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Growing seed

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BEEKEEPING: ADDITIONAL SOURCE OF INCOME FOR FARMERS OF UTTAR PRADESH

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Beekeeping is one of the excellent business opportunities for small and marginal farmers where they can invest in and bring the green business revolution, which is mainly driven by the demand of consumers who are interested in purchasing goods that incorporate eco-friendly manufacturing processes and saving natural resources. It involves the rearing of honeybees for the benefit of human being and also has the capabilities of building up any nation (Ononye and Akunne, 2015). Apart from honey and other byproducts, bees contributed to sustaining as well as enhancing crop production through their pollination services. In our country, about sixteen lakh people are involved in beekeeping and allied activities directly or indirectly. In India, honey and beekeeping have a long history, and also honey was the first sweet food tasted by our forefathers inhabiting rock shelters and forests (Khanra and Mukherjee, 2018). They hunted bee hives for this gift of God. Now honey and bee products find use in several industries such as pharmaceuticals, bees wax industries, bee venom, royal jelly, bee nurseries, bee equipment, and hives etc. Bee-keeping is quite profitable in areas with good floral pasturage. According to recent statistics, about 50 million hectares of land is under the cultivation of oilseeds, pulses, orchards, and other crops which is useful to bees and benefitted by bee pollination. In addition, there is about 60 million hectares of forest area with beekeeping potential. This vast area of agriculture

Beekeeping in India

India has the potential to keep about 120 million bee colonies that can provide self-employment to over 6 million rural and tribal families (Abrol and Shankar, 2015). In terms of production, these bee colonies can produce over 1.2 million tons of honey and about 15,000 tons of beeswax. Organized collection of forest honey and beeswax using improved methods can result in additional production of at least 120,000 tons of honey and 10,000 tons of

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beeswax. The major honey producing states include Punjab, Haryana, Uttar Pradesh, Bihar, and West Bengal. Govt. of India has approved a new Central Sector Scheme entitled "National Beekeeping & Honey Mission (NBHM)" for two years for overall promotion and development of scientific beekeeping in mission mode to achieve the goal of "Sweet Revolution" in the country by giving thrust on capacity building & training, specific focus on women, input support for promotion & production, setting up of Integrated Beekeeping Development Centres (IBDCs), other infrastructures, digitization /online registration, processing, value addition, market support, etc. In Uttar Pradesh, the beekeeping program is being operated in various 15 districts of the state by the Department of Horticulture and food processing, with the motive to promote beekeeping for the business purpose among the farmers of the state. For training, the centers are Allahabad, Saharanpur, Basti, and Moradabad, while Sub-centers are Lucknow, Gorakhpur, Agra, Bareilly, Varanasi, Sultanpur, Ghazipur, Jaunpur, Faizabad, Kanpur Nagar, and Azamgarh.

Requirements and Market Potential for Beekeeping

The raw materials for the beekeeping industry are mainly pollen and nectar that come from flowering plants. Both the natural and cultivated vegetation in India constitute an immense potential for the development of beekeeping. About 500 flowering plant species, both wild and cultivated, are useful as major or minor sources of nectar and pollen. A rich diversity of bee flora and fauna is available in Uttar Pradesh that can be utilized for the development of the honey industry in the country. Beehives neither demand additional land space nor do they compete with agriculture or animal husbandry for any input (Agrawal, 2014). The beekeeper needs only to spare a few hours in a week to look after his bee colonies. Beekeeping is therefore ideally suited to him as a part-time occupation.

In the domestic market, very little amount of honey is used for personal consumption, while the pharmaceutical and confectionary industry utilizes the majority. With changing lifestyles and increasing health consciousness, the consumption of honey is increasing as health food. This is likely to drive domestic demand in the future. As per the information available from the Agricultural & Processed Food Products Export Development Authority, India has exported 51547.31 MT of Natural Honey to the world for the worth of Rs. 653.58 crore/ 101.32 USD million during the year of 2017-18, and the Major Export Destinations (2017-18) are USA, Saudi Arab, UAE, Canada, and Qatar.

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Low budget Investment: Bee Farming is not a manufacturing activity, as such costly machines and tools are not required. There is nothing like production capacity as well. Only small wooden frames with boxes are needed. Their sizes are also standardized. To begin with, around 15 such sets/boxes can be purchased or assembled at a rate of Rs.1500.00 per box that would cost Rs.22 500/- for 15 Boxes. Honey extractors would cost to the tune of Rs.5 000/- each with filtration facilities. For other miscellaneous expenditures, including training and consultancy services, a sum of Rs.5000.00 can be earmarked. That means a total of Rs.32 000.00 would be required to start Bee Farming with 15 Boxes which is equivalent to or less than the cost of cultivation of one acre of paddy field.

Better Returns: As per the established norms, each box comprises 7-8 hives which is able to harvest around 30-35 kg of honey in a year. The annual harvest of honey starting with 15 bee boxes could be 450-525 kg, depending on the flowering season. Even after considering a very conservative selling price of Rs. 150/- per kg, the annual realization would be to the tune of Rs. 67,500/- to Rs.78,750/-. Therefore, Bee Farming can be considered as an excellent, profitable agro-based green enterprise for landless farmers and entrepreneurs (Singh and Mehla, 2019).

Value addition in Byproducts of Beekeeping

By and large, at present, beekeeping in our country is practiced mainly for honey production. To make this trade more fascinating and higher income generation, more focus should be given to diversify beekeeping to get other valuable bee products- bee wax, bee venom, royal jelly, propolis, and pollen, and using beekeeping for commercial pollination services.

Honey- Honey is a best health food, which is considered a wonderful creation. It is very useful in weight management, throat and cough irritation, allergies etc. When we compare to sugar, it contains vitamins, minerals, antioxidants, and lesser calories.

The following seasonal chart of various types of honey can provide the exploration of different flora for honey and a source of a good income during the different months:

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September	**Khair honey, arhar honey, til honey, jowar honey**
October	Rape honey, eucalyptus honey
November	Mustard honey/pollen, eucalyptus honey
December	Mustard honey/pollen, eucalyptus honey
January	Mustard honey/pollen
February	Mustard honey/pollen, eucalyptus honey, coriander honey, saunf honey, coconut honey, rubber honey
March	Mustard honey/pollen, eucalyptus honey, multi flower honey, litchi honey, plum honey, saunf honey, sehjan honey
April	Shisham honey, eucalyptus honey, multi flower honey, litchi honey, plum honey, coriander honey, saunf honey
May	Sunflower honey, berseem honey, neem honey

Mead or honey wine- It is the first alcoholic drink brewed by men, earlier than wine or beer. Today mead has evolved and expanded its flavors to include fruits such as blueberry and cherry, malt as well as various herbs and spices, which may increase the value of honey as well as the income of beekeepers.

Beeswax- Around 30-40 percent of the world's trade in beeswax is used for the pharmaceutical and cosmetics industry. The world price is usually around US$ 4-10 per kilogram. Around 20 percent of the beeswax trade is used for candle making. Around 20 percent is used for models and casting in industry and art. Wax is also used to make figures, decorations or sculptures and jewelry before they are placed in a mold for casting in silver, gold or bronze. In India, beeswax is available in the market at the cost of Rs.250-1500 per kg.

Pollen - Bee Pollen is known as the most natural & complete food. Bee Pollen has been found to contain a wide spectrum of trace nutrients and includes - Complex Vitamins, & Vitamins B, C, D, E, K, & Beta Carotene (Vitamin A), Vitamin B6 (Methionine) plus numerous minerals, enzymes & coenzymes, plant source fatty acids, carbohydrates, proteins,

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& amino acids. In India, Bee Pollen Caps @ 500 mg (250 Capsules) are available at the cost of Rs. 2,100.00/-(approx.)

Propolis - Propolis or bee glue is a mixture of beeswax and resins collected from leaves and twigs. Propolis contains easily volatile etheric oils possessing clearly marked antimicrobial effects. It is very much beneficial for all kinds of dental & oral problems, inflammation, and any kind of tumor and a very good antioxidant. In India, India Mart is selling propolis (Forever Bee Propolis) at the cost of Rs 1,800/bottle containing 60 tablets.

Royal jelly - It is perhaps the most important bee product which stimulates regular growth and development of an organism, adds the needed strength, activates metabolic processes in an organism, and maintains a regular functioning of the endocrinal system.

Bee Venom - Venom may have benefits to humans in curing arthritis and rheumatism. Bee venom prices are also vary, from $30.00 US (sometimes even much low) up to $300.00 US per grams.

Bee pollination- By adding bee colonies to increase pollination, farmers and beekeepers can gain much more than just the yield of honey. Pollination is, as far as earnings are concerned, the most important product of beekeeping. Bees in general and social bees in particular are the most important pollinators of cultivated plants; they depend almost entirely on the pollen and nectar of flowers. Honeybees, and in particular *Apis mellifera* L., are the most economically valuable pollinators of crop monocultures worldwide; they are available throughout the growing season, they pollinate a wide variety of crops, and they can be concentrated in large numbers whenever and wherever needed (Rai, *et al* 2020). Thus, among all pollinators, bees are recognized as the most efficient pollinators.

Conclusion

Beekeeping provides an excellent source of employment for the rural unemployed, enhances the income of farmers and the landless beekeepers. It enhances the productivity levels of agricultural, horticultural, and fodder crops through pollination services. A number of small scale industries depend upon bees and bee products. It provides them valuable nutrition in the form of honey, qprotein-rich pollen and brood. Production of honey has been the major aim of the industry. Modern beekeeping also includes the production of beeswax, bee collected pollen, bee venom, royal jelly, and propolis. It is vital to make the beekeeping

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industry more vibrant, to contribute to the national goal for reducing poverty, improving community livelihoods, and maintaining sustainable natural resources under the Green Business Revolution.

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FIGS: HIGH INCOME WITH FRESH AND DRIED FRUITS

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The experiment was carried out at instructional Farm, College of Mojerla, SKLTSHU, Madanapuram, Wanaparthi, Telangana. We have planted three varieties of fig such as Turkey Brown, Poona Red, and Deanna.

Fig (*Ficus carica*) belongs to the family Moraceae. It is one of the first few plants that were popular worldwide for its dry and fresh consumption. This is an important fruit due to its high economic and nutritional values. It is also a good source of food for fruit eating animals in tropical areas.

Nutrition and Uses

The fresh and dried figs also contain high amounts of fiber and polyphenols. Figs are an excellent source of phenolic compounds, such as pro-anthocyanidins, whereas red wine and tea, which are two good sources of phenolic compounds, contain phenols lower than those in fig.

- Figs common edible part is the fruit which is fleshy, hollow, and receptacle. Fig fruits can be eaten raw, dried, canned, or in other preserved forms.
- Fig fruit, root, and leaves are used in traditional medicine to treat various ailments such as gastrointestinal (colic, indigestion, loss of appetite, and diarrhea), respiratory (sore throats, coughs, and bronchial problems), and cardiovascular disorders and as anti-inflammatory and antispasmodic remedy.
- Fig leaves are used for fodder in India. They are plucked after the fruit harvest.

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- The latex is collected at its peak of activity in the early morning, dried, and powdered for use in coagulating milk to make cheese and junket.
- From it can be isolated the protein digesting enzyme 'ficin', which is used for tenderizing meat, rendering fat, and clarifying beverages.
- Dried seeds of fig contain 30 percent of fixed oil, which is edible oil and can be used as a lubricant.

Botany

Fig may be a gynodioecious (functionally dioecious), deciduous tree, or large shrub, growing to a height of 7–10 meters, with smooth white bark. It bears fragrant leaves which have three or five lobes. The complex inflorescence consists of a hollow fleshy structure called the syconium, which is lined with numerous unisexual flowers. The flower itself isn't visible outwardly because it blooms inside the inflorescence. Although commonly mentioned as a fruit, the fig is really the inflorescence or scion of the tree, referred to as a pome or aggregate fruit, during which the flowers and seeds are borne. It's a hollow ended stem containing many flowers. The tiny orifice (ostiole) visible on the center of the fruit may be a narrow passage, which allows the specialized fig wasp, *Blastophaga psenes*, to enter the fruit and pollinate the flower, whereafter the fruit grows seeds. The product consists of the mature syconium containing numerous one seeded fruits (druplets). The depart the fig fruit is thin and tender, usually green, and turns purple or brown after ripening. Fig has milky sap (laticifer). The sap of the fig's green parts is an irritant to human skin. The edible seeds are generally hollow unless pollinated. Pollinated seeds provide the characteristic nutty taste of dried figs.

Important Varieties

Characters	Poona	Deanna	Conadria	Excel
Plant height (m)	1.80	1.56	0.90	1.38
Plant canopy	3.42	3.52	0.78	1.17
Earliness	Late	Early	Early	Early
Av. Fruit wt. (g)	38.5	61.5	38.5	34
Fruit shape	Phyriform	Phyriform	Phyriform	Ovoid
Skin colour	Light purple	Lemon - Yellow	Green	Yellow

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Pulp colour	Strawberry	Light yellow	Pink	Pink – Yellow
Flavor	Distinct	Very mild	Mild	Mild
TSS (^{o}B)	22	21	20.5	21
Seeds	Few	Many	Many	Few
Taste	Sweet acidic	Sweet	sweet	Slightly acidic
Tolerance for splitting	Very poor	Good	good	Very good
Susceptibility to rust	Moderate	Susceptible	Moderate	Moderate
Fruit Yield (Kg/tree)	2.69	3.94	1.87	1.75

Propagation and Planting

Rooted hardwood cuttings are the common method of propagation in fig. Rooting was the best in cuttings from two to three years old wood with 30-40 cm length and 1.5- 2 cm thick. Cuttings are taken during January-February at the time of pruning in North India, whereas; the cuttings are taken during the season in South India.

A spacing of 3-5 m is suggested depending upon the fertility status of the soil for max yield. Planting season varies from place to put viz., South India (August – September), Western India (June – July), North India (January – February).

Training and Pruning

Fig trees are usually fan trained. The tree shouldn't be allowed to become tall because it is straightforward to reap fruits by handpicking from low headed trees. Pruning is additionally done to encourage new growth. In Pune, notching of buds is completed in July for inducing fruit bearing shoots by giving slant cuts over dormant buds to get rid of a little slice of bark with wood, and two buds are notched in each shoot.

Maturity and Harvesting

Though fig starts bearing fruits from the second year, commercial harvesting is completed from the 2nd year. The yield increases with an increase in canopy size of the tree and stabilizes during the 7-8th year. The economic lifetime of the plant is about 35 years. The

harvesting season starts in February- March and is over by May June. The fruits are harvested in 2-3 day intervals manually. Figs destined for the fresh fruit market or canning should be picked once they become fully colored and still firm. They're harvested by hand with a twisting and pulling motion. Pickers should wear gloves because the latex from the tree can cause skin irritation. The fruit is then placed into buckets or shallow fats for transport to the packing shed. Fruit should be carefully packed to avoid latex drops staining the skin of harvested fruit. The fruit should be cooled to 0°C as soon as possible.

Processing

The most common method of processing in fig is drying. Smyrna and Calimyrna figs are the foremost suitable for drying, because the seeds contribute to the ultimate flavor. In California, drying figs remains a viable industry. Fruit is allowed to ripen and fall naturally before it's collected from the bottom. After harvest, the figs are immersed in a boiling brine solution (100 g salt per 5 L water). This removes soil and cracks the skin to assist with drying. The figs are rinsed in clean water and then dried further by sun drying or dehydration. The final moisture content is aimed at 17 percent. Dried fruits are graded to remove damaged, sunburnt, split, diseased, and defective fruit. They are then sent to processors in bulk bins.

Conclusion

Here we are cultivating the fig verities *i.e.* Deanna, Poona Red, Turkey Brown, and describe the important characteristics of fresh fig cultivars, including fruit length and diameter, Average weight of fruit, fruit skin, and pulp color, and fruit shape. Consumer acceptance of fresh figs was affected by ease of peeling, pulp flavor, juiciness, sweetness, and acidity. Among the tested varieties, Fruits of Deanna are good for drying, canning, high yielding, and the most acceptable for fresh consumption. Based on our analyses, we recommend the consumption of the whole fig fruit of Deanna.

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POTENTIAL OF MICROBES IN DECONTAMINATING AGRICULTURAL SOILS

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Lorenz Hiltner, a pioneer in rhizosphere microbial nature and soil bacteriology research, when properly cited soil as the wellspring of endless life because of the wide scope of capacities it performs. There is no denying in the way that "A healthy soil is the backbone of agriculture." Soil health is the condition of the soil concerning its inherent (or potential) capability to sustain biological productivity, maintain environmental quality, and promote plant and animal health.

Therefore, healthy soil is productive, sustainable, and profitable. Industrialization and modernization have adverse effects on soil health, leading to its degradation of land. Bioremediation is the process by which living organisms degrade hazardous pollutants. Among different bioremediation methods, microbial metabolism is accepted as a safer and efficient tool for the removal of many pollutants. Different bioremediation approaches have been successfully applied for the removal of soils contaminated with a variety of xenobiotic compounds. Pesticides have been the major source of contamination in agricultural soils for years. These chemicals tend to persist in the soil for years and bioaccumulate and biomagnify in the food chain, finally entering the human body cause health risks. Heavy metals are another major source of contamination that has gained importance in recent years. Genetically engineered microorganisms (GEMs) are playing an increasingly important role in tackling soil contamination.

What is Soil Contamination?

Soil contamination occurs when the concentration of chemicals, nutrients, or elements in the soil becomes more than it normally or naturally is due to human action. If this contamination goes on to harm living organisms, we may call it pollution. Soil Science Society of America defined soil contamination as "Any substance in the soil that exceeds naturally-occurring levels and poses human and soil health risks is a soil contaminant."

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Examples of soil contaminants include chlorinated solvents, trinitrotoluene (TNT), heavy metals, pesticides, aromatic hydrocarbons (benzene, toluene, etc.), polyaromatic hydrocarbons.

Agricultural Activities as a Major Cause of Soil Contamination

Compound usage has gone up hugely since innovation furnished us with present day pesticides and composts. They are brimming with synthetic substances that are not created in nature and can't be separated by them. Therefore, they saturate the ground after they blend in with water and gradually decrease the fruitfulness of the dirt. Different synthetic substances harm the piece of the dirt and make it simpler to dissolve by water and air. Plants ingest a significant number of these pesticides, and when they decay, they cause soil contamination since they become a piece of the land.

Bioremediation

Bioremediation is defined as the process by which microorganisms are stimulated to rapidly degrade hazardous pollutants to environmentally safe levels in soil, sediments, substances, materials, and groundwater.

For bioremediation to be effective, microorganisms should enzymatically attack the contaminations and convert them to innocuous items. As bioremediation can be useful just where ecological conditions permit microbial development and action, its application regularly includes the control of natural boundaries to permit microbial development and continue to degrade at a quicker rate. Microorganisms have certain catalysts that utilize natural impurities as food, and as a result of their small size, they can contact toxins without any problem.

Microorganisms used in Bioremediation: We can subdivide these microorganisms into the following groups:

- **Aerobic bacteria:** It requires oxygen for functioning. They have the ability to degrade pesticides and hydrocarbons. Examples of aerobic bacteria having such degradative abilities include *Pseudomonas*, *Alcaligenes*, *Sphingomonas*, *Rhodococcus*, and *Mycobacterium*. These utilize contaminants as the sole source of carbon and energy.

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- **Anaerobic bacteria:** It does not require oxygen for functioning and is less frequently used than aerobic bacteria. The use of anaerobic bacteria for bioremediation of polychlorinated biphenyls (PCBs) in river sediments, dechlorination of the solvent trichloroethylene (TCE), and chloroform is gaining interest.

- **Methylotrophs:** These are aerobic bacteria that grow by utilizing methane as a source of carbon and energy. The initial enzyme in the pathway for aerobic degradation, methane monooxygenase, has a broad substrate range and is active against a wide range of compounds, including the chlorinated aliphatics trichloroethylene and 1,2-dichloroethane.

- **Ligninolytic fungi: these include** fungi such as the white rot fungus *Phanaerochaetechrysosporium*that can degrade an extremely diverse range of persistent or toxic environmental pollutants. The common substrates used include straw, sawdust, or corn cobs.

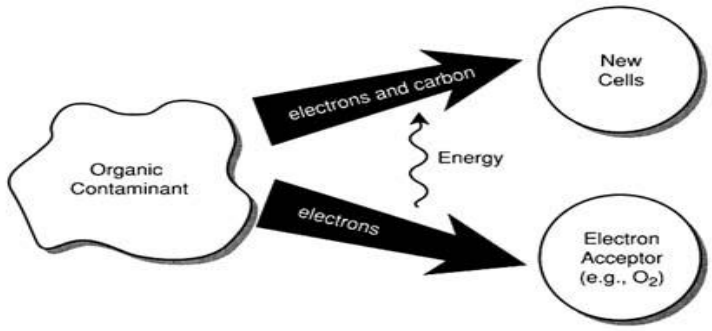
Microbial Metabolism

Contaminants may serve as:

1. Primary substrate- enough available to the sole energy source.

2. Secondary substrate- provides energy, not available in high enough concentration

3. Co-metabolic substrate- utilization of a compound by a microbe relying on some other primary substrate.



Organic contaminants serve two purposes for organisms firstly, as a source of carbon, and secondly, as the provision of electrons. Microorganisms degrade contaminants in light of the fact that in the process, they acquire energy that permits them to develop and repeat.

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Microorganisms get energy from the impurities by breaking substance bonds and moving electrons from the pollutants to an electron acceptor, like oxygen. They "contribute" the energy, alongside certain electrons and carbon from the pollutant, to create more cells.

Variations on Basic Metabolism

Aerobic respiration	• Molecular oxygen acts as electron acceptor
Anaerobic respiration	• Inorganic compounds acts as an electron acceptor
Inorganic Compounds as Electron Donors	• Electron acceptor is usually oxygen molecule
Fermentation	• Organic contaminant acts both as an electron acceptor and electron donor
Secondary Utilization and Co-metabolism	• Incidental reaction catalysed by enzymes
Reductive Dehalogenation	• Halogen atom is replaced with a hydrogen atom.

Major Contaminants of Agricultural Soils

A. PESTICIDES

Undoubtedly, pesticides are one of the major contaminants of agricultural soils. About 4 million tonnes of pesticides are applied to agricultural crops annually for pest control worldwide, and less than 1% of total applied pesticides generally get to the target pests. When pesticides are applied to soil, these tend to persist in the soil for several days. Apart from persistence, pesticides also tend to biomagnify and bioaccumulate.

- ✓ The Indian pesticide industry is the biggest in Asia and 12th in the world.
- ✓ The pesticide market is expected to grow at 12-13% per annum to reach $6.8billion(2017)
- ✓ Cotton and paddy are the crops with a maximum pesticide consumption rate of 50% and 18% resp. (*Source*: agropages.com)

For example, the microbial degradation of Atrazine occurs in two ways-

1. Decholrination by *Pseudomonas* sp.

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2. Dealkylation by *Aspergillus fumigatus* followed by dehalogenation by a *Rhodococcus* strain and by two *Pseudomonas* sp. strains.

B. HEAVY METALS

Heavy metals can be described as any metallic elements which have a relatively high density and are poisonous even at very low concentrations in every organism. These groups of metals and metalloids have atomic densities greater than 4 gm/cm^{3,} which is five times higher than water.

The significant contributions of heavy metals (for example, lead, cadmium, arsenic, mercury) into farming frameworks are composts, pesticides, natural squanders like excrement, wastewater water system, and environmental stores. These are extremely persistent, non-biodegradable, non-thermo degradable consequently promptly gather to harmful levels. Some cultivating methods, similar to water systems can prompt the accumulation of selenium (Se), bringing about downstream water supplies containing concentrations of selenium that are harmful to untamed life, animals, and people. This interaction is known as the "KestersonEffect". Heavy metals seriously degrade the soil quality, development, and yield of crop plants, quality of agricultural products, and pose genuine dangers to animals and people.

Heavy metals don't undergo degradation yet change their chemical forms (speciation), and bioavailability is, notwithstanding, conceivable. These can be consumed by microorganisms at cellular binding sites. Extracellular polymers of these organisms can complex heavy metals through different mechanisms. The microbes prevalent in heavily metal-contaminated soil can alter the oxidation state of the heavy metals by immobilizing them, permitting them to be effectively eliminated. Bioremediation of heavy metals from microbes isn't vigorously investigated, generally because of inadequate comprehension of the genetics of the microbes used in metal adsorption.

- ✓ *B. subtilis* have been reported to reduce selenite to the less toxic elemental Se.
- ✓ Several microorganisms, especially bacteria (*Bacillus subtilis, Pseudomonas putida, and Enterobacter cloacae*) have been successfully used for the reduction of Cr (VI) to the less toxic Cr (III)

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- ✓ *Desulfovibrio desulfuricans* converts sulphate to hydrogen sulphate which reacts with heavy metals such as Cd and Zn to form insoluble forms of these metal sulphides.

Genetically Engineered Microorganisms (GEMs)

GEMs are playing an increasingly important role in tackling soil contamination. Naturally-occurring chemicals can be broken down by microbes that have evolved for the purpose. However, man-made chemicals found in cosmetics, pesticides, insecticides, cleaners, and paints cannot be degraded into less toxic products by naturally occurring microbes.

- ✓ *Pseudomonas putida* was the 1st genetically engineered strain that is capable of utilizing complex chemical compounds like hydrocarbons
- ✓ *Deionococcus radiodurans*, a soil bacterium capable of breaking down radioactive mercury and toluene. It is listed as the world's toughest bacterium in the Guinness book of world records
- ✓ *Stenotrophomonas* sp. strain YC-1 was genetically engineered to produce an organophosphorus hydrolase (OPH) enzyme, which could degrade a mixture of six synthetic organophosphate pesticides completely within 5 hours.
- ✓ *Pseudomonas cepacia* RHJ1, a recombinant strain created by performing conjugation between *R.eutropha* JMP134(2,4D degrader) and *B.cepacia*AC1100(2,4,5 trichloro phenoxy acetate degrader) has been reported to degrade the herbicides mixture simultaneously.

Conclusion

Bioremediation is an exceptionally promising innovation for remediation, cleaning, managing, and recovering techniques for solving contaminated soils through microbial activity. It's anything but a natural and financially powerful remediation elective that can be applied to an expansive scope of contaminants. Research is needed to develop and engineer bioremediation technologies that are appropriate for sites with complex mixtures of contaminants that are not evenly dispersed in the environment. Also, there is a strong need to carry out work on the unculturable microorganisms and their activities during biodegradation

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using advanced techniques like denaturing gradient gel electrophoresis(DGGE) and other cultivation independent techniques.

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ADVANCEMENT OF COMPUTER APPLICATIONS AND TECHNOLOGY FOR AGRICULTURE DEVELOPMENT

Article Id: AL202180

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Agriculture referred as the "backbone" of the GDP of the Indian economy, which involves more than half of the population directly or indirectly. It also generates employment opportunities within the country and earns foreign exchange from other countries. Agriculture and the natural resource base is put under serious pressure due to the current rising population (7 billion) of the world, which is expected to rise about 10 billion in 2050. An increase in demand for food due to the rising population generates several problems which contaminate the environment and the earth. The major challenges of agriculture in the present scenario are:

I. Bio-diversity is endangered due to deforestation and habitat fragmentation.
II. Contributions from land clearing, crop production, and excessive fertilization towards "Greenhouse emissions" have risen upto 1/3 of the global emissions.
III. Different nutrient cycles like nitrogen and phosphorous have been disturbed, which affected water quality, aquatic ecosystem, and marine fisheries.
IV. Depletion of fresh water resources with 80% of fresh water used in irrigation.

These harmful environmental impacts can be monitored along with high food production with the use of advanced technologies and computer applications. These advancements in computer applications are commonly used nowadays in agriculture and agronomy to monitor agriculture activities. This is because agriculture is a seasonal activity where productivity is mainly governed by the physical landscape as well as weather parameters and agricultural management practices. All the factors are highly variable in time and space. Moreover, productivity can change within a short time due to adverse growth conditions. Therefore, agriculture monitoring needs to be timely in order to utilize resources efficiently and enhance productivity in an effective manner. According to FAO (Food and

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Agriculture Organization, 2011), the need for timeliness is a major factor underlying agricultural statistics and associated monitoring systems—information is worth little if it becomes available too late. Computer applications are useful for agriculture development help to overcome these barriers.

Advantages of Using Computer Application in Agriculture

There are several advantages of utilizing different computer applications and advanced technologies in agriculture, but the important ones are as follows:

- Providing a more timely and accurate picture of production and productivity of agriculture.
- Provide information about a large area in an accurate manner.
- Provide information about whether parameters of a particular area in a simple manner.
- It helps in identifying the vegetation vigor of a particular area and monitoring drought stress.
- also helps in assessing crop phonological development
- helps in gathering information about crop acreage estimation and cropland mapping
- Mapping of disturbances and land use/land cover changes.
- Helps in managing and controlling disease and pests occurring in specific areas.

Although scientific technologies are used in agriculture, information technology is being greatly used in this area. Technological advancements like satellite navigation, sensor network, grid computing, ubiquitous computing, and also context-aware computing are employed in the agriculture sector for improved monitoring and decision making capabilities. In evolution towards a sustainable agriculture system, it was clear that important contributions can be made by utilizing arising new innovations. These new technologies include Smart Agriculture, Precision Agriculture (PA), Variable Rate Technology (VRT), Precision Farming, Global Positioning System (GPS) Agriculture, Farming by Inch, Information-Intensive Agriculture, Site SpecificCrop Management etc. but all of them are sensor based. These sensor technologies and their networks are supporting agriculture practices in a very progressive direction. These technologies are discussed below in brief:

- **Global Positioning System (GPS)** - Satellite based system which gives exact location that provides continuous position information in real time while in motion.

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The satellite broadcasts signals which are received by GPS receivers to work out locations. This accurate location information allows crop and soil measurements to be mapped at any period. PS receivers, either carried to the field or mounted on implements, permit clients to get back to explicit areas to test or treat those regions. While purchasing a GPS receiver, its differential correction type and coverage area relative to the use area should be considered. Differential correction is the position correction provided by the uncorrected GPS signals when compared with land based satellites. Uncorrected GPS signals have an exactness of around 300 feet. The modified position accuracy is typically 63-10 feet.

- **Geographic information systems (GIS)**: Geographic information systems (GIS)are computer equipment and software programs that use feature attributes and location data to create maps. An imperative function of an agricultural GIS is to accumulate layers of information, like yields, soil survey maps, remotely sensed data, crop scouting reports, and soil nutrient levels.

- **Precision Agriculture**–Also known as satellite farming or site specific crop management (SSCM) can be called a farming management model based on observing, measuring, and responding to inter and intra-field variability in crops. Precision Agriculture is also known as satellite agriculture, as-needed farming and site-specific crop management. Precision agriculture is a concept of the modern world where different computer applications and resources can be used all together inefficient way to increase agriculture productivity by observing, analyzing, and supplying nutrients according to theneed of crops in the field. The end goal of precision agriculture is to maximize economic return by optimizing crop yield and minimizing environmental impact.

- **Smart Agriculture** – Smart agriculture is mainly another word used for Climate Smart Agriculture (CSA). It is mainly another approach of farming towards the changing of climate globally. It has basically three objectives:

  - ✓ Improving productivity of agriculture to maintain increased incomes, food security, and development.

  - ✓ Increasing adaptive capacity at different levels (from farm to nation)

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- ✓ Reducing greenhouse gas emissions and increasing carbon sinks.

CSA and sustainable intensification highly complement each other. Intensification means accomplishing more significant returns through expanded data sources, further developed agronomic practices like drop irrigation, improved crop varieties and other innovations. Computer applications will be helpful in this intensification in a quick time.

- **Variable rate application-**It has three components: Control computer, Locator, and Actuator. The application map is stacked into a PC mounted on a variable-rate applicator. The computer utilizes the application map and a GPS receiver to coordinate a product-delivery controller that modifies the quantity and/or kind of product, according to the application map.

- **Remote sensing:** It is the assortment of information from a distance. Data sensors can essentially behand-held devices mounted on aircraft or satellite-based. Remotely sensed data provide a tool for evaluating crop health. Plant stress related to moisture, nutrients, compaction, crop diseases, and other plant health concerns is often easily detected in overhead images. Remote sensing can show in-season variability that influences agricultural productivity and can be used to make prompt management adjustments that boost current crop profitability.

It has already been mentioned that all these technologies are mainly based on sensor technologies. Therefore, we should gather information about the sensor and their uses. There are many questions related to sensors, but the main question to the sensor is:

Why are Sensors Used in Agriculture?

Sensors can be defined as the innovations which are used to collect data on physical and environmental variables, and actuators are used to react to this data and offer feedback in order to maintain control over situations. Context is the data collected by sensors that characterize an object or environment and is used to identify individuals, locations, things, and their states. The context acquisition provides a valuable contribution in modeling situations of domains that have a variety of time variant attributes. Agriculture is also one such sector that has several requirements:

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I. Gathering of weather, crop, and soil information
II. Observing of distributed land
III. Various crops on a single piece of land
IV. Different fertilizer and water necessary to different pieces of uneven land
V. Diverse requirements of crops for different weather and soil Conditions.
VI. Preemptive solutions rather than reactive solutions

Size of sensors has been reduced due to advancements of technologies to the extent that that enabled them to be used in various spheres of human life. Several issues related to sensors are still in research. Wireless sensors and actuators are also required to acquire the necessary data and respond to various scenarios. A sensor is a device that can measure physical characteristics and turn them into signals for the observer to see. An actuator is an additional sort of component in the WSN. The addition of an actuator expands WSN's monitoring and control capabilities. These sensors and actuators are utilized in various agricultural services like irrigation, fertilization, pesticide spraying, animal and pastures monitoring.

- Irrigation- The artificial application of water to field crops for an increase in production is called irrigation. Different types of irrigation help inefficient utilization of water like drip irrigation, sprinkler irrigation etc. These irrigation types are mainly based on sensors.

  In Spain, Damas created and tested a remote-controlled, automatic irrigation system for irrigated land. The findings revealed significant water conservation, ranging from 30 to 60%. Self-propelled, linear-move and center-pivot irrigation systems require precise irrigation control. The system used wireless sensors to help with irrigation scheduling, utilizing remotely sensed data and weather data. In Portugal, for smart irrigation, a wireless data-gathering network was set up to collect climate data as well as soil moisture. With the use of sensors, irrigation water is managed to improve yield. Sensor-based irrigation system invented by Yunseop Kim. Using Bluetooth and GPS technology, soil moisture and temperature, meteorological information, and sprinkler location were all monitored remotely.

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Fertilizer – Fertilizers are nutrient sources for plants in order to increase productivity and production of food grains. Researchers are working day and night for efficient utilization of nutrients with the help of computer applications. Cugati innovated an automated fertilizer applicator consisting of Input, decision support, and output modules using GPS technology, real-time sensors, and Bluetooth technology. D. Ehlert has also created a mechanical sensor(Pendulum meter) for site-specific fertilization. An integral optimal fertilization decision support system using wireless sensors LAN using IEEE 802.11protocol (Wi-Fi) and GPS analysis server.

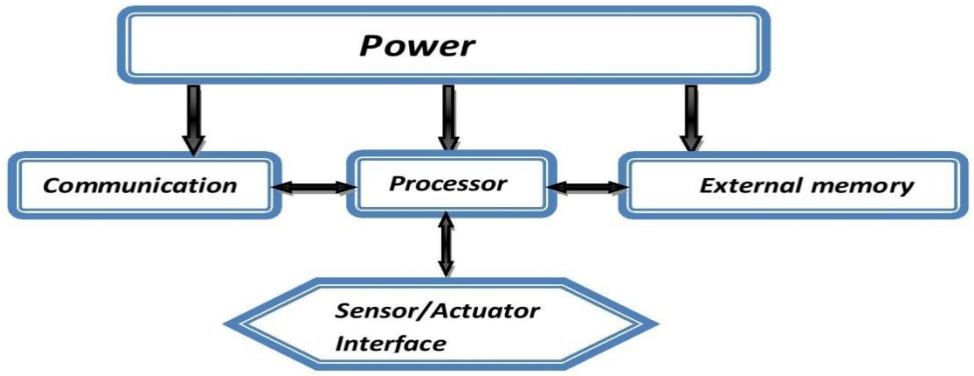

Figure1: Design of wireless sensor node

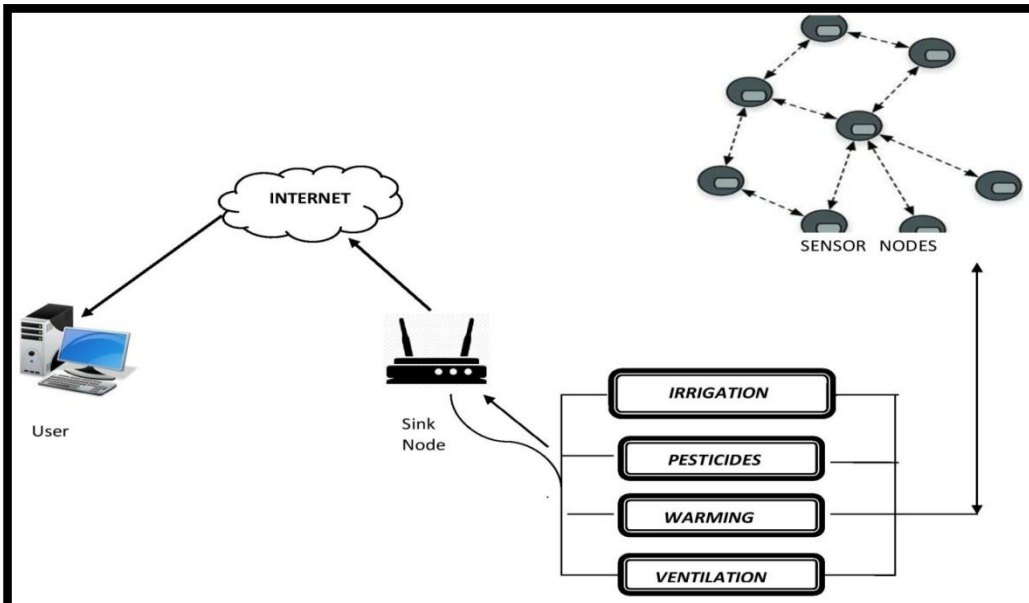

Figure2 : Schematic view of working mechanism of computer application in agriculture

(Aqeel-ur-Rehman et al, 2011)

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Conclusion

Agriculture is a diverse sector in which the scope of use of different computer applications and advanced technologies like wireless sensor technology has become essential day by day. This is because the global production of food crops needed to be increased in order to meet the demands of over increasing population. Computer applications can contribute significantly to this cause in a sustainable manner without deterioration of environmental quality. They will also help in the vertical expansion of food production in the coming future. Therefore, developing countries like India needed to revolutionize the agriculture sector by using computer applications in order to meet the food production demands of a growing population. Government and private sector should be encouraged to invest more in this sector to explore the new possibilities of higher production with the help of technologies.

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RECIRCULATORY AQUACULTURE SYSTEM (RAS)

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The Recirculatory Aquaculture System (RAS) is a water recycling and reuse technology which also eliminates suspended matter and metabolites through mechanical and biological filtration. This technique is used for the high-density culture of various fish species while using a minimal portion of land and water.

It is a high-density fish culture that is more intensive than other aquaculture production systems. Instead of growing fish outdoors in open ponds and raceways, this system typically rears fish in indoor/outdoor tanks under controlled environmental conditions. By recycling water back to fish culture tanks, recirculating systems filter and clean it. The technology is essentially focused on the employment of mechanical and biological filters, and the process can be applied to any aquaculture species. Only new water is added to the tanks to compensate for splash out, evaporation, and waste material flushing. The reconditioned water circulates through the system, and no more than 10% of the system's total water volume is replaced daily. In order to compete economically and efficiently use the substantial capital investment in the recirculation system, the fish farmer needs to grow as much fish as possible in the inbuilt capacity. The quantity and quality of feed, as well as the kind of filtration, are critical factors in the administration of recirculating systems. Many different filter types are utilized in

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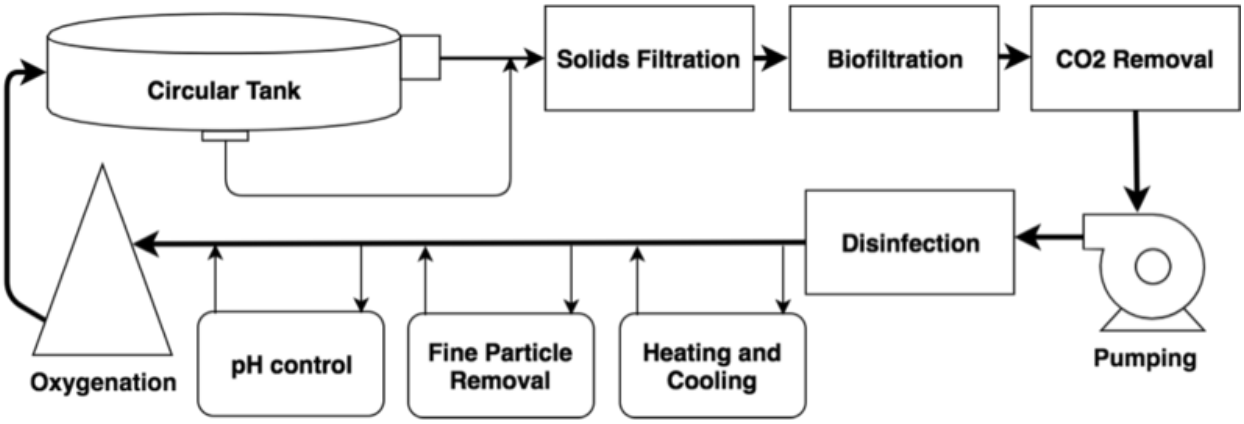
recirculating systems, but the ultimate purpose of all filtration is to remove metabolic wastes, excess nutrients, and particles from the water and provide good water quality for aquatic animals. It is important to examine all the factors when designing and investing in aquaculture systems.

However, in order to encourage small-scale fish farmers and entrepreneurs, as well as to facilitate fish production in urban and semi-urban areas where land and water are rare, Backyard Recirculation Aquaculture Systems should be promoted.

Flow-Chart of Recirculatory Aquaculture System



Advantage of RAS

- ✓ Equipment and other tanks have been predicted to last for a long time.
- ✓ Because antibiotics and therapeutics are used less frequently, there is a greater chance of obtaining high-quality fish.
- ✓ Direct operational costs linked with feed, predator control, and parasites will be decreased to some extent.
- ✓ Potentially eliminate parasites in recipient waters.
- ✓ Risk reduction due to environmental factors(Climatic change), disease, and parasite impacts
- ✓ RAS production can promote flexibility in terms of location for farming, proximity to market.

- ✓ Allow for the production of a diverse variety of species regardless of temperature needs. Feed management is much improved in RAS when feeding can be closely monitored for 24 hours. Stock stress on RAS can be mitigated by reducing exposure

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to elements such as bad weather, adverse temperature conditions, external pollutants, and predation.

- ✓ Enable secure production of non-endemic species.
- ✓ Judicial use of water and land areas.

Disadvantage of RAS

- Constant uninterrupted power supply is required if electric power fails then backup of electricity is required
- Capital cost of starting a recirculating aquaculture system is high as compared to ponds and raceways.

Species Suitable for RAS

- ➢ Baramundi/ Asian Seabass/Bhetki (Lates calcarifer)
- ➢ Cobia (Rachycentron canadum)
- ➢ Silver/Indian Pompano (Trichinotus Blochii/ Trichinotus mookalee)
- ➢ Tilapia (Oreochromis niloticus)
- ➢ Pearl spot/Karimeen (Etroplus suratensis)
- ➢ Pangasius (Pangasianodon hypophthalmus)
- ➢ Rainbow Trout (Oncorhynchus mykiss), especially in Hilly/cold water Region.

Feed

- A high protein feed that contains all of the necessary minerals and vitamins
- Species-specific feed
- Feeding can be done at 3-5 percent of the fish's body weight, depending on the quality and protein level of the feed.
- More frequent feedings (many times per day) will result in faster growth rates and, as a result, a better feed conversion ratio.

Water Quality Management

- Source of water is important in Recirculatory Aquaculture- Well water is suitable, which is free from contaminants. If Municipal water is used, it should be treated with chlorine compounds to avoid pathogens.

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- Most important water quality parameter is temperature; it affects the metabolic rate in microorganisms as well as cultural species. During the culture period, pH and temperature should be maintained at the lowest end of the optimal range to decrease the unionized ammonia.

- Fish survival is mostly depending upon Dissolved oxygen, and it can be maintained by the aeration process. Warm water and cold water fishes require 4 and 5 ppm DO, respectively.

- High and low pH causes ammonia and hydrogen sulfide toxicity respectively, Carbon-dioxide will cause acidic in nature if proper aeration is reduced.

- From the total feed, 25% becomes waste, immediately uneaten feed should be removed by different methods such as mechanical filtration, Flotation and Skimmers etc.,

- Copper toxicity increases due to low alkalinity; to overcome this effect sodium bicarbonate is used to increase alkalinity.

Conclusion

Recirculating Aquaculture Systems (RAS) are examined in order to provide better solutions for future management; potential areas for overcoming issues in the fishing industries are highlighted. Selection of species and regulation of water quality are the essential aspects of the RAS system, and greater knowledge of the RAS system was conveyed to fish farmers, researchers, and extension workers in order to promote the RAS system.

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E-MARKETING – AN ADAPTATION FOR FARMERS TO SUSTAIN COVID-19 AND POST- COVID-19 SITUATION

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India is regarded as a developing country with an agriculture-based economy. The agricultural and allied sector is important to the economy and is considered the backbone of the Indian economy. It accounts for approximately one-sixth of Indian national GDP and employs nearly half of the labor force (NABARD, 2020). Initiatives of the government and other organizations have helped improve agricultural production over the years; the major problem lies in the very low income of farmers (Beriya. A. 2020). Small landholdings, low productivity, insufficiency of the market channel, middleman dominance in marketing make farming unprofitable, leading farmers to turn away from farming and become miserable year by year.

To pore water on drawn mouse global pandemic, COVID-19 has hit the country and has had a negative influence on the economy as well as other sectors, including agriculture. To counteract COVID-19, the government imposed a lockdown, causing a disruption to the Indian economy. Though agricultural operations were exempted, the agriculture value chain saw significant disruptions in the early stages of the lockdown due to limitations on vehicle movement and a total prohibition on the opening of rural ‘haats’ by the country's local authorities (NABARD, 2020). In addition to that, fish and fisheries product export decreased due to the closing of state and nation boundaries.

One of the ways of sustaining farming activity is to enhance farmers’ incomes through the use of Digital Technologies in the Agriculture marketing process.

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Benefits of E-Marketing to Farmers

1. **Large market**

   Farmers may sell their products all over the world as it provides a virtually global distribution marketplace. Online marketing serves a vast number of clients from many states and nations.

2. **No scheduled time for selling**

   Farmers may sell their produce at any time they choose because the online market is available 24 hours a day, seven days a week.

3. **Less expensive**

   Online selling of agricultural produce is less expensive because this eliminates the needs of the middleman; the commission expense is low or, in certain cases, free.

4. **Better price**

   Farmers get a negotiating power in online marketing as they are trading from their home, and if they don't get a good deal for their products, they don't spend a penny, unlike offline marketing, where they face a subsequent cost of transportation and labor. They just need to sell their items to the appropriate person if they obtain a fair price for them.

5. **Reduction of agricultural waste.**

   Most agricultural items are occasionally destroyed as a result of consumers failing to be available on time. There is no waste of any product because digital shopping is a continuous market.

Factors influencing E-Marketing of Agricultural Products

There are three key factors responsible for the growth of E-marketing of agriculture produce and will influence future growth. They are:

1. Increase in smartphone and high-speed internet penetration among farmers.
2. Improvement of digital skills among farmers and rural population.

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3. A community that is accustomed or eager to adopt digital agri-preneurship and innovations.

(Bose, S. C., &Kiran, R., 2021)

India has seen unprecedented growth in smartphone and high-speed mobile internet penetration in recent years, which has helped in increasing digital literacy and also has increased customer base. With newly acquired skills in digital technology, people find it convenient to use digital purchasing. With an increase in customer base, the number of different online portals, mobile apps, social media, and digital engagement platforms has significantly increased, which has improved access to information and services for those who are involved in agriculture production and distribution. With the entry of e-commerce giants such as Amazon, Flipkart, Alibaba common people have become habituated to online buying and started to trust online portals as an alternative marketplace. Also, the Government of India has taken up several initiatives, the most significant being the "Digital India Movement" in 2015, which is aimed at transforming rural India into a digitally powered economy. All these has created an opportunity for farmers to sell online and to get a fair price for their produce.

E- Platforms for Marketing of Agricultural Products in India

There are many digital platforms offering facilities to farmers to discover better prices & sell their products online. Some of them are-

1. **National Agriculture Market or eNAM**

The National Agriculture Market (eNAM) is a pan-India electronic trading site that connects present APMC mandis to form a unified national market for agricultural commodities. It was launched on 14 April 2016, by the Ministry of Agriculture, Government of India. This market assists farmers, traders, and buyers in online commodity trading. It also assists in the discovery of better prices for items and the seamless marketing of agricultural products. The eNAM platform helps farmers to trade directly through a mobile app or through registered commission agents (eNAM, 2021; Bhosage, S.M., 2018)

Source- enam.gov.in

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2. Agricultural Marketing Information Network (AGMARKNET)

Source- agmarknet.gov.in

In March 2000 the Ministry of Agriculture launched the Agricultural Marketing Information Network, commonly known as AGMARKNET. AGMARKNET is a government of India portal on agricultural marketing that is supported by a wide-area information network that connects agricultural markets, state marketing boards/directorates and provides links to the websites of major national and international organizations. The site gives simple access to commodity- and variety-specific daily pricing and arrivals information for over 2000 varieties and 300 commodities from wholesale marketplaces around the nation.(AGMARKNET, 2021; S.M., 2018)

3. e-Choupal:

Source- www.itcportal.com

e-Choupal is developed by ITC Limited to link farmers and businesses via the internet for procurement of agricultural and aquaculture products like wheat, coffee, soybeans, and prawns. The program places PCs with Internet connections in rural parts of India to provide farmers with up-to-date marketing and agricultural information. Farmers may use online access to get information about mandi pricing and best farming techniques, as well as place orders for agricultural supplies like seeds and fertilizer. This assists farmers in improving the quality of their crops and receiving a higher price (e-choupal, 2021; S.M., 2018).

4. KisanMandi.com

Source- kisanmandi.com

KisanMandi Online Agri market Private Limited (KisanMandi.com) is providing assistance to farmers and helping them to develop skills of grading, packing, logistic support to sell their agricultural products directly to end customers, and claims that farmers will get the better price of agricultural produce as compared to the current APMC mandi price. It was registered as a Private Limited Company on 26-04-2016

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and recognized as a startup by the Department of Industrial Policy and Promotion, Govt. of India (S.M., 2018; S.M., 2018).

5. **Others**

There are numerous online trading websites that provide a platform for marketing farm products directly to buyers without any need for middlemen. Like - krishi-market.com, agrimp.com, agribazaar.com, Ninjacart.com etc.

E- Platforms for Marketing of Fishery Products in India

Fish, unlike any other agricultural commodity, is very perishable. In general, the fish supply chain operates on a four-day cycle, during which all stakeholders do not necessarily follow scientific criteria. In the absence of a proper cold chain, bacterial contamination usually occurs within 30 minutes causes smell and bad taste. (Sajeev, M. V. 2020). There are many mobile apps that provide facilities to farmers to sell their products online and deliver the customer a quality product at their doorstep. Some of them are- Aqua Pulse, Daily fish India, Marine fish sales, Smart fish, Delybazar etc.

There are even more than a number of e-commerce websites; www.freshtohome.com, www.dailyfish.in, www.mathafreshfish.com, www.suvichar.in, www.wildfish.in, www.biggro.com, www.healthyfishonline.com, www.freshandhealthy.in, www.onedaycart.com, www.onlinekochi.com, www.nallameen.com, www.bigbasket These fish E-commerce firms provide a wide range of options, especially from the local coast. Pre-ordered fresh fish is delivered to clients' homes in curry cut, steak, totally cleaned, or whole fish form at prices that satisfy the most discerning housewife. (Sajeev, M. V. 2020).

Challenges for E-marketing of Agricultural Products

1. **Inadequate knowledge of electronic media**

Because the majority of farmers lack computer expertise and are unable to use Android phones, they may find it difficult to engage in e-marketing of agricultural products.

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2. **High competition**

   There are a large number of suppliers from various geographical locations and nations. As a result, it is impossible to anticipate our items to sell at the appropriate price and at the right time.

3. **Risk of fraud websites:**

   Farmers may occasionally access fake websites or online portals. This will be a waste of time and resources.

4. **Consumer preference**

   Because many buyers still prefer to buy items in person. So it is necessary to depend on the offline market also.

5. **Communication**

   India is a multi-lingual country having 22 scheduled languages. Rural farmers do not have multilingual skills, limiting their capability to communicate and sell products of their own.

Conclusion

Traditional agricultural markets in India have several challenges, including low competition, fragmentation, inefficiency, the presence of executive middlemen, and frequent price manipulation. The introduction of an E-Platform for agricultural goods is critical to eliminating these disadvantages. Farmers' development is critical to the development of the nation since farmers, as the nation's backbone, directly or indirectly support the growth of the secondary and tertiary sectors of the economy. Through online marketing, farmers will get better marketing opportunities, with a better price for their goods, which will contribute significantly to the nation's growth.

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