carotene which is helpful to eyes and skin health and prevents certain cancers.

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INSECT PEST OF PEA, NATURE OF THE DAMAGE AND THEIR MANAGEMENT

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Introduction

Pea is an important vegetable grown all over the country. In Himachal Pradesh, it is mainly grown as off season vegetable and is an important source of income for the farmers. But, at the same time it is attacked by a large number of insect pests throughout the growth period. In this efforts have been made to discuss the host range, damage symptoms, life cycle and management strategies for important pests of peas.

Insect pest of pea

Pea pod borers and Leaf Miner

1. **Pea pod borer/ Lentil pod borer** *Etiella zinckenella* (Phycitidae: Lepidoptera)

Host range: This pest attacks in peas, lentil and other pulse crops.

Damage: Caterpillars of this pest cause damage in the plant. Caterpillars starts feeding on floral parts, seeds which are inside the pods and newly form pods resulting heavy reduction in the yield.

Identification: Newly emerged caterpillars are greenish. Well grown larvae are purplish and rosy coloured. Moths are well grey in colour with a wing stretch of about 25 mm. The anterior wings are surrounded with the dark marginal lines and orcheous scales are present in it.

Life cycle: Eggs needed a temperature of 25ºC to hatch and it takes around 5 days in the processing of hatching. In around 10-27 days larval stage gets completed in this pest. Also 10-15 days more needed for the pupal development. Completes five over lapping generations.

Salient features: The moths emerge during February-March. This insect lays eggs singly only but sometimes lays eggs in cluster also. Newly emerged larvae feed on floral parts. Subsequently bore into the pods and eat the developing seeds. Pupate inside the depth of 2-4 cm in soil. Breeds throughout the year.

Management: Spray of suitable amount of deltamethrin @ 0.0028% should be done when flower starts its initiation. Insecticides which are commend for the management of *H. armigera* are also effective and they can be used in it.

2. Tomato fruits borer, *Helicoverpa armígera*

Insect pest of this group are very destructive in nature and can cause high damage to the crop that results in major loss of crop yield of tomato, also decreases its economical value. These insects have many host plant so they are polyphagous in nature. These insects cause severe damage to crop and field which not only decrease the yield of the crop but also deceases the quality if the tomato crop. Host plants: It infests on many hosts that is over 100 host plants including tomato, castor, cowpea, millets, linseed, tobacco, safflower, pigeon pea, okra, carnation etc.

Damage: Larva of this insect cause the damage. The larva remove the tomato foliage in instar stage makes bores in the fruit makes it unsuitable for the market which not only damage it but decreases its economic value in the market. These insect feeds on the leaves of the plants foliage, flowers, buds and fruits also and decreases the economic value of the fruits. Small young green fruits are attacked quickly by this insect. Larva in its second instar

stage is very dangerous and single lava only can destroy many fruits by making bores in it. Damage chances is more in the month of March to June

Identification: The eggs time phase is around 5 to 6 days. The well matured caterpillar measures around 11 to 13mm in the length and are generally pinkish in colour. Adult moth is cream white in colour having wingspan of 25mm with the transparent wings. Life span of adult moth varies from 6 to 7 days. Eggs of the larva are yellow in colour dome shaped and around 0.5 mm in diameter but in the young stage eggs are yellowish white in colour as it also depend upon the food they consume. Full matured adult caterpillars are around 40-50 mm long in height with having longitudinal stripes of whitish gray in colour. Wings colour varies from male to female as in male forewings are usually light yellowish in colour whereas in females it is light brown in colour. Apical portion of the wings of the insect are marked by the blackish brown lines which are clearly visible having a spot of black colour which is clearly visible in the upper sides of the forewings. Buch of hairs are present on the point end of the abdomen of female which is one of the specific features of the female.

Life cycle: Incubation period: 2-5 days; Larval period: 15-22 days; Prepupal period: 1-2 days; Pupal period: 10-14 days; Adult longevity: 6-10 days.

Salient features: Insect lays eggs singly on the leaves, flower and fruits. Juvenile larvae feed on tender foliage and older bore fruits. Larva is very destructive in nature can one larva only can destroy 4 to 8 fruits easily makes bore on them makes them unfit for the market. Caterpillars thrust only a part of their body inside the fruit and feed on the inner contents. Fruits that are incompletely damaged are attacked by other microbes which also cause further diseases in them. The caterpillars of this species are flesh eating in natures.

Management: We can do tillage operations and deep ploughing so that the field and the pupae should be exposed to sunlight. We can use African marigold (*Tagetes erecta*) as a trap crop which attracts insect toward itself hence saving the main crop of tomato. Pheromone traps of (5 traps/ ha) of moths are used for surveillance. Monitoring of top three leaves for egg laying. We can also spray a nuclear polyhedrosis virus of H that is HaNpv at the rate of 250 LE per hectare in one week intervals.

Formulation of Bt that is *Bacillus thuringienisis* is widely used at the rate of 0.5kg per hectare. Neem Seed Kernal Extract at the rate 4 % is also used to control this insect. Periodic releases of egg parasitoid, *Trichogramma chilonis* or *T. pretiosum* @ 100000 /ha. Emergency

shower of cypermethrin (0.0075%) or deltamethrin (0.0028%). Natural enemies like *Campoletis chloridae*, *Bracon brevicornis* and *Trichogramma spp* are active in nature.

3. Pea Leaf miner, *Chromatomyia horticola* (Agromyzidae: Diptera)

Hosts: Peas, Brassica crops and some ornamentals.

Damage: Maggots mine in to leaves. Feed on mesophyll leaving the two epidermal layers intact. The mines start from the periphery and ends up towards the mid rib. Photosynthesis is considerably reduced. Under severe infestation wilting of the leaves starts and are shed. Flowering and fruiting is reduced considerably.

Identification: The eggs are oval, spherical, pure white in colour when freshly laid but turns dull white before hatching. The larva is translucent white and the inverted "Y" shaped oral hook is clearly visible. Pupa is fusiform with distinctly defined segments. Initially it is light brown but turns dark towards maturity. Adults are two winged flies having grayish black mesonotum. Females are black with brown head.

Life cycle: 1-2 days of incubation period. Time period of larval days in around 6 days. Time period of pupal development is 9 to 11 days approx. Adult female lives around 27 days while male of this insect lives lifespan of around 10 days. Mating occur after 1-8 days of emergence. A female on an approximately gives 294 eggs during its total life span.

Salient features: Lay eggs inside the tissue of the leaf. Only 1egg is laid in one insertion. Most of the eggs are laid near the leaf margin. Pupate inside the mine.

Management: Implementation of oxy- demeton methyl, dimethoate, chlorpyriphos, have been reported effective against this pest. Very huge number of its larval (*Diglyphus sp, Neochrysocharis sp, Asecodes spp*, etc.) and also larval- pupal (*Opius sp*.) parasitoids are active in nature. Avoid insecticides when parasitoids are active.

4. Pea stem fly or bean fly: *Ophiomyia phaseolii* (Agromyzidae: Diptera)

Major hosts: Cowpea, peas, lima bean, soybean and many other beans.

Damage: The maggots mine through the leaf petioles into stems. Females also puncture the leaves. Leaves turn yellow, giving the plants a dry appearance. The stems turn brown, become swollen and break down. Spring crop suffers less than the late summer crop. The attacked plants bear fewer pods which are mostly empty or having very small seeds.

Identification: Eggs are slender, oval, less than 0.5 mm long and white in colour. Maggots are initially white, but latter turn yellowish. They are small in size (less than 1mm). Pupae are in the shape of a barrel and generally dark brown in colour. Adults are metallic black flies, 2.0 to 2.5 mm. Female are slightly bigger than males, wing expense is on an average 5mm.

Life cycle: Total life span period is completed in 2-3 weeks. As many as seven generations. The flies mate 2-6 days after emergence. Start oviposition 2-4 days after mating. Incubation, larval and pupal periods last for 2-4, 9-12 and 18-19 days, respectively, during Nov-Dec. Average longevity of male is 11 days; however, females can live up to 22 days.

Salient features: Eggs are laid singly in holes made on the upper surface of young leaves, especially near the petiole end. On hatching, the maggot forms a short linear leaf mine. Further tunnels to the stem through leaf stalk. Pupation takes place inside the stem.

Management: Remove and destroy all the affected branches during the initial stage of attack. In case of wide spread incidence, spray the crop with diamethoate @ 0.03%.

Minor pests of pea:

Bihar hairy caterpillar	*Spilarctia (Spilosoma) obliqua* (Arctiidae: Lepidoptera)
Rice army worm	*Mythimna separata* (Noctuidae: Lepidoptera
Tobacco caterpillar	*Spodoptera litura* (Noctuidae: Lepidoptera)
Tussock moth	*Euproctis fraterna* (Lymantriidae: Lepidoptera)
Pea stem borer	*Grapholita (Lasperesia) torodelta* (Eucosmidae: Lepidoptera
Leaf eating beetle	*Madurasia obscurella* (Chrysomelidae: Coleoptera)
Cotton whitefly	*Bemisia tabaci* (Aleyrodidae: Hemiptera)
Gujhia weevil	*Tanymecus indicus* (Curculionidae: Coleoptera)
Leaf hoppers	*Empoasca kerri motti* (Cicadellidae: Hemiptera) *Empoasca binotata* (Cicadellidae: Hemiptera)

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BANANA CULTIVATION USING TISSUE CULTURE

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"Plant tissue culture is a collection of techniques used to maintain or grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium of known composition. It is widely used to produce clones of a plant in a method known as micropropagation."

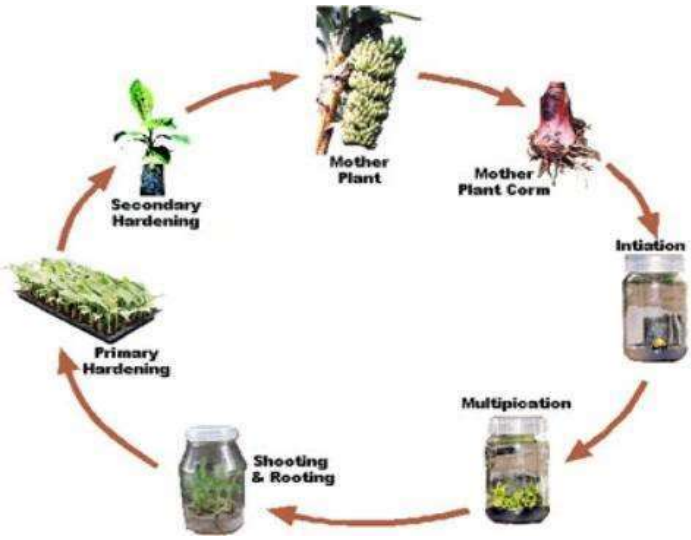
Introduction

Banana (*Musa spp*.) is believed to have originated in South Eastern Asia with India as one of the centres of origin apart from Indonesia, Philippines, and Malaysia. Bananas are believed to have been the world first cultivated fruit. Banana ranks first in production and second in area among the fruits grown in India. Banana is one of the popular fruits in India because of its low cost and free availability. Banana provides a balanced diet than other fruits. Banana is composed of mainly water and carbohydrates which provides energy (104 Cal. Per 100 g.) It is rich in Minerals, Phosphorus and Calcium. The major problem however faced in the banana growing areas is the shortage of uniform and disease free planting materials, which

is due to the vegetative mode of propagation of the plant (through side sucker) at a slow pace in conventional cultivation This difficulty can be addressed by employing the commercial tissue culture technology for mass production of the popular banana varieties.

Tissue culture in banana

"Plant tissue culture is a collection of techniques used to maintain or grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium of known composition. It is widely used to produce clones of a plant in a method known as micropropagation." This tissue culture technology can also be utilized for conservation and multiplication (as per requirement) of the other locally important, elite, endangered and ornamental banana varieties. Banana plants produced through tissue culture not only reduce the risk of disease movement from one field to the other, but high yielding varieties propagated through tissue culture also increase overall production and improve national economy.



Why tissue culture so popular in banana

Tissue culture technique in banana propagation eliminates most of these pests and reduce infestation in new plantation thus contributes to higher yields and production. Tissue cultured plants had higher total number of leaves, functional leaves, stem circumference and height at three months interval than conventional suckers. They also flowers and yields bigger bunches than conventional suckers. Conventionally, one banana plant produces only five to ten suckers in a year depending on the variety. Through tissue culture large quantities of clean banana plantlets are produced within a short period. Tissue-cultured banana include high field establishment rate, uniformity in growth ensuring synchronized harvesting, and high production. Tissue cultured plants have more functional green leaves at planting and therefore this enables them to manufacture their own food, while conventional suckers use the food stored in the corm to start the initial growth. The fast vegetative growth of tissue cultured plants was reflected in their early flowering in the plant crop and the more number of leaves at flowering. Bunch weight of conventional suckers started to decrease from the fifth cycle, it increased with tissue-cultured plants. Hence, using of tissue cultured plants is most income generative and easy adoptive technology than the conventional suckers.

Requirments

- **Infrastructure:** A tissue culture laboratory, a poly- house facility for weaning tissue culture plantlets.

- **Equipment:** Standard glass ware, tissue culture racks, clean-air bench, autoclave, pH meter, weighing balances, surgical-ware etc.

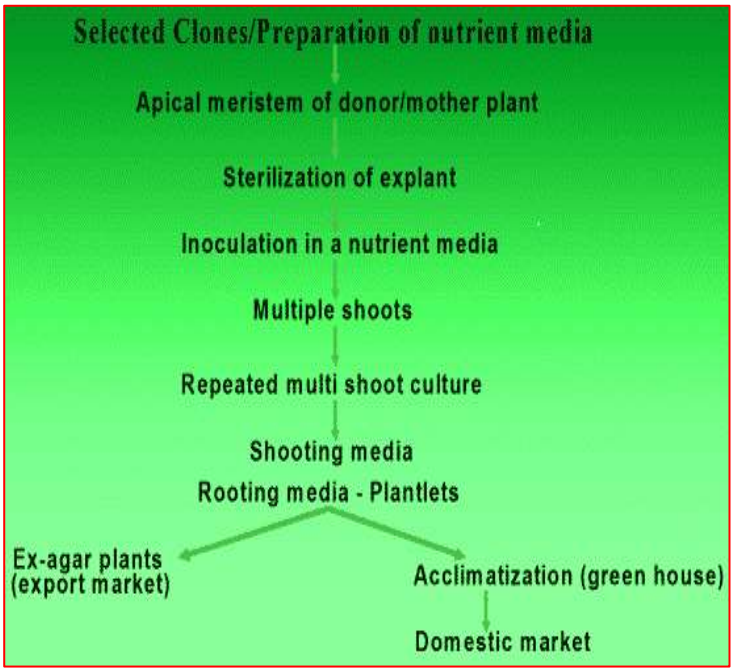
- **Chemicals:** All the ingredients of Murashige and Skoog basal medium, sucrose, growth hormones, gelling agents etc.

- **Manpower:** Skilled technicians (trained in a tissue culture laboratory) for laboratory work and supporting staff & workers.

General steps involved

The banana tissue culture process involves:

- Initiation of aseptic cultures from shoot tips obtained from disease free banana plants.
- Multiplication of the shoots to the desired scale.
- Induction of roots to individual shoots
- Primary & secondary hardening of the tender plantlets in the poly-house.
- Field transfer of the hardened tissue culture plants.



Climates required for banana cultivation

Banana is strictly a tropical plant however it is also grown in subtropical to humid climates. The optimum temperature required for bananas is between 25 to 30°C, with upper and lower limits of about 40° and l0°C respectively. For the optimum growth of the banana plant, the area should have a monthly rainfall of 20-22 mm. distributed evenly.

Advantages of tissue culture banana

- They are disease free and therefore grow faster and vigorously.
- They mature earlier, and the yield is more than conventional ones.
- Large numbers can be produced in a relatively short time occupying a relatively small space.
- Through banana tissue culture, development of new genotypes resistant to pests and diseases is possible. This can be extended to improved quality and storability.
- Banana tissue culture can facilitate safe international exchange of banana germ plasm from one country to another in a closed sterile environment free of diseases.
- There is a possibility of incorporating vaccines of common diseases in banana, as it is popular fruit throughout the world.

Disadvantages of tissue cultured banana

- The tissue cultured banana is expensive and so it is not reachable to the normal man.
- For the production of tissue cultured banana, it needs labour intensively.

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